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PREPARED IN COLLABORATION WITH
ALASKA DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS,
RUSSIAN ACADEMY OF SCIENCES, AND
GEOLOGICAL COMMITTEE OF NORTHEASTERN RUSSIA

METALLOGENESIS OF MAINLAND ALASKA AND THE RUSSIAN NORTHEAST

By

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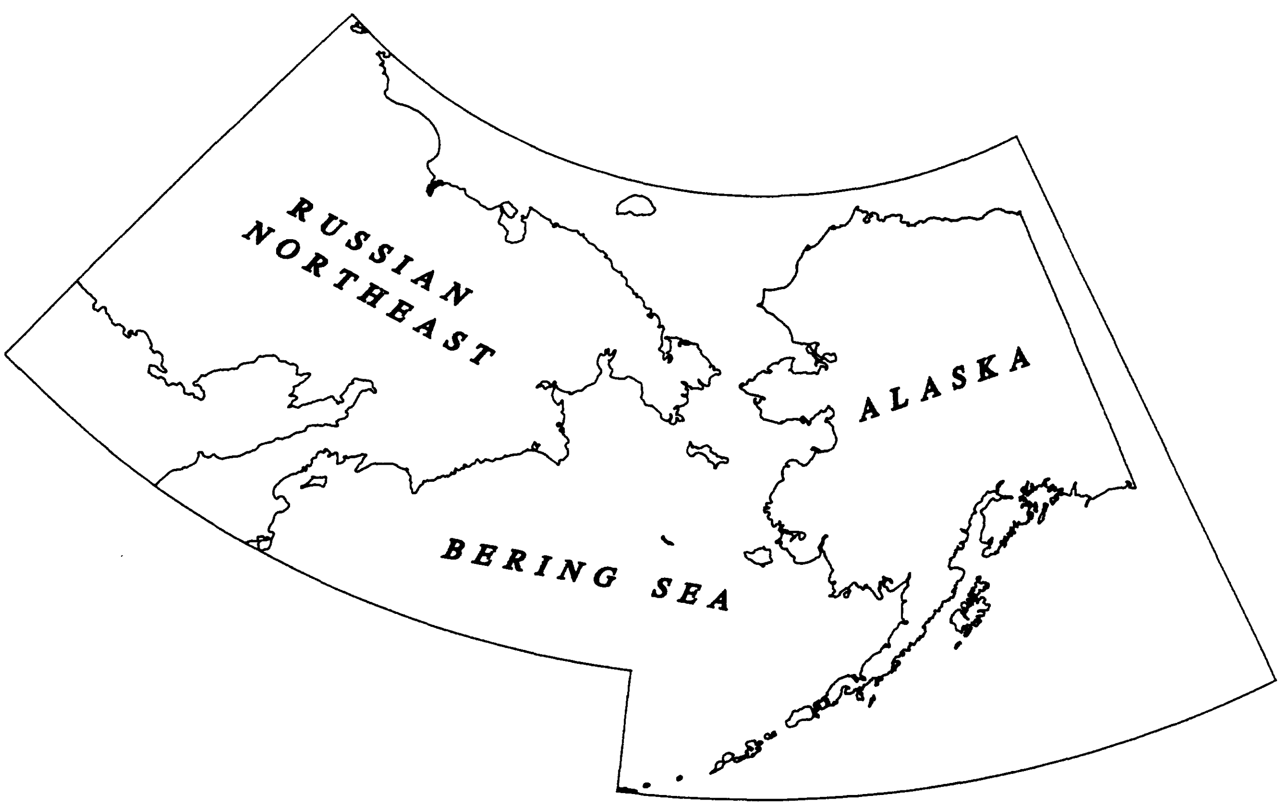

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EXPLANATION TO SHEET 1 OF 3
OPEN-FILE REPORT 93-339

EXPLANATION FOR MAP SHOWING SIGNIFICANT LODE DEPOSITS AND PLACER DISTRICTS FOR MAINLAND ALASKA AND THE RUSSIAN NORTHEAST

By

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WITH A TECTONO-STRATIGRAPHIC TERRANE BASE MAP

By

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Scale 1:4,000,000

EXPLANATION - LODE MINERAL DEPOSITS AND PLACER DISTRICTS

EXAMPLE OF LODE DEPOSIT SYMBOL

◆ 2 Cu, Zn	(Deposit number 2; lode deposit related to marine felsic to mafic extrusive rocks; Cu and Zn major metals)

SYMBOLS FOR LODE AND PLACER DEPOSIT MODELS

Symbol	Deposit Model
◆	**Deposits Related to Marine Felsic to Mafic Extrusive Rocks** Kuroko Zn-Pb-Cu massive sulfide (Ag, Au, Cd, Sn, Sb, Bi, barite) Besshi Cu-Zn massive sulfide (Ag, Au) Cyprus Cu-Zn-Ag massive sulfide (Au, Pb, Cd, Sn) Volcanogenic Mn
▼	**Deposits Related to Subaerial Extrusive Rocks** Au-Ag Epithermal vein Volcanic-hosted Hg (Plamennoe type) Hot-spring Hg Silica-carbonate Hg Volcanic-hosted Sb (Au, Ag, As) Rhyolite-hosted Sn (felsic volcanic Sn)
●	**Stratiform Deposits in Fine-Grained Clastic and Siliceous Sedimentary Rocks** Sedimentary exhalative Zn-Pb Bedded barite
~	**Stratabound Deposits in Coarse Clastic Sedimentary Rocks and Subaerial Basalt** Sediment-hosted Cu (Kuperschiefer and redbed) Basaltic Cu (volcanic redbed Cu) Kennecott Cu Clastic sediment-hosted Hg (Nikitovka type) Sediment-hosted U
▲	**Deposits in Carbonate and Chemical-Sedimentary Rocks** Kipushi Cu-Pb-Zn Mississippi Valley Pb-Zn Ironstone Chemical-sedimentary subtype Prikoklyma subtype Stratabound W (Austrian Alps-type) Iron Formation (Omolon type) Carbonate-hosted Hg
	Deposits Related to Calc-Alkaline and Alkaline Intrusions
▬	***Veins and Replacements*** Polymetallic vein Sb-Au vein (simple Sb)

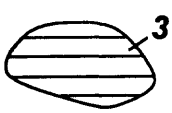
Sn quartz vein
Sn silicate-sulfide vein (Cornish type)
Sn polymetallic vein (Southern Bolivian type)
Co-arsenide polymetallic vein

Skarns and Greisens
Cu (± Fe, Au, Ag, Mo) skarn
Zn-Pb (± Ag, Cu, W) skarn and associated Manto replacement
W skarn
Fe (± Au. Cu, W, Sn) skarn
Sn skarn and greisen

Porphyry and Granitic Pluton-Hosted Deposits
Porphyry Cu-Mo (Au, Ag)
Porphyry Mo (± W, Sn, Bi)
Porphyry Sn
Granitoid-related Au
Felsic plutonic U-REE
W vein

Deposits Related to Mafic and Ultramafic Rocks
Zoned mafic-ultramafic Cr-PGE (± Cu, Ni, Au, Co, Ti, or Fe) (Alaskan PGE)
Gabbroic Ni-Cu (synorogenic-synvolcanic; irregular gabbro pipes and stocks)
Podiform Cr
Serpentine-hosted asbestos

Deposits Related to Regionally Metamorphosed Rocks
Au quartz vein (includes concordant vein and shear zone Au)
Disseminated Au-sulfide (Maiskoe type)
Clastic sediment-hosted Sb-Au
Cu-Ag quartz vein (vein Cu)



Deposits Related to Surficial Processes: Placer, Paleoplacer, and Laterite Deposits
Placer and paleoplacer Au
Placer Sn
Placer PGE-Au
Placer Ti

BASE MAP

Planimetric base from Arctic Sheet of the Geographic Map of the
Circum-Pacific Region by George Moore (1990)
Circum-Pacific Council for Energy and Mineral Resources.
Map Center Point: 70° N., 164° W.
Lambert Azimuthal Equal Area Projection

EXPLANATION FOR TECTONO-STRATIGRAPHIC TERRANE BASE MAP

MAP UNITS - MAINLAND ALASKA

POST-ACCRETION CENOZOIC AND UPPER CRETACEOUS SEDIMENTARY ROCKS

Czs	**Chiefly continental sedimentary rocks, undifferentiated (Cenozoic)**
Ks	**Sedimentary rocks (Upper Cretaceous)**
KJs	**Sedimentary rocks (Jurassic and Early Cretaceous)**

POST-ACCRETION CENOZOIC AND UPPER CRETACEOUS VOLCANIC ROCKS

(Note: Siliceous includes felsic and intermediate igneous rocks.)

QTvs	**Siliceous volcanic rocks (Quaternary and late Tertiary)**
QTvm	**Mafic volcanic rocks (Quaternary and late Tertiary)**
mTvs	**Siliceous volcanic rocks (middle Tertiary)**
mTvm	**Mafic volcanic rocks (middle Tertiary)**
eTpm	**Mafic plutonic rocks (early Tertiary)**
TKvf	**Felsic volcanic rocks (early Tertiary and Late Cretaceous)**
TKvi	**Intermediate volcanic rocks (early Tertiary and Late Cretaceous)**

POST-ACCRETION UPPER MESOZOIC SEDIMENTARY ROCKS

GN	**Gravina-Nutzotin belt (Upper Jurassic to mid-Cretaceous)**
KA	**Kandik River overlap assemblage (Upper Jurassic and Lower Cretaceous)**
KH	**Kahiltna overlap assemblage (Upper Jurassic and Cretaceous)**

POST-ACCRETION LATE JURASSIC AND YOUNGER PLUTONIC ROCKS

(Note: Siliceous includes felsic and intermediate igneous rocks)

QTps	**Siliceous plutonic rocks (late Tertiary)**
mTps	**Siliceous plutonic rocks (middle Tertiary)**
TKpf	**Felsic plutonic rocks (early Tertiary and Late Cretaceous)**
TKpi	**Intermediate plutonic rocks (early Tertiary and Late Cretaceous)**
Kps	**Siliceous plutonic rocks (Cretaceous)**
Kpm	**Mafic plutonic rocks (Cretaceous)**
lJg	**Granitic plutonic rocks (Late Jurassic)**

PRE-ACCRETION MIDDLE JURASSIC AND OLDER PLUTONIC ROCKS

mJg	**Granitic plutonic rocks (Middle Jurassic)**
JTrg	**Granitic plutonic rocks (Early Jurassic and Late Triassic)**
JTru	**Ultramafic and mafic plutonic rocks (Early Jurassic and Late Triassic)**
lPzg	**Granitic to mafic plutonic rocks (late Paleozoic)**
mPzg	**Granitic plutonic rocks (middle Paleozoic)**
ePzg	**Granitic plutonic rocks (early Paleozoic)**
P_g	**Granitic plutonic rocks (Proterozoic)**

CRATON MARGIN AND OCEANIC ROCK UNITS

NAM	**North America plate**
PAC	**Pacific plate**

TECTONO-STRATIGRAPHIC TERRANES

[Arranged alphabetically by map symbol; inferred tectonic environment in parentheses]

Arctic Alaska Superterrane

- AAD **DeLong Mountains terrane (passive continental margin)**
- AAE **Endicott Mountains terrane (passive continental margin)**
- AAH **Hammond terrane (passive continental margin)**
- AAN **North Slope terrane (passive continental margin)**
- AAT **Tigara terrane (passive continental margin)**

AM **Angayucham terrane (subduction zone - dominantly oceanic rocks)**
AP **Aurora Peak terrane (continental margin arc)**
AX **Alexander terrane (island arc)**
BP **Broad Pass terrane (metamorphic)**

Chugach terrane

- CGM **McHugh Complex and correlative units, and adjacent blueschist and greenschist (subduction zone - dominantly oceanic rocks)**
- CGV **Valdez Group and correlative units (accretionary wedge - dominantly turbidites)**

CH **Chulitna terrane (ophiolite)**
CO **Coldfoot terrane (displaced continental margin)**
CW **Clearwater terrane (island arc)**
CZ **Crazy Mountains terrane (passive continental margin)**
DL **Dillinger terrane (passive continental margin)**
GD **Goodnews terrane (subduction zone - dominantly oceanic rocks)**
KI **Kilbuck-Idono terrane (cratonal)**
KY **Koyukuk terrane (island arc)**
LG **Livengood terrane (oceanic crust)**
MA **Manley terrane (turbidite basin)**
MK **McKinley terrane (sea mount)**
ML **Maclaren terrane (continental margin arc)**
MN **Minchumina terrane (passive continental margin)**
MNK **Minook terrane (turbidite basin)**
MY **Mystic terrane (passive continental margin)**
NX **Nixon Fork terrane (passive continental margin)**
NY **Nyac terrane (island arc)**
PC **Porcupine terrane (passive continental margin)**
PE **Peninsular terrane (island arc)**
PN **Pingston terrane (turbidite basin)**
PW **Prince William terrane (accretionary wedge - dominantly turbidites)**
RB **Ruby terrane (displaced continental margin)**
SD **Seward terrane (displaced continental margin)**
ST **Stikinia terrane (island arc)**
SM **Seventymile terrane (subduction zone - dominantly oceanic rocks)**
SU **Susitna terrane (sea mount)**
TG **Togiak terrane (island arc)**
TK **Tikchik terrane (island arc)**
VE **Venetie terrane (turbidite basin)**
WM **White Mountains terrane (passive continental margin)**
WR **Wrangellia terrane (island arc)**
WS **Wickersham terrane (passive continental margin)**
WY **Windy terrane (metamorphic)**
YA **Yakutat terrane (accretionary wedge - dominantly turbidites)**
YO **York terrane (passive continental margin)**
YT **Yukon-Tanana terrane (displaced continental margin)**

MAP UNITS - RUSSIAN NORTHEAST

POST-ACCRETION CENOZOIC AND UPPER CRETACEOUS SEDIMENTARY ROCKS

Qs	**Sedimentary rocks (Cenozoic)**
QTs	**Continental and near-shore marine sedimentary rocks (Neogene, mainly Pliocene, Pliocene-Quaternary and Quaternary)**
eTs	**Continental sedimentary rocks (early Tertiary - Paleogene, Eocene and Eocene-Oligocene)**
eTvs	**Continental volcanic, volcaniclastic, and sedimentary rocks (Paleogene, Eocene and Eocene-Oligocene)**
Czs	**Chiefly continental sedimentary rocks, undifferentiated (Cenozoic)**

POST-ACCRETION CENOZOIC AND UPPER CRETACEOUS VOLCANIC ROCKS

Qvi	**Intermediate volcanic rocks (Quaternary)**
QTvi	**Intermediate volcanic rocks (Quaternary and late Tertiary)**
mTvi	**Intermediate volcanic rocks (middle Tertiary)**
eTvi	**Intermediate volcanic rocks (early Tertiary)**
TKvi	**Continental intermediate volcanic rocks (early Tertiary and Late Cretaceous)**

POST-ACCRETION MESOZOIC AND OLDER SEDIMENTARY AND VOLCANIC ROCKS

eKs	**Continental and marine sedimentary rocks (Early Cretaceous)**
Ks	**Continental and marine sedimentary rocks (Cretaceous)**
Kvs	**Siliceous volcanic rocks (Cretaceous)**
Kvi	**Intermediate volcanic rocks (Cretaceous)**
KJs	**Shallow-marine sedimentary rocks (Early Cretaceous and Late Jurassic)**
KJvi	**Intermediate volcanic rocks (Early Cretaceous and Late Jurassic)**
KJvs	**Siliceous volcanic rocks (Early Cretaceous and Jurassic)**
lJvi	**Intermediate volcanic rocks (Late Jurassic)**
lJs	**Shallow-marine sedimentary rocks (Late Jurassic)**
lJvs	**Volcanic rocks (Late Jurassic)**
Js	**Marine sedimentary rocks (Jurassic)**

POST-ACCRETION CRETACEOUS AND YOUNGER PLUTONIC ROCKS

(Note: Siliceous includes felsic and intermediate igneous rocks)

(Adapted from Gelman, 1986)

QTps	**Siliceous plutonic rocks (late Tertiary)**
Tps	**Siliceous plutonic rocks (Tertiary)**
Kps	**Siliceous plutonic rocks (Late Cretaceous)**
Kpi	**Intermediate plutonic rocks (Cretaceous)**
eKps	**Siliceous plutonic rocks (Early Cretaceous)**
lJps	**Siliceous plutonic rocks (Late Jurassic)**

PRE-ACCRETION PLUTONIC ROCKS

Pzg	**Granite, monzonite, granodiorite, and diorite (Paleozoic)**

TECTONO-STRATIGRAPHIC TERRANES

[Arranged alphabetically by map symbol; inferred tectonic environment in parentheses]

AK **Avekova terrane (displaced continental margin)**
AV **Alkatvaam terrane (accretionary wedge or subduction zone - dominantly turbidites)**
Chukotka terrane (passive continental margin)
- CHA **Anyui subterrane**
- CHC **Chauna subterrane**
- CHW **Wrangel subterrane**

EK **Ekonay terrane (accretionary wedge - dominantly oceanic rocks)**
Kolyma-Omolon superterrane
- KAC **Aluchin terrane (ophiolite)**
- KAG **Argatass terrane (oceanic crust)**
- KAL **Alazeya terrane (island arc)**
- KBR **Beryozovka terrane (turbidite basin)**
- KOL **Omulevka terrane (passive continental margin)**
- **Oloy terrane (island arc)**
  - KOLE **Eropol subterrane**
  - KOLS **Siverskiy subterrane**
- KOM **Omolon terrane (cratonal)**
- KYK **Yana-Kolyma terrane (turbidite basin)**
- KPK **Prikolyma terrane (passive continental margin)**
- KRS **Rassokha terrane (oceanic crust)**

Kony-Murgal terrane (island arc)
- KMM **Murgal subterrane**
- KMT **Taigonos subterrane**
- KMW **West Pekul'ney subterrane**

KT **Khetachan terrane (island arc)**
MY **Mainitskiy terrane (island arc)**
NU **Nutesyn terrane (island arc)**
OK **Okhotsk terrane (cratonal)**
Olyutorka-Kamchatka terrane (island arc)
- OKI **Iruneiskiy subterrane subterrane**
- OKO **Olyutorka subterrane**
- OKV **Valaginskiy subterrane**

Penzhina-Anadyr terrane (accretionary wedge or subduction zone - dominantly oceanic rocks)
- PAB **Ust'Belaya subterrane**
- PAG **Ganychalan subterrane**
- PAM **Main subterrane**

PK **Pekuiney terrane (accretionary wedge and subduction zone - dominantly turbidites)**
South Anyui terrane (subduction zone - dominantly oceanic rocks)
- SAS **Shalaurov subterrane**
- SAU **Uyamkanda subterrane**
- SAV **Vel'May subterrane**

Seward terrane (displaced continental margin)
- SDS **Senyavin subterrane**
- SDU **Uelen subterrane**

Talovskiy terrane (subduction zone - dominantly oceanic rocks)
- TLA **Ainynskiy subterrane**
- TLK **Kuyul subterrane**

VA **Vaega terrane (subducton zone - dominantly oceanic rocks)**
VL **Viliga terrane (passive continental margin)**

VT Vetlovskiy terrane (accretionary wedge - dominantly oceanic rocks)

West Kamchatka terrane (accretionary wedge or subduction zone - dominantly turbidites)

- WKU **Ukelayat subterrane**
- WKO **Omgon subterrane**

YN **Yanranay terrane (accretionary wedge - dominantly oceanic rocks)**

YR **Yarakvaam terrane (island arc)**

ZL **Zolotogorskiy terrane (displaced continental margin)**

GEOLOGIC MAP SYMBOLS

Contacts and Faults

Post-accretion contact--Depositional or intrusive contact that is not a terrane boundary. Includes marginal contacts of overlap sedimentary and volcanic assemblages, and plutons. Dashed where approximately located

Fault bounding terrane--Dashed where approximately located; dotted where concealed beneath post-accretion Cenozoic deposits. Sense of displacement unknown or complex

Strike-slip fault bounding terrane--Dashed where approximately located; dotted where concealed beneath post-accretion Cenozoic deposits. Arrows denote relative movement

Thrust or reverse fault bounding terrane--Dashed where approximately located; dotted where concealed beneath post-accretion Cenozoic deposits. Teeth point towards upper plate

Post-accretion fault--Relatively young faults that may represent extensive reactivation of older faults bounding terranes. Dashed where approximately located; dotted where concealed beneath post-accretion Cenozoic deposits. Strike-slip arrows or thrust barbs denote relative movement

CONTENTS

INTRODUCTION

This report is an study of the metallogenesis of mainland Alaska, west of 141°W longitude, and the Russian Northeast, north of about 56° N latitude and east of about 144° E longitude. Three major goals are defined for this study. (1) The study provides detailed tabular summaries of the important features of the significant lode deposits and placer districts, location maps, and cited references. Tabular summaries with references are provided for approximately 273 significant lode deposits and 43 significant placer districts of mainland Alaska, and 251 significant lode deposits and 41 significant placer districts of the northern Russian Northeast (Tables 1 through 4). The locations of significant lode deposits and placer districts are depicted at a scale of 1:4,000,000 on a tectono-stratigraphic terrane base map (Sheet 1). The term *significant mineral deposit* (either lode deposit or placer district) is defined as a mine, mineral deposit, prospect, or occurrence that is judged as important for the metallogenesis of a geographic region. (2) This study also provides summaries of the mineral deposit types that occur in the region and cited references. And (3) this study also provides a synthesis of the metallogenic belts of lode mineral deposits and of the relation of the metallogenic belts to host rocks, and cited references. Various pre-, syn-, and post-accretionary metallogenic belts are depicted at a scale of 1:10,000,000 (Sheets 2, 3). Each metallogenic belt consists of a group of coeval and genetically-related lode deposit types that are interpreted to have formed during a specific tectonic event. This methodology enables the correlation of belts of related lode deposits to the tectonic origin of host rock units, and was first employed for Northern and Central America by Albers and others (1988).

Alaska and the Russian Northeast are commonly regarded as frontier areas in the world for the discovery of metalliferous lode and placer deposits. A recurring theme in the last 100 years has been "rushes" or "stampedes" to sites of newly discovered deposits. In the last few decades, substantial exploration for lode and placer deposits has occurred. These studies have resulted in abundant new information on lode and placer deposits. In the same period, substantial new geologic mapping has also been completed with the help of new logistical and technical tools. One result of these geologic mapping and associated geologic studies in Alaska and the Russian Northeast in recent years is the recognition of numerous fault-bounded assemblages of rocks defined as tectono-stratigraphic terranes. Proponents of this concept suggest that most of Alaska and the Canadian Cordillera, and the Russian Far East consist of a collage of fault-bounded assemblages designated as tectono-stratigraphic terranes (Jones and others, 1987; Monger and Berg, 1984, 1987; Zonenshain and others, 1990; Silberling and others, 1992; Nokleberg and others, 1992, 1993). In this report, the lode mineral deposits of mainland Alaska and the Russian Northeast are grouped into metallogenic belts that are classified as to whether they formed either: (1) early in the history of terranes, thereby constituting pre-accretionary metallogenic belts; (2) during the collision and accretion of terranes, thereby constituting accretionary metallogenic belts; or (3) during formation of suites of younger sedimentary and igneous rocks that overlap or intrude into previously-accreted terranes, thereby constituting post-accretionary metallogenic belts.

The Alaskan mineral deposit data and metallogenic maps are derived from revisions of Nokleberg and others (1987, 1988; in press), from new unpublished data of the authors, and from recent publications. The Russian Northeast mineral deposit data and metallogenic maps represent new compilations by the Russian authors using cited references and unpublished data of the authors. The tectonostratigraphic terrane map of the Russian Northeast and mainland Alaska that is used as a base map for Sheet 1, is adapted from Nokleberg and others (1992, 1993) and will be published as a companion publication. The geographic base map for Sheets 1 through 3 is part of the Arctic Sheet of the Circum-Pacific Council for Energy and Mineral Resources (Moore, 1990).

METALLOGENIC AND TECTONIC DEFINITIONS

The following tectonic and mineral deposit definitions are adapted from Coney and others (1980), Jones and others (1983), Howell and others (1985), Monger and Berg (1987), Nokleberg and others (1987, 1988, 1992, 1993), and Wheeler and others (1988).

Accretion. Tectonic juxtaposition of two or more terranes, or tectonic juxtaposition of a terrane(s) to a continental margin.

Accretionary wedge terrane. Fragment of a mildly to intensely deformed complex of turbidite deposits and lesser amounts of oceanic rocks. Divided into units composed dominantly of turbidites or of oceanic rocks. Formed adjacent to zones of thrusting and subduction along the margin of a continental or an island arc. Commonly associated with subduction zone terranes. May include large, fault-bounded units with coherent stratigraphy.

Craton. Mainly regionally metamorphosed and deformed Archean and Early Proterozoic sedimentary, volcanic, and plutonic rocks and overlying Late Proterozoic, Paleozoic, and local Mesozoic sedimentary and lesser volcanic rocks. Includes both shield and platform successions.

Craton margin. Mainly Late Proterozoic through Jurassic sedimentary rocks deposited mainly on a continental shelf or slope. Locally has, or is inferred to have had, an Archean and Early Proterozoic craton basement. Consists mainly of platform successions.

Cratonal terrane. Fragment of a craton.

Continental margin arc terrane. Fragment of an igneous belt of coeval plutonic and volcanic rocks, and associated sedimentary rocks that formed above a subduction zone dipping beneath a continent. Inferred to possess a sialic basement.

Continental rift terrane. Fragment of a continent or miogeocline that contains extensive rift-related plutonic rocks and coeval rift-related volcanic rocks.

Deposit. A general term for any lode or placer mineral occurrence, mineral deposit, prospect, and (or) mine.

Displaced continental margin terrane. Fragment of a craton margin, sometimes highly metamorphosed and deformed, that cannot be linked with certainty to the nearby craton, but may be derived from a more distant site from the nearby craton, or from another craton.

Island arc terrane. Fragment of an igneous belt of plutonic rocks, coeval volcanic rocks, and associated sedimentary rocks that formed above an oceanic subduction zone. Inferred to possess a simatic basement.

Metallogenic belt. A geologic unit (area) that either contains or is favorable for a group of coeval and genetically-related, significant lode and placer deposit models.

Metamorphic terrane. Fragment of a highly metamorphosed and (or) deformed assemblage of sedimentary, volcanic, and (or) plutonic rocks that cannot be assigned to a single tectonic environment because original stratigraphy and structure are obscured. Includes highly-deformed structural melanges, exclusive of subduction zone or accretionary wedge melanges, that contain intensely-deformed pieces of two or more terranes.

Mine. A site where valuable minerals have been extracted.

Mineral deposit. A site where concentrations of potentially valuable minerals for which grade and tonnage estimates have been made.

Mineral occurrence. A site of potentially valuable minerals on which no visible exploration has occurred, or for which no grade and tonnage estimates have been made.

Oceanic crust, seamount, and ophiolite terrane. Fragment of part or all of a suite of eugeoclinal, deep-marine sedimentary rocks, pillow basalts, gabbros, and ultramafic rocks that are interpreted as oceanic sedimentary and volcanic rocks, and upper mantle. Includes both inferred offshore ocean and marginal ocean basin rocks. Includes minor volcaniclastic rocks of magmatic arc derivation. Mode of emplacement onto continental margin uncertain.

Overlap assemblage. A sequence of sedimentary and (or) igneous rocks deposited on, or intruded into two or more adjacent terranes. The sedimentary and volcanic parts depositionally overlie, or are interpreted to have originally depositionally overlain two or more adjacent terranes, or terranes and the craton margin. Overlap plutonic rocks, in some areas are coeval and genetically related to overlap volcanic rocks, and weld or stitch together adjacent terranes, or a terrane and a craton margin.

Passive continental margin terrane. Fragment of a craton margin.

Post-accretion rock unit. Suite of sedimentary, volcanic, or plutonic rocks that formed in the late history of a terrane, after accretion. May occur also on an adjacent terrane(s) or on craton margin as an overlap assemblage unit. A relative time term for denoting rocks formed after tectonic juxtaposition of one terrane to an adjacent terrane.

Pre-accretion rock unit. Suite of sedimentary, volcanic, or plutonic rocks that formed in the early history of a terrane, before accretion. Constitutes the stratigraphy inherent to a terrane. A relative time term for denoting rocks formed before tectonic juxtaposition of one terrane to an adjacent terrane.

Prospect. A site of potentially valuable minerals in which excavation has occurred.

Significant mineral deposit. A mine, mineral deposit, prospect, or occurrence that is judged as important for the metallogenesis of a geographic region.

Subduction zone terrane. Fragment of variably to intensely deformed oceanic crust and overlying units, oceanic mantle, and lesser turbidite and continental margin rocks that were tectonically juxtaposed in a zone of major thrusting of one lithosphere plate beneath another. Divided into units composed dominantly of turbidites or of oceanic rocks. Many subduction zone terranes contain fragments of oceanic crust and associated rocks that exhibit a complex structural history, occur in a major thrust zone, and possess blueschist facies metamorphism. Commonly associated with accretionary wedge terranes. May include large, fault-bounded blocks with coherent stratigraphy.

Subterrane. A fault-bounded unit within a terrane that exhibit similar, but not identical geologic history relative to another fault bounded unit in the same terrane.

Superterrane. An aggregate of terranes that is interpreted to share either a similar stratigraphic kindred or affinity, or a common geologic history after accretion (Moore, 1992). A synonym is *composite terrane* (Plafker, 1990).

Terrane. A fault-bounded geologic entity or fragment that is characterized by a unique geologic history that differs markedly from that of adjacent terranes (Jones and others, 1983; Howell and others, 1985). Constitutes a physical entity, i.e., a stratigraphic succession bounded by faults, or an intensely-deformed structural complex bounded by faults. Some terranes may be faulted facies equivalents of other terranes.

Turbidite basin terrane. Fragment of mainly orogenic forearc, backarc, or depositional basin of terrigenous clastic basin deposits. Includes continental slope and rise turbidite deposits, and submarine fan turbidite deposits deposited on oceanic crust. May include minor epiclastic and volcaniclastic deposits.

LODE AND PLACER MINERAL DEPOSIT MODELS FOR ALASKA AND THE RUSSIAN NORTHEAST

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Russian Academy of Sciences

Classification of Mineral Deposits

Metalliferous lode and placer deposits in this report are classified into various models or types described below. This classification of mineral deposits was derived mainly from the mineral deposit types of Eckstrand (1984), Cox and Singer (1986), Nokleberg and others (1987), cited references for specific models, and unpublished data of the Russian authors. The lode deposit types are grouped according to host rock lithologies and (or) origin. Lode deposit types that share a common origin, such as contact metasomatic deposits, or porphyry deposits, are grouped together under a single heading.

The mineral deposit types used in this report consist of both descriptive and genetic information that is systematically arranged to describe the essential properties of a class of mineral deposits. Some types are descriptive (empirical), in which instance the various attributes are recognized as essential, even though their relationships are unknown. An example of a descriptive mineral deposit type is the basaltic Cu type in which the empirical datum of a geologic association of Cu sulfides with relatively Cu-rich metabasalt or greenstone is the essential attribute. Other types are genetic (theoretical), in which case the attributes are related through some fundamental concept. An example is the W skarn deposit type in which case the genetic process of contact metasomatism is the essential attribute. For additional information on the methodology of mineral deposit types, the reader is referred to the discussions by Eckstrand (1984) and Cox and Singer (1986). For each deposit type, the principal references are listed in parentheses.

Deposits Related to Marine Felsic to Mafic Extrusive Rocks

Kuroko Zn-Pb-Cu massive sulfide (Ag, Au, Cd, Sn, Sb, Bi, barite) (D.A. Singer in Cox and Singer, 1986)

This deposit type consists of volcanogenic massive to disseminated sulfides that occur in felsic to intermediate marine volcanic, pyroclastic, and bedded sedimentary rocks. The volcanic rocks are mainly rhyolite and dacite flows and tuff with subordinate basalt and andesite. The depositional environment is mainly hot springs related to marine volcanism in island arcs or in extensional regimes behind island arcs. The deposit minerals are mainly pyrite, chalcopyrite, sphalerite, and lesser galena, tetrahedrite, tennantite, and magnetite. Local alteration to zeolites, montmorillonite, silica, chlorite, and sericite may occur.

Besshi Cu-Zn massive sulfide (Cu, Zn, Ag) (D.P. Cox in Cox and Singer, 1986)

This deposit type consists of thin sheet-like bodies of massive to well-laminated pyrite, pyrrhotite, and chalcopyrite, and lesser sulfide minerals, within thinly laminated clastic sedimentary rocks and mafic tuffs. The rock types are mainly marine clastic sedimentary rocks, basaltic and less commonly andesitic tuff and breccia, and local black shale and red chert. The depositional environment is interpreted as submarine hot springs related to submarine basaltic volcanism along spreading oceanic ridges near a continental margin supplying clastic detritus. Associated minerals include sphalerite, and lesser magnetite, galena, bornite, and tetrahedrite, with gangue quartz, carbonates, albite, white mica, and chlorite. Alteration is sometimes difficult to recognize because of metamorphism.

Cyprus Cu-Zn-Ag massive sulfide (Au, Pb, Cd, Sn) (D.A. Singer in Cox and Singer, 1986)

This deposit type consists of massive sulfides in pillow basalt. The depositional environment consists of submarine hot springs along an axial graben in oceanic or back-arc spreading ridges, or hot springs related to submarine volcanoes in seamounts. The deposit minerals are mainly pyrite, chalcopyrite, sphalerite, and lesser marcasite and pyrrhotite. The sulfides occur in pillow basalt that is associated with tectonized dunite, harzburgite, gabbro, sheeted diabase dikes, and fine-grained sedimentary rocks, all part of an ophiolite assemblage. Beneath the massive sulfides is sometimes stockwork pyrite, pyrrhotite, minor chalcopyrite, and sphalerite. The sulfide minerals are sometimes brecciated and recemented. Alteration in the stringer zone consists of abundant quartz, chalcedony, chlorite, and lesser illite and calcite. Some deposits are overlain by Fe-rich and Mn-poor ochre.

Volcanogenic Mn (Shatsky, 1954; R.A. Koski in Cox and Singer, 1986)

This deposit type consists of sheets and lenses of hausmannite-rhodochrosite, rhodochrosite, and oxidized braunite in intercalated shales, jasper, marine basalt flows, and mafic tuff. The host-volcanic rocks differ from normal tholeiite basalt in being relatively rich in potassium, sodium, and titanium. The deposits generally occur in sequences with abundant chert, rather than in sequences dominated by volcanic rocks. The deposits are often associated with volcanogenic Fe deposits, and sometimes contain complexly-oxidized ferromanganese minerals. The depositional environment is presumably related to hot springs associated with marine basaltic magmatism. No relation exists between zones of Mn-minerals and volcanic edifices.

Deposits Related to Subaerial Extrusive Rocks

Au-Ag epithermal vein (D.L. Mosier in Cox and Singer, 1986)

This deposit type consists of quartz-adularia, and quartz-adularia-carbonate veins with a wide variety of minerals, including gold, silver, sulfosalts, pyrite, chalcopyrite, argentite, galena, sphalerite, cinnabar, and stibnite. One class of epithermal vein deposits, such as those at Creede, Colorado and Dukat, Russian Northeast, has high concentrations of Pb, Zn, and Ag, sometimes high Cu and low Au; another class, such as those at Sado, Japan, has high Au, moderate to low Ag, sometimes high Cu, and generally low Pb and Zn concentrations. For both groups, the host volcanic rock composition ranges from andesite to rhyolite. The depositional environment is intermediate to felsic volcanic arcs and centers developed over miogeosynclinal rocks (Creede-type) or older volcanic and plutonic rocks (Sado-type). Associated minerals include electrum, chalcopyrite, copper and silver sulfosalts, with lesser tellurides and bornite. Alteration minerals include quartz, kaolinite, montmorillonite, illite, and zeolites.

Volcanic-hosted Hg (Plamennoe type) (Kuznetsov, 1974; Babkin, 1975)

This deposit type consists of massive to disseminated, veinlet-disseminated and brecciated cinnabar occurring either in: (1) in bed-like, lens-like and irregular bodies mostly in felsic and to a lesser extent, in intermediate and mafic volcanic horizons; or (2) at the contacts of subvolcanic intrusive and volcanic rocks. The depositional environment is generally the tectonic boundaries of major volcanic depressions and calderas. In addition to cinnabar, the deposit minerals commonly include stibnite, pyrite, and marcasite, with subordinate or rare arsenopyrite, hematite, lead, zinc and copper sulfides, and tetrahedrite, schwatzite, silver sulfosalts, gold, realgar, and metallic mercury. The gangue minerals are mainly quartz, chalcedony, sericite, hydromica, kaolinite, dickite, alunite, carbonate, chlorite, and solid bitumen. Cinnabar and associated minerals commonly occur in multiple layers. Wallrocks may be propylitically altered to quartz, sericite, kaolinite, and epidote. Mercury is deposited mainly during intense metasomatic replacement, and, to a lesser extent, by filling of open fissures and voids.

Hot spring Hg (J.J. Rytuba in Cox and Singer, 1986)

This deposit type consists of cinnabar, antimony, pyrite, and minor marcasite and native mercury in veins and in disseminations in graywacke, shale, andesite and basalt flows, andesite tuff and tuff breccia, and diabase dikes. The depositional environment is near paleo-groundwater table in areas of former hot springs. Various alteration minerals such as kaolinite, alunite, Fe oxides, and native sulfur occur above the paleo-groundwater table; pyrite, zeolites, potassium feldspar, chlorite, and quartz occur below the paleo-groundwater table.

Silica-carbonate Hg (Kuznetsov, 1974; Voevodin and others 1979; J.J. Rytuba in Cox and Singer 1986)

This deposit type consists of cinnabar and associated minerals at the contact of serpentinite and graywacke in major thrust zones. The deposit minerals are mainly common mercury minerals, including cinnabar, and native mercury, along with stibnite, pyrite, realgar, orpiment, native mercury and native arsenic, sometimes nickel and cobalt minerals, and sometimes tungsten minerals, including tungstenite, scheelite, and wolframite. Gangue minerals are mainly dolomite, breunnerite and ankerite in association with quartz, opal, chalcedony, calcite, dickite, and talc. Massive, veinlet, and disseminated minerals commonly occur in irregular lens-like bodies and veins in crush belts and mylonite zones, and in adjacent sedimentary rocks. Cinnabar mineralization is closely associated with silica-carbonate and argillic alteration. The depositional environment consists of zones of faults like thrusts containing lenses of serpentinite, ultramafic rocks, and graywacke.

Volcanic-hosted Sb (Au, Ag, As) vein (Berger, 1978)

This deposit type consists of veins, stockwork, and irregular mineralized zones that occur in felsic to intermediate volcanic sequences, intercalated volcaniclastic sedimentary rocks, flows, hypabyssal dikes and sills, and shallow parts of fractured granitic intrusions. The depositional environment is subaerial, calc-alkaline volcanic flows and shallow intrusions. The principal deposit mineral is stibnite with accessory arsenopyrite, pyrite, marcasite, berthierite, chalcopyrite, sphalerite, galena, native silver, native gold, native arsenic, cinnabar, realgar, orpiment, jamesonite, tetrahedrite-tennantite, silver sulfosalts, carbonate minerals, barite, fluorite, sericite, adularia, and clay minerals. Gangue minerals are mainly chalcedony, quartz and opal. Argillic hydrothermal alteration is common; other alterations may include carbonate minerals, pyrite, and zeolites. Associated volcanic rocks are generally of highly differentiated calc-alkalic composition. Mineralization commonly occurs on the flanks of subaerial volcanoes. Deposit type often occurs at the periphery of volcanic structures that host associated gold-silver, disseminated gold-sulfide, and mercury deposits.

Rhyolite-hosted Sn (B.L Reed in Cox and Singer, 1986)

This deposit type consists of cassiterite and wood tin that occur in discontinuous veinlets and stockworks, and in disseminations in rhyolite-flow dome complexes. Accessory minerals include topaz, fluorite, bixbyite, pseudobrookite, and beryl. Besides cassiterite and wood tin, the deposit minerals also include hematite, cristobalite, fluorite, tridymite, opal, chalcedony, adularia and zeolites. The associated wall-rock alteration minerals are generally cristobalite, fluorite, smectite, kaolinite and alunite. The host rhyolites commonly contain more than 75 percent silica and are enriched with potassium. Mineralization is controlled by fractured and brecciated zones occurring in the most permeable upper portions of flow-dome complexes. The depositional environment is regions of felsic volcanism erupted onto continental crust.

Stratiform Deposits in Fine-Grained Clastic and Siliceous Sedimentary Rocks

Sedimentary exhalative Zn-Pb (J.A. Briskey in Cox and Singer, 1986)

This deposit type consists of stratiform, massive to disseminated sulfides and barite occurring in sheet-like or lens-like tabular bodies that are interbedded with euxinic marine sedimentary rocks including dark shale, siltstone, chert, and sandstone. The depositional environment consists of marine epicratonal embayments and intracratonic basins with smaller local restricted basins. The deposit minerals include pyrite, pyrrhotite, sphalerite, galena, and barite, and rare celesite and chalcopyrite. Extensive alteration may occur near vents, including stockwork and disseminated sulfides, silica, albite, and chlorite.

Bedded barite (G.J. Orris in Cox and Singer, 1986)

This deposit type consists of stratiform, massive, and nodular barite interbedded with marine cherty and calcareous sedimentary rocks, mainly dark chert, shale, mudstone, and dolomite. The depositional environment consists of epicratonal marine basins or embayments, often with smaller local restricted basins. The deposit type is often associated with sedimentary exhalative Zn-Pb or kuroko massive sulfide deposits (both described above). Alteration consists of secondary barite veining and local, weak to moderate sericite replacement. Associated minerals include minor witherite, pyrite, galena, and sphalerite. Also associated are phosphate nodules.

Stratabound deposits in Coarse Clastic sedimentary Rocks and Subaerial Basalts

Sediment-hosted Cu (Kupferschiefer and Redbed)
(Bogdanov and others, 1973; Eckstrand, 1984; D.P. Cox in Cox and Singer, 1986)

This deposit type consists of disseminated to less prevalent veinlet sulfide ores that occur in lens-like and layered bodies in red clastic sedimentary rocks, including shale, siltstone, and sandstone, that are often intercalated with basalts. The depositional environment is epicontinental, shallow marine basins that occur on passive continental margin shelfs, or adjacent to volcanic island arcs. This deposit type is commonly associated with Cu-bearing, island arc trachybasalts (shoshonites) formed at or near rift zones. The main deposit minerals are bornite, chalcocite, hematite, with rare chalcopyrite as large crystals, metasomatic veinlets, and clastic grains. Wall-rock alteration consists of disappearance of red color of host rocks, and occurrence of quartz-carbonate-sulfide veinlets. The latter are sometimes abundantly associated with low-grade contact or greenschist facies regional metamorphism. Weathering results in development of green sinter and malachite and azurite crusts.

Basaltic Cu (Dzhalkan type) (Eckstrand, 1984; D.P. Cox in Cox and Singer, 1986)

This deposit type consists of stratabound disseminated copper minerals in basalt lavas erupted into shallow coastal marine basins, and more seldomly onto the subaerial parts of island arcs. The volcanic rocks are generally interbedded with red sandstone, conglomerate and siltstone. The basalts lavas are generally potassic or alkalic and may include shoshonites and trachybasalts. The depositional environment is epicontinental, shallow marine basins that occur on passive or rifted continental margin shelfs, or adjacent to volcanic island arcs. The depositional environment includes porous roof of basalt flows and synvolcanic fissures. Major deposit minerals are bornite, chalcopyrite, chalcocite, pyrite and native copper. These minerals occur both in the matrix of, and as amygdules in the porous roofs of basalt flows, and in veinlets within the basalts. The wallrocks are altered mainly to epidote, calcite, chlorite and zeolites. The deposit type is often associated with sediment-hosted Cu deposit type (Kupferschiefer and Redbed, described above).

Clastic sediment-hosted Hg (Nikitovka type) (Kuznetsov, 1974; Babkin, 1975)

This deposit type consists of cinnabar and associated minerals that occur in lenses, stockworks, and other structures in flysch sequences composed of siltstone, shale, and conglomerate. Ore bodies include stockworks, lenses, bed-like and irregular bodies, and simple and complex veins in fault zones. Mineralization is controlled by sets of fractures and feathering major faults; the deposits occur in anticlinal structures and dome-like uplifts. Deposits usually contain several ore horizons. Deposit minerals are mainly cinnabar with subordinate stibnite, realgar, orpiment, various other sulfide minerals and sulfosalts, and native arsenic and native mercury. Gangue minerals are mainly quartz, chalcedony quartz, carbonate minerals, and dickite. Wall rocks may be altered to quartz, argillite, and carbonate minerals. Associated igneous rocks are mainly felsic and intermediate dikes. Mineralization is interpreted to form low-temperature hydrothermal fluids related to either deep magmatic chambers, or to low-grade regional metamorphism.

Sandstone-hosted U (C.E. Turner-Peterson and C.A. Hodges in Cox and Singer, 1986)

This deposit type consists of concentrations of uranium oxides and related minerals in localized, reduced environments in medium- to coarse-grained feldspathic or tuffaceous sandstone, arkose, mudstone, and conglomerate. The depositional environment is continental basin margins, fluvial channels, fluvial fans, or stable coastal plain, sometimes with nearby felsic plutons or felsic volcanic rocks. The deposit minerals include pitchblende, coffinite, carnotite, and pyrite.

Deposits in Carbonate and Chemical-Sedimentary Rocks
Kipushi Cu-Pb-Zn (D.P. Cox and L.R.. Bernstein in Cox and Singer, 1986)

This deposit type consists of stratabound, massive sulfides hosted mainly in dolomitic breccia. The depositional environment consists mainly of high fluid flow along faults or karst(?)-breccia zones. Generally no rocks of unequivocal igneous origin are related to the deposit. The deposit minerals include pyrite, bornite, chalcocite, chalcopyrite, carrollite, sphalerite, and tennantite with minor reinerite and germanite. Local alteration to dolomite, siderite, and silica may occur.

Mississippi Valley Pb-Zn (J.A. Briskey in Cox and Singer, 1986)

This deposit type consists of stratabound, carbonate-hosted deposits of Pb-, Zn-, and Cu-sulfide minerals in rocks having primary and secondary porosity, commonly related to reefs on paleotopographic highs. The deposits are hosted mainly in dolomite, but are locally hosted in sandstone, conglomerate, and calcareous shale. The deposit minerals are mainly galena, sphalerite, chalcopyrite, pyrite, and marcasite, with minor siegenite, bornite, tennantite, barite, bravoite, digenite, covellite, arsenopyrite and other associated sulfide minerals. The depositional environment is areas of shallow-water marine carbonates, with prominent facies control by reefs growing on the flanks of paleotopographic basement highs. The deposits commonly occur at the margins of clastic basins. Alteration consists of regional dolomitization, extensive carbonate dissolution, and development of residual shale. The deposit minerals occur at interfaces between gray and tan dolomite, and also in traps at interfaces between permeable and impermeable units.

Ironstone

Chemical-sedimentary subtype (Kosygin and Kulish, 1984). This subtype consists of sheet-like horizons of magnetite and hematite-magnetite in clastic carbonate rocks that are associated with chert, quartz-sericite-chlorite schist, and dolomite. The deposits occur in early Paleozoic sedimentary rocks formed in basins overlying Precambrian granitic and metamorphic complexes. This subtype is a Paleozoic analog of itabirites.

Prikolyma subtype (R.A. Eremin, this study). This subtype consists of iron and titanium minerals that occur in bed-like and lens-like bodies in sandstone grit and conglomerate. The deposit minerals are mainly clastic hematite, magnetite, ilmenite, and zircon grains that form concentrations that range up to 50 to 60 percent of the hosting clastic quartz, and feldspar-quartz sandstone beds. Bedded clastic rocks exhibit parallel-, cross-, and wavy-bedding. Ferruginous sandstones are sometimes interlayered with carbonate rocks, which sometimes form rich iron deposits. Conformable and crossing bodies of massive and brecciated hematite ores also occur in regional metamorphosed carbonate rocks. The deposit type is interpreted as ancient lithified sea beach placers that are often highly metamorphosed and deformed.

Stratabound W (Austrian Alps-type)
(Denisenko and others, 1986; V.I. Shpikerman, this study).

This deposit type consists of stratabound, thin veinlet, and disseminated scheelite ores that occur in bedded carbonaceous calcareous siltstone and argillite, commonly metamorphosed to phyllite and greenschist. Igneous rocks are generally lacking, except for scarce metamorphosed basalt sills. The deposit minerals are mainly scheelite, pyrite, with lesser realgar, galena and chalcopyrite. The deposit minerals are concentrated in carbonaceous calcareous siltstone beds surrounded by shale or mudstone beds. The deposit minerals may also be concentrated along minor crossing faults, and in associated calcite and quartz veinlets. Tungsten is geochemically associated with antimony, mercury, and arsenic. The deposit type is interpreted as forming during metamorphic regeneration of carbonaceous sedimentary rocks initially enriched with tungsten.

Iron Formation (Omolon type)
(Gelman and others, 1974; Zhulanova, 1990; R.A. Eremin, this study)

This deposit type consists of banded, massive and disseminated magnetite and quartz that occur in bed-like and lens-like bodies in Archean rocks. Host rocks are mainly granitic gneiss, plagio- and granite migmatite, amphibolite, mafic schist, and quartzite. The deposit minerals are magnetite and quartz in association with amphibole, pyroxene, apatite, garnet, epidote, hematite, sericite, chlorite, and carbonate minerals. Mineralization is controlled by deep fault zones with deposit minerals generally confined to fractures, faults, and minor fold hinges. Magnetite and quartz replace mainly migmatites, and also metamorphosed mafic and ultramafic rocks. Magnetite-quartz aggregates are commonly conformable with metamorphic banding, but locally are cross-cutting. The depositional environment is mainly metamorphosed or metasomatized magnetite skarns associated with granitic intrusions. Deposit type is confined to Archean strata. This deposit type contains abundant silicate minerals, and does not form large deposits. Mineralization is related to either (1) post-magmatic stages of granitic migmatization; or (2) a combination of later basalt magmatism that occurred after regional metamorphism and granitization.

Carbonate-hosted Hg (Khaidarkan type)
(Babkin, 1975; Fedorchuk, 1983)

This deposit type consists mainly of cinnabar in veinlets and in disseminations that occur in stratabound bodies in dolomite breccia and to a lesser extent in limestone breccia. The host rocks are reef and shelf limestones that formed in carbonate reefs and shelf areas of passive continental margins. The host rocks are subsequently altered to dolomite and brecciated during diagenesis and karst-formation. Mineralization is confined to deep fault zones and is localized under impermeable clay layers. Magmatic rocks are rare diabase sills. The deposit minerals are cinnabar and lesser pyrite, sphalerite, stibnite, and anthraxolite, and rare galena and fluorite. Wall-rock alteration consists of jasperoid, and quartz and calcite veinlets. The depositional environment is artesian thermal water with possible deep sources of mercury.

Deposits Related to Calc-Alkaline and Alkaline Granitic Intrusions-
Veins and Replacements

Polymetallic vein (D.P. Cox in Cox and Singer, 1986)

This deposit type consists of quartz-carbonate veins often with silver, gold, and associated base-metal sulfides. The veins are related to hypabyssal intrusions in sedimentary and metamorphic terranes, or to metamorphic fluids forming during waning regional metamorphism. The associated intrusions range in composition from calcalkaline to alkaline and occur in dike swarms, hypabyssal intrusions, small to moderate size intermediate to granitic plutons, locally associated with andesite to rhyolite flows. The depositional environment is near-surface fractures and breccias within thermal aureoles of small to moderate-size intrusions, including within the intrusions. The deposit minerals include native gold, electrum, pyrite, and sphalerite, sometimes with chalcopyrite, galena, arsenopyrite, tetrahedrite, Ag sulfosalts, and argentite. Alteration consists of wide propylitic zones, and narrow sericite and argillite zones. In the Russian Northeast, polymetallic vein deposits almost invariably contain cassiterite and (or) stannite in addition to dominant Fe-, Pb-, Zn-, and Cu-sulfides. The veins occur: (1) mainly in flysch or olistostromes in Mesozoic accretionary wedges; or (2) sometimes in postaccretionary volcanic rocks. Polymetallic veins are analogs of skarn deposits and occur where noncalcareous clastic rocks dominate instead of carbonate rocks.

Sb-Au vein (simple Sb) (J.D. Bliss and G.A. Orris in Cox and Singer, 1986; Nokleberg and others, 1987)

This deposit type consists of massive to disseminated stibnite and lesser gold in quartz-carbonate veins, pods, and stockworks that occur in or adjacent to brecciated or sheared fault zones, in sedimentary, volcanic and metamorphic rocks, adjacent to granitic plutons, in contact aureoles around granitic plutons, and peripheries of granodiorite, granite, and monzonite plutons. Some Sb-Au vein deposits grade into polymetallic vein deposits. The depositional environment is faults and shear zones, epizonal fractures adjacent to or within the margins of epizonal granitic plutons. Associated minerals are mainly arsenopyrite, chalcopyrite, and tetrahedrite, and sometimes cinnabar, galena, and sulfosalts. Alteration minerals are mainly quartz, sericite, and clay minerals. Associated granitic plutons are often strongly peraluminous.

Sn quartz vein (Rudny Gory or Replacement Sn type) (Kosygin and Kulish, 1984; W.D. Sinclair and R.V. Kirkham in Eckstrand, 1984; B.L. Reed in Cox and Singer, 1986; Lugov, 1986)

This deposit type consists of simple and complex infilling and replacement veins, vein systems, and stockworks that occur in the apices of collisional mesozonal and hypabyssal granitoid plutons, and above granitic domes. The host rocks are commonly metamorphosed shale, sandstone, and sometimes carbonate rocks. This deposit type is commonly associated with multiple intrusions of biotite, two-mica, alkalic, alaskite granites. Granite, pegmatite and aplite dikes are common. Volatiles are dominated by fluorine, and boron content of granites is low. The deposits tend to occur within or above the apices of granitic cusps and ridges. The deposit minerals are cassiterite, wolframite, albite, muscovite, topaz, fluorite, arsenopyrite and löllingite. Less common are potassium feldspar, tourmaline, beryl, scheelite, molybdenite, tantalo-niobate minerals, bismuth minerals, pyrrhotite, sphalerite, galena, and chalcopyrite. Complex tin-tungsten ores are dominate. Quartz is the dominant gangue mineral. The dominant wall rock alteration is formation of greisen. The deposit type is associated with Sn-greisen and Sn-skarn, wolframite-quartz veins, and uranium and fluorite deposits.

Sn silicate-sulfide vein (Cornish type) (Kosygin and Kulish, 1984; W.D. Sinclair and R.V. Kirkham in Eckstrand, 1984; Lugov, 1986; B.L. Reed in Cox and Singer, 1986)

This deposit type consists of fissure veins, mineralized zones, stockworks, and pipe-like bodies related to multiple granitoid plutons, and to isolated small intrusions of gabbro-diorite, quartz diorite, and potassic alaskite granites. Late-stage tourmaline-bearing granites and pegmatites also occur. The deposit type commonly occurs in late orogenic to post-orogenic settings. Tin mineralization is commonly fault-controlled, and occurs near and above intrusive rocks. The deposit minerals are mainly tourmaline, chlorite, and quartz, with lesser cassiterite, pyrrhotite, pyrite, chalcopyrite, galena, sphalerite, arsenopyrite, wolframite, scheelite, bismuthinite, axinite, fluorite, muscovite, sericite, stannite, sulfostannates, lead, antimony, copper and silver sulfosalts, gold, silver, stibnite, calcite, and clay minerals. Alteration minerals are tourmaline, muscovite, quartz, and chlorite. The deposit type includes tourmaline and chlorite subtypes. The upper and lower portions of ore vein systems are dominated by sulfides, and silicates and quartz, respectively.

Sn polymetallic vein (Southern Bolivian type) (Lugov, 1986; Yukio Togashi in Cox and Singer, 1986)

This deposit type consists of cassiterite and associated minerals in veins, stockworks, mineralized zones and breccia pipes. The deposits are controlled by sets of regional faults and fractures in subvolcanic and volcanic structures. The depositional environment is fissures in and around felsic, continental marginal volcanic arcs. Mineralization occurs in volcanic rocks above intrusions, but may be far-removed from granitic rocks. Associated igneous rocks are hypabyssal and subvolcanic diorite, granodiorite, and hypabyssal-andesite intrusions, and felsic, intermediate, and mafic dikes. The deposit minerals are cassiterite, pyrrhotite, pyrite, stannite, sphalerite, galena, chalcopyrite, wolframite, tetrahedrite, tennantite, bismuth minerals, sulfostannates, arsenopyrite, lead, silver, antimony and germanium sulfosalts, with subordinate quartz, manganese-ferruginous carbonate minerals, sericite, and kaolinite. Tourmaline and chlorite may also occur. This deposit type may also include tin-silver deposits containing freibergite, pyrargyrite, polybasite, andorite, stephanite, argentite, argyrodite, canfieldite and others. The principal wall-rock alterations are sericite, chlorite, quartz, kaolinite, and alunite. The deposit type is in associated with Sn-silicate-sulfide and Ag polymetallic vein, rhyolite-hosted Sn, porphyry Sn, and Au-Ag epithermal vein deposits.

Co-arsenide polymetallic vein (Borisenko and others, 1984;R.A. Eremin and V.I. Shpikerman, this study)

This deposit type consists of quartz-tourmaline and quartz-chlorite veins containing cobalt, arsenic, bismuth, silver and gold minerals. The veins are associated with hypabyssal intrusions varying from diorite to granite, and widespread albitized granite-porphyry dikes. Mineralization occurs in: (1) fractures and in brecciated zones in siltstone, shale, and sandstone; (2) contact metamorphic aureoles around intrusions or, more seldom, in intrusions; and (3) sometimes greisen and skarn. The deposits are often confined to cross-faults. The deposit minerals are arsenopyrite, pyrite, pyrrhotite, löllingite, cobaltite, skutterudite, smaltite, glaucodot, chloantite, bismuthinite, bismuth, and gold, silver, lead and bismuth tellurides and selenides. Vein gangue minerals are quartz, chlorite, tourmaline, calcite, fluorite, and adularia.

Deposits Related to Calc-Alkaline and Alkaline Granitic Intrusions - Skarns and Greisens

Cu (±Fe, Au, Ag, Mo) skarn (contact metasomatic) (D.P. Cox and T.G. Theodore in Cox and Singer, 1986, V.I. Shpikerman, this study).

This deposit type consists of chalcopyrite, magnetite, and pyrrhotite in calc-silicate skarns that replace carbonate rocks along intrusive contacts with plutons ranging in composition from quartz diorite to granite, and from diorite to syenite. Zn-Pb-rich skarns tend to occur farther from the intrusion; Cu- and Au-rich skarns tend to occur closer to the intrusion. The depositional environment is mainly calcareous sedimentary sequences intruded by felsic to intermediate granitic plutons. Associated minerals are pyrite, hematite, galena, molybdenite, sphalerite, and scheelite. Mineralization is multistage, with several stages of mineral deposition. The deposit type is commonly associated with porphyry Cu-Mo deposits.

Zn-Pb (±Ag, Cu, W) skarn (contact metasomatic) and associated Manto replacement (D.P. Cox in Cox and Singer, 1986)

This deposit type consists of sphalerite and galena in calc-silicate skarns that replace carbonate rocks along intrusive contacts with plutons varying in composition from quartz diorite to granite, and from diorite to syenite. Zn-Pb-rich skarns tend to occur farther from the intrusion relative to Cu- and Au-rich skarns. The depositional environment is mainly calcareous sedimentary sequences intruded by felsic to intermediate granitic plutons. Associated minerals are pyrite, chalcopyrite, hematite, magnetite, bornite, arsenopyrite, and pyrrhotite. Metasomatic replacements consist of a wide variety of calc-silicate and related minerals. In the Russian Far East, the deposit type generally occurs at a considerable distance from source granitic intrusions, at the contacts of limestones with siltstones and felsic volcanic rocks. Ore bodies are rather narrow, but may extend down dip to 1 km. The deposits are controlled by ring faults around volcanic-tectonic depressions.

W skarn and greisen (adapted from D.P. Cox in Cox and Singer, 1986)

This deposit type consists of scheelite in calc-silicate skarns that replace carbonate rocks along or near intrusive contacts of quartz diorite to granite plutons. The depositional environment is along contacts and in roof pendants in batholiths, and in contact metamorphic aureoles of stocks that intrude carbonate rocks. Associated minerals are molybdenite, pyrrhotite, sphalerite, chalcopyrite, bornite, pyrite, and magnetite. Metasomatic replacements consist of a wide variety of calc-silicate and related minerals. In the Russian Far East, scheelite typically occurs in quartz-topaz and quartz-mica greisen that formed during replacement of older skarns.

Fe (±Au, Cu, W, Sn) skarn (D.P. Cox in Cox and Singer, 1986)

This deposit type consists of magnetite and (or) Fe sulfides in calc-silicate skarn that replace carbonate rocks or calcareous clastic rocks along intrusive contacts with diorite, granodiorite, granite, and coeval volcanic rocks. The depositional environment is calcareous sedimentary sequences intruded by granitic or siliceous volcanic stocks. The chief associated mineral is chalcopyrite. Metasomatic replacements consist of a wide variety of calc-silicate and related minerals.

Sn greisen and skarn (B.L. Reed in Cox and Singer, 1986)

These two deposit types commonly occur in the same area, and may grade into one another. The Sn greisen deposit type consists of disseminated cassiterite, cassiterite-bearing veinlets, and Sn sulfosalts in stockworks, lenses, pipes, and breccia in granite altered to greisen, mainly biotite and (or) muscovite leucogranite emplaced in a mesozonal to deep volcanic environment. Sn greisens are generally postmagmatic and are associated with late-stage, fractionated granitic magmas. Associated minerals include molybdenite, arsenopyrite, beryl, scheelite, and wolframite. Alteration minerals consist of incipient to massive replacement by quartz, muscovite, tourmaline, and fluorite.

The Sn skarn deposit type consists of Sn, W, and Be minerals in skarns, veins, stockworks, and greisen near intrusive contacts between generally epizonal(?) granitic plutons and limestone. The deposit minerals include cassiterite, sometimes with scheelite, sphalerite, chalcopyrite, pyrrhotite, magnetite, and fluorite. Alteration consists of greisen near granite margins, and metasomatic andradite, idocrase, amphibole, chlorite, chrysoberyl, and mica in skarn.

Deposits Related to Calc-Alkaline and Alkaline Granitic Intrusions-
Porphyry and Granitic Plutons-Hosted Deposits

Porphyry Cu-Mo (Au, Ag) (D.P. Cox in Cox and Singer, 1986)

This deposit type consists of stockwork veinlets and veins of quartz, chalcopyrite, and molybdenite in or near porphyritic intermediate to felsic intrusions. The veins contain mainly quartz and carbonate minerals. The intrusions occur mainly in stocks and breccia pipes that intrude granitic, volcanic, or sedimentary rocks. The depositional environment is high-level intrusive porphyries that are contemporaneous with abundant dikes, faults, and breccia pipes. Associated minerals are pyrite and peripheral sphalerite, galena, and gold. Alteration minerals consist of quartz, K-feldspar, and biotite or chlorite. Most deposits exhibit varying amounts sodic, potassic, and phyllic alterations. The tectonic environment is mainly weakly to strongly alkalic granitic plutons emplaced in back-arc settings of subduction zones.

Porphyry Mo (±W, Sn, Bi) (T.G. Theodore in Cox and Singer, 1986)

The porphyry Mo deposit type consists of quartz-molybdenite stockwork veinlets in granitic porphyries and adjacent country rock. The porphyries range in composition from tonalite to granodiorite to monzogranite. The depositional environment is epizonal. Associated minerals are pyrite, scheelite, chalcopyrite, and tetrahedrite. Alteration consists of potassic grading outward to propylitic, sometimes with phyllic and argillic overprints.

Porphyry Sn (B.L. Reed in Cox and Singer, 1986; Evstrakhin, 1988;
R.A. Eremin, this study)

This deposit type consists of mainly cassiterite and associated minerals in stockworks, veinlets, and disseminations that occur in veins, pipes, and shoots. The deposit minerals are cassiterite, quartz, pyrrhotite, pyrite, arsenopyrite, chalcopyrite, sphalerite, galena, stannite, wolframite, muscovite, chlorite, tourmaline, albite, adularia, siderite, rhodochrosite, calcite, topaz, fluorite, sulfostannates, and silver and bismuth minerals. The depositional environment is mainly volcanic-plutonic igneous arcs formed on continental crust. Mineralization occurs in shallow complex multiphase granitic plutons, granitic porphyry stocks, subvolcanic and volcanic rhyolite breccias, and also in coeval volcanic rocks and surrounding clastic rocks. Associated features are magmatic-hydrothermal breccias, and extensive metasomatic propylitic alteration along with formation of quartz, tourmaline, sulfide minerals, and sericite. Some deposits exhibit a quartz-tourmaline core with a peripheral zone of sericite. The deposit type is often associated with Sn- and Ag-bearing polymetallic veins. Other features of this deposit type are complex ore composition, variable mineral composition, extensive development of stockworks, extensive metasomatic alteration, both veinlet and disseminated.

Granitoid-related Au (R.I. Thorpe and J.M. Franklin, in
Eckstrand, 1984; Sidorov and Rozenblum, 1989; Aksenova, 1990)

This deposit type consists of fissure veins, en-echelon vein systems, and veinlet-stockwork zones with disseminated gold and sulfide minerals that occur generally in complex small granitic intrusions in volcanic-plutonic complexes. Plutonic rock composition includes gabbro, diorite, granodiorite, and granite of both calc-alkalic and sub-alkalic compositions. The deposits may occur as disseminations within granitic plutons, at apices of plutons, or in contact metamorphic aureoles. The deposit minerals are native gold, Au-bearing tellurides and sulfide minerals, with accessory quartz, tourmaline, muscovite, sericite, chlorite, feldspar, carbonate minerals, and fluorite. Disseminated sulfide minerals in wall rocks, especially arsenopyrite, are commonly enriched in gold and silver. Alteration to greisen is common with formation of quartz, sericite, tourmaline, chlorite. The depositional environment is tentatively interpreted as epizonal plutons intruded into miogeoclinal sedimentary rocks that in some cases were regionally metamorphosed and deformed before intrusion. The deposit type displays systematic mineralogy and chemical environment; and is often associated with polymetallic vein deposits with disseminated gold-bearing sulfide minerals, gold-bearing epithermal vein, and porphyry deposits.

Felsic plutonic U-REE (Nokleberg and others, 1987)

This deposit type consists of disseminated uranium minerals, thorium minerals, and REE-minerals in fissure veins and alkalic granite dikes in or along the margins of alkalic and peralkalic granitic plutons, or in granitic plutons, including granite, alkalic granite, granodiorite, syenite, and monzonite. The depositional environment is mainly the margins of epizonal to mesozonal granitic plutons. The deposit minerals include allanite, thorite, uraninite, bastnaesite, monazite, uranothorianite, and xenotime, sometimes with galena and fluorite.

W vein (Kosygin and Kulish, 1984; D.P. Cox and W.C. Bagby in Cox and Singer, 1986)

This deposit type consists mainly of massive and disseminated wolframite and molybdenite in quartz veins. Other deposit minerals are bismuthinite, pyrite, pyrrhotite, arsenopyrite, bornite, chalcopyrite, scheelite, cassiterite, beryl, and fluorite. The veins occur in the upper level, apices of granitic plutons, including alaskite, and in peripheral, contact metamorphosed sandstone and shale. Associated hydrothermal alteration includes formation of greisen, albite, chlorite, and tourmaline. The depositional environment is tensional fractures in epizonal granitoid plutons that intruded, and in some cases formed from anatectic melting of continental crust. The deposit type is sometimes associated with Sn-W vein, Mo-W vein, and Sn greisen deposits.

Deposits Related to Mafic and Ultramafic Rocks

Zoned mafic-ultramafic Cr-PGE (±Cu, Ni, Au, Co, Ti, or Fe) (Alaskan PGE) (N.J Page and Floyd Gray in Cox and Singer, 1986)

This deposit type consists of crosscutting ultramafic to mafic plutons with approximately concentric zoning that contain chromite, native PGE, PGE minerals and alloys, and Ti-V magnetite. In most areas of Alaska, the depositional environment consists of intermediate-level intrusion of mafic and (or) ultramafic plutons that are interpreted as the deeper-level magmatic roots to island-arc volcanoes. The deposit minerals include combinations of chromite, PGE minerals and alloys, pentlandite, pyrrhotite, Ti-V magnetite, bornite, and chalcopyrite.

Gabbroic Ni-Cu (synorogenic-synvolcanic; irregular gabbro pipes and stocks) (N.J Page in Cox and Singer, 1986)

This deposit type consists of massive lenses, matrix, and disseminated sulfides in small to medium-size composite mafic and ultramafic intrusions in metamorphic belts of metasedimentary and metavolcanic rocks. In most areas of Alaska, the depositional environment consists of post-metamorphic and post-deformational, intermediate-level intrusion of norite, gabbro-norite, and ultramafic rocks. The deposit minerals include pyrrhotite, pentlandite, and chalcopyrite, sometimes with pyrite, Ti- or Cr-magnetite, and PGE minerals and alloys. Accessory cobalt minerals also occur in some deposits.

Podiform Cr (J.P. Albers in Cox and Singer, 1986)

This deposit type consists of podlike masses of chromite in the ultramafic parts of ophiolite complexes, locally intensely faulted and dismembered. The host rock types are mainly dunite and harzburgite, commonly serpentinized. The depositional environment consists of magmatic cumulates in elongate magma pockets.

Associated minerals are magnetite and PGE-minerals and alloys.

Serpentine-hosted asbestos (N.J Page in Cox and Singer, 1986)

This deposit type consists of chrysotile asbestos developed in stockworks in serpentinized ultramafic rocks. The depositional environment is usually an ophiolite sequence, sometimes with later deformation of igneous intrusion. Associated minerals are magnetite, brucite, talc, and tremolite.

Deposits Related To Regionally Metamorphosed Rocks

Au quartz vein (includes concordant vein, and shear zone Au) (B.R. Berger in Cox and Singer, 1986)

This deposit type includes low-sulfide Au quartz vein, turbidite-hosted, concordant vein, and shear zone Au deposits types and consists of gold in massive, persistent quartz veins in regionally metamorphosed volcanic rocks, metamorphosed graywacke, chert, and shale. The depositional environment is low-grade metamorphic belts. The veins are generally late synmetamorphic to postmetamorphic and locally cut granitic rocks. Associated minerals are minor pyrite, galena, sphalerite, chalcopyrite, arsenopyrite, and pyrrhotite. Alteration minerals include quartz, siderite, albite, and carbonate minerals.

Disseminated Au-sulfide (Maiskoe type) (Sidorov, 1987)

This deposit type consists of fine-grained, disseminated sulfide minerals with subordinate veinlets and veins that occur in deformed and metamorphosed clastic metasedimentary rocks, mainly black shale. Gold occurs mainly in finely-dispersed sulfide minerals, mainly in acicular arsenopyrite, and Au-rich pyrite. Other deposit minerals are subordinate pyrrhotite, sphalerite, galena, chalcopyrite, various sulfosalts, quartz, and stibnite. Quartz-stibnite is the latest-formed assemblage. The deposits occur at the base of volcanic arcs in orogenic zones, and are controlled by extensive ductile shear zones, complex folds, and dome structures. Host rocks generally exhibit greenschist facies metamorphism. No relation exists between deposit type and granitic intrusions, except for local dikes. This deposit type may be associated with epithermal vein, granitoid-related gold, polymetallic vein, and various antimony and mercury deposits. The deposits type is interpreted to have formed from deep-seated, reducing, hydrothermal-metamorphic fluids.

Clastic-sediment-hosted Sb-Au (Berger, 1978, 1993)

This deposit type consists of stibnite and associated minerals that occur in simple and complex ladder and reticulate veins and veinlets, sometimes with subconformable disseminations. The main ore minerals are stibnite, berthierite, pyrite, arsenopyrite, and gold, with subordinate sphalerite, galena, chalcopyrite, tetrahedrite, chalostibite, scheelite, sphalerite, galena, tetrahedrite, pyrrhotite, marcasite, gudmundite, gersdorffite, native antimony, and native silver. Gangue minerals are mainly quartz and lesser ankerite, and lesser calcite, dolomite, siderite, sericite, and gypsum. The depositional environment is strongly-deformed fold belts developed along the former intracratonic rift troughs. Wall rocks are altered to varying combinations of quartz, carbonate, sericite, and pyrite. The host rocks for this deposit are: (1) Archean greenschist derived from mafic and ultramafic volcanic and volcaniclastic rocks; (2) interbedded carbonaceous black shale and volcanogenic-clastic rocks; or (3) to a lesser extent, retrogressively-metamorphosed granitic rocks. The deposit type occurs mainly in linear zones of folding and mylonites associated with regional strike-slip faults. Deposit type is associated with low-grade greenschist facies regional metamorphism; this association suggests a hydrothermal-metamorphic origin. The deposit type may also be associated with Au-quartz vein deposits

Cu-Ag quartz vein (vein Cu) (Nokleberg and others, 1987)

This deposit type consists of Cu sulfides and accessory silver in quartz veins and disseminations in weakly regionally metamorphosed mafic igneous rocks, mainly basalt and gabbro, and in lesser andesite and dacite. The depositional environment is low-grade metamorphic belts. The veins are generally late-stage metamorphic. The deposit minerals include chalcopyrite, bornite, lesser chalcocite, and rare native copper. Alteration minerals include epidote, chlorite, actinolite, albite, quartz, and zeolites.

Kennecott Cu (adapted from basaltic Cu deposit type by D.P. Cox in Cox and Singer, 1986, and from Nokleberg and others, 1987)

This deposit type consists of copper sulfides in large pipes and lenses in carbonate rocks within a few tens of meters of disconformably underlying subaerial basalt. The depositional environment consists of subaerial basalt overlain by mixed shallow marine and nearshore carbonate sedimentary rocks, including sabkha-facies carbonate rocks. Subsequent subaerial erosion of Cu-bearing basalt, and low-grade regional metamorphism may concentrate copper sulfides into pipes and lenses. The deposit minerals are chalcocite and lesser bornite, chalcopyrite, other Cu sulfide minerals, and oxidized Cu minerals. Alteration minerals are sometimes obscured by, or may include, malachite, azurite, metamorphic chlorite, actinolite, epidote, albite, quartz, zeolites, and secondary dolomite.

Deposits Related to Surficial Processes: Placer, Paleoplacer, and Laterite Deposits

Placer deposits are classified primarily by metals and secondarily by sedimentary processes. The principal sedimentary processes are fluvial and glaciofluvial, shoreline, and eluvial or residual. Fluvial and glaciofluvial deposits form where river velocities lessen at hydraulic flexures, on the inside of meanders, below rapids and falls, and beneath boulders. Shoreline deposits form in areas of strandline accumulations that are caused by shoreline drift, beach storms, wind, and wave actions. Eluvial and residual deposits form by the mechanical and (or) chemical disintegration of bedrock in the general absence of the concentrating force of water.

Placer and paleoplacer Au (W.E. Yeend in Cox and Singer, 1986)

This deposit type consists of elemental gold as grains and rarely as nuggets in gravel, sand, silt, and clay, and their consolidated equivalents in alluvial, beach, eolian, and rarely in glacial deposits. The depositional environment is high-energy alluvial where gradients flatten and river velocities lessen as at the inside of meanders, below rapids and falls, beneath boulders, and in shoreline areas where the winnowing action of surf causes gold concentrations found in raised, present, or submerged beaches. The major deposit minerals are gold, sometimes with attached quartz, magnetite or ilmenite.

Placer Sn (Nokleberg and others, 1987)

This deposit type consists of mainly cassiterite and elemental gold in grains in gravel, sand, silt, and clay, and their consolidated equivalents, mainly in alluvial deposits. The depositional environment is similar to that of placer Au deposits.

Placer PGE-Au (W.E. Yeend and N.J Page in Cox and Singer, 1986)

This deposit type consists of PGE minerals and alloys in grains in gravel, sand, silt, and clay, and their consolidated equivalents in alluvial, beach, eolian, and rarely in glacial deposits. In some areas, placer Au and placer PGE deposits occur together. The depositional environment is high-energy alluvial where gradients flatten and river velocities lessen as at the inside of meanders, below rapids and falls, beneath boulders, and in shoreline areas where the winnowing action of surf causes PGE and gold concentrations in raised, present, or submerged beaches. The major deposit minerals are Pt-group alloys, Os-Ir alloys, magnetite, chromite, and ilmenite.

Placer Ti (E.R. Force in Cox and Singer, 1986)

This deposit type consists of ilmenite and other heavy minerals concentrated by beach processes and enriched by weathering. The hosting sediment types are medium- to fine-grained sand in dune, beach, and inlet deposits. The depositional environment is a stable coastal region receiving sediment from bedrock regions. The major deposit minerals are low-Fe ilmenite, sometimes with rutile, zircon, and gold.

CLASSIFICATION OF LODE MINERAL DEPOSITS INTO METALLOGENIC BELTS

This study classifies the lode mineral deposits of Alaska and the Russian Northeast into metallogenic belts according to known significant mineral deposits, mineral deposit types, tectonic setting, and tectonic environment. This classification uses the following subdivision of deposits, based on tectonic setting: (1) pre-accretionary deposits that formed early in the geologic history of each tectono-stratigraphic terrane and are thereby unique to each terrane; (2) (syn)accretionary deposits that formed during periods of major structural juxtaposition, regional deformation, and penetrative deformation that generally occurred during collision of now adjacent terranes; and (3) post-accretionary deposits that formed late in the geologic history of groups of terranes, and generally occur in two or more adjacent terranes. The metallogenic belts defined in this report are based on the significant deposits of the region which were selected to be representative of the metallogeny of the region. Other, less well-defined metallogenic belts may be defined for larger groups of relatively small mineral deposits.

The major tectonic environments used to characterize metallogenic belts in this study are: (1) accretionary wedge; (2) continental-margin arc; (3) continental rift; (4) island arc; (5) metamorphic; (6) oceanic crust, seamount, and ophiolite; and (7) subduction zone. Definitions of these environments are provided above. The tectonic classifications of lode mineral deposits is currently a topic of considerable debate (Sawkins, 1990); however classification of lode mineral deposits by mineral deposit types and tectonic environment can be extremely useful. These classifications can be used for regional mineral exploration and assessment, for research on the critical or distinguishing characteristics of metallogenic belts, and for synthesizing of metallogenic and tectonic models. To describe the metallogenic belts of Alaska and the Russian Northeast, the significant lode deposits are classified both according to mineral deposit type and tectonic environment.

LODE METALLOGENIC BELTS OF MAINLAND ALASKA

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Pre-Accretionary Metallogenic Belts: Podiform Cr and Related Deposits

Several major pre-accretionary metallogenic belts containing podiform Cr and related deposits occur throughout mainland Alaska (Map 1, Sheet 2). These deposits are mainly hosted in either ophiolite or island arc terranes of Paleozoic and early Mesozoic age. In the ophiolite terranes, the deposits occur in ultramafic tectonites. The ophiolite terranes generally occur in thin, but laterally extensive thrust slices that formed during Mesozoic obduction of Paleozoic and early Mesozoic oceanic lithosphere onto the margin of continental-affinity terranes (Patton, Box, and Grybeck, 1989). In the island arc terranes, the deposits generally occur in mafic to ultramafic plutons, some of which are zoned.

Southern Brooks Range Belt of Podiform Cr Deposits

A metallogenic belt of podiform Cr and associated PGE deposits, and one serpentine-hosted asbestos deposit occurs along the southern flank of the Brooks Range (Map 1, Sheet 2). The geologically favorable area for the metallogenic belt is the Angayucham oceanic terrane (Jones and others, 1987). This belt extends for several hundred kilometers along the southern flank of the Brooks Range. The major podiform Cr deposits are at Iyikrok Mountain, Avan, Misheguk Mountain, and Siniktanneyak Mountain. A serpentine-hosted asbestos deposit occurs at Asbestos Mountain.

The podiform Cr and PGE deposits are hosted by dunite and harzburgite tectonite which occur as fault-bounded slabs in the Misheguk igneous sequence that also contains pillow basalt, gabbro, chert, and minor limestone (Roeder and Mull, 1978; Zimmerman and Soustek, 1979; Nelson and Nelson, 1982; Foley, 1992). The age of the ultramafic rocks hosting the podiform Cr deposits is probably Jurassic (Patton and others, 1989). This sequence is part of the Angayucham oceanic terrane which ranges in age mainly from Devonian to Triassic and is interpreted as a dismembered ophiolite (Patton and others, 1989). The ultramafic rocks hosting the Asbestos Mountain deposit also occur as fault-bounded slabs in the Angayucham terrane. The Angayucham terrane is interpreted as imbricated oceanic crust and lithosphere that formed during a long-lived period of sea-floor setting from the Devonian to Triassic (Patton and others, 1989). The thrust slices of ultramafic rocks in the Angayucham terrane are typical of the lower part of an ophiolite succession. However, geologic and geochemical data suggest that these rocks formed in a complex multistage environment at a spreading axis in a volcanic arc environment (Loney and Himmelberg, 1989, Patton and Box, 1989). Because of this complex interpretation, the general term of an oceanic rift is used for the tectonic environment of both the southern Brooks Range belt and the Yukon River belt of podiform Cr deposits, discussed below.

Along the southern margin of the Brooks Range, the Angayucham oceanic terrane occurs mainly in a major east-west-striking, south-dipping thrust sheet that extends for several hundred km, and in sparse isolated klippen. These thrust sheets and klippen are thrust along south-dipping faults over the highly deformed metamorphosed, middle Paleozoic and older metasedimentary, metavolcanic, and lesser metagranitic rocks of the Coldfoot displaced continental margin terrane to the north, and in turn are overthrust by the mainly island-arc, Late Jurassic and Early Cretaceous Koyukuk island arc terrane to the south (Moore and others, 1992; Patton and others, 1989).

Eastern Seward Peninsula and Marshall Belt of Podiform Cr Deposits

A complexly-deformed, fault-bounded unit of ophiolite and related rocks occur discontinuously in five belts from the eastern Seward Peninsula southward to the Marshall area (Foley, 1992). In the eastern Seward Peninsula area, the units consists of fault-bounded slivers of ultramafic rocks and serpentinite that occur along the tectonic boundary between the Koyukuk island arc terrane to the east and the Seward displaced continental margin terrane to the west. In the Marshall area, the unit consists of pillow basalt, chert, diorite, gabbro, serpentinite, and harzburgite. In both areas, the ophiolite and related rocks are interpreted as small, isolated klippen of the Angayucham oceanic terrane, most of which are too small to depict on the base map. The ultramafic rocks in both areas contain small, isolated occurrences of nickel sulfide minerals and are interpreted as the sources of PGE minerals recovered in placer mines in Sheep Creek and Dime Creek, and in the Ungalik River in the Koyuk district.

Yukon River Belt of Podiform Cr Deposits

A second major metallogenic belt of podiform Cr deposits occurs mainly south of the Yukon River along the southern flank of the Yukon-Koyukuk Basin (Map 1, Sheet 2) (Foley, 1992). As in the podiform Cr belt to the north, the geologically favorable area is also the Angayucham oceanic terrane. This belt extends for several hundred kilometers. The principal deposits in the northeastern part of this belt are at Caribou Mountain, Lower Kanuti River, and Holonada. The major deposits in the southwestern part of this belt are in the Tozitna and Innoko areas with the larger deposits at Mount Hurst and Kaiyuh Hills. These deposits are also hosted in the Angayucham oceanic terrane which in this region is thrust along north-dipping faults over the metamorphosed, middle Paleozoic and older metasedimentary, metavolcanic, and lesser metagranitic rocks of the Ruby displaced continental margin terrane to the south. In turn, the Angayucham oceanic terrane is overthrust by the island-arc Koyukuk island arc terrane along north-dipping thrust faults (Patton and others, 1989).

Eastern Seward Peninsula and Marshall Belt of Podiform Cr Deposits

Complexly deformed, fault-bounded ophiolite and related rocks crop out discontinuously in five belts from eastern Seward Peninsula southward to Pilcher Mountain near Marshall. On eastern Seward Peninsula, the ophiolitic rocks appear to occur in fragments of the Angayucham that occur along the boundary between submarine volcanic rocks of the Koyukuk arc on the east and the Seward displaced continental margin terrane on the west. The ultramafic and related rocks of this belt contain small, isolated occurrences of nickel sulfides and are the source of placer platinum recovered from Sweep and Dime Creeks and Ungalik River in the Koyuk District.

East-Central Alaska Belt of Podiform Cr and Serpentinite-Hosted Asbestos Deposits

A metallogenic belt of asbestos and Pt deposits occurs in east-central Alaska in the Yukon-Tanana Upland (Map 1, Sheet 2) (Foley, 1992). The geologically favorable unit for this belt is Seventymile oceanic terrane which occurs in discontinuous klippen thrust over the eastern part of Yukon-Tanana displaced continental margin terrane in the Yukon-Tanana Upland (Jones and others, 1987; Foster and others, 1987). The significant deposits are a large serpentinite-hosted asbestos deposit at Slate Creek, and a PGE deposit in ultramafic rocks at Eagle C-3. Both the asbestos and podiform Cr deposits occur in discontinuous remnants of thrust sheets of ultramafic and associated rocks of the Seventymile terrane that is structurally thrust onto the subjacent Yukon-Tanana terrane. The Seventymile terrane consist of serpentinized harzburgite and associated ultramafic rocks, gabbro, pillow basalt, chert, argillite, andesite, and graywacke of Permian to Triassic age (Foster and others, 1987). The Seventymile terrane is interpreted as a dismembered ophiolite that formed during a Permian to Triassic period of sea-floor spreading (Foster and others, 1987; Nokleberg and others, 1989). Consequently, an oceanic rift environment is interpreted for the east-central Alaska belt of podiform Cr and serpentinite-hosted asbestos deposits. The structurally subjacent Yukon-Tanana displaced continental margin terrane is a highly deformed and metamorphosed, middle Paleozoic and older sequence of continental-margin metasedimentary, metavolcanic, and metagranitic rocks (Foster and others, 1987; Nokleberg and others, 1989).

Southwestern Alaska Belts of Zoned Mafic-Ultramafic PGE Deposits

Several metallogenic belts of zoned mafic-ultramafic PGE deposits occur in southwestern Alaska (Map 1, Sheet 2). The geologically favorable area for the belt is the Goodnews and Togiak terranes. The major deposits are at Red Mountain and a concealed Fe-Ti (PGE) deposit at Kemuk Mountain (Foley, 1992). The Red Mountain deposit consists of sparse PGE minerals in a Middle Jurassic, crudely zoned pluton which is adjacent to the Goodnews Bay PGE placer district (Southworth and Foley, 1986). The ultramafic pluton at Red Mountain intrudes the younger part of the Goodnews oceanic terrane which is a highly-deformed oceanic crustal sequence of Permian and early Mesozoic argillite, basalt, volcaniclastic rocks, chert, limestone, and local ultramafic tectonites interpreted as remnants of oceanic lithosphere (Box, 1985; Jones and others, 1987).

The ultramafic plutons in both areas are a part of a belt of similar zoned mafic to ultramafic plutons that intrude both the Goodnews oceanic terrane and the adjacent Togiak island arc terrane. The Goodnews terrane is interpreted as the subduction zone complex of oceanic rocks that is tectonically linked to the island arc Togiak island arc terrane (Box, 1985; Patton and others, 1989). These plutonic rocks are interpreted as the oldest known remnants of an island arc that collided with continental North America in the Late Jurassic to Early Cretaceous (Box and Patton, 1989). Because of these relations, an island-arc environment is interpreted for the southwestern Alaska belt of zoned mafic-ultramafic PGE deposits.

Southern Alaska Belt of Gabbroic Ni-Cu Deposits

A metallogenic belt of gabbroic Ni-Cu deposits occurs in southern Alaska in the eastern Alaska Range and Wrangell Mountains (Map 1, Sheet 2) (Foley, 1992). The geologically favorable areas for the belt are the portions of the Wrangellia island arc terrane that are underlain by the Upper Triassic Nikolai Greenstone. These deposits occur in small- to moderate size gabbro plutons and local cumulate mafic and ultramafic rocks that intrude the Nikolai Greenstone and older rocks, and are interpreted as being co-magmatic with the mafic magmas that formed the Late Triassic Nikolai Greenstone during a short-lived period of rifting of the Wrangellia terrane (Nokleberg and others, 1985; 1987, 1988; Nokleberg and Lange, 1985a; Nokleberg and others, 1993). Because of these relations, an oceanic rift environment is interpreted for the southern Alaska belt of gabbroic Ni-Cu deposits (Nokleberg and others, 1988).

Kodiak Island and Border Ranges Belt of Podiform Cr Deposits

A metallogenic belt of podiform Cr deposits and one gabbroic Ni-Cu deposit occurs in southern Alaska along the northern margin of Kodiak Island, on the Kenai Peninsula, and along the northern flank of the Chugach Mountains (Map 1, Sheet 2) (Foley, 1992). This belt occurs sporadically along a strike distance of several hundred kilometers from Kodiak Island to the southwest to the eastern Chugach Mountains to the east. The geologically favorable area for these deposits is the Border Ranges ultramafic-mafic assemblage that forms the southern part of the Peninsular island arc terrane (Burns, 1985; Plafker and others, 1989). The major deposits are at Halibut Bay, Claim Point, Red Mountain, and Bernard and Dust Mountains. A possibly related gabbroic Ni-Cu deposit occurs at Spirit Mountain.

This belt of podiform Cr and associated deposits occurs in the mainly Early Jurassic Border Ranges ultramafic and mafic assemblage (Burns, 1985; Plafker and others, 1989), an igneous belt of ultramafic tectonites and cumulate gabbro and norite that is immediately north of the Border Ranges fault system (MacKevett and Plafker, 1974; Burns, 1985). The ultramafic and mafic rocks are interpreted as the deep-level root for the mainly Jurassic Talkeetna island arc of the Peninsular terrane (Burns, 1985; Plafker and others, 1989). Consequently, a deep-level island-arc environment is interpreted for the Kodiak Island and Border Ranges belt of podiform Cr deposits. If these interpretations are correct, the pre-accretionary Alaska Peninsular metallogenic belt that occurs in the Talkeetna arc, discussed below, represents the mid- to upper levels of ore formation in the island arc volcanic and plutonic arc rocks of the Peninsular terrane.

Pre-Accretionary Metallogenic Belts: Massive Sulfide and Associated Deposits

Several major metallogenic belts of massive sulfide and associated deposits occur throughout mainland Alaska (Map 2, Sheet 2). These deposits are mainly hosted in submarine, intermediate to felsic volcanic and related rocks that formed during island arc or submerged continental-margin arc volcanism (Nokleberg and others, 1988). These island arc terranes are generally interpreted as remnants of arcs now accreted into the collage of terranes forming Alaska (Jones and Silberling, 1982). The continental-margin arc terranes are generally interpreted as displaced fragments of the North American continental margin (Jones and Silberling, 1982). The older massive sulfide deposits are of Paleozoic age and occur in interior and northern Alaska whereas the younger massive sulfide deposits occur in the younger accreted terranes in southern Alaska.

Northwestern Brooks Range Belt of Sedimentary-Exhalative Zn-Pb, Bedded Barite, and Vein Sulfide Deposits

A major metallogenic belt of large sedimentary exhalative Zn-Pb-Ag and bedded barite deposits occurs in the northwestern Brooks Range (Map 2, Sheet 2). The geologically favorable area for the belt is the Kagvik sequence in the Endicott Mountains passive continental margin terrane of the Arctic Alaska superterrane. The belt extends along strike for more than 200 km. Locally associated with the sedimentary exhalative deposits are vein sulfide deposits. The larger Zn-Pb-Ag deposits are at the Lik deposit and at Red Dog Creek. The sedimentary exhalative Zn-Pb-Ag and bedded barite deposits occur in a tectonically disrupted and strongly folded assemblage of Mississippian and Pennsylvanian chert, shale, limestone turbidite, minor tuff, and sparse intermediate to silicic volcanic rocks, mainly keratophyre, named the Kuna Formation by Mull and others (1982). The Kuna Formation forms the basal unit of the Kagvik sequence of Churkin and others (1979) and the Kagvik terrane of Jones and others (1987). This unit, and younger, late Paleozoic and early Mesozoic cherts and shales are interpreted either as a deep-water, allochthonous oceanic assemblage (Churkin and others, 1979; Nokleberg and Winkler, 1982; Lange and others, 1985) or as an assemblage deposited in an intracratonic basin (Mull and others, 1982; Mayfield and others, 1983). Depending upon interpretation of stratigraphy, the tectonic environment for the origin of the sedimentary exhalative Zn-Pb-Ag and bedded barite deposits in the northwest Brooks Range belt is interpreted as either an incipient submarine, continental-margin arc, or in the early stages of a long-lived, sediment-starved, epicontinental basin. The metamorphosed sulfide deposit at Hannum Creek in the northeastern part of the Seward Peninsula may be an extension of the northwestern Brooks Range belt. This deposit is interpreted as a metamorphosed laminated exhalite that possibly originated as a sedimentary exhalative Zn-Pb deposit (J.A. Briskey, written commun., 1985).

South of this belt are a group of sulfide vein deposits at Story Creek, Whoopee Creek, and Frost, and a Kipushi Cu-Pb-Zn deposit at Omar. The vein deposits generally consist of sphalerite and galena with quartz and minor carbonate gangue in veins and fractures. The vein deposits occur in the middle Paleozoic continental-margin sedimentary rocks of the Arctic Alaska superterrane. The veins and fractures occur in linear zones from 1.5 to 3 km long and that cross tightly folded strata, indicating an epigenetic origin (I.F. Ellersieck and J.M. Schmidt, written commun., 1985). No tonnage and grade data are available. Insufficient data preclude assignment of these deposits to a specific mineral deposit type. The vein deposits are interpreted by some workers as the possible feeders to the sedimentary-exhalative Zn-Pb deposits and as having possibly formed during dewatering of the same source basin (Schmidt, 1993). However, this interpretation is contradicted by the field relation that the vein deposits crossing tightly-folded strata, indicating formation of veins after Cretaceous deformation of the strata..

Southern Brooks Range Belt of Kuroko and Kipushi Massive Sulfide Deposits

An extensive metallogenic belt of major kuroko massive sulfide deposits and one Kipushi Cu-Pb-Zn deposit occurs in the southern Brooks Range along an east-west trend for about 260 km (Map 2, Sheet 2). The geologically favorable area for this belt is a sequence of metavolcanic and sedimentary rocks that occur in the Coldfoot displaced continental margin terrane in the southern Brooks Range, and in the Nome Group in the southern Seward Peninsula in the Seward displaced continental margin terrane. The largest deposits are in the Ambler district (Hitzman and others, 1986) at Arctic and Ruby Creeks. The kuroko massive sulfide deposits in the southern Brooks Range occur in or adjacent to submarine mafic and felsic metavolcanic rocks and associated carbonate, pelitic, and graphitic metasedimentary rocks of the Devonian and Mississippian Ambler sequence (Hitzman and others, 1982, 1986) that forms part of the informally named *schist belt* or Coldfoot displaced continental margin terrane of the southern Brooks Range (Moore and others, 1992). The Ambler sequence is generally multiply deformed and exhibits metamorphism of both greenschist and blueschist facies (Hitzman and others, 1982). A back-arc rift environment is interpreted by most workers in the southern Brooks Range belt of kuroko massive sulfide deposits (Hitzman, 1986; Schmidt, 1986). However, this belt shares many characteristics with the broadly coeval eastern Alaska Range belt of kuroko massive sulfide deposits, described below, which is interpreted as forming in a submerged continental-margin arc environment.

Alaska Range and Yukon-Tanana Upland Belt of Kuroko Massive Sulfide Deposits

A major metallogenic belt of kuroko massive sulfide deposits occurs in the central and eastern Alaska Range in the southern Yukon-Tanana displaced continental margin terrane (Map 2, Sheet 2). The massive sulfide deposits extend for 350 km along strike on the northern flank of the Alaska Range, and constitute one of the longer belts of massive sulfide deposits in Alaska. Associated with the western end of this belt are polymetallic vein and Sb-Au deposits in the Kantishna area, discussed below. The major deposits occur at WTF, Red Mountain, Sheep Creek, Liberty Bell, Anderson Mountain, Miyaoka, Hayes Glacier, McGinnis Glacier, and in the Delta district. Most of the deposits in the Bonnifield District (central Alaska Range belt) occur in the Mystic and Moose Creek Members of the Totatlanika Schist (Wahrhaftig, 1968; Gilbert and Bundtzen, 1979). This belt of kuroko massive sulfide deposits occurs in a west-northwest trending unit of Devonian-Mississippian metavolcanic and interlayered metasedimentary rocks, mainly which are polymetamorphosed and poly-deformed. The metavolcanic rocks, which host most of the major base and precious metal deposits, are derived from a volcanic suite varying in composition from spilite to keratophyre. The interlayered metasedimentary rocks are mainly pelitic schist, quartz schist, calc-schist, and marble (Aleinikoff and Nokleberg, 1985; Nokleberg and Aleinikoff, 1985; Lange and others, 1990, 1993; Nokleberg and others, 1993), and forms the upper structural and stratigraphic level of the Yukon-Tanana terrane (Nokleberg and Aleinikoff, 1985).

The eastern Alaska Range belt of kuroko massive sulfide deposits is interpreted as forming during Devonian and lesser Mississippian submarine volcanism. In the deeper stratigraphic/structural levels of the Yukon-Tanana displaced continental margin terrane to the north are locally abundant and coeval Devonian and lesser Mississippian metagranitic and augen gneiss plutons that are interpreted to form the deep levels of a coeval igneous arc (Foster and others, 1987; Nokleberg and others, 1989). Most studies of kuroko massive sulfide deposits interpret a back-arc or arc-related rift for the origin of these deposits (Sawkins, 1990). In the eastern Alaska Range, the lack of mafic igneous rocks appears to preclude a rift origin. Field, petrologic, and isotopic data indicate that the submarine volcanism and associated granitic plutonism occurred along a submerged continental-margin igneous arc that may be an allochthonous fragment derived from along the North American continental margin (Nokleberg and Lange, 1985b; Nokleberg and others, 1989; 1993; Lange and others, 1993). Consequently, a continental-margin arc environment is interpreted for the eastern Alaska Range belt.

The eastern Alaska Range and southern Brooks Range belts of kuroko massive sulfide deposits share many characteristics. Both are hosted in Devonian and possibly Mississippian marine, continental-margin volcanic and associated sedimentary rocks that are highly deformed and metamorphosed. Both are paired with coeval metagranitic belts that occur in deeper stratigraphic/structural levels to the north. Both display chemical and isotopic signatures characteristic of continental-margin magmatism (Aleinikoff and others, 1987; Moore and others, 1992). And both are overthrust by middle Paleozoic to Triassic oceanic lithosphere. In addition, their host rocks, the Coldfoot and Yukon-Tanana terranes may be the offset equivalents of each other (Grantz and others, 1991), and consequently, the two massive sulfide belts may be the offset equivalents of each other.

Eastern Seward Peninsula (Kiwalik Mountain) Belt of Massive Sulfide Deposits

A metallogenic belt kuroko massive sulfide deposits occurs in the Kiwalik Mountain region of the Seward Peninsula (Map 2, Sheet 2). The geologically favorable unit for this belt is thin, tectonically-transposed (middle Paleozoic?) felsic schists and metavolcanic rocks of the Seward displaced continental margin terrane. Two small deposits on the west flank of Kiwalik Mountain consist of chalcopyrite, galena, tetrahedrite, and sphalerite layers, and disseminations from 0.2 to 2 m thick parallel to compositional layering in a 200 meter-thick section of metafelsite, "button schist", and metatuff. The Kiwalik Mountain belt may be an extension of the Southern Brooks Range metallogenic belt of kuroko massive sulfide deposits described above (T.K. Bundtzen and Thomas Crafford, written commun., 1991).

Sinuk River Belt of Massive Sulfide Deposits

A metallogenic belt favorable for kuroko massive sulfide deposits occurs in the Sinuk River area in the southwestern part of the Seward Peninsula (Map 2, Sheet 2). The geologically favorable unit is a 250 km^2 region of metamorphosed upper Paleozoic carbonate dominated section of the Seward displaced continental margin terrane that occur about 30 km west of Nome (Herreid, 1968, 1971; Hudson and others, 1977). At least 15 separate occurrences of galena, sphalerite, fluorite, massive hematite, and barite occur in the region. The deposits vary widely in morphology and size and consist of: (1) structurally controlled lead-zinc-barium-fluorite veins and stockworks in calc schist and marble; and (2) massive segregations and lenses of hematite and magnetite in marble; and 3) disseminated to laminated galena and sphalerite in calc schist and mafic (metavolcanic?) schists. The Sinuk River area is regarded either as a kuroko massive sulfide, and (or) Mississippi Valley environment. The largest deposit at Monarch contains at least an estimated 750,000 tonnes of 35 - 40% Fe_2O_3 and anomalous lead and zinc. The Aurora Creek zinc-lead deposit extends along strike for at least 2,200 meters.

Mystic Massive Sulfide and Barite Deposit Belt

A metallogenic belt of massive Besshi massive sulfide deposits occur in interior Alaska in the central and western Alaska Range (Map 2, Sheet 2). The major deposit is at Shellebarger Pass and consists of a Besshi-type deposit composed of very fine-grained mixture mainly of pyrite and marcasite with lesser sphalerite, chalcopyrite, galena, and pyrrhotite in a gangue of siderite, calcite, quartz, and dolomite (Reed and Eberlein, 1972). The sulfides are hosted in Triassic or Jurassic chert, dolomite, siltstone, shale, volcanic graywacke, conglomerate, aquagene tuff, pillow basalt, agglomerate, and breccia of the continental margin Mystic passive continental margin terrane. The available data are insufficient to determine the tectonic environment for the Shellebarger Pass deposit.

The Mystic terrane contains syngenetic bedded barite deposits. Upper Devonian (Frasnian) shales and clastic rocks host sedimentary-exhalative barite mineralization at the Gagaryah Deposit in the Lime Hills D-4 Quadrangle. Barite nodules and spheroids are commonly encountered in either Devonian or Mississippian strata at other localities in the Mystic Terrane to the northeast. The known deposits and occurrences are very similar to deposits described in The Earn Group of the Selwyn and McKensie Mountains in North central Yukon Territory; Bundtzen and Gilbert (1991) speculate that the Mystic passive continental margin terrane may represent a similar sedimentary-tectonic environment to the Earn Group in Canada emplaced into Alaska by large scale transcurrent fault displacement. T.K. Bundtzen (written commun., 1992) observed very high copper backgrounds (350-450 ppm

Cu) in Upper Triassic basalt of the Mystic terrane in the McGrath Quadrangle and discovered several small syngenetic Cyprus-type chalcopyrite deposits within interstices of pillow structures and in aquagene tuff.

Alaska Range-Wrangell Mountains Massive Sulfide Belt

A metallogenic belt of Besshi massive sulfide deposits occurs in the Alaska Range and the Wrangell Mountains (Map 2, Sheet 2). The geologically favorable unit is marine pillow basalt and interlayered marine clastic metasedimentary rocks of the Upper Triassic Nikolai Greenstone of the Wrangellia island arc terrane. The significant deposit is at Denali, a Cu-Ag Besshi massive sulfide(?) deposit that consists of stratiform bodies of very fine-grained, thinly layered chalcopyrite and minor pyrite in thin-bedded carbonaceous, and calcareous argillite in a zone as much as 166 m long and 9 m wide. The argillite occurs within the Upper Triassic Nikolai Greenstone (Stevens, 1971; Seraphim, 1975). The Nikolai Greenstone is a thick and vast unit of submarine and subaerial tholeiitic basalt that forms a major part of the Wrangellia terrane in southern Alaska (Nokleberg and others, 1985, 1993; Jones and others, 1987). The sulfides typically are rhythmically layered. The argillite and greenstone locally are moderately folded and are metamorphosed to the lower greenschist facies. The Nikolai Greenstone is interpreted as forming during a short-lived period of rifting (Nokleberg and Lange, 1985a; Nokleberg and others, 1985) and consequently a oceanic rift tectonic environment is interpreted for the Denali deposit.

Talkeetna Mountains - Alaska Range Kuroko Massive Sulfide Belt

A metallogenic belt of kuroko-like massive sulfide deposits occurs in the Talkeetna Mountains (Map 2, Sheet 2). The geologically favorable unit is the submarine tuff, andesite, and dacite of the Lower Jurassic Talkeetna Formation. The significant deposit at Johnson River consists of quartz-sulfide veins and massive sulfide lenses contain chalcopyrite, pyrite, sphalerite, galena, and gold in discordant pipe-like bodies of silicified volcanic rocks. Veins of chlorite, sericite, anhydrite and a cap of barite occur proximal to the four ore horizons now recognized. The deposit occurs in pyroclastic and volcaniclastic rocks of Portage Creek agglomerate; similar mineralized horizons have been found along strike to the northeast. Tuffs of the Talkeetna Formation also contain disseminated chalcopyrite-barite mineralization in the Oshetna River Drainage of the Nelchina District northeast of Anchorage. Specifically, gold enriched massive sulfide deposits in the Eskay Creek District contain many similar morphological features to those described at Johnson River.

Prince William Sound Massive Sulfide Belt

A metallogenic belt of Besshi and Cyprus massive sulfide deposits occurs in the Prince William Sound district along the eastern and northern margins of the Gulf of Alaska (Map 2, Sheet 2) (Nokleberg and others, 1988; Crowe and others, 1992). The geologically favorable area for the belt is the southern margin of the Chugach and the Prince William accretionary wedge-turbidite terranes (Jones and others, 1987). The major deposits are at Beatson, Copper Bullion, Ellamar, Fidalgo-Alaska, Knight Island, Latouche, Midas, Pandora, Standard Copper, and Threeman. Many of these deposits were producing mines in the early part of the century.

These and the deposits in the Prince William Sound belt, except for the Midas deposit, are hosted in the early Tertiary Orca Group that constitutes most of the Prince William terrane and consists of a strongly deformed, thick assemblage of Paleocene and Eocene(?) graywacke, argillite, minor conglomerate, pillow basalt, basaltic tuff, sills, and dikes (Winkler and Plafker, 1981; Jones and others, 1987). The mafic volcanic rocks of the Prince William terrane are interpreted as forming during an early Tertiary period of oceanic rifting that was immediately succeeded by a flood of sediment derived from uplift and erosion of the Coast Mountains (Plafker and others, 1989). Consequently, an oceanic-rift environment is interpreted for the Prince William Sound metallogenic belt. The Cyprus massive sulfide deposits are interpreted as forming during rifting without abundant covering by clastic debris whereas the Besshi deposits are interpreted as forming during sedimentation of clastic debris onto an active oceanic rift.

The Midas deposit consists of disseminated to massive chalcopyrite, pyrite, pyrrhotite, sphalerite, and minor galena in a folded, lens-shaped body (Moffit and Fellows, 1950; Rose, 1965; Jansons and others, 1984; Crowe and others, 1992). The sulfides occur in highly deformed phyllite and metagraywacke of the Upper

Cretaceous Valdez Group in the southern Chugach accretionary wedge-turbidite terrane. Mafic metavolcanic rocks crop out in the footwall within a few hundred m of the ore body. On the basis of whole rock REE analyses, the mafic volcanic rocks in the southern Chugach terrane are interpreted by Lull and Plafker (1990) as forming in a short-lived island-arc environment. With this interpretation, an island-arc environment is interpreted for the Midas deposit.

Pre-Accretionary Metallogenic Belts: Granitic Magmatism Deposits

Several major metallogenic belts of granitic magmatism deposits occur throughout mainland Alaska (Map 3, Sheet 2). These deposits are mainly hosted in or near granitic, siliceous hypabyssal, and siliceous volcanic rocks that formed during either Mesozoic or older island arc or continental-margin arc igneous activity (Jones and Silberling, 1982; Nokleberg and others, 1988). The major deposit types are porphyry, polymetallic vein, and skarn deposits. As with the units hosting the kuroko massive sulfide and related deposits, the island arc terranes are generally interpreted as remnants of igneous arcs now accreted into the collage of terranes forming Alaska (Jones and Silberling, 1982; Nokleberg and others, 1988). The continental-margin arc terranes are generally interpreted as displaced fragments of the North American continental margin (Jones and Silberling, 1982).

Brooks Range Belt of Granitic Magmatism Deposits

A metallogenic belt of granitic magmatism deposits, mainly porphyry, polymetallic vein, and skarn deposits, occurs in the core of the Brooks Range (Map 3, Sheet 2). The geologically favorable environment for the belt is the Hammond and North Slope terranes of the Arctic Alaska superterrane (Moore and others, 1992). This belt extends for over 900 km along the length of the Brooks Range. The major deposits occur in two groups, a major group in the central Brooks Range, and a minor group in the northeastern Brooks Range.

Vein, Skarn, and Porphyry Deposits, Central Brooks Range. Significant deposits in this belt in the central Brooks Range are at Mount Igikpak and Arrigetch Peaks, Sukakpak Mountain, Victor, and Geroe Creek (Map 3, Sheet 2). These deposits include polymetallic quartz veins with base-metal sulfides, Sn skarns with disseminated cassiterite and base-metal sulfides, Cu-Pb-Zn skarns with disseminated Fe and base-metal sulfides, and porphyry Cu and Mo deposits. The deposits in the central Brooks Range are in a structurally complex and polymetamorphosed assemblage of Devonian or older carbonate rocks, including the Silurian and Devonian polymetamorphosed limestone, calc-schist, quartz-mica schist, and quartzite, that is intruded by mainly Late Devonian and lesser late Proterozoic gneissic granitic rocks that together with the metasedimentary rocks constitute the Hammond passive continental margin terrane of the Arctic Alaska superterrane (Moore and others, 1992).

Skarn, Vein, and Porphyry Deposits, Northeastern Brooks Range. Major deposits in this belt in the northeastern Brooks Range are a cluster of Pb-Zn skarn, fluorite vein, polymetallic vein, and porphyry Cu deposits at Esotuk Glacier, Porcupine Lake, Romanzof Mountains, and Galena Creek (Map 3, Sheet 2). These mineral deposits are hosted in a variety of Paleozoic and late Proterozoic metasedimentary rocks, mainly marble, calc-schist, limestone, quartzite, and greenstone of the North Slope passive continental margin terrane of the Arctic Alaska superterrane where intruded by Devonian gneissose granite plutons (Newberry and others, 1986). The paucity of deposits in the northeastern Brooks Range most likely reflects the limited geological exploration of the area. Although not part of this metallogenic belt, a porphyry Mo deposit in this area at Bear Mountain consists of molybdenite- and wolframite-bearing Tertiary rhyolite porphyry stock (Barker and Swainbank, 1986). The stock intrudes the Neruokpuk(?) Quartzite. Insufficient data preclude assigning a tectonic environment to this deposit.

Origin of the Central and Northeastern Brooks Range Metallogenic Belt. Field, chemical, and isotope data indicate the granitic magmatism deposits in the central and northeastern Brooks Range metallogenic belt formed during intrusion of the Devonian gneissic granitic rocks. Most of the gneissic granitic plutons are highly evolved, peraluminous biotite and two-mica granites with high initial Sr ratios indicating a major inherited crustal component (Miller, in press). Most interpretations favor a continental-margin subduction zone origin (Newberry and others, 1986). Consequently a continental-margin arc environment is interpreted for the belt. U-Pb zircon isotopic ages indicate that the Devonian gneissic granitic rocks intruded about 30 to 40 m.y. after the eruption of the submarine volcanic rocks that host the kuroko massive sulfide deposits in the southern Brooks Range metallogenic belt (Newberry and others, 1986). A complicated tectonic history thereby exists for the origin of the kuroko massive sulfide deposits and granitic magmatism deposits with back-arc rifting followed by continental-margin magmatism. The abundance of deposits in the central and northeastern Brooks Range belt deposits contrasts sharply with the lack of any significant deposits in or adjacent to the possibly correlative Devonian metagranitic rocks of the Yukon-Tanana displaced continental margin terrane to the south in east-central Alaska.

Alaska Range-Wrangell Mountains Belt of Granitic Magmatism Deposits

A metallogenic belt of granitic magmatism deposits, mainly porphyry, polymetallic vein, and skarn deposits, occurs in the Alaska Range and in the Nutzotin and Wrangell Mountains to the east and southeast (Map 3, Sheet 2). The geologically favorable environment for the belt is the late Paleozoic part of the Wrangellia island arc terrane containing late Paleozoic volcanic and granitic rocks. The significant deposits are at Rainy Creek, Rainbow Mountain, and Chistochina. Farther to the southeast in the Nutzotin and Wrangellia Mountains, similar small, subvolcanic intrusions occur in the Permian and Pennsylvanian Slana Spur, Hazen Creek, and Station Creek Formations, and in the Tetelna Volcanics (Richter, 1975; MacKevett, 1978). No significant deposits are yet discovered in these areas. Field, petrologic, and isotopic data indicate the Rainy Creek Cu-Ag skarn and the Rainbow Mountain porphyry Cu deposits are granitic magmatism deposits formed during late Paleozoic island arc volcanism of the Skolai arc (Nokleberg and others, 1984, 1985; Nokleberg and Lange, 1985a; Plafker and others, 1989). The granitic rocks in this arc are mainly granodiorite and granite that were preceded by gabbro and diorite, and succeeded by shoshonite (Beard and Barker, 1989). Consequently an island-arc environment is interpreted for the eastern Alaska Range metallogenic belt.

Eastern-Southern Alaska Belt of Granitic Magmatism Deposits

A major metallogenic belt of granitic magmatism deposits, mainly porphyry Cu and Mo, polymetallic vein, and Fe-Au skarn deposits, occurs in eastern-southern Alaska (Map 3, Sheet 2). The geologically favorable area is the northern part of the Wrangellia island arc terrane, in and adjacent to the area underlain by the Late Jurassic and Early Cretaceous Gravina-Nutzotin belt where intruded by a belt of Late Jurassic and Early Cretaceous granitic plutonic rocks. This granitic belt was designated as part of a volcanic-plutonic arc by Richter and others (1975), and named the Nutzotin-Chichagof belt by Hudson (1983), the Chisana arc by Plafker and others (1989), and the Gravina arc by Stanley and others (1990). This granitic belt extends for a few hundred kilometers within and parallel to the northern margin of the Wrangellia island arc terrane. The major deposits are the Nabesna and Rambler Fe-Au skarn deposits, the Orange Hill and Bond Creek porphyry Cu and Mo deposits, and the Midas Cu-Au skarn deposit.

The deposits of the eastern-southern Alaska metallogenic belt are associated with Early to mid-Cretaceous granitic rocks, mainly granite and granodiorite (Miller, in press). Most of the granitic rocks are calc-alkaline and intermediate in composition. Chemical data suggest that the Cretaceous granitic rocks of east-central Alaska are part of a subduction-related arc (Miller, in press).

The eastern-southern Alaska metallogenic belt occurs in the central and northern part of the Wrangellia island arc terrane, in and adjacent to the area underlain by the Late Jurassic and Early Cretaceous Gravina-Nutzotin belt. In the Nutzotin Mountains between the Alaska Range and Wrangell Mountains, this belt contains abundant Early Cretaceous basaltic and andesitic and related rocks of the Chisana Formation that are interpreted as coeval with the Late Jurassic and Early Cretaceous granitic rocks in the region (Berg and others, 1972; Richter and others, 1975). Together, the granitic and andesitic rocks define the Gravina island arc which is interpreted to have formed on the northern, or leading edge of the Wrangellia island arc terrane during migration towards North America (Nokleberg and others, 1984, 1985; Nokleberg and Lange, 1985a; Plafker and others, 1989). Consequently, an island arc environment is interpreted for the eastern-southern Alaska metallogenic belt.

The Gravina arc is interpreted to have formed during subduction of the Late Triassic to Early Cretaceous McHugh Complex under the Peninsular and Wrangellia terranes as both terranes migrated towards North America (Nokleberg and others, 1985; Plafker and others, 1989). The eastern-southern Alaska metallogenic belt of

Mesozoic age is superposed on the eastern Alaska Range granitic magmatism belt of late Paleozoic age, described above. These relations reveal the long and complex history of the Wrangellia island-arc terrane (Nokleberg and others, 1984, 1985; Nokleberg and Lange, 1985a).

Alaska Peninsula Belt of Granitic Magmatism Deposits

A metallogenic belt of granitic magmatism deposits, mainly Cu-Au, Cu-Zn, and Fe skarn deposits, occurs on the northeastern Alaska Peninsula (Map 3, Sheet 2). The geologically favorable environment is the central and northwestern part of the Peninsular island arc terrane where intruded by Jurassic granitic plutons. The significant skarn deposits are at Crevice Creek and Glacier Fork, Kasna Creek and Magnetite Island. The Cu-Au and Cu-Zn skarn deposits occur in areas where Jurassic(?) quartz diorite and tonalite intrude the calcareous sedimentary rocks, and generally consist of epidote-garnet skarn in limestone or marble, with disseminations and layers of chalcopyrite, sphalerite, and pyrrhotite. The Fe skarn deposits occur in dolomite or marble and generally consist of magnetite skarn with lesser garnet, amphibole, and rare chalcopyrite. The Fe skarns occur in areas where Jurassic(?) quartz diorite and tonalite intrude calcareous sedimentary rocks. These skarn deposits occur in marine sedimentary rocks of the Upper Triassic Kamishak Formation, in Lower Triassic marble, and in volcanic and volcaniclastic rocks of the Early Jurassic Talkeetna Formation.

The skarn deposits constituting this metallogenic belt occur in, or adjacent to the Middle and Late Jurassic Talkeetna arc which extends for several hundred km along the strike length of the Peninsular island arc terrane (Burns, 1985; Plafker and others, 1989). Abundant field, chemical, and isotopic data indicate that the Talkeetna arc is mainly gabbro, diorite, tonalite, and rare granodiorite, with calc-alkaline compositions and lower initial Sr ratios that formed in a subduction zone environment (Reed and others, 1983) in an island arc (Burns, 1985; Plafker and others, 1985). Consequently, an island arc environment is interpreted for the northeastern Alaska Peninsula metallogenic belt.

Accretionary Metallogenic Belts: Au Quartz Vein, Cu-Ag Quartz Vein, and Basaltic Cu Deposits, and Anatectic Granitic-Magmatism-Related Deposits

Several major metallogenic belts of Au and Cu-Ag quartz vein deposits, and basaltic Cu deposits, and anatectic granitic-magmatism-related deposits occur throughout mainland Alaska (Map 1, Sheet 3). These deposits are mainly hosted in quartz veins that occur generally in greenschist facies, regional grade metamorphic rocks of Jurassic, Cretaceous, or early Tertiary age. The regional-grade metamorphic rocks hosting the vein deposits generally occur along the deformed margins of terranes and are interpreted as forming during the accretion and structural juxtaposition of adjacent terranes. The vein deposits are interpreted as forming from hydrothermal fluids generated during the waning stages of regional metamorphism and locally are associated with basaltic Cu deposits.

Southern Brooks Range Belt of Au Quartz Vein Deposits

A metallogenic belt of Au-bearing quartz vein deposits occurs in the southern Brooks Range (Map 1, Sheet 3). The geologically favorable environment is the Hammond terrane of the Arctic Alaska superterrane and the Coldfoot terrane to the south. The significant deposits are the Mikado vein system in the Chandalar district that consists of gold and sparse sulfides in quartz veins in a zone about 4.0 km wide and 1.6 km long. The Au quartz vein deposits occur along steeply dipping normal faults in greenschist facies metasedimentary rocks and are interpreted to have been emplaced during fault movement. The deposits are hosted by a structurally complex and polymetamorphosed and poly-deformed assemblage of Devonian or older carbonate rocks, including the Silurian and Devonian Skajit Limestone, calc-schist, quartz-mica schist, and quartzite, that is intruded by Proterozoic and Late Devonian gneissic granitic rocks. These early Paleozoic metasedimentary rocks and Devonian metagranitic rocks form a major part of the Hammond passive continental margin terrane of the Arctic Alaska superterrane (Jones and others, 1987; Moore and others, 1992).

Field relations indicate the hydrothermal fluids from which the veins were deposited during normal faulting. The normal faulting may be associated with a period of regional extension which is associated with the waning stages of Early to mid-Cretaceous greenschist facies, regional metamorphism and companion penetrative deformation (Moore and others, 1992; Nokleberg and others, in press). This period of regional metamorphism is interpreted as the last major metamorphic event in the Hammond terrane to the north and Coldfoot terrane to the south. In a few areas, the Coldfoot terrane and Hammond terrane exhibit relict blueschist facies minerals that formed in a Jurassic or older period of convergent deformation and metamorphism (Armstong and others, 1986; Moore and others, 1989). The convergent deformation and blueschist facies metamorphism probably occurred during Late Jurassic and Early Cretaceous subduction of the Coldfoot and Hammond terranes under the oceanic Angayucham oceanic terrane, and Koyukuk island arc terrane to the south (Moore and others, 1989; Patton and others, 1989). These relations suggest a collisional-deformational zone environment for this metallogenic belt. Au quartz vein deposits only occur in a small portion of the greenschist facies metasedimentary rocks of the southern Brooks Range. However, gold placers occur discontinuously along the Brooks Range, and may be derived from undiscovered Au quartz vein deposits (Nokleberg and others, 1988).

Seward Peninsula Belt of Au Quartz Vein Deposits

A metallogenic belt of mesothermal, sulfide-poor, Au-bearing quartz vein deposits occur in a 200 km long, east-west belt along the southern margin of the Seward Peninsula (Map 1, Sheet 3). The most favorable mineralized areas are confined to upper greenschist facies metamorphic rocks. Two major concentrations of deposits are (1) at Bluff and Big Hurrah in the Solomon District; and (2) at Rock Creek, Mount Distin, and Sophia Gulch in the Nome District. In both areas deposits mainly consist of sulfide-poor, gold-quartz deposits in individual high grade veins or in zones of multiple, more-or-less en echelon sheeted veins that generally contain lower gold grades. The quartz veins, which typically contain minor carbonate, albite, and oligoclase, cut shallow-dipping metamorphic foliation.

The best studied deposits in the Nome District are at Rock Creek and Mount Distin immediately north of Nome (Gamble and others, 1985; Apodaca, 1992). These newly evaluated lodes may be the sources for the rich placer gold deposits mined in the Nome District. The Rock Creek deposit is the best example of a sheeted vein system. Arsenopyrite, scheelite bearing, sulfide poor veins occur in densities of 1 to 4 per meter within a 70 meter wide zone that extends for at least 1200 meters along a north-south strike. Fluid inclusion studies show that the low salinity, CO_2 enriched inclusions were deposited in the mesothermal range. At Mount Distin, several similar, en echelon gold quartz veins have intruded along an east west trending thrust fault for at least 3 km.

The Big Hurrah and Bluff deposits in the Solomon District exhibit several similarities to those in the Nome District, including low sulfide-mineral concentration, fault localization, and confinement to low-grade, greenschist facies metamorphic rocks. In all the deposits, a post-metamorphic fluid origin is suggested for the deposits by (Gamble and others, 1985): (1) the discordance of the veins to metamorphic foliations; (2) preliminary oxygen isotope and fluid inclusion data; (3) similarities to other occurrences in metamorphic rocks; and (4) the absence of known or suspected intrusions near the veins. These relations indicate that the gold deposits formed from fluids that equilibrated with the sedimentary and(or) volcanic protoliths of the Nome Group under greenschist facies regional metamorphism. Subsequently, the fluids moved upward during a later, post-kinematic event to deposit the vein minerals. As in the southern Brooks Range, regional metamorphism of the Seward displaced continental margin terrane occurred during two stages. A relatively older blueschist facies event happened in the Jurassic followed by an Early Cretaceous retrograde, greenschist facies event (Armstrong and others, 1986). As in the southern Brooks Range, Au quartz vein deposition probably immediately succeeded the retrograde greenschist facies event. These relations suggest a collisional-deformational zone environment for this metallogenic belt, and that the belts of Au quartz vein deposits in the Seward Peninsula and southern Brooks range may be correlative.

Marshall Belt of Au-Quartz Vein Deposits

A belt of sulfide-poor, Au-bearing quartz vein deposits occur at the Arnold Lode near the head of Willow Creek in the Marshall District of southwestern Alaska (Map 1, Sheet 3). The veins intrude a package of meta-andesite flows, metatuff, and phyllite of presumed Triassic to Lower Cretaceous age in a distinctive east-west trending zone of shear at least 2 km wide and about 30 km long. The mineralized quartz stockwork contains minor molybdenite and chalcopyrite within a zone of silica-carbonate-iron altered greenstone. A distinctive albite rhyolite dike or sill parallels the main mineralized structure. The mineralization in the Marshall District could be related to small late Cretaceous felsic plutons and dikes as in other parts of SW Alaska; however, there are several compelling similarities to the Treadwell mine in southeast Alaska, or the Mikado vein system in the Chandalar District, suggesting that part of the Marshall District may reflect a Mesozoic accretionary event as at the Nome and Solomon District, or the Southern Brooks Range.

Yukon-Tanana Upland Belt of Au-Quartz Vein Deposits

A metallogenic belt favorable for low-sulfide Au-bearing quartz vein deposits occurs in the Yukon-Tanana Upland in east-central Alaska (Map 1, Sheet 3). The geologic unit favorable for the tract is the Devonian and Mississippian metasedimentary and lesser metavolcanic rocks of southern Yukon-Tanana displaced continental margin terrane and the Stikinia(?) island arc terrane where metamorphosed to greenschist facies during major regional metamorphic event(s) ending in the mid-Cretaceous. The significant deposit is at Purdy.

Alaska Range-Wrangell Mountains Belt of Cu-Ag Quartz Vein, Au Quartz Vein, and Kennecott Cu Deposits

A metallogenic belt of Au quartz vein, and Cu-Ag quartz vein and associated Kennecott Cu deposits occurs in eastern-southern Alaska in the eastern Alaska Range, Nutzotin Mountains, and the Wrangell Mountains (Map 1, Sheet 3). The geologically favorable area is the portion of the Wrangellia island arc terrane underlain by Late Cretaceous and older stratified rocks, particularly the Upper Triassic Nikolai Greenstone, and older late Paleozoic sedimentary and volcanic rocks. In addition, Au-bearing quartz vein deposits are hosted in metaplutonic and metasedimentary rocks of the Maclaren metamorphic belt.

Maclaren Belt of Au-Quartz Vein Deposits. A metallogenic belt of Au quartz vein deposits occurs in the Maclaren continental margin arc terrane in the central Alaska Range in the Upper Jurassic(?) flysch (argillite and metagraywacke) of Maclaren Glacier metamorphic belt (Map 1, Sheet 3). The significant deposits are at Timberline Creek and Lucky Hill. Ar-Ar ages of metamorphic minerals in auriferous quartz veins that occur in lower greenschist facies and range from about 58 to 62 Ma (early Tertiary) (Adams and others, 1992). The Maclaren terrane and associated Au-quartz vein deposits are interpreted as the offset equivalent of the Juneau gold belt in southeastern Alaska (Nokleberg and others, 1985, 1993).

Cu-Ag Vein Deposits. An extensive suite of minor Cu-Ag vein deposits occurs mainly along the northern margin of the Wrangellia island arc terrane (Map 1, Sheet 3). The significant deposits are at Kathleen-Margaret, Nugget Creek, and Nikolai. The deposits typically consist of quartz veins in the Upper Triassic Nikolai Greenstone with bornite, chalcopyrite, pyrrhotite, and local secondary copper. The gangue is commonly quartz and minor calcite. The largest Cu-Ag vein deposit is at Kathleen-Margaret (MacKevett, 1965). The veins occur in the Upper Triassic Nikolai Greenstone. Throughout the Nikolai Greenstone and older rocks in the Wrangellia terrane, quartz veins, with locally abundant Cu sulfides, grade into clots of quartz, chlorite, actinolite, and epidote (Nokleberg and others, 1984; Nokleberg and Lange, 1985a). This relation suggests that the deposits formed during the waning stages of lower greenschist facies regional metamorphism (Nokleberg and others, 1984). This metamorphism occurs in the Late Jurassic and Early Cretaceous Gravina-Nutzotin belt and older units of the Wrangellia terrane, and is interpreted as occurring during the mid-Cretaceous accretion, deformation, and low-grade regional metamorphism of the Wrangellia terrane (Nokleberg and others, 1985; Plafker and others, 1989). Consequently, a collisional-deformational environment is indicated for this metallogenic belt.

Kennecott Cu Deposits. The largest and best known Kennecott Cu deposits occur in the Kennicott district (Map 1, Sheet 3), which produced about 544 million kg Cu and 280 million g Ag from about 1913 to 1938. The Kennicott district includes the Bonanza, Jumbo, Erie, Mother Lode, and Green Butte mines. The deposits are localized in the lower, largely dolomitic parts of the Upper Triassic Chitistone Limestone, generally less than 100 m above the disconformably underlying Middle and (or) Upper Triassic Nikolai Greenstone (Bateman and McLaughlin, 1920; MacKevett, 1976; Armstrong and MacKevett, 1982). The major ore bodies are mainly irregular masses of Cu-sulfides containing chalcocite and covellite, subordinate enargite, bornite, chalcopyrite, luzonite and pyrite, and rare tennantite, galena, and sphalerite. Secondary malachite and azurite occur locally.

Armstrong and MacKevett (1982) interpret the Cu deposits in the Kennicott district as having formed by derivation of Cu from the Nikolai Greenstone, followed by deposition from oxygenated groundwater in the lower part of the overlying Chitistone Limestone along dolomitic sabkha interfaces and as open-space fillings in fossil karsts. They interpret the age of deposition as Late Triassic, with possible later remobilization. In contrast, Nokleberg and others (1984, 1988) suggest that lower greenschist facies regional metamorphism of the Nikolai Greenstone may have been the source of hydrothermal fluids that either deposited or further concentrated the Cu-sulfides in the Kennecott Cu deposits in the Kennicott district. With this interpretation, a collisional-deformational environment also occurred for the Kennecott Cu deposits as well as the Cu-Ag quartz vein deposits in the Wrangellia terrane.

Talkeetna Mountains Belt of Au Quartz Vein Deposits

A metallogenic belt of Au quartz vein deposits occurs in the Talkeetna Mountains in southern Alaska (Map 1, Sheet 3). The geologically favorable unit for this belt is the Early Jurassic Talkeetna Formation and intruded Jurassic and Cretaceous granitic rocks, where deformed and metamorphosed to lower greenschist facies during early Tertiary. The major deposits in the Willow Creek District contain variable amounts of pyrite, chalcopyrite, arsenopyrite, sphalerite, galena, and gold tellurides. The deposits are interpreted as having formed during early Tertiary metamorphism that occurred during underthrusting of the Valdez Group of the Chugach accretionary wedge/turbidite terrane. Metamorphic minerals in deposit have K-Ar ages of 66 and 55-57 Ma (Madden-McGuire and others, 1988).

Chugach Mountains Belt of Au Quartz Vein Deposits

A metallogenic belt of Au quartz vein deposits occurs on Kodiak Island, the southeastern Kenai Peninsula, and in the central and eastern Chugach Mountains in southern Alaska (Map 1, Sheet 3). The geologically favorable area for this belt is the southern portion of the Valdez Group of the Chugach accretionary wedge-turbidite terrane. The deposits in this belt are of small tonnage but locally high grade. The major deposits are the Cliff, Alaska Oracle, Chalet Mountain, Crown Point, Gold King, Granite, Jewel, Kenai-Alaska, Lucky Strike, Mineral King, Monarch, and Ramsey-Rutherford deposits. Substantial gold production occurred in this district until the early 1940's; recent exploratory work has been conducted at the Cliff Mine near Valdez, the largest of the many known deposits.

The Au quartz vein deposits occur in the Upper Cretaceous Valdez Group and correlative Kodiak Formation which consist of complexly folded and weakly metamorphosed metagraywacke and argillite, locally interleaved with pillow basalt, basaltic tuff, and mafic plutons (Winkler and others, 1981a; Winkler and others, 1981b). Undeformed, narrow, early Tertiary granodiorite and diorite dikes and hypabyssal plutons locally intrude the intensely deformed Valdez Group. The Valdez Group and Kodiak Formation are parts of a flysch sequence deposited on oceanic crust, and form the southern part of the Chugach terrane (Plafker and others, 1985, 1989). The Au quartz vein deposits are generally small, but high grade; most mines contain a maximum of a few hundred m of underground workings. The Cliff Mine was an exception; this vein was developed by 3 km of underground workings on 5 levels.

The Au-bearing veins generally are the younger of two generations of quartz fissure veins in the Valdez Group (Richter, 1970; Goldfarb and others, 1986; Nokleberg and others, 1989). The older and mostly barren veins are approximately parallel to the regional schistosity and parallel to axial planes of minor and major folds. Their strike varies from northwest in the east to northeast in the west. The younger veins locally carry gold, occur in a set of tensional cross joints or fractures, and are normal to the older quartz veins. The strike of the younger set of quartz veins also varies from northwest in the eastern part of the region to northeast in the western part of the region. Both sets of quartz veins generally dip steeply to vertically. The Au quartz vein deposits occur both in (meta) sedimentary rocks and locally in early Tertiary granitic plutons intruding the Prince William and Chugach terranes. The deposits are interpreted to have formed during early Tertiary regional metamorphism, after underthrusting of the Orca and the Valdez Groups (Goldfarb and others, 1987, 1988, 1991).

Post-Accretionary Metallogenic Belts: Igneous Arc Deposits

Several major metallogenic belts of igneous arc deposits, mainly porphyry, polymetallic vein, epithermal, skarn, and related deposits, occur throughout mainland Alaska (Map 2, Sheet 3). These deposits are mainly hosted in or near granitic plutonic, hypabyssal siliceous, and volcanic rocks that formed during either younger, mainly Late Cretaceous and Cenozoic continental-margin arc igneous activity (Nokleberg and others, 1988; Moll-Stalcup, 1990). These post-accretionary, igneous arc deposits occur across several adjacent terranes, mainly in central and southern Alaska. A general geographic and temporal pattern exists with the older metallogenic belts and associated igneous rock belts, mainly of Late Cretaceous age, occurring towards the north in interior Alaska, and the younger, Cenozoic belts occurring progressively to the south towards the active continental-margin igneous arc on the Alaska Peninsula (Nokleberg and others, 1988; Moll-Stalcup, 1990).

Seward Peninsula Belt of Granitic Magmatism Deposits

A metallogenic belt of granitic magmatism deposits, mainly Sn granite, porphyry Mo, polymetallic vein, and felsic plutonic U deposits, occurs on the western part of the Seward Peninsula and St. Lawrence Island (Map 2, Sheet 3). The geologically favorable area is the portion of the region intruded by Late Cretaceous silicic granitic plutons (Hudson and Arth, 1983). The major Sn deposits are at Cape Mountain, Potato Mountain, Ear Mountain, Lost River, and Kougarok. These deposits are commonly referred to as the Cretaceous tin province of the Seward Peninsula. Sparse polymetallic vein deposits, and one porphyry Mo deposit also occur on the eastern Seward Peninsula. The polymetallic vein deposits are at Serpentine Hot Springs, Omilak, Independence, and Quartz Creek, and the porphyry Mo deposit is at Windy Creek. The origins of many of these metallic veins remain somewhat enigmatic.

A complex, multi-phase, felsic plutonic U deposit occurs at Eagle Creek and a sandstone U deposit occurs at Death Valley, both in the eastern part of the Seward Peninsula. The felsic plutonic deposit consists of disseminated U-, Th-, and REE-minerals along the margins of alkaline dikes intruded into a Cretaceous granite pluton and adjacent wall rocks (Miller, 1976; Miller and Bunker, 1976). The Death Valley sandstone U deposit consists mainly of metaautunite in Paleocene sandstone along the margin of a Tertiary sedimentary basin (Dickinson and Cunningham, 1984). The U in the sandstone probably was transported by groundwater from Cretaceous granitic plutons to the west (Dickinson and Cunningham, 1984).

The deposits of the Sn granite, porphyry Mo, and polymetallic vein deposit on the Seward Peninsula occur in or adjacent to moderate or highly silicic granites of latest Cretaceous age. The porphyry Mo, felsic plutonic U, and polymetallic vein deposits occur in slightly older and slightly less siliceous granites whereas the Sn granite and associated deposits occur in slightly younger and more silicic deposits. The granites associated with both groups of deposits are interpreted as forming during melting of the continental Proterozoic and Paleozoic metasedimentary rocks of the Seward displaced continental margin terrane (Hudson and Arth, 1983; Swanson and Newberry, 1988).

Northwestern Koyukuk Basin Belt of Felsic Plutonic U Deposits

A metallogenic belt of felsic plutonic U deposits occurs in the Purcell district in the northwestern Koyukuk Basin (Map 2, Sheet 3). The geologically favorable area for this belt is the portion of the region underlain by the Late Cretaceous Hogatza plutonic belt (Miller, in press). The significant deposits are at Wheeler Creek, Clear Creek, and Zane Hills (Miller and Elliott, 1969; Miller, 1976; Jones, 1977). These deposits consist mainly of uranothorite and gummite in quartz-rich veinlets in altered Late Cretaceous alaskite, uraniferous nepheline syenite and bostonite dikes that cut Early Cretaceous andesite, and uranothorite, betafite, uraninite, thorite, and allanite in veinlets in a foliated monzonite border phase, locally grading to syenite.

This calc-alkaline intrusive belt extends about 300 km from Hughes on the Koyukuk River westward to near the Seward Peninsula. The granitic plutonic rocks are mainly granodiorite with lesser tonalite and high-silica granite. The granites intrude a sequence of andesitic flows, tuffs, breccia, agglomerate, conglomerate, tuffaceous graywacke, and mudstone with local intercalations of Early Cretaceous limestone that form part of the Koyukuk island arc terrane (Patton and others, 1989). These plutons are interpreted to have formed during a short-lived period of subduction on the basis of a calc-alkaline compositional trend, high sodium contents, relatively, locally abundant mafic xenoliths, and low initial Sr ratios (Miller, in press). As for the Seward Peninsula metallogenic belt, an inner arc-setting in a continental-margin arc environment is interpreted for this belt. The granitic magmas related to the formation of the two metallogenic belts are envisioned to have formed as a result of subduction along the southern Alaska margin in the Late Cretaceous.

Southwestern Kuskokwim Mountains Belt of Gold Polymetallic vein Deposits

A major metallogenic belt with numerous gold-polymetallic vein deposits are associated with Cretaceous-Early Tertiary granitic plutons and volcanic fields occurs for 500 km along the northeast trending Kuskokwim Mountains of Southwestern Alaska (Map 2, Sheet 3) (Bundtzen and Miller, 1991; Bundtzen and others, 1992; Miller and Bundtzen, 1993). Much of the 80,000 kg of gold, 9500 kg of silver, and 1.5 million kg of mercury was produced from these igneous complexes their placer deposits. Three major types of igneous complexes have been identified: (1) calc-alkalic, metaaluminous granite and quartz monzonite of Early and mid-Cretaceous age (about 100 Ma); (2) peraluminous - to metaaluminous, alkali-calcic to quartz alkalic, volcanic plutonic complexes that feature plutons ranging in composition from alkali gabbro to quartz syenite; and (3) highly peraluminous potassium enriched granite porphyry sills and dikes. The latter two have K-Ar crystallization ages that range from 75 to 58 Ma (Late Cretaceous and early Tertiary). All igneous rocks intrude or overlie the Triassic-to-Lower Cretaceous Gemuk Group and flysch of the late Cretaceous Kuskokwim Group.

According to Bundtzen and Miller (1991), the lode deposits are in veins, disseminations, stockworks, and greisens formed in upper mesothermal to epithermal environments. These include: (1) the Cirque, and Headwall, Sleitat greisen or greisen-like tin-copper-silver-arsenic (gold) deposits (upper mesothermal); (2) the Golden Horn, Chicken Mountain, and Arnold gold-arsenic-base metal deposits (lower mesothermal); and (3) the Red Devil, DeCoursey, Donlin, and Mountain Top mercury-antimony (gold) deposits (epithermal deposits). The gold polymetallic vein deposits at Chicken Mountain, Golden Horn, and Donlin resemble granitoid-related Au deposits, but lack symmetrical hydrothermal alteration. In addition, unusual uranium rich, rare earth element enriched accumulations occur in ultra-potassic felsic igneous rocks at Sischu Creek, and Wolf Mountain (Patton and others, 1984; T.K. Bundtzen, written commun., 1992). A plausible metallogenic model suggests that most of these deposits represent similar vertically zoned, hydrothermal systems exposed at various erosional levels in the Cretaceous and early Tertiary igneous complexes and surrounding rocks.

Northeastern Koyukuk River Belt of Igneous Arc Deposits

A minor metallogenic belt of igneous arc deposits, mainly polymetallic vein and W skarn deposits, occurs in the northeastern Koyukuk River area (Map 2, Sheet 3). The geologically favorable area for this belt is the portion of the region underlain by Late Cretaceous and early Tertiary plutonic rocks that are equivalent in age to the Kuskokwim Mountains belt to the southwest (Moll-Stalcup, 1990). The significant deposits are at Upper Kanuti River and Bonanza Creek. Neither deposit is well studied.

Origin of the Kuskokwim Mountains and Northeastern Koyukuk Igneous Arc Metallogenic Belts

The deposits in both the Kuskokwim Mountains and Koyukuk River metallogenic belts are associated with Late Cretaceous and early Tertiary plutonic rocks of the Kuskokwim Mountains magmatic belt, mainly granite, granodiorite, monzonite, and lesser gabbro. These plutonic rocks are coeval with a suite of calc-alkalic to shoshonitic volcanic rocks that range in composition from basalt to rhyolite (Moll-Stalcup, 1990). Andesite and rhyolite are the most common volcanic rock types. Most of the plutonic rocks are calc-alkalic to quartz alkalic and have average alkali-calcic geochemical trends. Chemical data indicate that some of the plutons formed from magmas contaminated by continental crust in areas underlain by the Ruby displaced continental margin terrane (Moll-Stalcup, 1990; Miller, in press). These data suggest that the plutonic and coeval volcanic rocks of the Kuskokwim Mountains magmatic belt are the inner parts of an elongate continental-margin arc that formed in region of back-arc spreading in a region of high heat flow and local extensional tectonics (Bundtzen and Miller, 1991; Bundtzen and others, 1992; Miller and Bundtzen, 1993).

East-Central Alaska Belt of Granitic Magmatism Deposits

A major, long, and extensive metallogenic belt of granitic magmatism deposits occurs in east-central Alaska (Map 2, Sheet 3). The major deposit types in the belt are porphyry Cu-Mo, felsic plutonic U, polymetallic vein, Sb-Au vein, Sn greisen and skarn, and W skarn. The geologically favorable area for this belt is the portion of the area underlain by mid- to Late Cretaceous and early Tertiary granitic rocks of the Yukon-Tanana Upland (Miller, in press). The major deposits are unclassified vein, Sb-Au vein, Au quartz vein, felsic plutonic U, and Sn vein and greisen deposits in the Manley and Livengood region, a wide variety of granitic magmatism deposits in the northern and eastern Yukon-Tanana Upland, and polymetallic and Sb-Au vein deposits in the northern Alaska Range.

The major lode deposits in the Manley area are a polymetallic vein deposit at Hot Springs Dome, a Mn-Ag vein at Avnet, and a Sb-Au vein deposit at Sawtooth Mountain (Map 2, Sheet 3). Major lode deposits in the Livengood area include Sb-Au and Au quartz vein deposits at Gertrude Creek, Griffen, and Ruth Creek, and the Hudson Cinnabar Hg vein deposit. Northeast of Livengood, a felsic plutonic U deposit occurs at Roy Creek, and a Sn greisen and Sn vein deposit occurs at Lime Peak. The early Tertiary biotite syenite and granite hosting these deposits intrude a sequence of weakly deformed, quartz-rich sandstone, grit, shale, and slate, locally with probable Early Cambrian fossils and forms part of the Wickersham passive continental margin terrane (Jones and others, 1987).

A wide variety of gold-polymetallic deposits in the northern and eastern Yukon-Tanana Upland (Map 2, Sheet 3) are spatially associated with early Cretaceous to Early Tertiary plutons. These include: Sb-Au vein deposits at Dempsey Pup and Scrafford; Au-quartz vein deposits at Table Mountain, polymetallic vein deposits at Cleary Summit, Ester Dome, Democrat, Blue Lead, Tibbs Creek, and Gray Lead; W skarn deposits at Salcha River and in the Gilmore Dome area near Fairbanks; porphyry Cu-Mo deposits at Mosquito, Asarco, Bluff, and Taurus; a Au-As vein deposit at Miller House; and a Sn greisen deposit at Ketchem Dome. The deposits at Scrafford, Cleary Summit, Gilmore Dome, Ester Dome, and Democrat are in the Fairbanks district, one of the major mining areas in Alaska. This region is underlain by multiply metamorphosed and penetratively deformed, middle Paleozoic and older quartz-metasedimentary, sparse metavolcanic, and rare metagranitic rocks of the Yukon-Tanana displaced continental margin terrane that are intruded by abundant mid- to Late Cretaceous and sparse early Tertiary granitic plutons (Foster and others, 1987).

The polymetallic and Sb-Au vein deposits of the Fairbanks District (Map 2, Sheet 3) are related to intrusion of Cretaceous and early to mid Tertiary granitic plutons (Metz and Halls, 1981; Metz, 1991). The Au quartz vein deposits are interpreted as occurring with widespread regional metamorphism that culminated with intrusion of Late Cretaceous granitic plutons. The skarn deposits are associated with a suite of early Tertiary granitic plutons that extends westward into east-central Alaska from the Yukon Territory. The porphyry deposits, which are also early Tertiary in age, occur at the western end of a broad metallogenic belt of porphyry deposits extending from the Dawson Range in western Canada into eastern Alaska (Hollister, 1978).

An extensive district of polymetallic and Sb-Au vein deposits in the Kantishna District in the western part of the northern Alaska Range at Slate Creek, Eagles Den, Quigley Ridge, Banjo, Spruce Creek, and Stampede (Map 2, Sheet 3). The vein sulfide deposits occur in middle Paleozoic or older, polymetamorphosed and poly-deformed submarine metavolcanic and metasedimentary rocks of the Yukon-Tanana terrane that host an extensive belt of kuroko massive sulfide deposits described above (Aleinikoff and Nokleberg, 1985; Nokleberg and Aleinikoff, 1985). Most of the vein deposits occur as crosscutting quartz-carbonate-sulfide veins and are confined to a 60-km-long, northeast-trending fault zone that extends from Slate Creek to Stampede (Bundtzen, 1981). Mineralization occurred before, during, and after fault-zone movement, as illustrated by both crushed and undeformed ore shoots in the same vein system. The Kantishna vein system is likely to have evolved in a similar fashion to those in the Fairbanks District.

The granitic magmatism deposits in the east-central Alaska metallogenic belt are associated with mid- and Late Cretaceous, and early Tertiary granitic rocks, mainly granite and granodiorite (Foster and others, 1987). Most of the granitic rocks are calc-alkaline and intermediate in composition. Chemical data indicate that some of the plutons formed from magmas contaminated by continental crust in areas underlain by the Yukon-Tanana displaced continental margin terrane. The plutonic rocks exhibit high initial Sr ratios and are interpreted as forming from a mixture of mantle-derived magma and continental crust (Miller, in press). These data suggest that the granitic plutonic rocks of east-central Alaska may be part of a subduction-related arc, possibly the discontinuous extension of the Kuskokwim Mountains magmatic belt. Consequently a continental-margin arc environment is interpreted for the east-central Alaska granitic magmatism metallogenic belt.

Southern Alaska Belt of Granitic Magmatism Deposits

A major metallogenic belt with a wide variety of granitic-magmatism-related deposits occurs in the southern and western Alaska Range and the Talkeetna Mountains (Map 2, Sheet 3). The granitic rocks associated with the metallogenesis range in age from Latest Cretaceous to Late Tertiary, with the largest events focused in the early Tertiary. The most significant districts include Ag-Pb-Au (Cu) skarn and porphyry Cu deposits in the Farewell District at Bowser, Sheep, Tin, and Rat Fork Creeks; Sn-Au-polymetallic deposits in the upper Chulitna District; and Cu-Au skarns at Zackly in the Valdez Creek District.

In the western part of the belt in the Farewell District, the polymetallic Ag-Pb-Zn-Cu skarns and porphyry deposits are generally disseminated in or cut small granitic plutons of two ages: Paleocene (52 to 60 Ma) and Oligocene (25 to 30 Ma). The Cu porphyry and breccia pipe mineralization appears to be of Paleocene age; however many of the low temperature Pb-Zn skarns in the Tin Creek and Sheep Creek drainages replace and alter granodiorite dikes of Oligocene age. Host rocks for these deposits are the carbonate-clastic deposits of the Dillinger passive continental margin terrane, a deep-water section that ranges in age from upper-most Cambrian to early middle Devonian.

Farther east, various Sn-Au-polymetallic deposits in the Upper Chulitna District are of two distinct ages. Au-polymetallic deposits in the Golden Zone, Nim, and Zackley areas range from 65 to 68 Ma (Swainbank and others, 1977). Sn-greisen and Mo porphyry deposits at Miss Molly, Coal Creek, and Ready Cash are part of the McKinley sequence, which ranges in age from 55 to 60 Ma.

Granitic magmatism in southern Alaska occurred during distinct pulses from Late Cretaceous to Late Tertiary time. Many of the deposits in the western and southern Alaska Range are in or near the McKinley sequence of granodiorite to granite plutons that intruded during from about 55 to 60 Ma. These granitic rocks have high initial Sr ratios and are interpreted as the product of crustal melting (Reed and Lanphere, 1973; Lanphere and Reed, 1985). The plutons and batholiths of the McKinley sequence crosscut and weld together the Dillinger, Peninsular, Kahiltna, and Wrangellia terranes (Jones and others, 1987). The latest Cretaceous and Late Tertiary granodiorite to granite plutons that are associated with base metal and Au-polymetallic deposits in the Farewell and Upper Chulitna Districts have calc-alkaline chemical trends and low initial Sr ratios (Szumigala, 1987). Collectively, the batholithic complexes and smaller plutons that parallel the southern margin of Alaska are manifestations of an evolving continental margin setting that spanned Late Cretaceous to Late Tertiary time.

Alaska Peninsula and Aleutian Islands Belt of Igneous Arc Deposits

A major metallogenic belt of igneous arc deposits occurs on the Alaska Peninsula and the Aleutian Islands (Map 2, Sheet 3). The geologically favorable environment is the area underlain or adjacent to the middle and late Tertiary granitic and volcanic rocks of the Aleutian arc in the eastern Aleutian Islands and the southwestern Alaska Peninsula. The arc is composed mainly of early Tertiary to Holocene andesite to dacite flows, tuff, and intrusive and extrusive breccia; hypabyssal diorite and quartz diorite and small silicic stocks, dikes, and sills; and volcanic graywacke, shale, and lahars (Burk, 1965; Wilson, 1985). Underlying parts of the southwestern Alaska Peninsula, almost as far west as Cold Bay, is the mainly Mesozoic bedrock of the Peninsular island arc terrane.

Numerous epithermal vein, polymetallic vein, and porphyry Cu and Cu-Mo deposits occur in the southwestern Alaska Peninsula belt. The significant deposits are: (1) epithermal vein deposits at Canoe Bay, Aquila, Apollo-Sitka, Shumagin, San Diego Bay, Kuy, and Fog Lake; (2) polymetallic vein deposits at Sedanka, Warner Bay, Cathedral Creek, and Kilokak Creek; and (3) porphyry Cu and Mo deposits at Pyramid, Kawisgag, Mallard Duck Bay, Bee Creek, Rex, and Mike. The epithermal and polymetallic vein and porphyry deposits of the Alaska Peninsula and Aleutian Islands belt occur over a distance of over 800 km. This belt is related to the epithermal and hydrothermal activity associated with the late-magmatic stages of Tertiary and Quaternary hypabyssal plutonic and associated volcanic centers. These centers are along part of the Aleutian arc, one of the classic igneous continental-margin arcs along the rim of the Pacific Ocean. Consequently, a continental-margin arc environment is interpreted for the somewhat older, mid to Late Tertiary southwestern Alaska Peninsula metallogenic belt.

LODE METALLOGENIC BELTS OF THE RUSSIAN NORTHEAST

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Pre-Accretionary Metallogenic Belts: Podiform Chromite and Related Deposits

A number of pre-accretionary metallogenic belts of podiform Cr and related deposits occur in the Russian Northeast (Map 1, Sheet 2). These belts are in ophiolite, oceanic crust and seamount, and island arc terranes of Paleozoic and Late Mesozoic age, mainly in tectonized ultramafic complexes, and in zoned mafic-ultramafic complexes. These terranes generally occur in extensive nappes and imbricate thrust fault zones that formed during accretion of oceanic and island arc sequences onto the margin of the Russian Northeast.

Aluchin Belt of Podiform Cr Deposits

A metallogenic belt of podiform Cr deposits occurs in the Anui River basin (Map 1, Sheet 2). The geologically favorable environment for the belt is the Aluchin ophiolite terrane of the Kolyma-Omolon superterrane. The Aluchin terrane consists of a large, linear mass of dunite and harzburgite that extends for over 100 km. The known podiform Cr deposits are hosted by dunite and serpentinite, and occur in the north-eastern and southern portions of the metallogenic belt. The significant deposit in the belt is the Teleneut deposit; other smaller deposits also occur in the region. Locally podiform Cr occurrences are also associated with sparse Fe-Cu-Ni sulfide deposits. Related alluvial placer deposits contain both PGE minerals and gold. The ultramafic rocks hosting the deposits are part of a faulted succession of the Aluchin terrane that also contains Middle Paleozoic to Early Cretaceous sedimentary and volcanic sequences. The ultramafic rocks are Paleozoic or older. The ultramafic rocks of Aluchin terrane are similar in composition and structure to the ophiolite bodies of the Koryak Highlands (Lychagin, 1985).

Kuyul Belt of Podiform Cr and PGE Deposits

A metallogenic belt of podiform Cr and associated PGE deposits occurs in the southern part of the major nappe and thrust belt of the Koryak Highlands. The belt extends for more than 900 km from the Taigonoss Peninsula to the northern spurs of the Pekulney Range (Map 1, Sheet 2). The geologically favorable environment for the metallogenic belt is the Kuyul ophiolite in the Gankuvayam and Elistratov units of the Kuyul subterrane of the Talovskiy subduction zone-oceanic terrane (Sheet 1). The Kuyul ophiolite contains about 20 poorly-prospected Cr deposits in serpentinized peridotites that occur in about 50 mainly small, discontinuously-exposed ultramafic bodies. The significant deposits are at Talov and Tikhorechen. Chromite and accessory chromium spinel occur with PGE minerals in dunite and associated ultramafic rocks. PGE minerals, in association with gold, occur in serpentinite and rodingite that occur adjacent to peridotite and dunite. Local Cu-Zn-Co-Ag sulfide minerals occur in carbonate breccias (Gorelova, 1990).

The Kuyul ophiolite is composed mainly of harzburgite and subordinate lherzolite, dunite, and pyroxenite. The Kuyul subterrane consists mainly of a thick marine sedimentary sequence dominated by Upper Jurassic to Cretaceous clastic rocks, allochthonous Paleozoic ophiolite plates and blocks of Paleozoic to Lower Mesozoic clastic, carbonate, and metamorphic rocks, and various olistostromes (Chekov, 1982; Markov and others, 1982). The Kuyul ophiolite succession is underlain by a serpentinite melange zone, and overlain by a Upper Jurassic to Valanginian sequence of chert and volcanic rocks. The ophiolite assemblage is interpreted as forming either: (1) during spreading of a marginal-sea basin during the early stages of island arc formation; or (2) adjacent to a transform fault zone along the margins of oceanic basins (Palandjan and Dmitrenko, 1990).

Ust-Belaya Belt of Podiform Cr Deposits

A metallogenic belt of podiform Cr deposits occurs in the Ust-Belaya dunite-harzburgite subterrane of the Penzhina Anadyr accretionary wedge-oceanic terrane. This subterrane consists mainly of a large early Paleozoic ophiolite with an areal extent exceeding 1,000 km^2 (Map 1, Sheet 2). Extensive zones of chromite deposits are confined to dunites that occur together with peridotite, metagabbro, amphibolite, and gabbro. Small faulted blocks contain Devonian and Lower Carboniferous spilite, mafic tuff, siltstone, sandstone, chert, and limestone. The significant deposit in the belt is at Ust-Belya (Map 1, Sheet 2). The chromite is of economic, low- and medium-Cr metallurgical grade (Silkin, 1983). The associated PGE mineral deposits are dominated by Os, Ir, and Ru, and rare platinoid minerals that are typical of dunites and harzburgites, particularly in the Koryak Highlands (Dmitrenko and others, 1990).

Pekulney Belt of Podiform Cr Deposits

A metallogenic belt of podiform Cr deposits occurs in the Pekulney Range (Map 1, Sheet 2). The geologically favorable environment is the Pekulney subduction zone-oceanic terrane that contains spinel peridotite, dunite, and serpentinite that are interfaulted with Upper Jurassic and Lower Cretaceous sedimentary and volcanic rocks (Sheet 1). These faults are steeply- to vertically-dipping. The metallogenic belt contains a group of poorly-prospected chromite deposits hosted in dunite and peridotite. No significant lode deposits are known. Economically significant PGE mineral concentrations occur in placer gold and platinum deposits (not depicted on Sheet 1) that are widespread in this area.

Tamvatney-Mainits Belt of Podiform Chromite Deposits

A metallogenic belt of podiform Cr deposits occurs in the Tamvatney ophiolite and other similar units that are tectonically interlayered with the Mainitskiy island arc terrane (Map 1, Sheet 2). The deposits consist of sparse localities of massive chromite with accessory Os-Ru-Ir minerals in dunite, pyroxenite, and associated rocks. Cr-rich spinel is associated with Pt, Rh, and Pd minerals (Dmitrenko and others, 1987, 1990). The significant deposits at Chirynai and Krassnaya Gora and occur in dunites and layered complexes of gabbro, dunite, and peridotite. The deposits contain the highest grade metallurgic chromite (Silkin, 1983). The economically significant concentrations of PGE minerals are mainly in spatially-related placer gold and PGE deposits.

The Tamvatney ophiolite consists of a large, steeply-dipping tectonic block composed of mainly serpentinized peridotite dominated by lherzolite, and Upper Jurassic to Lower Cretaceous (Neocomian) basalt, andesite, and mafic volcaniclastic rocks (Dmitrenko and others, 1990). These and other similar units of ultramafic and related rocks hosting the podiform Cr and related deposits are thrust onto sequences of Paleozoic, Middle Jurassic through Lower Cretaceous, and Upper Cretaceous chert, clastic rocks, tuff, flysch, and volcanic rocks. The chromite-bearing dunite and harzburgite bodies, such as those hosting the Chirynai and Krasnaya Gora deposits, and others, are only mildly deformed. Some of the ultramafic bodies are associated with hypabyssal gabbro, tonalite, and keratophyre intrusive rocks, and chert and volcanic sequences of Late Jurassic and Early Cretaceous age (Tilman and others, 1982; Markov and others, 1982). The ultramafic rocks hosting this metallogenic belt are interpreted as forming either in transform fault zones in a Late Jurassic-Early Cretaceous oceanic-marginal basin adjacent to an island arc, or along a spreading center (Palandjan and Dmitrenko, 1990).

Vatyn Belt of Zoned Mafic-Ultramafic PGE Deposits

A metallogenic belt of zoned mafic-ultramafic PGE deposits occurs in the Olyutorka subterrane of the Olyutorka-Kamchatka island arc terrane in the southern Koryak Highlands (Map 1, Sheet 2). The metallogenic belt consists mainly of minor platinum-group metal and chromite deposits that occur in small, zoned, Alaskan-type plutons composed of gabbro, dunite, and clinopyroxenite. The significant deposit is at Snezhnoe. Accessory PGE minerals occur in many of the zoned mafic-ultramafic plutons, along with chromium spinel. The PGE minerals are mainly isoferroplatinum, sperrylite, tetraferroplatinum, native osmium, and other sulfide minerals (Kutyev and others, 1991). The podiform Cr deposits in this belt are not as widespread as in the podiform Cr metallogenic belts to the north. Minor titanomagnetite and copper sulfide deposits also occur in pyroxenite in some of the zoned plutons.

These plutons intrude the Upper Cretaceous volcanogenic-sedimentary rocks of the Olyutorka subterrane that consists of tholeiitic and calc-alkaline basalt, argillite, carbonate rocks, and chert, mafic volcaniclastic and tuffaceous rocks, and turbidite. The Olyutorka-Kamchatka terrane is interpreted as island arc rock sequence underlain by oceanic crust. The zoned mafic-ultramafic plutons generally display intrusive contacts with host rocks. The succession from pluton cores to margins is generally dunite that grades into pyroxenite that grades into gabbro and gabbro-diabase. Intrusion occurred in the latest Cretaceous and the plutons are interpreted as the deep-level, magmatic roots of an island arc (Bogdanov and others, 1987). The Olyutorka subterrane is intricately faulted with, and thrust over the nearly coeval, Upper Cretaceous and Paleogene Ukelayat turbidite basin subterrane of the West Kamchatka terrane to the northwest (Sheet 1). The available geologic and petrologic and geochemical data indicate that the zoned PGE-bearing plutons formed in a marginal-oceanic basin and frontal island arc during subduction of an oceanic plate under the Olyutor Range (Bogdanov and others, 1987).

Pre-Accretionary Metallogenic Belts: Stratiform and Stratabound Massive Sulfide and Associated Deposits

Several major pre-accretionary metallogenic belts of stratiform and stratabound massive sulfide and associated deposits occur in the western part of the Russian Northeast (Map 2, Sheet 2). The principal deposits types are Australian Alps W, Kipushi Cu-Pb-Zn, Mississippi Valley Pb-Zn, volcanogenic-sedimentary Mn, basaltic Cu, bedded barite, carbonate-hosted Hg, shoshonite-hosted Cu, iron formation, and sediment-hosted Cu deposits. The host rocks are predominantly marine sedimentary and volcanic sequences of continental-margin terranes, which are interpreted as displaced fragments of the Eastern Siberia craton and craton margin (Sheet 1). Some deposits are associated with Early Paleozoic shoshonites that are interpreted as either a fragment of an island arc accreted to continental-margin terranes, or as a fragment of a continental-margin rift (Grinberg and others, 1981). To the southeast, several metallogenic belts of basaltic Cu, volcanogenic-sedimentary Mn, and massive sulfide deposits occur in accreted oceanic and island arc terranes in the Koryak Highlands (Map 2, Sheet 2).

Urultin Belt of Austrian Alps W and Kipushi Cu-Pb-Zn Deposits

A metallogenic belt of stratabound Austrian Alps W and Kipushi Cu-Pb-Zn deposits occurs in the northern Omulevka passive continental margin terrane of the Kolyma-Omolon superterrane between the Moma and Omulevka rivers (Map 2, Sheet 2). The belt is greater than 250 km long and ranges up to 80 km wide. The Australian Alps W deposits are in a Middle Ordovician flysch sequence of carbonaceous shale, argillaceous limestone, and calcareous siltstone of the Krivun suite that is deformed and metamorphosed to greenschist facies. The significant deposit is at Omulev. The Krivun and underlying Lower and Middle Ordovician Mokrin suite were deposited on a fragment of the passive margin of the Siberia craton. Kipushi stratabound Cu-Pb-Zn deposits occur in the Lower-Middle Ordovician graptolitic calcareous shale, calcareous siltstone, and limestone of the Eriekhin and Minutka suites formed in the same depositional environment. The significant deposit is at Vesnovka. Local tuff beds in these suites (Bulgakova, 1986), suggesting that a volcanic island arc occurred near the Early and Middle Ordovician continental-margin sedimentary basin.

Sudar Belt of Stratiform and Stratabound Deposits

A metallogenic belt of Mississippi Valley Pb-Zn, volcanogenic-sedimentary Mn, basaltic Cu, bedded barite, and carbonate-hosted Hg deposits occurs in three discontinuous fragments that extend northwesterly for 170 km (Map 2, Sheet 2). The southeastern portion of the belt is in the Sudar River basin, and the northwestern portion of the belt is in the Upper Taskan and Urultun Rivers. The deposits occur in various parts of the Paleozoic Sudar rift deposits in the Omulevka passive continental margin terrane. Mississippi Valley-Pb-Zn-fluorite deposits are most prevalent; the significant deposit is at Urultun. The Mississippi Valley deposits occur in Upper Ordovician through Middle Devonian strata (Shpikerman, 1987). The host rocks are diagenetic dolomite formed from reefal limestone that occur in a carbonate shelf along the Siberia craton passive margin. The deposit minerals and host rocks are stratigraphically overlapped by deep-sea argillaceous and often carbonaceous sedimentary rocks.

Carbonate-hosted Hg deposits are interpreted as forming in the same event as the Mississippi Valley deposits. The significant deposit is at Uochat. Both types of deposit are interpreted as forming in a Late Paleozoic thermal artesian paleobasin in a major petroleum area. Early and middle Carboniferous rifting is interpreted as the source of mineralizing fluids.

Stratiform basaltic Cu deposits occur in rift-related trachybasalt flows of the Givetian suite that formed in shallow marine environment (Map 2, Sheet 2). The significant deposit is at Batko. Stratiform volcanogenic-sedimentary Mn deposits and bedded barite deposits occur in folded Lower Carboniferous (Mississippian) through Upper Permian siliceous shales, cherts and siliceous-carbonate rocks that are intercalated with tuff and diabase bodies. The principal volcanogenic-sedimentary deposit is at Lyglykhtakh. The Prizovoe bedded barite deposit occurs in the Lower and Middle Carboniferous Batkov suite. Associated stratiform rhodochrosite deposits occur at Lyglykhtakh and elsewhere in the Sudar and nearby river basins in the lower part of the Upper Permian Turin suite. Stratigraphic breaks may exist between these suites of sedimentary rocks.

These deep-marine sedimentary and mafic volcanic rocks are interpreted either as allochthonous blocks of oceanic-floor sedimentary rocks, or as sedimentary and volcanic rocks deposited during rifting of a continental-margin. Pyroclastic debris is characteristic of the sedimentary rocks and indicates that submarine volcanism and was associated with these sedimentary-exhalative mineral deposits. This interpretation is by anomalous values of Pb, Zn, Cu, Ag, and Hg in the host rocks. In spite the variety of mineral deposit types in this belt, a genetic relation is interpreted between most of the deposits. The sedimentary-exhalative accumulation of Mn and barite ores, and higher Pb, Zn, Cu, Ag, and Hg concentrations are interpreted as having formed during deposition of the Mississippi Valley-type Pb-Zn deposits in artesian horizons.

Rassokha Belt of Shoshonite-Hosted Cu Deposits

A metallogenic belt of basaltic Cu and sandstone-hosted Cu deposits occurs in the Rassokha oceanic crust terrane of the Kolyma-Omolon superterrane (Map 2, Sheet 2). The belt is 80 km long and 20 km wide (Map 2, Sheet 2). The significant deposit is at Agyndja. Associated Pb and Zn vein deposits occur in the Middle and Late Ordovician Bulkut suite that consists of potassic trachybasalt, trachyandesite, basalt, and trachyte flows, interbedded tuff, siliceous shale, red sandstone, conglomerates and gray limestone, and hypabyssal shoshonite bodies. Bedding is generally faulted and steeply-dipping. The suite is interpreted as part of an island arc shoshonite assemblage. The Cu sulfide deposits occur in submarine lava flows, subvolcanic porphyry intrusions, and shallow-water sandstones. The Pb-Zn vein deposits are interpreted as forming during post-volcanic hydrothermal activity. This metallogenic belt is interpreted as forming in an island arc that was subsequently accreted to the paleocontinental margin.

Argatass Inferred Belt of Kuroko Massive Sulfide Deposits

An inferred metallogenic belt of kuroko massive sulfide deposits occurs in Upper Jurassic volcanic rocks in the Argatass Range (Map 2, Sheet 3). The belt extends northwest for nearly 250 km and is the southeastern part of a more extensive belt to the northwest (Danilov and others, 1990). The belt occurs in a widespread, Upper Jurassic bimodal basalt-rhyolite assemblage dominated by silicic rocks. To the northwest, outside of the map area, both minor Cu and polymetallic stratiform massive sulfide deposits occur conformable to bedding and are intensely deformed together with the Late Jurassic host rocks. The ore minerals are mainly barite, galena, sphalerite and chalcopyrite. Anomalous silver occurs in the host rocks. The ore-bearing Kimmeridgian Dogda suite consists of interbedded submarine siltstone, rhyolite, andesite tuff, basalt, and volcaniclastic sandstone. The mineralization environment is similar to the Miocene kuroko deposits in Green Tuff belt of Japan.

Shamanikha Belt of Ironstone and Sediment-Hosted Cu Deposits

A metallogenic belt of ironstone and sediment-hosted Cu deposits occurs in the Shamanikha subterrane of the Prikolyma passive continental margin terrane of the Kolyma-Omolon superterrane, mainly in Shamanikha River basin (Map 2, Sheet 2). The belt trends north-south for 400 km with a maximum width of 100 km along the axis of thePrikolyma terrane. The Shamanikha subterrane consists mainly of Middle Proterozoic clastic sedimentary rocks, mainly sandstone and siltstone metamorphosed to greenschist facies. Cu sulfide deposits occur in the Oroek suite and consist of disseminated bornite horizons that are conformable with primary bedding in sandstone and siltstone that are metamorphosed to phyllite, epidote-chlorite schist, and quartzite. Metabasalt also occurs in the suite. The principal Cu-sulfide deposit is at Oroek.

Ironstone deposits occur in the Late Proterozoic Spiridon and Gorbunov suites. The significant deposit at Pobeda in the Spiridon suite is a fossil littoral zircon-titanium-magnetite placer deposit. The dolomite-hosted iron deposit in the overlying Gorbunov suite is interpreted as forming during metamorphism and chemical redeposition of Fe from the Spiridon suite. The host rocks are folded and may occur, along with Devonian rocks, in allochthonous plates. The Shamanikha and Yarkhodon subterranes of the Prikolyma terrane are interpreted as the Middle and Late Proterozoic continental shelf part of the adjacent Kolyma-Omolon superterrane.

Yarkhodon Belt of Mississippi Valley Pb-Zn Deposits

A metallogenic belt of Mississippi Valley Pb-Zn-barite deposits occurs in the Yarkhodon subterrane in the eastern part of the Prikolyma passive continental margin terrane in the Yarkhodon River basin (Map 2, Sheet 2). The belt is 330 km long and up to 50 km wide. The significant deposits are at Slezovka and Gornoe (Davydov and others, 1988). All of the deposits occur in the same stratigraphic level of the Yarkhodon suite of Givetian and are hosted in diagenetic dolomite and dolomitized limestone. The depositional environment for the original limestone is interpreted as a carbonate bank formed on a passive continental shelf. Early and middle Carboniferous rifting is interpreted as the source of mineralizing fluids.

Berezov Belt of Polymetallic Vein and Probable Stratiform Sulfide Deposits

A metallogenic belt of polymetallic vein and probable stratiform sulfide deposits occurs in the Upper Devonian through Upper Permian Berezov turbidites in the Berezovka River basin in the Beryozovkha turbidite basin terrane of the Kolyma-Omolon superterrane (Map 2, Sheet 2). The northwest-trending belt is 120 km long and up to 100 km wide. The belt occurs in four areas divided by units of post-accretionary volcanic rocks. Numerous vein and veinlet-disseminated gold- and silver-bearing Pb-Zn deposits occur in this belt. The significant deposit is at Berezovskoe. The deposits are hosted in the Frasnian and Famennian Tynytyndzhin suite that consists of tuffaceous sandstone and siltstone, and rhyolite and basalt flows. Local quartz-carbonate-sulfide and barite veins and stringers, part of the suite of polymetallic vein deposits, are conformable to bedding in the host rocks. The polymetallic vein deposits are interpreted as forming during Late Mesozoic magmatism that remobilized and redeposited sedimentary-exhalative Pb-Zn deposits (Davydov and others, 1988). Because of the occurrence of bimodal basalt-rhyolite in the Devonian rocks of the Berezovka terrane (Dylevsky, 1992), potential exists for discovery of stratiform massive sulfide deposits.

Omolon Belt of Iron Formation Deposits

A metallogenic belt of iron formation deposits occurs in the Archean metamorphic rocks of the Omolon cratonal terrane of the Kolyma-Omolon superterrane (Map 2, Sheet 2). The belt occurs in more than ten local outcrops of the terrane. The significant deposit in the belt at Verkhny-Omolon consists of magnetite-rich quartzite of metasomatic origin, that is intercalated with mafic schist, amphibolite, and plagiogneiss. The original quartzites may be derived from marine sedimentary rocks. The host rocks are extensively granitized. Rb-Sr isotopic data reveal multiple metamorphism of the Archean basement. Granulite facies metamorphism occurred at 3.4 to 3.8 Ga; regional granitization occurred approximately at 2.0 Ga; and low grade metamorphism and deformation occurred approximately at 1.0 Ga (Milov, 1991). The latter event is interpreted as resulting in metasomatism and formation of the Omolon-type iron formation deposits in the region (Zhulanova, 1990).

Pekulney Belt of Basaltic Cu Deposits

A metallogenic belt of basaltic Cu deposits occurs in the island arc and oceanic basalts of the Upper Jurassic and Lower Cretaceous Western Pekulney and Pekulney terranes (Map 2, Sheet 2). The north-east-trending belt extends along the Pekulney Range for about 170 km ranges up to 20 km wide. The significant deposit at Skalistaya consists of native copper. The deposit occurs in the Pekulneyveem sequence that is composed of basalt flows up to 60 to 80 m thick that are interbedded with tuff, and cherty shale, all with abundant hematite (Shkursky and Matveenko, 1973). The native copper occurs in pumpellyite-silica-carbonate and epidote-carbonate veinlets in the basalt. The basaltic Cu deposits are interpreted as forming in primitive island arc and neighboring sea-floor environment.

Mainits Probable Belt of Massive Sulfide Deposits

An inferred metallogenic belt of massive sulfide deposits occurs in the Upper Jurassic and Early Cretaceous island arc Mainitskiy terrane (Map 2, Sheet 2). The east-west-trending belt is 170 km long and up to 40 km wide. The significant deposit at Ugryumoe consists of massive pyrite and chalcopyrite-pyrite-quartz ores and is interpreted as a Cyprus-type massive sulfide deposit (Oparin and Sushentsov, 1988). The deposit occurs in the Hettangian and Sinemurian Lazov sequence that consists of interbedded basalt, plagiorhyolite, tuffs, and tuffaceous siltstone that forms the basement of a Late Jurassic-Early Cretaceous island arc. The Lazov sequence and associated massive sulfide deposits are interpreted as forming in a primitive island arc environment. Abundant geological data suggest significant potential for additional massive sulfide deposits in this belt.

Vatyn Belt of Volcanogenic-Sedimentary Mn Deposits

A metallogenic belt of volcanogenic-sedimentary Mn deposits occurs in parts of the oceanic crust and ophiolite rocks of the upper Carboniferous through Lower Jurassic rocks of the Olyutorka-Kamchatka island arc terrane, and to a lesser extent in the Alkavatvaam turbidite basin and Yanranay accretionary wedge-oceanic terranes (Map 2, Sheet 2). The east-west trending belt occurs in several fragments, is up to 680 km long, and varies from 5 up to 100 km wide. The significant deposit at Itchauyvayam and others occur in a sequence of Valanginian and Campanian chert and basalt (Sheet 1). The lens-like braunite Mn deposits occur mainly in the Olyutorka-Kamchatka island arcterrane, and the chert-hosted Fe- and Mn-bearing layers and crusts occur at the surface of basalt flows in the Yanranay accretionary wedge-oceanic terrane. The volcanogenic-sedimentary Mn deposits are interpreted as forming in a deep marginal-sea or oceanic basin environment during submarine basalt eruption. Subsequently, the deposits were metamorphosed and locally redeposited as cross-cutting veins (Kolyasnikov and Kulish, 1988).

Pre-Accretionary Metallogenic Belts:
Felsic Magmatism Deposits

A pre-accretionary metallogenic belt of felsic magmatism-related deposits occurs in the central part of the Russian Northeast (Map 3, Sheet 2). The deposits are related to a suite of mid-Paleozoic plutonic and volcanic rocks intruding the Omolon cratonal terrane of the Kolyma-Omolon superterrane, and adjacent areas. A similar possible metallogenic belt of Paleozoic granitic-magma-related deposits may occur in the Chukotka passive continental margin terrane to the northeast (Sheet 1). However, a lack of isotopic data on ages of gneissic granitic plutons preclude definition.

Yassachny Belt of Granitic-Magmatism Deposits

A metallogenic belt of Pb-Zn and Sn Skarn, and Cu-Ag vein deposits occurs in the Yassachnaya River basin (Map 3, Sheet 2). The belt extends in two branches to the northwest for nearly 170 km and ranges up to 50 km wide. The skarn and associated Cu-Ag quartz vein deposits are associated with Late Jurassic granitic and hypabyssal intrusive bodies of the Uyandin-Yassachny volcanic-plutonic belt. The significant deposits are at Terrassnoe, Kunarev, and Bolshoy Kanyon. The skarns occur mainly in Paleozoic carbonate rocks of the Omulevka passive continental margin terrane of the Kolyma-Omolon superterrane, where intruded by Upper Jurassic granite, diorite, and rhyolite. Petrochemical zonation suggests that the igneous rocks of this arc and associated metallogenic belt formed over a southwest-dipping subduction zone.

Kedon Belt of Felsic Magmatism Deposits

The Kedon metallogenic belt consists of epithermal Au-Ag vein, porphyry Mo, Fe skarn and associated deposits that occur in early and middle Paleozoic granite, and coeval rhyolite, silicic tuff, and associated sedimentary rocks of the Omolon cratonal terrane of the Kolyma-Omolon superterrane (Map 3, Sheet 2). The areal extent of the Kedon metallogenic belt is approximately 40,000 km^2. Au-Ag epithermal vein deposits occur in subaerial felsic extrusive rocks and subvolcanic equivalents, and in tuff of the Middle Devonian through Lower Carboniferous Kedon series. The significant deposits are at Olcha, Kubaka, Zet, Tumannaya, Obyknovennoe, and Yolochka. Some epithermal vein deposits, like the Grisha deposit, may also occur in Lower Paleozoic syenite. Porphyry Mo-Cu deposits, like the Vechernee and other deposits, occur in Middle Paleozoic, potassic granitic rocks and subvolcanic rhyolites. Fe skarn deposits, like the Skarnovoe and other deposits, occur in Early Paleozoic granite that intrude Archean iron formation that provided iron for the Fe skarn deposit (Fadeev, 1975). The available field, isotopic, and paleoflora data indicate that the magmatic rocks of the Kedon belt formed mainly in the Middle Devonian through the Early Carboniferous (Lychagin and others, 1989). The lode deposits and host rocks of the Kedon metallogenic belt are interpreted as forming in a continental-margin magmatic arc whose origin is difficult to determine.

Oloy Belt of Porphyry Cu-Mo and Au-Ag Epithermal Vein Deposits

A metallogenic belt of porphyry Cu-Mo and epithermal vein deposits occurs mainly in the Oloy volcanic-plutonic island arc belt mainly in the drainages between the Oloy and Bolshoy Anyui rivers (Map 3, Sheet 2). The belt extends for 400 km; the central part ranges up to 160 km wide. Numerous porphyry Cu-Mo-Au deposits and Au-Ag epithermal deposits occur in the belt. The significant porphyry Cu deposits are at Peschanka, Dalny, Innakh, and Asket, and the significant epithermal Au-Ag deposits are at Vesennee, and Klen; all are related to magmatic rocks of the Oloy volcano-plutonic island arc belt. Associated Cu-Mo stockwork deposits occurs mainly in stocks and small bodies of gabbro-monzonite-syenite series (Gorodinsky and others, 1978). Au-Ag epithermal veins generally occur peripheral to granitic intrusions hosting porphyry Cu-Mo deposits. Au quartz-carbonate-sulfide polymetallic vein deposits occur in intermediate sites. The age of mineralization age is interpreted by Gulevich (1974) as Late Jurassic. However, some K-Ar isotopic data reveal an Early Cretaceous age for some of the associated intrusions; some deposits occur in Lower Cretaceous wall rocks (Gorodinsky and others, 1978). Some, still younger porphyry and epithermal vein deposits may be related to remobilization of during post-accretionary magmatism in the Late Cretaceous. The porphyry deposits in this belt contain characteristic, widespread magnetite, Co, and PGE minerals which are attributed to hosting oceanic terranes.

Accretionary Metallogenic Belts:
Metamorphic and Granitic Magmatism Deposits

Several major accretionary metallogenic belts of granitic magmatism deposits occur in the Russian Northeast (Map 1, Sheet 3). The principal deposit types are either metamorphic-related, such Au quartz vein deposits, or are granitic-magmatism-related, such as Sn and Cu-Ag vein, Pb-Zn and Sn skarn, porphyry Cu-Mo, Au-Ag epithermal vein, and associated deposits. The deposits are mainly located in Upper Proterozoic, Permian, Triassic and Lower Jurassic units. Both the metamorphic and granitic units that host the deposits occur mainly along the deformed terrane boundaries, and are interpreted as forming during accretion and structural interaction of terranes. The metamorphic vein deposits are interpreted as resulting from hydrothermal fluids that formed during the late stage of regional greenschist facies metamorphism. The various porphyry Cu-Mo, Au-Ag epithermal vein, and Pb-Zn and Sn skarn deposits are associated with Late Jurassic and early Cretaceous volcanic and plutonic belts that are interpreted as having formed during and immediately after accretion.

Chukotka Belt of Au Quartz Vein and Sn and Sn-W Polymetallic Vein Deposits

A metallogenic belt of Sn and Sn-W polymetallic vein, and Au quartz vein deposits occurs in the northern part of the Russian Northeast in the central and western part of the Paleozoic and early Mesozoic Chukotka passive continental margin terrane (Map 1, Sheet 3). Various Sn and complex Sn-W-quartz polymetallic vein, and minor associated Sn greisen deposits occur in Middle Paleozoic and Early Mesozoic sandstone, argillite, and rare carbonate rocks of the Palyavaam and Kuul subterranes. The lode deposits are closely related to Early Cretaceous leucocratic, anatectic, potassic granitic plutons. The main Sn-W vein deposits occur to the east in the Iultin ore district. The Iultin, Svetloe, Chaantal, Tenkergin, and associated deposits of this district contain the most of the regional inferred tungsten reserves, and the Iultin and Svetloe deposits produce all of the tungsten and by-product tin in the Russian Northeast. These deposits are interpreted as forming in zones of granitization that resulted from the Late Barremian through Middle Albian collision of the sialic blocks of the Chukotka passive continental margin terrane with neighboring oceanic units of the South Anyui subduction zone-oceanic terrane the south during spreading in the Arctic ocean basin to the north (Filatova, 1988).

Also part of the belt is a group of Au quartz vein deposits that occur in the Anyui and Chauna subterranes of the Chukotka passive continental margin terrane. The significant deposits are at Karalveem, Ozernoe, Sredne-Ichuveem, Draznyaschy, Upryamy, and Lenotap. The only commercial deposit at Karalveem is characterized by high-grade ore and unique gold nuggets. The Au-quartz vein deposits and Au shear zones deposits occur in anticlinal structures formed in Triassic siltstone, shale, and sandstone and intruded by widespread Triassic gabbro-diabase sills and Early Cretaceous granitic dikes. The Au deposits are controlled by major, north-west-trending faults and feathering fault zones that formed during low-grade, greenschist facies metamorphism. A few Au-quartz vein deposits also occur in thrust zones in middle Paleozoic clastic and carbonate rocks, and in Upper Jurassic and Lower Cretaceous volcanic and sedimentary rocks. These Au quartz vein deposits are probably the main lode source for numerous gold placer deposits of Chukotka. However, in detail, the known lode gold deposits do not correspond to the known large gold placer deposits. This observation suggests that undiscovered Au quartz vein or other types of undiscovered deposits may exist in the region. The Au quartz vein deposits are herein interpreted to have formed in the Early Cretaceous during regional deformation and metamorphism that occurred in a major collisional-deformational event, mainly before intrusion of the granitic rocks.

Shamanikha Belt of Au Quartz Vein and Cu-Ag Quartz Vein Deposits

A metallogenic belt of Au quartz and Cu-Ag vein deposits occurs in a zone of metamorphic rocks in Paleozoic and older rocks, adjacent to a Late Jurassic volcanic and plutonic belt (Map 1, Sheet 3). The belt is in the western part of the Shamanikha subterrane of the passive continental margin Prikolyma terrane of the Kolyma-Omolon superterrane. The belt extends north-south for about 350 km and varies in width from 5 to 50 km. Most of the belt occurs in the Shamanikha River basin.

The Au quartz vein deposits generally occur as thin quartz veins in Upper Proterozoic sedimentary rocks metamorphosed to greenschist facies. The significant Au quartz vein deposits are at Glukhariny and Kopach. The main ore mineral is native gold. Cu-Ag quartz veins occur in Upper Proterozoic Cu-bearing sandstone metamorphosed to greenschist facies. The significant deposit is at Opyt. The Cu-Ag quartz vein deposits occur adjacent to the Late Jurassic volcanic and plutonic belt, and exhibit a more diverse mineral composition compared to the Au quartz vein deposits in the same belt. The cause of metamorphism, formation of quartz veins and contained lode deposits, and the formation of the volcanic and plutonic belt are herein interpreted as forming during intense deformation that occurred between the Shamanikha subterrane of the Prikolyma passive continental margin terrane, and adjacent terranes to the west.

Darpir Belt of Igneous Arc Deposits

A metallogenic belt of igneous-arc-related deposits occurs in a zone of Early Cretaceous granitic intrusions that trends northwest along the boundary between the Omulev and Yana-Kolyma terranes for nearly 600 km (Map 1, Sheet 3). The metallogenic belt and zone of granitic intrusions is transverse, or nearly orthogonal to the trend of the Okhotsk-Chukotka volcanic-plutonic belt. The metallogenic belt consists mainly of granitic-intrusive-related Sn polymetallic vein, Sn silicate-sulfide, and Co-arsenide polymetallic vein deposits, and porphyry Cu deposits that occur mainly in stockworks in rhyolite subvolcanic stocks, and Pb-Zn skarn deposits. Sn polymetallic vein and Sn silicate-sulfide deposits, such as the Darpir and Lazo deposits, commonly occur in or near Early Cretaceous granite plutons that intrude contact metamorphosed, Early and Middle Jurassic siltstone. Bi-bearing, Co-arsenide vein deposits, such as the Verkhny Seimchan deposit, and granitoid-related Au deposits, such as the Chepak deposit, occur in a similar setting. The porphyry Cu stockwork deposit at Datsytovoe is spatially associated with the relatively older Pb-Zn skarn deposit at Kunarev. These relations define a complex ore fields with distinct zonation of porphyry Cu and Pb and Zn skarn deposits.

The Early Cretaceous granitic intrusions hosting the metallogenic belt crosscut Paleozoic and Lower Mesozoic bedrock in the Omulev and Yana-Kolyma terranes. The bedrock is, in turn, overlapped by Lower Cretaceous subaerial volcanic rocks of the Okhotsk-Chukotka volcanic-plutonic belt. The zone of granitic intrusions and associated metallogenic belt are interpreted as forming during the collision of the continental-shelf Omulev and Yana-Kolyma terranes during the Late Jurassic and Early Cretaceous.

Yana-Kolyma Belt of Au Quartz Vein, Sn Vein and Greisen, W Vein and Clastic-Sediment-Hosted Hg Deposits

A metallogenic belt of mainly Au quartz vein, lesser Sn vein, Sn greisen, W vein deposits, and clastic-sediment-hosted Hg deposits occurs in the upper Paleozoic through middle Mesozoic rocks of the Yana-Kolyma turbidite basin terrane of the Kolyma-Omolon superterrane (Map 1, Sheet 3). This belt extends from the territory of Yakutia to the northwest, to the Okhotsk-Chukotka volcanic belt to the southeast (Sheet 1). The geologically favorable units for this metallogenic belt are the Inyali-Debin, Ayan-Yuryakh and Orotukan subterranes that are composed of graywacke, shale, and flysch of the Verkhoyan Complex.

Major wide shear zones, distinct folds, and numerous granitic intrusions characterize the host rocks of the metallogenic belt. These structures and intrusions are interpreted as forming during collision of continental blocks in the Late Jurassic to Early Cretaceous. The granitic intrusions define the Late Jurassic and Early Cretaceous Kolyma granite belt that extends along the northeastern boundary of the Yana-Kolyma terrane, and consists mainly of peraluminous biotite and two-mica granitic plutons. The granitic rocks were preceded by an intrusion of mainly andesite dike swarms.

Numerous Au quartz vein lode and related gold placer deposits are sites of past Russian Northeast gold production (Shilo, 1960; Firsov, 1957, 1985). The most important gold lode occurrences in the metallogenic belt are the Natalka deposit, in production since 1945, and the Igumen, Rodionov, Vetrenskoe, Utinka, Srednekan, Shturm, and other deposits. At some deposits mining has temporarily ceased. The majority of the deposits are not thoroughly prospected.

Also part of the metallogenic belt are Sn quartz vein, Sn greisen, W vein, Sn-bearing pegmatite, Sb-Au vein, and clastic-sediment-hosted Hg deposits (Map 1, Sheet 3). The best examples of each deposit type are the Sn quartz vein deposit at Butugychag, the Sb-Au vein deposit at Krokhalin, and the clastic-sediment-hosted Hg deposit at Kuzmichan. Most of the Sn deposits are small, except for Butugychag. The Sn, Sb, and associated Hg deposits are interpreted as forming during intrusion of the anatectic granitic rocks of Late Jurassic and Early Cretaceous Kolyma granite belt. The Au quartz vein deposits may have formed during regional deformation and metamorphism that was associated with anatexis. Alternatively, Babkin (1975) and V.I. Berger (written commun., 1993) interpret that the clastic-sediment-hosted Hg deposits formed during a younger event in the Paleocene.

The host rocks for the Au quartz vein deposits range in age from Permian to Jurassic and locally contain anomalous syngenetic carbonaceous matter in black shales. Gold mineralization is associated with burial and low-grade greenschist facies metamorphism that included both contact and regional, penetrative metamorphism, and hydrothermal activity (Gelman, 1976). The deposits occur as linear bands and clusters that are controlled by two major sets of strike-slip fault zones that trend northwest for over 500-600 km. Secondary controlling structures are less extensive, diagonal and transverse fault zones that are bounded by northwest-trending strike-slip fault. The larger Au quartz vein deposits generally occur in the northwest-trending fault zones, and are confined to the axial parts of metamorphic or "thermal anticlines" that are characterized by intense retrogressive metamorphism. The main types of the Au deposits occur in: (1) mineralized shear zones (linear stockworks) with low-grade ores that are not as widespread as the other types of ore, but contain approximately half of the gold reserves in the region; (2) quartz veins that commonly contain high-grade ores and coarse gold that are most favorable for milling, but contain smaller reserves; and (3) gold-bearing, altered dikes. Some areas in the belt may have potential for stratabound gold-quartz deposits.

The Au quartz vein deposits of the Yana-Kolyma metallogenic belt are similar to other deposits of this type throughout the world. The main features of this deposit type are: (1) predominance of quartz; (2) minor amounts of subordinate sulfide minerals, mainly arsenopyrite and pyrite; (3) less than 3-5% mica, feldspar, carbonate minerals, and chlorite; and (4) in many places, a considerable down-dip extension of ore with little or no vertical zonation. Most of the Au quartz vein deposits formed during the retrogressive, low-grade greenschist facies metamorphism before intrusion of the major granitic plutons, and were subsequently thermally metamorphosed. Consequently, the Yana-Kolyma Au quartz vein deposits are interpreted as being genetically or paragenetically related to the nearly coeval, pre-granitic dikes or granitic plutons. The gold is interpreted as forming from the hydrothermal fluid generated during metamorphism of sediment-hosted gold that in turn was derived from an older period of multi-stage redeposition of gold from auriferous zones of pyrrhotite and pyrite in sedimentary-exhalative deposits.

Inferred Anadyr River Belt of Au Quartz Vein and Associated Deposits

An inferred metallogenic belt of placer gold deposits occurs in the eastern part of the Russian Northeast in the Anadyr region (Map 1, Sheet 3). Significant associated placer Au districts are at Kenkeren, Otrozhny, Pekulney, and Zolotaya Gora. The knowledge of associated lode deposits is poor, although prospecting in 1906 discovered the first gold placer in the Zolotoy Range. The placer gold districts occur in island arc, oceanic crust, and flysch terranes, which occur in intricate fold, thrust, and nappe structures. The lode sources for the gold placers are interpreted as: (1) various Au quartz and sulfide-quartz veins containing feldspar, carbonate minerals, epidote, chlorite, and other minerals; and (2) various mineralized zones in Paleozoic and Mesozoic clastic rocks, chert, volcanogenic rocks mainly associated with Late Cretaceous calc-alkaline magmatism. An example of the former is the Vaegi Au quartz vein deposit that occurs in a nappe of early Paleozoic and possibly older metavolcanic rocks that display both greenschist facies metamorphism and extensive host rock replacement by sulfide minerals and quartz, and that may have potential for vein-disseminated gold deposits (Ivanov and others, 1989). An example of the latter is the Nutekin Au quartz vein deposit in the Kenkeren Range that consists of veins in diabase dikes. Some gold occurrences are associated with PGE deposits that occur in silica-carbonate metasomatic rocks in serpentinite melange. These multi-stage gold and PGE deposits may have formed during the beginning of accretion of island arc terranes.

Post-Accretionary Metallogenic Belts: Igneous Arc Deposits

Several major of post-accretionary metallogenic belts occur throughout mainland the Russian Northeast (Map 2, Sheet 3). Most of the belts occur in extensive volcanic-plutonic belts that formed during Late Cretaceous and Cenozoic continental-margin arcs, and in adjacent broad tectonic-magmatic zones. These metallogenic belts contain a most diverse spectrum of lode deposits, but also have a high potential for discovery of new deposits. The distribution of types of lode deposits in the belts depends to a great extent on the character of the host rocks of the basement terranes, and exhibits a general metallogenic zoning typical of continental-margin arcs. The metallogenic belts, and hosting igneous arc rocks are progressively younger toward the active Pacific continental margin.

Eastern Asia-Arctic Belt of Igneous Arc Deposits

A major metallogenic belt of igneous-arc-related lode deposits, the eastern Asia-Arctic belt, occurs in and adjacent to the Okhotsk-Chukotka volcanic-plutonic belt (Gelman, 1986) (Map 2, Sheet 3). The main deposit types in the belt are porphyry Cu-Mo, Au-Ag epithermal vein, disseminated Au-sulfide, granitoid-related Au, Sn-Ag polymetallic vein, porphyry, and skarn, Hg, Sb, and associated deposits. The belt includes the rear, frontal and perivolcanic zones of the Albanian through Senonian Okhotsk-Chukotka volcanic-plutonic belt that extends more than 3,000 km between the Mesozoic Verkhoyan-Chukotka tectonic region to the north and west, and the Mesozoic and Cenozoic Koryak and Kamchatka tectonic region to the south and east (Sheet 1). This volcanic-plutonic belt constitutes a major assemblage that overlaps previously-accreted terranes. The frontal part of this Pacific-facing, continental-margin volcanic-plutonic belt zone lies on the transitional crust whereas the rear part lies on thick, Mesozoic, Paleozoic, and Precambrian continental crust. The frontal zone is dominated by basalt and the rear zone by andesite and rhyolite. Coeval granitic through gabbroic intrusions also occur in the rear zone (Bely, 1977, 1978; Filatova, 1988). The structure and general outlines of the metallogenic belt are controlled by longitudinal and orthogonal faults. North-south- and northwest-trending orthogonal faults appear to control rhyolite and granitic magmatism and associated belts of lode deposits that extend several hundreds of kilometers to the northwest away from the northeast-trending mass of the Okhotsk-Chukotka volcanic-plutonic belt (Sheet 1).

Porphyry Cu-Mo Deposits. Porphyry Cu-Mo deposits occur mainly in the frontal part of the Okhotsk-Chukotka volcanic-plutonic belt along uplifts centered on magma-related faults (Map 2, Sheet 3). Most of these zones, like the Chelomdja-Yama and Anadyr, occur along a regional gravity gradient between the axes of the volcanic-plutonic belt. The best-known Magadan district extends for 500 km along the Okhotsk Sea coast that contains porphyry Cu-Mo deposits as at Osennee, Oksa, Usinskoe, Nakhatandjin, Ikrimun and others. These deposits generally occur in multiphase batholith plutons of Early Cretaceous gabbro, tonalite, and plagiogranite characterized by low initial Sr ratios. Late Cretaceous gabbro, granodiorite, and granite are subordinate. The Cu-Mo deposits commonly define the outlines of ring structures that vary from 7 to 12 km in diameter (Skibin, 1982; Anorov and Mayuchaya, 1988). Towards the continent, deposits richer in Cu are replaced successively by deposits richer in Mo and W. These relations are correlated with a thicker continental crust, greater abundance of potassium leucocratic granite, and increased silver. Porphyry Mo-Cu deposits occur in Cretaceous gabbro, diorite, and alkaline granite along the Anadyr fault zone in the rear and perivolcanic parts of the volcanic belt. The significant deposits are at Shurykan in Middle Chukotka, and Khakandya on the Okhotsk Sea coast. Porphyry Mo deposits occur in granodiorite and granite intrusions of the Korkodon-Nayakhan orthogonal plutonic chain that crosses the structures along the boundary of the Omolon cratonal terrane of the Kolyma-Omolon superterrane. The significant deposit is at Orlinoe.

Au-Ag Epithermal Vein Deposits. Spectacular examples of Au-Ag epithermal vein deposits in the eastern Asia-Arctic metallogenic belt form bonanza deposits in the rear and perivolcanic parts of the Okhotsk-Chukotka volcanic-plutonic belt (Map 2, Sheet 3) (Sidorov, 1978, 1987). The significant deposits occur in the southern part of the metallogenic belt, in the Okhotsk Sea coastal area at Karamken, Utessnoe, Agat, Oira, Burgagylkan, Nyavlenga, and Evenskoe. The northern two thirds of the belt, including the Penzhina-Anadyr and Chukotka regions, are poorly known; however, rich deposits occur at Kegali, Sergeev, Sopka Rudnaya, Valunistoe, and Pepenveem. Numerous, poorly-prospected, minor deposits also occur throughout the metallogenic belt.

The typical environment for the Au-Ag epithermal deposits consists of: (1) resurgent, subvolcanic dome uplifts around the peripheries of isometric collapse structures that range from 10 to 60 km in diameter; (2) volcanic sequences with abundant pyroclastic deposits; (3) abundant rhyolite-dacite and rhyolite ignimbrites; (4) subvolcanic intrusions and extrusive cupolas of potassic rhyolite, latite, and trachyandesite with injection breccias; (5) a combination of major faults, either exposed or concealed, and conformable ring and radial fractures; and (6) zones of low-temperature propylitic alteration. The Au-Ag deposits are generally characterized by: (1) low- or moderately abundant sulfide minerals; (2) widespread Ag-Sb sulfosalts, sulfostannates, Ag sulfides, selenides and less frequent telluride minerals along with electrum; (3) veins of quartz, chalcedony, adularia, and carbonate minerals; and (4) adularia-sericite wall-rock alteration. Au-Ag ratio ranges from 1:1-1:2 to 1:300 or more. According to the geologic and isotopic age data, the age of Au-Ag epithermal vein deposits is mainly Late Cretaceous and Paleogene, but some deposits may be as old as Early Cretaceous (Albian).

Disseminated Au-Sulfide Deposits . Disseminated Au sulfide deposits occur in large-scale mineralized shear zones in the eastern Asia-Arctic metallogenic belt, mainly in Chukotka in the perivolcanic part of the Okhotsk-Chukotka volcanic-plutonic belt (Map 2, Sheet 3). The deposits consist of disseminated arsenopyrite and pyrite and finely dispersed gold hosted in sedimentary rocks. Approximately 90% of the gold occurs in acicular arsenopyrite and arsenic-rich pyrite. The significant deposits are Maiskoe and Tumannoe. The typical environment for these consists of: (1) areas of flysch terranes adjacent to the volcanic belt; (2) structures cutting deposits formed in preceding accretion of terranes, including thrusts, intrusive and non-intrusive domes, and horsts; and (3) increased carbon content of clastic sedimentary rocks (Sidorov, 1987). The disseminated Au-sulfide deposits are interpreted the roots of the Au-Ag epithermal vein deposits (Sidorov, 1987).

Granitoid-related Au Deposits. Most of the granitoid-related Au deposits, generally small, occur in porphyritic granitoid plutons mainly in the perivolcanic part of the Okhotsk-Chukotka volcanic-plutonic belt (Map 2, Sheet 3). Besides Au and companion Ag, these deposits also contain Sn, Mo, W, Te, and Bi minerals. Many valuable deposits, such as the Shkolnoe deposit northwest of Magadan, occur in stocks of gabbro, diorite, granodiorite, or granite, and contain zones of finely disseminated gold-bearing sulfide minerals. Many granitoid-related Au deposits are similar to epithermal vein deposits, in terms of geochemistry and genesis. Other granitoid-related Au deposits are interpreted as being related to porphyry Cu-Mo deposits (Sidorov and Rozenblum, 1989).

Sn, Sn-Ag and Polymetallic Vein, Porphyry and Skarn Deposits. Two extensive areas of Sn, Sn-Ag polymetallic vein and porphyry deposits and accompanying Sn skarn deposits occur along (Map 2, Sheet 3): (1) the northern flank of the eastern Asia-Arctic metallogenic belt in Middle and Eastern Chukotka; or (2) the southern flank in the Okhotsk Sea coastal area. The geologically favorable environment for these deposits is the rear part of the Okhotsk-Chukotka volcanic-plutonic belt and adjacent areas of flysch and continental shelf terranes (Sheet 1). Sn deposits occur in a 900-km-long band in the northern metallogenic belt and include Sn polymetallic, Sn silicate-sulfide, porphyry Sn and rhyolite-hosted Sn deposit types. These deposits are generally associated with Late Cretaceous leucocratic and biotite granite plutons and intrusive and extrusive volcanic domes. The volcanic-hosted deposits are characterized by moderate to high Ag and In contents, along with W in some deposits. The significant deposits in Chukotka are at Valkumei, presently being mined, Pyrkakai, Ekug, Telekai, Kukenei, Mramornoe, and Dioritovoe. Most of the known Sn reserves in the Russian Northeast occur in stockworks of the porphyry Sn Pyrkakai deposit.

Associated Ag and Sn-bearing polymetallic skarn deposits occur in Paleozoic carbonate rocks in eastern Chukotka. The significant deposits are at Chechekuyum, Reechen, and Enpylkhkan. Some polymetallic skarn deposits may be older, remobilized and metamorphosed stratiform deposits. In the Okhotsk Sea coastal area, Sn and polymetallic and associated deposits occur mainly in the Arman Kheta and Verkhnaya Kolyma districts. Sn polymetallic vein and pipe-like deposits are most common. The significant deposits are at Kheta, Kandychan, and Tigrets-Industria. Some Sn silicate-sulfide vein deposits, like Dneprov, feature a combination of Sn mineral deposit types. Small rhyolite hosted Sn deposits may be spatially associated with epithermal vein, Ag-polymetallic vein, and skarn deposits, (Bulunga, Tektonicheskoe, Skarnovoe, and Svetloe), and Co-arsenide veins, (Verkhne-Seimkan group of deposits). Many Sn vein and polymetallic deposits contain Ag in concentrations comparable to Au-Ag epithermal vein deposits.

Hg and Sb Deposits. Numerous Hg deposits occur in the northern part of the eastern Asia-Arctic metallogenic belt in linear zones extending hundreds of kilometers along strike that are controlled by northwest- and northeast-striking faults (Sheet 1). The zones of Hg deposits are generally parallel to, and may frequently overlap zones of Au-Ag and Sn deposits. The host rocks are mainly Cretaceous rhyolite, dacite, andesite of the Okhotsk-Chukotka volcanic-plutonic belt, and to a lesser extent, ultramafic, clastic, and volcanic rocks in underlying terranes. The Hg deposits are mainly cinnabar, often with antimony, arsenic and gold that generally occur mainly in layers, and to a lesser extent in veins and stockworks (Babkin, 1975; Kopytin, 1978). The significant deposit types are clastic sediment-hosted Hg, volcanic-hosted Hg, and silica-carbonate Hg. The significant deposits are in the Palyavaam mercury zone that extends for nearly 600 km from the Chaun Inlet in the west to the Krest Bay in the east. The significant deposits in this zone are at Palyan, Plamennoe, and Matachingai. Along the southern flanks of the metallogenic belt are poorly developed Hg deposits, although wide cinnabar aureoles are well developed. These volcanic-hosted Hg deposits are usually spatially related to Au-Ag epithermal deposits. The significant deposit is at Utessnoe.

Sparse minor Sb deposits occur in the region. Simple Sb vein deposits are hosted in mid-Cretaceous intrusive rocks, as well as deposits with considerable As sulfide minerals, and native As, Au, and Ag. The significant deposit is at Elombal. A volcanic-hosted Sb deposit, the Utro Ag-Sb vein deposit, occurs in volcanic rocks along the southern flank of the eastern Asia-Arctic metallogenic belt (Map 2, Sheet 3).

Omsukchan Belt of Igneous Arc Deposits

This metallogenic belt of igneous-arc related deposits coincides with an extensive transverse branch of the Okhotsk-Chukotka volcanic-plutonic belt and is defined as a separate metallogenic structure (Map 2, Sheet 3). The belt is more 250 km long and ranges from 10-15 up to 60-70 km wide. The belt contains abundant polymetallic and epithermal Sn and Ag deposits. Mainly Sn, Ag polymetallic vein, and W, Au, and Co vein deposits occur in the northern and middle parts of the belt, whereas mainly Au-Ag epithermal vein and porphyry Mo-Cu deposits occur in the southern part. The significant Sn and Sn-Ag deposits, mainly Sn polymetallic vein, Sn silicate-sulfide, and porphyry Sn deposits, are at Nevskoe, Galimoe, Ircha, Khataren-Industrial, Trood, Novy Djagyn, and Maly Ken. Some of these deposits were recently discovered. Most of the numerous, small, but rich tin deposits were mined out in the 1940's. Various types of Sn deposits are associated with the Omsukchan granite and comagmatic extrusive-subvolcanic complexes. At depths, these Sn deposits are mainly associated with granitic plutonic rocks. At intermediate levels, the Sn deposits are associated with volcanic and plutonic rocks. Near the surface, the Sn deposits are associated with volcanic rocks, and consist mainly of Sn-Ag deposits, and associated Ag-polymetallic and epithermal Au-Ag deposits. The significant Ag-polymetallic vein deposits are at Mechta and Tidit.

A major Ag epithermal vein mine in this metallogenic belt occurs at Dukat where the major Dukat deposit consists of numerous, extensive disseminated replacement zones, and quartz-adularia-rhodochrosite-rhodonite veins with diverse silver and base metal sulfide minerals. The deposit occurs in ultra-potassic rhyolite, part of the Early Cretaceous Askoldin igneous complex that occurs over a concealed cupola of the Omsukchan granite. This deposit differs from similar precious metal epithermal deposits by a predominance of silver and multi-stage formation from the Early Cretaceous through the early Paleogene. The rich vein deposit is interpreted as forming during partial silver remobilization of the disseminated sulfide minerals that were deposited during Early Cretaceous Askoldin magmatism (Milov and others, 1990). This mining district has potential for additional, undiscovered deposits, similar to Dukat, with bulk-mineable low-grade silver deposits similar to Waterloo, and other Ag pipe-like deposits in Mexico (Natalenko and Kalinin, 1991).

The Omsukchan metallogenic belt occurs in a unique, rift tectonic environment that formed in continental crust up to 52 km thick. The trough associated with the rift is filled by Lower Cretaceous volcanic and sedimentary sequences of the continental coal-bearing molasse that are unconformably overlain by Albian through Cenomanian andesite, rhyolite, and ignimbrite. The total thickness is greater than 3,000 m. The lower part of the molasse includes the Aptian Ascoldin suite composed of high-siliceous, ultra-potassic rhyolite. The plutonic rocks associated with the metallogenic belt are dominated by the Omsukchan Complex potassic biotite granite, with an isotopic age of approximately 90 Ma.

Left Omolon Belt of Igneous Arc Deposit

This metallogenic belt of igneous-arc-related deposits is associated with a chain of Lower Cretaceous granodiorite stocks and small bodies that trend northwest for nearly 300 km along the left side of the Omolon River Basin (Sheet 1). The main deposit types in the belt are porphyry Mo-Cu and related Mo-Cu skarn deposits. The significant deposits are at Bebekan and Medgora deposits. Both veinlet-disseminated stockworks in metasomatically altered granodiorite, and skarn near granodiorite form different facies of a single porphyry Mo-Cu system. The porphyry Mo-Cu deposits are associated with Au-Ag and Pb-Zn vein deposits. The metallogenic belt occurs along the northeast marginal of the Omolon cratonal terrane. Two tectonic settings are interpreted for the Lower Cretaceous granitic intrusions hosting this metallogenic belt: (1) The Lower Cretaceous granitic intrusions may be a transverse, nearly orthogonal branch of the Cretaceous Okhotsk-Chukotka volcanic-plutonic belt; or (2) the Lower Cretaceous granitic intrusives may be a continuation of a separate, Early Cretaceous continental-margin magmatic arc that occurs to the northeast of the Omolon cratonal terrane. Consequently, this metallogenic belt is defined separately from the eastern Asia-Arctic metallogenic belt of igneous-arc-related lode deposits.

Central Koryak Belt of Igneous Arc Deposits

A metallogenic belt of igneous-arc-related lode deposits occurs in the Koryak Highlands in the eastern part of the Russian Northeast (Map 2, Sheet 3). The belt extends from the Penzhina Inlet to the Anadyr Bay for about 1,000 km (Sheet 1). The metallogenic belt is composed mainly of Sn polymetallic, Au-Ag epithermal, Hg-Sb vein, and porphyry Mo-Cu deposits that are related to the calc-alkaline magmatism of the Western Kamchatka-Koryak continental-margin volcanic belt of Late Eocene and Oligocene age (from about 45 to 25 Ma) (Pozdeev, 1986; Filatova, 1988). Various, isolated ring, volcanic-plutonic, and volcanic structures host about a third of the metallogenic belt, and unconformably overlie nappes of previous-accreted flysch, island arc, and ophiolite terranes (Sheet 1).

Sn polymetallic and Au-Ag epithermal vein deposits occur mainly along the southern flank of the metallogenic belt in a region underlain by mature crust composed of a granitic and metamorphic rocks up to 40 km thick. The Sn polymetallic vein deposits are hosted by metasedimentary rocks, silicic and intermediate volcanic rocks, and granite porphyry and rhyolite stocks and dikes that occur above concealed granitic batholiths (Lashtabeg and others, 1987). The significant deposits are at Ainavetkin, Reznikov, Khrustal, and Unnei. The deposits tend to be enriched in Ag, In, Bi, and sometimes Au. Various Ag-Au and Au-Ag epithermal vein deposits, such as at Ametistovoe, Ivolga, and Sprut, are related to intermediate composition, subvolcanic complexes (Khvorostov and Zaitsev, 1983). These epithermal deposits are vertically and lateral zoned with respect to Sn and Sn-Ag deposits. The area has potential for undiscovered Sn lode deposits. The northern part of the belt consists of the Parkhonai district which contains Sn, Au-Ag, Sb, and Hg polymetallic vein, and clastic-sediment-hosted Hg deposits.

Hg mineralization is ubiquitous throughout the metallogenic belt with higher concentrations in the southern and northern extreme parts. Extensive mineralized fault zones contain cinnabar, stibnite and realgar that are associated with intermediate-composition, small intrusions and dikes that intrude Upper Cretaceous through Paleogene sandstone and shale. The significant deposits are clastic sediment-hosted Hg deposits at Lyapganai, Neptun, and Krassnaya Gorka.

Both Hg and Sn deposits occur in a major, northwest-trending transverse lineament along the northeastern flank of the belt. The host rocks are rhyolite, andesite, basalt, clastic, and siliceous-volcanogenic rocks and ophiolite allochthons. The significant examples are the volcanic-hosted Hg deposit at Lamut, and a major silica-carbonate Hg and W deposit at Tamvatney deposit. Some Hg deposits are similar to hot-spring Hg deposits.

Au-bearing, porphyry Mo-Cu occurrences, such as at Kuibiveen, and numerous hydrothermal vein deposits, containing Au, Ag, Cu, Mo, Pb, and Zn, also occur in the metallogenic belt. These deposits formed at varying temperatures, represent a variety of mineral deposit types, and are spatially associated with the volcanic fields of the Central Koryak volcanic belt.

Kamchatka-Olyutor Belt of Igneous Arc Deposits

A metallogenic belt of igneous-arc-related deposits occurs in northern Kamchatka in the Kurils-Olyutor continental-margin volcanic-plutonic belt (Map 2, Sheet 3). The metallogenic belt extends for more than 600 km along the Bering Sea coast (Sheet 1). Meager information exists for this metallogenic belt. Several mineable Hg, Au, Mo, Cu, Pb and Zn deposits occur in many, slightly-eroded volcanic structures (Tarasenko and Titov, 1969). Numerous, poorly explored, porphyry Cu-Mo, Au-Ag epithermal vein, and Sn polymetallic vein deposits occur along the southern flank of the belt, and a zone of Hg-Sb and Hg-As deposits extends for more than 100 km along the Olyutor Bay coast. The significant deposit is at Olyutor, a clastic sediment-hosted Hg deposit. The deposits in this belt are hosted in Upper Oligocene and Lower Miocene flysch. Hg, Sb, and As deposits also occur in Neogene extrusive rocks, and in serpentinite melange zones.

The metallogenic belt also includes several porphyry Mo-Cu deposits, such as at Lalankytap, that occur in diorite and granodiorite porphyry stocks and dikes intruding Late Cretaceous and early Paleogene tuffaceous and clastic rocks. The porphyry Mo-Cu deposits extend more than 100 km in the northern part of the belt, with intrusion apparently related to major faults.

The origin of the metallogenic belt is related to the Neogene calc-alkaline magmatism of the Kurils-Olyutor volcanic-plutonic belt. The belt consists of isolated fields of Miocene subaerial volcanic rocks, mainly of intermediate and mafic composition, and comagmatic granitic intrusions that unconformably overlie and intrude previously-accreted flysch, island arc and ophiolite terranes (Filatova, 1988). These terranes were accreted along the Koryak continental margin by the Miocene. A minimal crustal thickness of 27 to 33 km thick occurs in the region.

EXPLANATION OF TABLES ON SIGNIFICANT LODE DEPOSITS AND PLACER DISTRICTS

Tabular Descriptions for Sizes of Lode Deposits

Size categories for lode mineral deposits, adapted from Guild (1981), are listed below. These size categories define the terms *world class, large, medium, and small.* These size categories are used mainly in Table 3 on lode deposits in the Russian Northeast where specific tonnage and grade data are not yet available. The *small* category may include occurrences of unknown size. Units are metric tons of metal or mineral contained, unless otherwise specified.

Metal	World Class >	Large >	Medium >	< Small
Antimony		50,000	5,000	
Barite ($BaSO_4$)		5,000,000	50,000	
Chromium (Cr_2O_3)		1,000,000	10,000	
Cobalt		20,000	1,000	
Copper	5 million	1,000,000	50,000	
Gold		500	25	
Iron (ore)		100,000,000	5,000,000	
Lead	5 million	1,000,000	50,000	
Magnesium ($MgCO_3$)		10,000,000	100,000	
Manganese (tons of 40% Mn)		10,000,000	100,000	
Mercury (flasks)		500,000	10,000	
Molybdenum	500,000	200,000	5,000	
Nickel	1 million	500,000	25,000	
Niobium-Tantalum (R_2O_5)		100,000	1,000	
Platinum group				
Pyrite (FeS_2)		20,000,000	200,000	
Rare earths (RE_2O_3)		1,000,000	1,000	
Silver		10,000	500	
Tin		100,000	5,000	
Titanium (TiO_2)		10,000,000	1,000,000	

Tungsten	30,000	10,000	500	
Vanadium	30,000	10,000	500	
Zinc	5 million	1,000,000	50,000	

Tabular Descriptions for Significant Lode Deposits

Map Number, Name, Major Metals

Map number refers to a specific deposit in a given region. Lode deposits and placer districts are numbered separately within individual quadrants bounded by integer values of 4° of latitude and 6° of longitude (Sheets 1, 2, 3). The quadrants are numbered from west to east, and are lettered from south to north. A latitude and longitude location is stated for each deposit in degrees and minutes. Names of lode deposits are derived from published sources or common usage. In some cases, two deposits are grouped together and both names are given. In other cases, an alternate name is given in parentheses. Major metals are the known potentially valuable metals reported for each deposit, and are listed in order of decreasing abundance and(or) value, and are shown by standard chemical symbols.

Lode Deposit Type

Type of lode deposit, or lode deposit model is an interpretation that was made by examining the summary of the deposit and then classifying the deposit using the deposit models previously described. The type is queried where insufficient description precludes precise determination. For a few deposits, either the closest two deposit models are listed, or else a short description is given in parentheses.

Summary with References

The summary is a brief description of the major features of the deposit. Where known, the major economic minerals, gangue minerals, and the deposit form are stated. Form of deposit denotes the physical aspect of a deposit, whether, for example, a vein, disseminated mineral grains, or masses of minerals. Form is descriptive, and is distinct from genetic terms such as "contact metasomatic" or "volcanogenic," which imply origin or history. Because lode deposits may be geologically complex, a deposit may contain more than one form, and certain forms may be gradational. Where known, estimates of tonnage and grade are listed, or else the terms small, medium, or large size, and low-, medium-, or high-grade are used. Tonnages are listed in tonnes (metric tons). Grades are stated either in percent (%), for abundant metals, or in grams per tonne (g/t) for scarce and precious metals. In many deposits, the only available information is on the grade(s) of grab samples. The metric system (SI) is used for all volume and weight measurements. If publicly known, the length, width, and depth of the deposit are stated. Additional information on the host rocks and their relation to the deposit are also stated. Information on extent of underground or surface workings and on the period of mining or development is given, if known. Sources of information, stated at the end of each summary, are the references and oral or written communications used to compile the data for each deposit. Unpublished data gathered expressly for this report are indicated by the terms "written communication" or "oral communication."

Tabular Descriptions for Significant Placer Districts

Table headings for deposits in placer districts are described only for headings differing from those for lode deposits. In Alaska, data are compiled for only those important districts with over 31,300 g (1,000 oz) gold production, whereas in the Russian Northeast, data are compiled for only large (major) districts. District refers to the name of a group of geologically and geographically related placer deposits, as derived from published sources or from general usage. In some cases, two or more districts are grouped together and both names are given. In other cases, an alternate name is given in parentheses. Type refers to the placer deposit type as determined by examining the description of the district and then classifying using one of the deposit models described above.

Economic and significant heavy minerals are reported for each district, listed in order of decreasing abundance.

Abbreviations in Tables

Standard chemical symbols: for example, Au, gold; Cu, copper; Fe, iron; U, uranium
PGE: Platinum-group elements--minerals and alloys
REE: Rare-earth elements
mm, cm, m, km: millimeter, centimeter, meter, kilometer
g, kg, t: gram, kilogram, metric ton
g/t, g/m^3: grams per metric ton, grams per cubic meter
tonne: metric ton
%: percent
sq: square

Conversion Factors for Tables

The following conversion factors were used to convert weight and volume from U.S. Customary to metric quantities:

1 cubic yard = 0.765 cubic meter
1 troy ounce per short ton = 34.29 grams per metric ton
1 part per million = 1 gram per metric ton
1 pound = 0.454 kilogram
1 troy ounce = 31.10 grams
1 short ton = 0.907 metric ton
1 flask (76.0 pounds mercury) = 34.7 kilograms

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We thank the many geologists who have worked with us for their valuable expertise in each region of mainland Alaska and the Russian Northeast. We also thank D.L. Mosier and V.I. Berger for their constructive and thorough reviews.

TABLE 1. SIGNIFICANT LODE DEPOSITS OF MAINLAND ALASKA

By
Warren J. Nokleberg[1], Thomas K. Bundtzen[2], Donald Grybeck[1], and Richard D. Koch[1]

[1]U.S. Geological Survey
[2]Alaska Division of Geological and Geophysical Surveys

Site No. Latitude Longitude	Deposit Name (District)	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
N3-1 53 45 166 10	Sedanka (Biorka)	Zn, Pb, Cu (Au, Ag) Polymetallic vein	Average grade of 6.8% Zn, 0.45% Cu, 0.29% Pb, 1.37g/t Au, 48 g/t Ag

SUMMARY: Disseminated sphalerite and pyrite, with minor galena and chalcopyrite along a fault zone striking east-northeast and dipping moderately south. Quartz and ankerite gangue. Fault zone with sulfides at least 1,000 m long, and up to 80 m thick. Hanging wall is Tertiary diorite, footwall is greenstone. **REFERENCES:** Webber and others, 1946.

N4-1 55 57 159 24	Kawisgag (Ivanof)	Cu, Mo, Au Porphyry Cu and (or) polymetallic vein	Grab samples with 0.2 to 1.0% Cu, up to 0.024% Mo, and 0.23 to 0.4 g/t Au. Small tonnage

SUMMARY: Area of intense sericitic and weaker potassic alteration over an area of about 200 by 700 m in nonmarine fluvial volcanic sandstone and conglomerate of the lower Tertiary Tolstoi Formation and black siltstone of the Upper Cretaceous Hoodoo(?) Formation. Minor propylitic alteration on periphery. Sedimentary rocks intruded small stocks and dikes. Alteration overprinted on contact-metamorphic aureoles around stocks. Iron-stained area of about 2.5 km^2. **REFERENCES:** R.F. Robinson, written commun., 1975; Frederic H. Wilson and Robert L. Detterman, written commun., 1985.

N4-2 55 35 161 16	Canoe Bay	Au, Ag (Hg, As, Pb, Zn) Epithermal vein	No data

SUMMARY: Quartz-cemented breccia with gold in altered late Tertiary or Quaternary felsic intrusive and extrusive rocks consisting of rhyolite to rhyodacite porphyry, and vent, explosion, and lithic breccia. Associated crystal tuff, and andesite to dacite dikes. Core of deposit is marked by sericite, pyrite, argillic, and silica alteration grading outward into weak propylitic alteration. Anomalous soil and rock values of Au, Ag, Hg, As, Pb, and Zn. Intrusive rocks intrude shale, sandstone, and conglomerate of the Cretaceous Hoodoo(?) Formation. **REFERENCES:** Gary L. Andersen, written commun., 1984; Frederic H. Wilson, written commun., 1985.

N4-3 55 37 160 41	Pyramid	Cu, Au (Mo) Porphyry Cu	Estimated 110 million tonnes grading 0.4% Cu, 0.03% Mo,and trace of Au

SUMMARY: Disseminated molybdenite and chalcopyrite(?) in iron-stained dacite porphyry stocks and dikes of late Tertiary age. Zonal alteration pattern with core of secondary biotite and about 3 to 10% magnetite, grading outward to envelope of quartz-sericite alteration. Peripheral sericite filled fractures adjacent to stock. Local oxidation and supergene enrichment blanket up to 100 m thick, mainly of chalcocite and covellite. Deposit centered on 3 sq km area within stock. Several smaller stocks nearby. Stocks intrudes fine-grained clastic rocks of the Upper Cretaceous Hoodoo Formation, and Paleocene or Eocene to Oligocene Stepovak(?) or Tolstoi(?)

Formation. Sedimentary rocks contact metamorphosed adjacent to stock. **REFERENCES:** Armstong and others, 1976; Hollister, 1978; Wilson and Cox, 1983; Gary L. Anderson, written commun., 1984; Robert L. Detterman, oral commun., 1986.

N4-4 56 38 160 31	San Diego Bay	Ag, Au, Cu, Pb, Zn Epithermal vein(?)	No data

SUMMARY: Area of propylitic, and local argillic or silicic alteration in middle Tertiary dacite flows, associated with Fe-stained area of 61 km^2. Rock samples from altered area contain 0.5% to 5.0% pyrite. Numerous small quartz veins with anomalous Ag and Au, and minor Cu-, Pb-, and Zn-sulfides. Quartz veins in altered middle Tertiary dacite. Veins and altered area may be upper part of porphyry Cu deposit. **REFERENCES:** Gary L. Andersen, written commun., 1984.

N4-5 55 11 160 40	Aquila	Au, Ag Epithermal vein	Grab samples with up to 7.8 g/t Au, 27 g/t Ag

SUMMARY: Quartz fissure vein system with gold in Tertiary andesite flows and tuffs. Veins extend up to 2,700 m and occur along northeast-striking regional fractures, a few kilometers apart, and parallel to similar fractures that host the Apollo-Sitka deposit. Deposit restricted to small ore shoots occurring at intersections of veins or where veins abruptly change strike. Argillic and silicic alteration generally restricted to narrow envelopes around individual quartz veins. **REFERENCES:** Gary L. Andersen, written commun., 1984.

N4-6 55 12 160 37	Apollo-Sitka	Au, Ag, Pb, Zn, Cu Epithermal vein	Produced about 3.3 million g Au from 435,000 tonnes ore grading 7.7 g/t Au. Estimated 163,000 tonnes remaining. Portions of drill core with up to 7.3 g/t Au, 240 g/t Ag

SUMMARY: Quartz-calcite-orthoclase veins and silicified zones with gold, galena, sphalerite, chalcopyrite, and native copper. Veins and zones occur in intensely developed, northeast-striking fracture systems that extend to at least 420 m below surface. At least eight major vein-fracture systems. Veins range from a few centimeters to 7 m wide. Higher grade parts of deposit occur in tensional flexures in the vein-fracture system. Abundant quartz comb structures and euhedral crystal druses indicate vein formation at shallow depths. Hosted in extensively propylitically altered Tertiary tuff and intermediate volcanic rocks. Main production from 1894 to 1906. About 5,100 m of underground workings. Considerable exploration activity from late 1980's to the present. **REFERENCES:** Martin, 1905, Brown, 1947.

N4-7 55 12 160 35	Shumagin	Au, Ag Epithermal vein	Estimated 540,000 tonnes grading 10.3 g/t Au, 34.3 g/t Ag; includes 256,000 tonnes grading 14.6 g/t Au and 54.9 g/t Ag

SUMMARY: Quartz fissure system with gold hosted in middle Tertiary (Miocene?) andesitic volcanic rocks. Estimated tonnage in area 2,700 m long, 610 m wide, and 120 m deep. Fissure system occurs on same northeast-southwest-trending structure as Aquila deposit. Extensive drilling in 1982 and 1983 and some activity since. **REFERENCES:** Gary L. Anderson, written commun., 1985.

O4-1 59 52 159 54	Kagati Lake	Sb, Hg (Sb-Hg vein)	No data; minor production

SUMMARY: Stibnite, cinnabar, and quartz veinlets along joint surfaces in a stock of Late Cretaceous monzonite and granodiorite. The zone of veinlets strikes northwest-southeast, is from 10 to 600 cm thick, and is traceable for

15 m. The stock intrudes Lower Cretaceous volcaniclastic rocks of the Gemuk Group. Workings consist of several trenches and a few pits. Sporadic development from 1927 through 1981. **REFERENCES:** Sainsbury and MacKevett, 1965.

O4-2 59 44 157 45	Kemuk Mountain	Fe, Ti, PGE Zoned mafic-ultramafic	Estimated 2,200 million tonnes grading 15 to 17 % Fe, and 2 to 3 % TiO_2

SUMMARY: Buried titaniferous magnetite deposit in crudely zoned pyroxenite, interpreted as part of zoned "Alaskan-type" ultramafic pluton. Steeply-dipping, high-temperature contact metamorphic zone with adjacent Permian quartzite and limestone. Aeromagnetic survey indicates pluton about 1,500 m thick and underlies about 6 sq km area. **REFERENCES:** Humble Oil and Refining Company, written commun., 1958; Eberlein and others, 1977; Charles C. Hawley, written commun., 1980.

O4-3 57 12 157 00	Rex	Cu, Au Porphyry Cu	No data

SUMMARY: Stockwork of chalcopyrite, pyrite, and molybdenite in disseminations and coatings on joint surfaces in series of intensely fractured, small hypabyssal andesite stocks. Hematite zones in brecciated hornfels in contact metamorphic aureoles. Stock about 3 sq km in area. Stocks intrudes the lower Tertiary Tolstoi Formation and overlying volcanic rocks of the Meshik Formation. K-Ar ages of stocks and hydrothermal alteration range from 34 to 39 Ma. Drilling in 1977. **REFERENCES:** Thomas K. Bundtzen, written commun., 1984; Frederic H. Wilson, written commun., 1985.

O4-4 57 11 156 24	Kilokak Creek	Pb, Zn Polymetallic vein(?)	No data

SUMMARY: Zone of alteration and sparse veins with anomalous Pb and Zn values in black siltstone of the Upper Cretaceous Hoodoo Formation, and shallow-water to nonmarine sandstone, shale, and conglomerate of the Chignik Formation, and in Eocene(?) volcanic and hornblende andesite plug. Little alteration of andesite plug; extensive disseminated pyrite in country rock surrounding plug. Zone of alteration and sparse veins on periphery of, but predates, the Pliocene Agripina Bay (granodiorite) batholith. **REFERENCES:** Frederic H. Wilson, written commun., 1985.

O4-5 57 03 157 13	Mike	Mo (Au, Ag, Pb, Zn) Porphyry Mo	No data

SUMMARY: Area of intense silicic alteration, and weak propylitic and potassic alteration, with disseminated molybdenite, pyrite, and chalcopyrite on joint surfaces with local pyrite zones. Alteration and mineralization occur in fractured Pliocene dacite and rhyodacite stock intruding sandstone, conglomerate, and siltstone of the Jurassic Naknek Formation. Samples with anomalous Au, Ag, and Mo from center of altered zone, and with anomalous Pb and Zn on periphery of altered zone. K-Ar age of 3.65 Ma for stock. Drilling in 1977. **REFERENCES:** Frederic H. Wilson and Dennis P. Cox, written commun., 1985; Robert L. Detterman, oral commun., 1986.

O4-6 56 30 158 44	Cathedral Creek, Braided Creek	Cu, As, Zn, Pb Polymetallic vein	No data

SUMMARY: Quartz, arsenopyrite, sphalerite, chalcopyrite, and galena in veins adjacent to various late Tertiary stocks of pyroxene andesite, hornblende andesite, and biotite dacite. Textures and field relations indicate shallow emplacement of stocks. Minor chalcopyrite and pyrite in zones of sericitic alteration of stocks and adjacent sedimentary rocks. Stocks intruded into the Chignik, Hoodoo, Tolstoi, and Meshik Formations. Stock at Cathedral, at Bee Creek (AP12, below), and others in area aligned along 65 km east-west-trending lineament that ends at Black Peak, a Holocene volcanic center. **REFERENCES:** R.F. Robinson, written commun., 1975; Cox and others, 1981; Wilson and Cox, 1983; Frederic H. Wilson, written commun., 1985.

O4-7 56 14 158 30	Mallard Duck Bay	Cu, Mo Porphyry Cu-Mo and(or) polymetallic vein(?)	No data

SUMMARY: Pyrite, chalcopyrite, and molybdenite veinlets in swarms concentrated along intersections of joint systems in Oligocene andesite flows, breccias, and lahars. Cut by numerous diorite dikes. Intense sericitic alteration over several square kilometers with weak propylitic alteration to northwest. **REFERENCES:** Wilson and Cox, 1983.

O4-8 56 31 158 24	Bee Creek	Cu, Au Porphyry Cu	Grab samples contain up to 0.25% Cu, 0.01% Mo, 0.06 g/t Au. Estimated 4.5 to 9.1 million tonnes grading 0.25% Cu, 0.01% Mo, and trace Au

SUMMARY: Disseminated chalcopyrite in arkosic sandstone near late Tertiary hypabyssal dacite stock. Zonal alteration pattern with a potassic-altered core, and a propylitically altered periphery. Sericite alteration superposed on both core and periphery. Altered part of dacite stock about 3 sq km in area. Stock intruded into the Upper Jurassic Naknek Formation. **REFERENCES:** E.D. Fields, written commun., 1977; Cox and others, 1981; Wilson and Cox, 1983; Robert L. Detterman, oral commun., 1986.

O4-9 56 10 158 20	Warner Bay (Prospect Bay)	Cu, Mo, Pb, Zn Porphyry Cu, Polymetallic vein	Average grade of 0.3% Cu, unknown Mo grade

SUMMARY: Disseminated molybdenite and chalcopyrite along joint surfaces in closely jointed granodiorite. Galena and sphalerite in veins parallel to main set of joints, or in distinct hematite-rich breccia zones. Occurs in several square kilometer area in the late Tertiary Devils batholith which ranges from quartz diorite to granodiorite. Little to no sericite or argillic alteration. Diatreme or breccia pipe at north end of deposit contains clasts of propylitically altered granodiorite cemented by galena, sphalerite, pyrite, calcite, and zeolites. **REFERENCES:** Atwood, 1911; Wilson and Cox, 1983; Thomas K. Bundtzen, written commun., 1984.

O5-1 59 53 155 24	Pebble Copper (Iliamna)	Au, Cu, Mo Porphyry Au-Cu	Inferred reserves 500 million tonnes of 0.35% Cu, 0.4 g/tonne Au, 0.015% Mo

SUMMARY: Disseminated chalcopyrite, pyrite, and molybdenum, accompanied by minor to trace galena, sphalerite, and arsenopyrite in stockwork vein system. Mineralization hosted in early Tertiary granodiorite porphyry and adjacent hornfels aureole. Granodiorite is part of larger composite 40 square km volcanic-plutonic complex that includes pyroxenite, alkali gabbro, quartz monzonite, and dacite volcanic overlyers. Chemically, volcanic and plutonic rocks plot in alkali-calcic and quartz alkali fields. Sulfides were introduced during late stage intense hydrofracture episode that was preceded by potassic, silicic, and sericitic alteration events. Tourmaline breccias locally present. Two K-Ar ages on hydrothermal sericite and igneous K-Spar are 90 and 97 Ma respectively. **REFERENCES:** Phil St. George, and T.K. Bundtzen, written commun., 1991; Bruce Bouley, oral commun., 1992.

O5-2 59 31 154 23	Fog Lake (Pond)	Au, Cu, Ag Epithermal vein	Grab samples with up to 37 g/t Au, 5 g/t Ag, >0.5% Cu

SUMMARY: Zone with swarms of pyrite- and chalcopyrite-bearing veinlets that cut altered quartz porphyry that intrudes Tertiary dacite tuffs, lahars, and breccias. Zone about 550 by 305 m. Veinlets are best developed at intersections of northwest-, northeast-, and east-northeast-trending structures. Envelopes of argillic alteration about 7 cm wide adjacent to veinlets. Outer, weaker propylitic alteration. To the northwest, mineralization grades into sphalerite and minor galena with anomalous Ag and Au. Quartz porphyry altered to sericite and pyrite; propylitic alteration in adjacent volcanic rocks. Dacite tuffs, lahars, and breccia, and associated agglomerate and conglomerate unconformably overlie Late Cretaceous to Paleocene(?) quartz diorite to granodiorite pluton. Andesite to dacite dikes crosscut volcanic rocks. **REFERENCES:** Reed, 1967; Gary L. Andersen, written commun., 1984.

O5-3 60 14 152 51	Magnetite Island (Tuxedni Bay)	Fe, Ti Fe skarn	Up to several thousand tonnes in zones with 20 to 75% magnetite

SUMMARY: Two magnetite-bearing skarn bodies replace upper Paleozoic to lower Mesozoic marble. Skarn bodies occur along northeast-striking faults in Upper Triassic marble and associated sedimentary and volcanic rocks adjacent to Jurassic quartz diorite pluton. Disseminated magnetite in hornfels of eastern deposit. Massive magnetite and garnet between marble hanging wall and hornfels footwall in western deposit. **REFERENCES:** Grantz, 1956; Detterman and Hartsock, 1966.

O5-4 59 16 154 38	Kuy	Au, Ag, Cu Epithermal vein	No data

SUMMARY: Quartz veins and quartz-vein breccia with gold-silver tellurides and chalcopyrite. Veins occur in gash fractures that strike west-northwest and dip steeply southeast. Fracture zone about 300 m wide and 900 m long. Veins exposed for about 90 m along strike. Abundant vugs and comb quartz. Quartz bodies form flattened rods that plunge steeply southeast. Veins and fracture system occur in dacite tuff-breccia that is the upper part of a dissected Tertiary summit caldera. Fracture zone exhibits intense argillite and pyrite alteration; silicic alteration occurs in narrow envelope surrounding quartz veins. Basement is Mesozoic(?) sedimentary rocks. **REFERENCES:** Gary L. Andersen, written commun., 1984.

O5-5 59 08 154 40	Crevice Creek (McNeil)	Au, Cu (Ag, Fe) Cu-Au skarn	Produced 11 tonnes from high-grade zones, with 4.5 g/t Au, 514 g/t Ag, and 17.5% Cu

SUMMARY: At least ten epidote-garnet skarn bodies occur in limestone over a 2 km^2 area adjacent to southwest part of the Jurassic(?) granodiorite stock of Pilot Knob. Skarn bodies 3 to 800 m long and a few centimeters to 60 m wide. Magnetite-rich skarn in isolated pods in nearby metavolcanic rocks. Skarn bodies developed in limestone, chert, and argillite of the Upper Triassic Kamishak Formation and in overlying metavolcanic rocks of the Jurassic Talkeetna Formation. Local disseminated magnetite zones in epidote-garnet skarns. Largest skarn body at Sargent Creek contains epidote, garnet, actinolite, quartz, pyrite, and chalcopyrite. Lenses up to 1 m wide and 10 m long average 7% Cu. Numerous magnetic anomalies in area surrounding granodiorite stock. **REFERENCES:** Martin and Katz, 1912; Richter and Herreid, 1965.

O5-6 59 33 150 35	Nuka Bay District (Nualaska, Lost Creek, Alaska Hills)	Au Au-quartz vein	Produced about 258,000 g Au; channel samples contain from 1 to 300 g/t Au

SUMMARY: Quartz veins up to 1.0 m wide and 100 m long with sparse gold, arsenopyrite, pyrite, chalcopyrite, and galena. Veins of irregular shape with local pinching and swelling generally strike east-west, normal to regional structure. Veins mainly fissure fillings in metagraywacke and to lesser extent in phyllite of the Upper Cretaceous Valdez Group. Veins probably fill tensional cross joints formed during late stages of regional folding of host rocks. Sparse Tertiary quartz diorite dikes are cut by quartz veins. Several mines and prospects. Explored and developed from about 1909 to 1940. About 1,300 m underground workings. Minor subsequent mining activity. **REFERENCES:** Richter, 1970.

O5-7 59 22 151 30	Red Mountain	Cr Podiform Cr	Two largest deposits are estimated to contain 87,000 tonnes of about 25 to 43% Cr_2O_3. One additional low-grade deposit with 1.13 million tonnes Cr_2O_3

SUMMARY: Layers and lenses of chromite concentrated in several areas several hundred meters long and 60 m wide in dunite tectonite. Largest chromite layer about 190 m long and up to 1.5 m wide. More than 10 smaller ore bodies. Occurs in Early Jurassic or older dunite tectonite interlayered with subordinate pyroxenite in zones about 60 m thick. Locally abundant serpentinite, especially at contacts of bodies. Ultramafic rocks part of the Early Jurassic or older, informally named, Border Ranges ultramafic and mafic complex of Burns (1985); faulted at base. Sporadic exploration and development from about 1919 to present. Several hundred meters of underground workings and trenches. About 26,000 tonnes of ore, ranging from 38 to 42% Cr_2O_3, produced from 1943 to 1957. Nearby Windy River chromite placer deposit in glaciofluvial sand and gravel deposits downstream from Red Mountain, is estimated to contain 15.6 million m^3 with 1.33% Cr_2O_3. **REFERENCES:** Guild, 1942; Bundtzen, 1983b; Burns, 1985; Foley and Barker, 1985; Foley and others, 1985.

O5-8 59 12 151 49	Claim Point	Cr Podiform Cr	Estimated 82,000 tonnes Cr_2O_3. Produced about 2,000 tonnes of chromite

SUMMARY: Layers and lenses of chromite up to 60 m long and 14 m wide, over area of about 500 by 500 m, in dunite tectonite. About 14 separate deposits occur in Early Jurassic or older layered dunite tectonite. Few olivine-pyroxene dikes; locally abundant serpentinite. Ultramafic rocks part of Early Jurassic or older, informally named Border Ranges ultramafic and mafic complex of Burns (1985). Faulted at base. Explored and developed from about 1909 to 1919. Mining from 1917 to 1918. Several hundred meters of underground workings and trenches. Sporadic exploration since; most recently in mid-1980's. **REFERENCES:** Guild, 1942; Burns, 1985; Foley and Barker, 1985.

O5-9 57 48 152 20	Chalet Mountain (Cornelius Creek)	W, Au, Ag Au quartz vein	Grab samples with up to 1.75% WO_3, 9.6 g/t Au, 120g/t Ag

SUMMARY: Silicified zones and quartz veins with disseminated scheelite and gold(?) occur within a 100 by 500 m area of silicified metagraywacke of the Upper Cretaceous Kodiak Formation at Chalet Mountain, and in nearby granodiorite pluton at Anton Larsen Bay. Scheelite concentrated in silicified zones localized in calcareous-rich part of metagraywacke. **REFERENCES:** Seitz, 1963; Rose and Richter, 1967.

O5-10 57 22 154 36	Halibut Bay	Cr Podiform Cr	Eight low-grade deposits with estimated 180,000 tonnes Cr_2O_3.

SUMMARY: Scattered small layers and lenses of chromite in dunite and subordinate clinopyroxenite tectonite in areas up to 300 m long and about 100 m wide. Ultramafic rocks part of the Early Jurassic or older, informally named Border Ranges ultramafic and mafic complex of Burns (1985), faulted at base. **REFERENCES:** Foley and Barker, 1984; Burns, 1985.

P4-1 63 16 159 16	McLeod	Mo Porphyry Mo	Extensive chip samples grade 0.09% MoS_2 over a 350 by 30 m surface area

SUMMARY: Platy aggregates of molybdenite in quartz veinlets in sericite core of altered Late Cretaceous to early Tertiary quartz-feldspar (granite) porphyry stock. Deposit underlain by 3-square-kilometer granite stock and associated with biotite latite dikes that intrude mid-Cretaceous graywackes. High-grade quartz-molybdenite veins up to 15 cm thick associated with nearby latite dikes in sedimentary host rocks. Pyrite-pyrrhotite-chlorite veinlets, locally comprise up to 10 percent by volume of contact metamorphosed country rock. Quartz-feldspar porphyry, and to lesser extent, biotite latite dikes exhibit intense silicic, phyllic, and hydrothermal alteration in a 300 by 1,100 m area of southern and western part of stock. Low-grade stockwork molybdenite occurs in northern part of biotite latite dike system over a 30 by 350 m area. **REFERENCES:** Mertie, 1937a, b; West, 1954; Jason Bressler, written commun., 1979; Harold Noyes, written commun., 1984.

P4-2 63 14 156 55	Mount Hurst	Cr, PGE Podiform Cr	Grab samples contain 22.0 to 61.2% Cr_2O_3

SUMMARY: Masses and bands of chromite in dunite layers in wehrlite tectonite. Largest of 16 chromite bands strikes north-south; pinches and swells from 10 to 800 cm over strike length of 10 m. Within bands, chromite varies from 30% to 80% by volume. Deposit truncated on north by fault. Cr:Fe ratios in six samples average 1.0. Probable source of Pt placer on Boob Creek 10 km to north. Dunite and wehrlite tectonite faulted at base; interpreted as part of intensely deformed and dismembered ophiolite occurring in klippe. **REFERENCES:** Chapman and others, 1982; Loney and Himmelberg, 1984; Roberts, 1984.

P4-3 63 13 156 04	Win-Won or Cloudy Mountain (Innoko)	Sn, Ag, Cu Sn polymetallic vein	Grab samples with up to 2% Sn and 1,720 g/t Ag

SUMMARY: Chalcopyrite, tetrahedrite, and cassiterite in en echelon quartz veinlet stockwork. Hosted in hornfels on northeast margin of Cretaceous(?) Cloudy Mountains volcanic field and related monzonite complex. About 4 veinlets per meter over a 100-m-wide area. **REFERENCES:** Thomas K. Bundtzen, written commun., 1984.

P4-4 62 53 156 59	Cirque, Tolstoi (Innoko)	Cu, Ag, Sn (W, Nb) Polymetallic vein and porphyry Cu	Grab samples with up to 20% Cu, 1,340 g/t Ag, 0.5% Sn; locally to 0.1% Nb

SUMMARY: Chalcopyrite, tetrahedrite, pyrite, arsenopyrite, and scheelite associated with tourmaline, axinite, and quartz occurring in (structurally) high-level, tourmaline greisen. Greisen usually along faults, or in tourmaline breccia pipes in cupolas of the Late Cretaceous Beaver Mountains (monzonite) stock. Monzonite capped by altered olivine basalt and andesite tuff. **REFERENCES:** Bundtzen and Laird, 1982.

P4-5 62 57 156 59	Independence (Innoko)	Au Sb-Au vein	Produced 1,770 g gold from 113 tonnes ore grading 16g/t Au (in 1912)

SUMMARY: Quartz-fissure fillings with gold, pyrite, and arsenopyrite in altered Cretaceous dacite to rhyolite dike. Dike may be part of Yankee Creek dike swarms that intrude clastic rocks of the Cretaceous Kuskokwim Group along trend 60-km-long by 3-km-wide. Several hundred meters of underground workings. **REFERENCES:** Bundtzen and Laird, 1983a.

P4-6 62 51 155 48	Candle (Innoko)	Cu, Pb, Ag Polymetallic vein or porphyry Cu?	Grab samples averaging 280 g/t Cu, 185 g/t Pb, 6.8 g/t Ag

SUMMARY: Cinnabar, arsenopyrite, and quartz in stockworks in altered, sericite, late Cretaceous monzonite near intrusive contact with overlying altered olivine basalt. Local quartz-chalcopyrite disseminations in the pluton. Recent exploration indicates low grade auriferous quartz vein stockwork in monzonite near faulted contact with basalt. Zone up to 200 m wide and 700 m long. Central part of basalt field contains 300 by 500 m zone of disseminated sulfides. Monzonite in creek valley is weakly mineralized with gold and mercury within stockwork quartz veinlets. **REFERENCES:** Bundtzen and Laird, 1983a, b; Thomas K. Bundtzen, written commun., 1984, 1990.

P4-7 62 31 157 55	Golden Horn, Minnie Gulch, Malemute, Iditarod (Flat District) (Iditarod-Flat)	Au, Ag, Sb, Hg, W Polymetallic vein or Sb-Au vein	Golden Horn: produced 479 tonnes grading 174 g/t Au, 171 g/t Ag, up to 20% WO_3. Estimated resource of about 3.15 million tonnes grading 1.3 g/tonne Au, 2.0 % As and 30 g/tonne Ag

SUMMARY: Golden Horn: Quartz-tourmaline-calcite veins of stibnite, cinnabar, scheelite, sphalerite, Pb-Sb sulfosalts, and chalcopyrite. Stibnite and cinnabar crosscut arsenopyrite, scheelite, and silver sulfosalt mineralization. Veins occur in irregularly distributed quartz-filled shear zones in the Late Cretaceous Otter Creek pluton (monzonite), or near intrusive contacts. Vein system from 3 to 30 m wide and at least 1 km in length; occurs along 3-km-long fault zone on eastern side of pluton. Pluton intrudes graywacke and shale of Cretaceous Kuskokwim Group. Malemute and Granite: Cinnabar, arsenopyrite, pyrite, and gold in quartz-calcite zones that strike north-south to northeast occur in altered basalt west of Otter Creek pluton. **REFERENCES:** Bundtzen and Gilbert, 1983; Bundtzen and Laird, 1983a; Bundtzen and others, 1985, 1988, 1992a; Bull, 1988.

P4-8 62 37 157 10	Broken Shovel, Iditarod (Iditarod-Flat)	Ag, Pb, Sb Polymetallic vein	Estimated 14,000 tonnes with 178 g/t Ag, 0.15% Pb, 0.15% Sb

SUMMARY: Tourmaline, tetrahedrite, arsenopyrite, and undetermined sulfosalts in quartz veins in central part of the Cretaceous Moose Creek pluton (monzonite). Veins, 1 to 3 m wide, occur in altered area marked by sericite and tourmaline about 300 by 400 m in size. **REFERENCES:** Bundtzen and Gilbert, 1983; Bundtzen and Laird, 1983a, 1988; Bundtzen and others, 1985.

P4-9 62 30 158 00	Chicken Mountain (Flat District) (Iditarod)	Au, As, Hg, Sb, Cu, Mo Granitoid-related gold-silver-(copper)	Estimated resource of about 14.5 million tonnes grading 1.2 g/tonne Au, 0.09 % Cu, 0.46% Sb

SUMMARY: Deposit contains quartz-sulfide veinlets containing a wide variety of ore minerals including free gold, stibnite, cinnabar, arsenopyrite, chalcopyrite molybdenite, silver sulfosalts, and arsenian pyrite. Quartz veins contain (5% total) sulfides. All mineralization hosted in cupola zones of altered monzonite and syenite of Chicken Mountain stock. Earlier monzodiorite, alkali gabbro, and wehrlite phases also present. Pervasive sericite and ankerite alteration halos present. Dolomite breccia phase synchronous with major sulfide phase. Surface extent of mineralization occupies a 300 by 800 meter area; drilling indicates at least 250 meters of vertical extent. Drill results and mapping indicates a vertical temperature zonation is present with epithermal gold-mercury-antimony zones crosscutting older mesothermal gold-copper-molybdenum and arsenic-copper events. Pluton and mineralization yield coeval K-Ar ages of 70 Ma. **REFERENCES:** Bundtzen and others, 1988; 1992a; Bull, 1988; Jason Bressler, written commun., 1980; Richard Gosse, written commun., 1990.

P4-10 62 15 158 30	DeCourcey Mountain (Crooked Creek)	Hg, Sb, As Hot-spring Hg	Produced 1,200 flasks Hg. Grab samples contain up to 6.5% Hg

SUMMARY: Cinnabar, minor stibnite, and traces of arsenopyrite in silica-carbonate dikes that cut sandstone and shale of Cretaceous Kuskokwim Group, and olivine basalt dated at 76 Ma. Sulfides occur usually in irregular breccia zones, or as replacement along intrusive contact. Individual ore bodies, from 0.2 to 2.0 m thick in zone 600 by 100 m in area with vertical relief of 20 m. Individual sulfide bodies rarely more than 20 m long, with common pinching and swelling. The silica dikes consist largely of quartz, carbonate, and clay minerals and probably represent altered basalt dikes. **REFERENCES:** Cady and others, 1955; Sainsbury and MacKevett, 1965; Thomas K. Bundtzen and Marti L. Miller, written commun., 1985.

P4-11 62 13 158 15	Snow Gulch-Donlin (Aniak)	Sb, Au, As, Hg Sb-Au vein	Inferred resources of about 3 million tonnes of 3 g/tonne Au in several deposits

SUMMARY: Stibnite, arsenopyrite, and complex arsenic sulfosalts and minor to trace cinnabar and free gold as blades, crystals and disseminations in quartz veins and shear zones associated with 4 km long sheeted dike and sill complex. At least three ages of dikes have been identified; dikes range in composition from quartz monzonite to alaskite to granite porphyry. One granite porphyry dike yields K-Ar age of 65 Ma. Mineralization usually occurs at contacts between dikes and mid-Cretaceous Kuskokwim Group flysch, but locally extensive auriferous zones up to 20 meters wide found permeating clastics and hornfels. Considerable gold found in lattice structures of arsenic minerals. **REFERENCES:** T.K. Bundtzen and M.L. Miller, written commun., 1988; Bruce Hickok and Robert Rutherford, written commun., 1990.

P4-12 61 46 158 32	Mission Creek, Headwall, Louise, and Owhat Prospect (Aniak)	Au, Ag, Cu, As (Sb, Bi, Co, W, Sn, U) Polymetallic vein	Inferred reserve of 225,000 tonnes grading 4.0g/tone Au,9.5% As, 0.61% Cu, 0.01% Sn, 0.2% Sb, and 0.02% Co

SUMMARY: Sheet-like greisen veins with tourmaline, tetrahedrite, chalcopyrite, arsenopyrite, cassiterite, metazeunerite, scheelite, and axinite. Zones of en-echelon vein-greisens all trend N20-25W and dip steeply or vertically. Zones occur about 3 km along strike and are about 1 km wide. Gold occurs as both free milling grains in gangue and in lattice structures of arsenopyrite. Bismuth sulfosalts bismuthinite, aramayoite, pekoite, and gladite locally in abundant. Veins occur in zones in cupola of Late Cretaceous porphyritic quartz syenite stock. Zones up to 20 m wide. About 300 m of drifts at Mission Creek. Local numerous euhedral gangue minerals. Louise deposit contains up to 1.50% Sn. **REFERENCES:** Bundtzen and Laird, 1991.

P4-13 61 45 157 23	Red Devil	Hg, Sb Clastic sediment-hosted Hg	Produced 34,745 flasks from 68,000 tonnes through 1963. Produced 4,000 flasks, 1970 to 1972. Average grade of 1.5% Hg and 2% Sb

SUMMARY: Cinnabar and stibnite in about 20 plunging chimney-like ore bodies located along intersections of north-northwest trending silica-carbonate dikes and bedding plane faults in graywacke and shale of the Cretaceous Kuskokwim group . Ore bodies are crudely prismatic and range from a few centimeters to about 0.4 m in thickness and from 0.1 to 10 m in strike length. Ore bodies plunge along and near intersections between northeast-southwest-trending altered dikes and northwest-southeast-trending faults. Vertical zonation in deposit with pure cinnabar at surface, and increasing stibnite to cinnabar ratios at depth. At 200 m below surface, mainly stibnite and quartz with trace cinnabar. Largest and best exposed of 15 deposits in Kuskokwim mercury belt. Produced about 80 percent of Alaska mercury from 1942 to 1974. Silica-carbonate dikes composed of fine-grained calcite, chalcedony, limonite, and sericite, and subordinate quartz, hematite, and clay minerals. Relict phenocrysts replaced by calcite. Relict diabasic textures in Parks and Willis deposits to northwest. Silica-carbonate veins are interpreted as altered basalt dikes that intrude graywackes and argillite of the Cretaceous Kuskokwim Group. Approximately 3,000 m of underground workings on five levels as of 1963. **REFERENCES:** Herreid, 1962; MacKevett and Berg, 1963; H.R.

Beckwith, written commun., 1965; Thomas K. Bundtzen, written commun., 1985; Miller and others, 1989; Goldfarb and others, 1990.

P4-14 62 20 00 161 29 15	Wolf Mountain	U, Th, As, Nb, Mo, REE (Hg) Felsic plutonic U	150 meter wide zone at Little Lockwood Creek is 180 ppm U, 130 ppm Th, 290 ppm As, 0.02 % Mo, 175 ppm Nb, about 0.10 % REE, and 0.01% Hg

SUMMARY: A circular field of andesite, dacite, and pyroclastic tuff has collapsed on an underlying composite pluton composed of granite, alaskite, and adamellite; radiometrically dated (K-Ar) at 57 Ma. This caldera complex intrudes and overlies oceanic stratigraphy of the Koyukuk terrane. Extensive ferricrete gossan and ferricrete breccias occur, mainly within high level portions of the Wolf Creek stock at 1) structurally controlled (fault) zones on Little Lockwood Creek, 2) northeast-trending fractures(?) on Tom Gray Creek, and 3) disseminated near pluton-volcanic contacts throughout the caldera complex. The only sulfides recognized in the field are arsenopyrite and cinnabar. Monazite and bastinite were also recognized. Metallogeny similar to that described in Sischu Volcanic field in northeast Medfra quadrangle (Sischu Creek deposit, WC21). **REFERENCES:** T.K. Bundtzen, written commun., 1992, Bruce Hickok and T. Turner, written commun., 1987, 1989.

P4-15 61 52 161 58	Arnold Prospect (Marshall)	Au,Ag (W,Cu,Mo) Au quartz vein or Granitoid-related Au	Grab samples contain up to 97 g/tonne and 100 g/tonne Ag

SUMMARY: An east-west to N70W trending quartz sulfide-poor vein system with free gold in quartz and carbonate gangue. Sulfides, which comprise less than 1% of the deposit, consist of disseminated chalcopyrite, molybdenite, galena, and tetrahedrite in or near sheared alaskite sills in lower(?) Cretaceous greenstone belt composed of tholeiite metabasalts and meta-andesite. Ore zone extends along strike for least 400 meters and ranges from 0.5 to 2m thick. Carbonate alteration is abundant adjacent to the main mineralized structure. Molybdenum anomalies readily apparent in soil geochemistry, and average about 80 ppm Mo in veins. Origin of deposit is either from deep crustal fluids (like Treadwell deposit, southeastern Alaska) or alternately, it evolved from late stage hydrothermal fluid from granitic hosted (alaskite) sources. **REFERENCES:** T.K. Bundtzen, written commun., 1991.

P4-16 61 07 158 15	Fortyseven Creek	Au, W Polymetallic vein(?)	Grab samples with up to 17.2 g/t Au

SUMMARY: Pyrite, arsenopyrite, gold, wolframite, jamesonite, Au-Ag tellurides, and scheelite in numerous, discontinuous quartz veins and pods in mineralized zone about 1.6 km long and 153 to 256 m wide. Veins trend northeast and dip from 50° west to 70° east. Several stockwork zones. Mineralized zone locally sheared and intruded by altered rhyolite dikes. K-Ar age of 57 Ma for white mica in veins. Subsurface drilling shows zone in lithic sandstone about 300 m wide by 4,000 m long, east of Holitna fault. Veins occur in contact metamorphosed siltstone and sandstone of the Kuskokwim Group. **REFERENCES:** Cady and others, 1955; Thomas E. Smith, written commun., 1985.

P4-17 60 52 157 40	Taylor Mountains	Hg, Au (As, Ag) Epithermal vein(?)	No data

SUMMARY: Disseminated arsenopyrite, cinnabar, pyrite, and minor gold in Late Cretaceous rhyolite over an area at least 200 by 300 m. Sparse sulfide concentrations in quartz-tourmaline veinlets in rhyolite. Sparse massive pyrite along contacts between lithic sandstone and rhyolite. Pyrite, cinnabar, and stibnite in nearby placer deposits in Taylor Creek. **REFERENCES:** Cady and others, 1955; Thomas K. Bundtzen, written commun., 1984.

P4-18	Cinnabar Creek	Sb, Hg	Produced about 525 flasks of Hg
60 46			from selected high-grade ore
158 46		Hot-spring Hg	

SUMMARY: Stibnite and cinnabar in shear zones, disseminations, irregular veinlets, and breccias in or near silica-carbonate dikes interpreted as hydrothermally altered basalt dikes. Dikes intrude argillite and other clastic rocks of the late Paleozoic to Cretaceous Gemuk Group. Most sulfides in altered sedimentary rocks. Deposit includes Cinnabar Creek shear zone, Lucky Day, and Landau areas. Ore chutes at Cinnabar exceed 40 m long and 0.5 m wide. Several periods of small-scale mining; the last in the early 1970's from surface trenches. **REFERENCES:** Cady and others, 1955; Sainsbury and MacKevett, 1965.

P5-1	Nixon Fork-Medfra	Au, Cu, Ag, Bi, Sn, W, Th	Produced about 1.24 to 1.87 million
63 14	(Nixon Fork)		g Au, and undisclosed Cu and Ag.
154 47		Cu-Au skarn	Estimated reserves of 258,000
			tonnes grading 42.0 g/tonne gold
			with minor Cu and Bi

SUMMARY: Chalcopyrite, pyrite, bornite, and native bismuth occur as irregular replacement bodies in skarns in recrystallized Ordovician limestone of the Telsitna Formation. Gangue minerals include diopside, garnet, plagioclase, epidote, and apatite. Oxidized actinolite skarn with limonite, quartz, malachite, pyrite, and gold. Skarns mainly in fractures up to 1 to 4 m wide and 50 m long, usually within 40 m of intrusive contact with Late Cretaceous monzonite. A few skarns in roof pendants overlying pluton. The monzonite pluton about 10 square km near the Nixon-Iditarod fault. Additional smaller skarn veinlets in fault controlled areas away from main skarn bodies. Extensive sericitic alteration locally. Most of ore from zone of secondary enrichment that formed during alteration of primary skarn by groundwater. Lower grade sulfide-rich ore at depths greater than 60 m. About 1,300 m of underground workings to depth of 170 m. Includes Crystal, Garnet, High Grade, Main, Mespelt, Recreation, and Whalen deposits. **REFERENCES:** Martin, 1921; Brown, 1926; Jasper, 1961; Herreid, 1966; Bundtzen and Gilbert, 1983b; C. Puchner, written commun., 1991.

P5-2	Reef Ridge	Zn, Pb	Grab samples with up to 20% Zn,
63 29			5% Pb, minor Ag. Estimated to
154 10		(Carbonate-hosted sulfide)	contain about 181,000 tonnes of
			15% combined Zn and Pb

SUMMARY: Stringers of brown sphalerite and minor galena in hydrothermal breccia in carbonate rocks of the Silurian and Devonian Whirlwind Creek Formation. Minimum strike length of 2,000 m and up to 15 m thick. Sulfides pinch and swell along strike. Best known of ten similar nearby occurrences. Deposit similar to Mississippi Valley-type Pb-Zn deposit of Cox and Singer (1986). **REFERENCES:** Harold Noyes, written commun., 1984.

P5-3	Medfra (Nixon Fork)	Fe, Cu, Zn, Au	Estimated 12,000 cubic meters
63 40			grading 85% Fe_2O_3, with traces of
154 04		Fe skarn	Cu, Au

SUMMARY: Magnetite, very minor chalcopyrite, and sphalerite in epidote and garnet skarn. Irregular, elliptically-shaped skarn body in Ordovician dolomitized limestone of the lower Paleozoic Telsitna Formation adjacent to Late Cretaceous granite stock. Computer modeling of magnetic survey suggests 40,000 to 50,000 tonnes of magnetite. **REFERENCES:** Patton and others, 1980, 1984.

P5-4	Sischu Creek	U, Th	Grab samples with 0.002 to 0.007%
63 58			U and 0.011 to 0.013% Th
153 17		Felsic plutonic U	

SUMMARY: Strongly radioactive U- and Th-rich Late Cretaceous and early Tertiary porphyritic sanidine rhyolite and quartz porphyry flows in two belts, each about 1.5 to 3 km wide, 6 km long. Rhyolite flows exhibit 400 to 600 cps on hand-held scintillometer. Associated rocks include mafic and intermediate volcanic piles, volcanic-plutonic complexes, silicic dikes, sills, domes, and flows, and numerous granitic stocks and plugs of 60 to 70 m.y old (K-Ar). **REFERENCES:** Miller and others, 1980; Patton and Moll, 1983.

P5-5 63 45 150 25	Stampede (Kantishna)	Sb Sb-Au vein	Estimated 410,000 tonnes with 10.5% Sb, minor Ag, Zn, and Au. Produced 1,570 tonnes ore

SUMMARY: Quartz-carbonate fissure veins with stibnite, and minor pyrite and sphalerite in pods and kidneys. Massive stibnite zones up to 5 m wide. Extensive vein system localized in a 5 km long, northeast-trending fault system. Veins formed before, during, and after several periods of movement on fault. Paragenetic sequence, from older to younger: pyrite, sphalerite, and stibnite. Fault system cuts the Spruce Creek sequence which is composed of middle Paleozoic or older metasedimentary and metavolcanic rocks. Production from 1937 to 1970. About 1,000 m of underground workings on two levels. **REFERENCES:** Barker, 1963a; Bundtzen, 1981, 1983a; Thomas K. Bundtzen, written commun., 1984.

P5-6 63 35 151 35	Spruce Creek (Kantishna)	Au, Ag, Pb, Zn, Sb Polymetallic vein	Estimated 77,000 tonnes with 2.4 g/t Au, 276 g/t Ag, and 2.5% combined Pb, Zn, Sb

SUMMARY: Quartz-carbonate fissure veins with galena, sphalerite, arsenopyrite, and gold. Veins occur along northeast-striking, steeply dipping fault zones in the Spruce Creek sequence composed of middle Paleozoic or older metasedimentary and metavolcanic rocks. **REFERENCES:** Bundtzen, 1981, 1983a; Thomas K. Bundtzen, written commun., 1984.

P5-7 63 33 150 45	Quigley Ridge (Kantishna)	Ag, Au, Pb, Zn Polymetallic vein	Estimated 380,000 tonnes with 1,300 g/t Ag, 4.8g/t Au, 6.4% Pb, and 2.3% Zn

SUMMARY: Quartz-carbonate fissure veins with galena, sphalerite, tetrahedrite, pyrite, chalcopyrite, and siderite. Paragenetic sequence, from older to younger: arsenopyrite, pyrite, base-metal sulfides, Ag sulfosalts, stibnite, and covellite. Locally contain Ag and Pb sulfosalts. Veins occur along northeast-striking, steeply dipping fault zones in the Spruce Creek sequence composed of middle Paleozoic or older, metavolcanic and metasedimentary rocks. **REFERENCES:** Bundtzen, 1981, 1983a; Thomas K. Bundtzen, written commun., 1984.

P5-8 63 34 150 44	Banjo (Kantishna)	Au, Ag, Pb, Zn, Sb (Cu) Polymetallic vein	Estimated 160,000 tonnes with 13.4 g/t Au, 123 g/t Ag, 1.5% combined Pb, Zn, Sb

SUMMARY: Quartz-carbonate fissure veins with arsenopyrite, pyrite, gold, and minor scheelite. Veins occur along northeast-southwest-striking, steeply dipping fault zones within the Spruce Creek sequence composed of middle Paleozoic or older metasedimentary and metavolcanic rocks of Yukon-Tanana terrane. **REFERENCES:** Bundtzen, 1981, 1983a; Thomas K. Bundtzen, written commun., 1984.

P5-9 63 25 151 12	Slate Creek, Eagles Den, Caribou Creek (Kantishna)	Sb (Ag, Zn) Sb-Au vein	Estimated 64,000 tonnes grading 12.0% Sb, with minor Ag and Zn

SUMMARY: Quartz-carbonate fissure veins mineralized mainly with stibnite, and mostly free of other sulfides common to district. Veins occur along northeast-striking, steeply dipping fault zones that cut metasedimentary and metavolcanic rocks of middle Paleozoic or older Yukon-Tanana terrane. **REFERENCES:** Bundtzen, 1981; Thomas K. Bundtzen, written commun., 1984.

P5-10	Ohio Creek	Sn	Grab samples with up to 0.1% Sn,
63 11		(Ag, As, Cu, Zn)	and minor Ag, As, Cu, Zn
149 55		Sn greisen and Sn vein	

SUMMARY: Zone of muscovite-tourmaline greisen and quartz arsenopyrite veins in tourmaline-bearing Tertiary granite stock. Zone about 1.6 km long and 0.8 km wide. Greisen zone about 4 m thick and 45 m long occurs along contact with biotite-rich inclusion. Stock part of the lower Tertiary McKinley plutonic sequence and intrudes argillite, graywacke, and conglomerate, part of Upper Jurassic(?), Cretaceous, and lower Tertiary(?) flysch in region. **REFERENCES:** Hawley and Clark, 1974.

P5-11	Coal Creek	Sn, Ag, W, Zn	Estimated 5 million tonnes of 0.28%
63 00			Sn and about 0.5% Cu. Grab
149 51		Sn greisen(?) and Sn vein	samples with up to 1.5% Sn, 148 g/t Ag

SUMMARY: Cassiterite occurs in sheeted vein system as disseminated grains and locally high concentrations; and in minor disseminations within and above apical dome of early Tertiary granite, which intrudes older, related granite; and in thin quartz topaz-sulfide veinlets, 1 to 3 mm wide, that postdate alteration; and in stockwork veinlets. Veins vary from hairline to 1 cm width, are nearly vertical, and reach a density of 10 veins per m in the most intensely fractured zones. Veins form stockwork along fracture(?) zone in granite across area of about 4,000 m^2. Sulfides include arsenopyrite, pyrite, pyrrhotite, and sphalerite. Granite adjacent to veinlets pervasively altered to quartz, tourmaline, topaz, sericite, and minor fluorite. Granite intrudes and contact-metamorphoses Devonian argillite, graywacke, and minor limestone of Chulitna area. Granite probably part of the McKinley plutonic sequence (K-Ar ages of 55 Ma). **REFERENCES:** Reed, 1977; Warner, 1985; Gregory Thurow, written commun., 1984.

P5-12	Partin Creek	Cu, Au, Ag	Grab samples with up to 0.7% Cu,
63 04			63 g/t Au, 300 g/t Ag
149 57		Polymetallic vein or Cu-Ag quartz vein	

SUMMARY: Zone contains pyrite, arsenopyrite, pyrrhotite, and chalcopyrite in veinlets, disseminations, or vesicle fillings. Zone at least 3,000 m long and 1,000 m wide in Triassic(?) metamorphosed pillow basalt and strongly limonite-stained marble. **REFERENCES:** Hawley and Clark, 1974.

P5-13	Boulder Creek	Sn	Contains an estimated 136,000 kg
62 53	(Purkeypile)		Sn. Grab samples with up to 18%
152 08		Sn greisen(?)	Sn, 7,900 g/t Ag

SUMMARY: Disseminated cassiterite and sulfides in clusters of narrow, open-space fracture fillings, suggestive of stockwork deposit. Deposit occurs in calc-silicate rock, quartzite, and argillite approximately 100 to 200 m north of Tertiary biotite granite, part of the lower Tertiary McKinley plutonic sequence. **REFERENCES:** Maloney and Thomas, 1966; Conwell, 1973; Reed and others, 1978; Warner, 1985.

P5-14	Shellabarger Pass	Cu, Ag, Fe, Zn	Estimated several hundred thousand
62 40			tonnes of unknown grade. Up to 5%
152 30		Besshi massive sulfide	Cu; average of about 2% Cu, 1% Zn

SUMMARY: Very fine grained mixture of mainly pyrite and marcasite with lesser sphalerite, chalcopyrite, galena, and pyrrhotite in a gangue of siderite, calcite, quartz, and dolomite. Sulfides and gangue occur in massive, lenticular sulfide bodies, as replacements of carbonate-rich beds, and as fracture fillings, mainly in chert and siltstone. Host rocks are Triassic and(or) Jurassic age; and consist of lower sequence of chert, dolomite, siltstone, shale, volcanic graywacke, conglomerate, aquagene tuff, and upper sequence of pillow basalt, agglomerate, and breccia. At least six individual sulfide bodies. Highest chalcopyrite concentrations in basal parts of bodies. Minor sphalerite in or near hanging walls. Main sulfide bodies may be proximal to basaltic flow fronts. Extensive hydrothermal alteration in footwall; rare to absent in hanging wall. High background Cu values of 250 to 300 g/t. **REFERENCES:** Reed and Eberlein, 1972; Bundtzen and Gilbert, 1983.

P5-15	Tin Creek	Pb, Zn, Cu	Estimated 230,000 tonnes with 16%
62 23			combined Pb and Zn
153 38		Cu-Pb-Zn skarn	

SUMMARY: Pyroxene-rich skarn with abundant sphalerite and minor chalcopyrite, and garnet skarn with chalcopyrite and minor sphalerite; and locally abundant epidote and amphibole. Pyroxene skarn distal, and garnet skarn proximal to extensive Tertiary granodiorite dike swarm in mid-Paleozoic marble. Skarns form small, discontinuous bodies up to 3 m wide along dikes, as mantos in marble, and as irregular bodies along thrust and high-angle faults. **REFERENCES:** Herreid, 1966; Reed and Elliott, 1968a, b; Bundtzen and Gilbert, 1983; Bundtzen and others, 1982; Szumigala, 1984.

P5-16	Rat Fork, Sheep Creek	Cu, Zn, Pb	Grab samples with up to 3% Cu and
62 14	(Farewell)		10% combined Zn, Pb
153 48		Cu-Pb-Zn skarn	

SUMMARY: Large slivers of Cu- and Zn-rich skarn between Tertiary granodiorite dikes in a 3-km-wide dike swarm that cuts lower Paleozoic marble. Johannsenite-sphalerite skarn in marble, and chalcopyrite-rich garnet endoskarn in dikes. Local Ag-rich galena vein in marble about 0.5 km north of dike swarm. Dikes trend east-west; skarn up to 25 m wide. **REFERENCES:** Herreid, 1968; Reed and Elliott, 1968a, b; Bundtzen and others, 1982; Szumigala, 1987.

P5-17	White Mountain	Hg	Chip samples contains 5 to 30%
62 10			cinnabar. Produced about 3,500
154 51		Carbonate-hosted Hg(?)	flasks of Hg.

SUMMARY: Cinnabar in fault zones between Ordovician limestone and shale along belt about 1 km wide and 3 km long on northwest side of Farewell fault. In southern zone, cinnabar occurs as thin crystalline coatings in brecciated dolomite, as coatings on breccia fragments, and as irregular veinlets. In central zone, cinnabar is more irregular and occurs in silicified limestone and dolomite. In northern zone, rich cinnabar masses occur on both sides of major fault between middle Paleozoic shale and limestone. One area in north zone contains a massive cinnabar body up to 350 m long and 10 to 15 cm thick. Locally cinnabar occurs in small karst-like caverns in dolomitized limestone. Gangue minerals consist of dolomite, chalcedony, calcite, dickite, and limonite. Production from 1964 to 1974 when mined from a series of open pits. **REFERENCES:** Sainsbury and MacKevett, 1965; Brian K. Jones, written commun., 1984; Thomas K. Bundtzen, written commun., 1984.

P5-18	Gagaryah	Ba	Inferred reserves of 2.3 million
61 49			tonnes containing 51% barite
154 28		Sedex Barite (lead-zinc)	

SUMMARY: Nodular, laminated, composite, and massive, light gray barite in Frasnian (early Late Devonian) shale, limestone and minor chert of Mystic Terrane. Deposit has minimum strike length of 640 meters, an average thickness of 20 meters, and estimated down-dip extension of 300 meters. Gagaryah deposits contains slightly elevated levels of silver vanadium, and strontium (as celestite), but no lead or zinc. Sulfide isotopic analyses of +20 and +24 determined from nodular and massive barite respectively. Barite was deposited syngenetically into host shale basin with barite rapidly precipitating from low temperature hydrothermal fluids distal from exhalative vents. **REFERENCES:** Bundtzen and Gilbert, 1991.

P5-19 62 14 154 20	Chip-Loy (Farewell)	Ni, Co, Cu Gabbroic Ni-Cu(?)	Estimated 9,100 tonnes of 1% Ni, 0.1% Co

SUMMARY: Massive to disseminated pyrrhotite, bravoite, and chalcopyrite in irregular, steeply dipping layer; occurs along contact between diabase and Ordovician shale. Other nearby Ni-Co sulfide deposits occur along contacts between diabase dikes. **REFERENCES:** Herreid, 1968; Gilbert and Solie, 1983; Bundtzen and others, 1985.

P5-20 62 11 153 40	Bowser Creek (Farewell)	Ag, Pb, Zn Pb-Zn skarn	Higher grade: estimated 14,000 tonnes with 1,300 g/t Ag, and up to 10% combined Pb and Zn. Lower grade: estimated 272,000 tonnes with 20% Pb and Zn, and 100 g/t Ag

SUMMARY: Pyrrhotite, sphalerite, galena, and chalcopyrite in a hedenbergite-johannsenite endoskarn occurring in marble adjacent to felsic dike that cuts an early Tertiary granitic pluton. Some veins with Ag-rich galena and pyrrhotite occur within marble adjacent to skarn. Small Zn- and Cu-rich stockwork veinlets in plutons, and disseminated sulfides in plutons and endoskarn occur nearby. **REFERENCES:** Bundtzen and others, 1988; Szumigala, 1987.

P5-21 60 51 151 48	Miss Molly (Hayes Glacier)	Mo Porphyry Mo	Grab and chip samples with up to 0.38% Mo, 0.16% Zn

SUMMARY: Quartz veins with medium- to coarse-grained molybdenite, pyrite, and local fluorite. Regularly spaced, subparallel, veins 2 to 10 cm wide are spaced 2 to 10 m apart. Veins occur in two zones about 545 m long and up to 150 m wide in early Tertiary leucocratic, equigranular biotite granite stock. Veins locally fill joints and less commonly shears. Zones of hydrothermal alteration up to 0.3 m wide are marked by sericite and pyrite and occur adjacent to veins. Granite stock intrudes siltstone in an Upper Jurassic and Lower Cretaceous flysch unit. Granitic plutons nearby, yield K-Ar ages of 56 to 59 Ma. **REFERENCES:** Fernette and Cleveland, 1984.

P5-22 60 45 154 30	Bonanza Hills	Ag, Cu, Pb, Au Polymetallic vein and Porphyry Cu	At Main Saddle estimated 45,000 tonnes grading 81 g/t Ag, 0.15% Cu, 0.67% Pb, and 0.15 g/t Au

SUMMARY: Main Saddle Deposit: tetrahedrite, arsenopyrite, galena, and chalcopyrite in quartz-limonite vein up to 3 m wide and 150 m long. Vein occurs in contact-metamorphosed dacite flow and sandstone sequence near Late Cretaceous, two-mica, hypabyssal, granite pluton. VABM Trail and Bonanza Deposits: stibnite, arsenopyrite, and gold in en echelon veinlets adjacent to dacite porphyry and quartz monzonite plutons. Extensive sericite and silicic alteration of plutonic rocks. Plutons intrude Lower Cretaceous shale and sandstone, part of regionally extensive Upper Jurassic and Lower Cretaceous flysch. **REFERENCES:** Eakins and others, 1978; Thomas K. Bundtzen, written commun., 1984; Nelson and others, 1985.

P5-23 60 51 153 12	Glacier Fork	Cu, Au (Zn, Ag) Cu-Zn skarn	Chip samples contain 0.76% Cu, 3.4% Zn, 0.38 g/t Au, 20g/t Ag

SUMMARY: Layers and veinlets of disseminated and massive pyrrhotite, chalcopyrite, arsenopyrite, and sphalerite in iron-poor, garnet-rich skarn. Skarn occurs in large roof pendant over granitic pluton. **REFERENCES:** Nelson and others, 1985.

P5-24	Kijik River	Cu, Mo	Grab samples with up to 0.25% Cu,
60 17			and 0.17% Mo. Estimated 91
154 15		Polymetallic vein and porphyry Cu	million tonnes

SUMMARY: Large area of low-grade, disseminated sulfides in, and adjacent to early Tertiary dacite porphyry. Distinctive orange gossan over a 3 km^2 area with extensive stockwork, and zones of sericite and sulfides. Extensive propylitic and silicic alteration of dacite porphyry. Early Tertiary dacite porphyry intrudes older volcanic rocks. **REFERENCES:** Eakins and others, 1978; Nelson and others, 1985; Thomas K. Bundtzen, written commun., 1984.

P5-25	Sleitat	Sn, Ag, W, As	Inferred reserves of 25 million
60 03			tonnes grading 0.20 % Sn with
157 05		Tin Greisen and Skarn	minor Ag, W

SUMMARY: Cassiterite, topaz, and quartz greisen accompanied by lesser amounts of arsenopyrite, pyrite, wolframite, argentite, chalcopyrite, and galena. Two largest greisens form resistant, irregular, east-west trending, vertically dipping dike-like features that protrude through less resistant host granite. Greisens vary from less than a meter wide and 20-30 meters long to zones 20-50 meters wide and 1200 meters long. Most greisens occur at contact between biotite-muscovite granite and muscovite granite phases of Sleitat pluton. Some mineralization in surrounding hornfels aureole. Pluton crops out across an area of 1.5 km^2. A much larger 20 km^2 hornfels aureole indicates a much larger intrusive mass underlies prospect area. Pluton intrudes Mesozoic flysch of Kahiltna Terrane or Kuskokwim Group. About 735 meters of diamond drilling completed; best hole yielded 29 meters of 1.56% Sn and 28 ppm Ag. Sleitat is probably correlative with other stanniferous plutons of 55-60 Ma McKinley sequence. Ar 40-39 age determinations indicate 58-59 Ma ages for granite and 56-57 Ma for greisen event. **REFERENCES:** Burleigh, 1991; Farnstrom, 1991; T.K. Bundtzen and Paul Layer, written commun., 1991.

P5-26	Kasna Creek	Cu	Chip samples averaging 0.95% Cu,
60 13	(Kontrashibuna)	(Au, Ag, Zn, Fe)	27% Fe, and traces of Au and Ag.
154 05		Cu-Fe skarn	Grab samples with up to 0.25% Zn.
			Estimated 9.1 million tonnes
			grading 1% Cu

SUMMARY: Skarn bodies contain specular hematite and lesser magnetite and chalcopyrite in amphibole-chlorite-calcite-quartz gangue that replaces Upper Triassic dolomite and limestone. Skarn bodies occur parallel to bedding and occur in a zone about 320 m long and 700 m wide adjacent to Jurassic tonalite. Tuffs, mafic volcanic rocks, and agglomerate associated with limestone. **REFERENCES:** Warfield and Rutledge, 1951; Reed and Lanphere, 1969; Eakins, 1970.

P5-27	Johnson Prospect	Au, Zn, Cu, Pb	Estimated resource of 16,795 Kg
60 07			gold and 127,000 tonnes Zn;
152 57		Kuroko massive sulfide	includes 453,500 tonnes grading 19
			g/tonne Au and 9.0% Zn

SUMMARY: Stockworks of quartz-sulfide veins and massive sulfide lenses with chalcopyrite, pyrite, sphalerite, galena, and gold. Stockwork occurs in a discordant, pipe-like body of silicified volcanic rocks. Veins also contain chlorite, sericite, anhydrite, and barite alteration minerals. Deposit occurs in volcaniclastic, pyroclastic, and volcanic rocks, part of the Portage Creek Agglomerate Member of the Lower Jurassic Talkeetna Formation. Deposit may represent deposition of sulfides directly over capped submarine vent system during Jurassic volcanic cycle. Nearby Late Jurassic quartz diorite and quartz monzonite. **REFERENCES:** R. L. Detterman, oral commun., 1984; Steefel, 1987; Madelyn Mollholyn, written commun., 1988; J. Proffett, written commun., 1991.

P6-1	Sheep Creek	Zn, Pb, Ag, Sn	Grab samples contain up to 15%
63 54			combined Pb and Zn, and 102 g/t
148 17		Kuroko massive sulfide(?)	Ag; zones up to 1 m wide with 1%
			Sn

SUMMARY: Fine-grained sphalerite, galena, and pyrite in massive lenses in siliceous phyllite and metaconglomerate of the Precambrian or Paleozoic Keevy Peak Formation. Sulfide zone extends along strike for 300 m, and vertically for 200 m. Sulfide lenses isoclinally folded; may be distally associated with tuffaceous chlorite schist and metamorphosed lapilli tuff. **REFERENCES:** Thomas K. Bundtzen, written commun., 1985; Gilbert and Bundtzen, 1979.

P6-2	Anderson Mountain	Cu, Pb, Zn, Ag	Grades up to 19% Cu, up to 5% Pb,
63 48			28% Zn, and 171 g/t Ag
147 57		Kuroko massive sulfide	

SUMMARY: Massive sulfide layers with pyrite, chalcopyrite, galena, sphalerite, enargite, and arsenopyrite in gangue of quartz, sericite, chlorite, calcite, barite and siderite. Hosted in metamorphosed marine tuffaceous rhyolite and metamorphosed calcareous clastic rocks correlated with the Moose Creek Member of the Mississippian Totatlanika Schist. Numerous high-angle faults. Sulfide beds appear to lie on irregular paleosurface in footwall. Domal sulfide accumulations at top of layers. Absence of footwall alteration and stringer mineralization suggests off-vent deposition. High geochemical values of As, Sb, Hg, and W may be derived from older schist basement. **REFERENCES:** Gilbert and Bundtzen, 1979; Curtis J. Freeman, written commun., 1984; Thomas K. Bundtzen, written commun., 1984.

P6-3	WTF, Red Mountain	Cu, Pb, Zn, Ag, Au	At WTF, estimated 1.10 million
63 45			tonnes grading 0.15% Cu, 2.5% Pb,
147 22		Kuroko massive sulfide	7.9% Zn, 270 g/t Ag, and 1.9 g/t Au

SUMMARY: Massive pyrite, sphalerite, galena, and chalcopyrite in quartz-rich gangue occurs in felsic metavolcanic rocks derived from crystal and lapilli tuff, minor flows, and in metasedimentary rocks. Massive sulfide layers on both sides of large east-west trending syncline. The massive sulfide layers of the Red Mountain deposit occur in a proximal setting on the south limb of the anticline, within sulfide-silica exhalite up to 130 m thick. An older, southern horizon hosts sphalerite and coarse pyrite in black chlorite schist. The thin blanket of fine-grained sulfides of the WTF deposit on the north limb of the fold in a distal setting relative to the vent. Deposits occur immediately below the Sheep Creek Member and above the Mystic Creek Member of the Mississippian Totatlanika Schist. **REFERENCES:** Gilbert and Bundtzen, 1979; David R. Gaard, written commun., 1984.

P6-4	Miyaoka, Hayes Glacier	Cu, Pb, Zn, Au, Ag	Grab samples with up to 0.92% Cu,
63 41			0.72% Pb, 0.5% Zn, 50 g/t Au, 50
146 39		Kuroko massive sulfide	g/t Ag

SUMMARY: Zone about 13 km long and up to 0.5 km wide of massive sulfide lenses, pods, and disseminations with pyrrhotite, chalcopyrite, sparse pyrite, and sphalerite. Individual lenses and pods up to 5 m long and 1 m thick. Sulfides are in interfoliated former marine sequence of quartz mica schist, muscovite-chlorite-quartz schist, quartz-feldspar augen schist, chlorite schist, calc-schist, and marble. Host rocks derived from Devonian felsic to intermediate volcanic rocks, mainly andesite, dacite, and quartz keratophyre flows and tuffs, and Devonian or older shale, marl, and marble. Metavolcanic and metasedimentary rocks part of Yukon-Tanana terrane. Two periods of metamorphism and deformation, an older period of lower amphibolite facies, and a younger period of lower greenschist facies. Intensely deformed with locally abundant mylonite schist. **REFERENCES:** Lange and Nokleberg, 1984; Nokleberg and Lange, 1985; Lange and others, 1993.

P6-5	McGinnis Glacier	Zn, Cu, Pb, Ag	Grab samples with up to 2.3% Zn,
63 36			0.26% Cu, 0.25% Pb, 50 g/t Ag
146 14		Kuroko massive sulfide	

SUMMARY: Disseminated to massive pods of pyrite, chalcopyrite, and sphalerite in two or three layers exposed discontinuously along a zone up to about 15 m thick and 2 km long. Individual pods up to 1 m thick. Gangue of quartz, chlorite, epidote, biotite, and actinolite. Sulfides occur in interfoliated marine sequence of metasedimentary rocks, mainly quartz schist, chlorite-quartz schist and marble, and lesser amounts of metamorphosed Devonian andesite, dacite, and keratophyre flows, tuff, and volcanic graywacke of the Yukon-Tanana terrane. Two periods of metamorphism and deformation, an older period of lower amphibolite facies, and a younger period of lower greenschist facies. Intensely deformed with locally abundant mylonite schist. **REFERENCES:** Lange and Nokleberg, 1984; Nokleberg and Lange, 1985; Lange and others (1993).

P6-6 63 17 149 27	Nim, Nimbus, Silver King	Au, Ag, Cu (Zn, Mo, As) Polymetallic vein and Porphyry Cu(?)	Nimbus and Silver King: grab samples with up to 2% Cu, 137 g/t Ag, 13 g/t Au

SUMMARY: Nim Deposit: Veins, veinlets, and disseminations of arsenopyrite, chalcopyrite, molybdenite, and chalcocite, with some pyrite, bornite, and pyrrhotite in disseminations and fracture fillings in breccia pipes and in dikes of early Tertiary rhyolite porphyry and quartz porphyry within a body of granite porphyry. Igneous rocks intrude Triassic(?) and Jurassic(?) clastic sedimentary rocks. Deposit occurs in area about 1 km by 2 km. Nimbus and Silver King Prospects: Lenses of massive chalcopyrite, arsenopyrite, stibnite, pyrite, and sphalerite, 1 to 2 m thick, and up to 10 m long occur in brecciated early Tertiary quartz diorite porphyry dike that occurs in strand of Upper Chulitna fault. **REFERENCES:** Hawley and Clark, 1974; Swainbank and others, 1977; Richard C. Swainbank, written commun., 1985, 1988.

P6-7 63 13 149 39	Golden Zone	Au, Cu, Zn, As, Sb, Ag, Pb Polymetallic vein and Au-Ag breccia pipe or Cu-Au porphyry	Inferred reserves of 1.6 million tonnes grading 5.2 g/tonne Au, and 0.5 % Cu. Produced 49,169 g Au, 267,990 g Ag, 19 tonnes Cu

SUMMARY: Auriferous arsenopyrite with minor chalcopyrite, sphalerite, and pyrite in quartz gangue, fills open spaces of breccia pipe in center of early Tertiary quartz diorite porphyry, and fractures in porphyry adjacent to breccia pipe. One zone about 125 m in diameter; high-grade ore occurs in breccia pipe approximately 75 m in diameter at surface. Abundant veins adjacent to porphyry. Porphyry, dated at 68 Ma; intrudes Permian to Jurassic sedimentary rocks of Chulitna area. Extensive exploration through much of the 1980's. **REFERENCES:** Hawley and Clark, 1974; Swainbank and others, 1977; Charles C. Hawley, written commun., 1985, 1990.

P6-8 63 09 149 52	Ready Cash	Au, Cu, Pb, Ag, Sn, Zn Polymetallic vein(?)	Chip sample with 1.4 g/t Au, 857 g/t Ag, 1.5% Cu, and 5% Pb

SUMMARY: Arsenopyrite, chalcopyrite, and galena in quartz-arsenopyrite-sulfide veins, massive sulfide-rich veins, and disseminations along a zone at least 1.6 km long. Zone occurs in Triassic(?) limestone and pillow basalt of Chulitna region. **REFERENCES:** Hawley and Clark, 1974.

P6-9 62 53 149 18	Treasure Creek	Mo, Cu (Au, Zn) Porphyry Cu-Mo	No data

SUMMARY: Disseminated molybdenite, chalcopyrite, arsenopyrite, sphalerite, fluorite, and epidote in silicified and sheared Tertiary granite stock, and in argillite and metagraywacke intruded by the granite. Local intense argillic alteration and limonite staining adjacent to fault and extending irregularly up to 100 m into granite stock. Argillite and metagraywacke part of regionally extensive Lower Cretaceous flysch unit. Granite stock part of the lower Tertiary McKinley plutonic sequence. **REFERENCES:** Richter, 1963; Csejtey and Miller, 1978.

P6-10 63 09 147 08	Denali (Pass Creek)	Cu, Ag Besshi massive sulfide?	Massive sulfide layers with abundant Cu and up to 13 g/t Ag

SUMMARY: Stratiform bodies of very fine grained and rhythmically layered chalcopyrite and pyrite laminations in thin-bedded, shaly, carbonaceous, and limy argillite enclosed in the Upper Triassic Nikolai Greenstone. Ore body up to 166 m long and 9 m wide, and extends at least 212 m below surface. Sulfides and host rocks metamorphosed at lower greenschist facies and locally moderately folded. Several hundred meters of underground workings. Property developed from 1964 to 1969, but never put into production. Interpreted to have formed in a submarine volcanic environment of a reducing or euxinic marine basin with abundant organic matter and sulfate reducing bacteria. **REFERENCES:** Stevens, 1971; Seraphim, 1975; Smith, 1981.

P6-11 62 11 15 147 16 18	Lucky Hill, Timberline Creek	Au, Ag Au-quartz vein	348,000 tonnes, averaging 7.1 g/tonne Au

SUMMARY: Free gold and minor pyrite, pyrrhotite, arsenopyrite, galena, and sphalerite in sheeted quartz veins striking east-northeast and dipping steeply to the northwest. Veins occur in semischist of the Maclaren Glacier metamorphic belt, but veins also cut granodiorite on Timberline Creek. Distinctive, yellowish ankeritic carbonate accompanies gold-quartz formation. At Gold Hill-Lucky Hill and Timberline Creek, Ar-Ar ages on primary micas from pluton give emplacement age of 90-100 Ma. The age of mineralization (veins) is 57-63 Ma. or the same age as that determined for the biotite blocking temperature in the Maclaren metamorphic belt. Because of this, gold mineralization is thought to be related to regional metamorphism. Fluid inclusions are low salinity, high CO_2 types with homogenization temperatures of about 270°C. **REFERENCES:** Smith, 1981; Adams and others, 1992.

P6-12 63 13 146 42	Zackly	Au, Cu, Ag Cu-Au skarn	Grab samples with up to 6.6% Cu, 4.4 g/t Au, 30 g/t Ag. Estimated 1.25 million tonnes of 2.6% Cu and 5.4 g/tonne Au

SUMMARY: Disseminated chalcopyrite, bornite, pyrite, and gold in zone of andradite garnet-pyroxene skarn and adjacent sulfide bodies in contiguous marble. In Upper Triassic marble along east-west-striking contact with albitized Cretaceous quartz monzodiorite. Zone about 650 m long and about 30 m wide. Marble and diorite locally intensely faulted. Higher Au grades mainly associated with supergene(?) assemblage of malachite, limonite, chalcedony, and native copper. Gold occurs only in skarn; granitic pluton and wall rocks barren of gold. General zoning from granitic pluton to skarn with (1) brown garnet with chalcopyrite, (2) green garnet with bornite and chalcopyrite, (3) clinopyroxene and wollastonite, and (4) marble with magnetite and bornite. **REFERENCES:** Rose, 1965b; Ian M. Lange and Warren J. Nokleberg, written commun., 1984; Nokleberg and others, 1984; Rainier Newberry, written commun., 1985; Clint R. Nauman, written commun., 1985; Ford, 1987.

P6-13 63 17 146 33	Kathleen-Margaret	Cu, Ag, Au Cu-Ag quartz vein	Grab samples with up to 13% Cu, 3.2 g/t Au, 300 g/t Ag. About 1.8 tonnes ore produced

SUMMARY: Quartz veins up to 140 m long and 3 m wide with disseminated to massive chalcopyrite, bornite, and malachite cut Upper Triassic Nikolai Greenstone. Veins strike east-west are intruded along shear zones. Some underground exploration but long dormant. **REFERENCES:** MacKevett, 1965; Nokleberg and others, 1984.

P6-14 63 20 146 02	Rainy Creek District	Cu, Ag, Au (Zn) Cu-Ag skarn	Grab samples with up to 5.6% Cu, 300 g/t Ag, 1.2 g/t Au, 0.07% Zn

SUMMARY: Zone about 10 km long and up to 5 km wide with scattered garnet-pyroxene skarn bodies that contain disseminated to small masses of chalcopyrite, and bornite, with minor sphalerite, galena, magnetite, secondary Cu-minerals, and sparse gold. Deposits occur in faulted lenses of marble of the Pennsylvanian and Permian Slana Spur Formation adjacent to late Paleozoic(?) metagabbro, metadiabase, and hypabyssal meta-andesite intrusive rocks. Local disseminated sulfides in meta-andesite. Zone of skarns up to about 10 km long and up to 5 km wide. Sulfide-bearing bodies and adjacent wall rocks locally intensely faulted. **REFERENCES:** Rose, 1966; Lange and others, 1981; Nokleberg and others, 1984; Ian M. Lange and Warren J. Nokleberg, written commun., 1984.

P6-15	Rainbow Mountain	Cu, Ag	Grab samples with up to 10% Cu,
63 20			44 g/t Ag, trace Au
145 41		Porphyry Cu	

SUMMARY: Zone with scattered occurrences of disseminated to small masses of chalcopyrite and pyrite, and minor sphalerite and galena in Permian meta-andesite and meta-dacite hypabyssal porphyries. Zone up to 6 km long and up to 1 km wide. Locally disseminated sulfides in metavolcanic and metasedimentary rocks near porphyries and meta-andesites. **REFERENCES:** Lange and others, 1981; Nokleberg and others, 1984; Ian M. Lange and Warren J. Nokleberg, written commun., 1985.

P6-16	Fish Lake	Cr, Ni	Grab samples with >0.5% Cr and
63 13			0.3% Ni
146 48		Gabbroic Ni-Co	

SUMMARY: Chromite, disseminated and in wispy layers, in serpentinized olivine cumulate. Zone up to 15 km long along strike and up to 2 km wide. Local anomalous Cu and Ni in stream-sediment and rock samples collected nearby. Olivine cumulate interpreted as comagmatic metamorphosed basalt of the Upper Triassic Nikolai Greenstone. **REFERENCES:** Nokleberg and others, 1984; Ian M. Lange and Warren J. Nokleberg, written commun., 1985.

P6-17	Delta District	Pb, Zn, Cu, Ag, Au	Largest deposit contains 18 million
63 14			tonnes of 0.3 to 0.7% Cu, 1 to 3%
144 10		Kuroko massive sulfide	Pb, 3 to 6% Zn, 34 to 100 g/t Ag, 1
			to 3.4 g/t Au

SUMMARY: Large massive sulfide district covers about 1,000 sq km, with about 26 stratiform, transposed, and fewer replacement deposits occurring along four regional trends. Consist of varying amounts of pyrite, chalcopyrite, galena, sphalerite, and lesser malachite and bornite. Gangue mainly quartz, carbonate, and white mica. Hydrothermal alteration marked by chlorite, quartz, sericite, pyrite, and lead-silver-gold sulfides. Massive sulfides and adjacent layers with disseminated sulfides occur in zones typically 500 m long, 200 m wide, and 15 m thick. Hosted in metamorphosed Devonian spilite and keratophyre suite derived from flows, tuffs, and breccia, and metamorphosed shallow- and deep-marine sedimentary rocks; now mainly quartz schist, quartz-chlorite-feldspar schist, calc-schist, and marble of the Yukon-Tanana terrane. Numerous tholeiitic greenstone sills spatially associated with the massive sulfide bodies, and possibly genetically related to the metavolcanic suite. **REFERENCES:** Nauman and others, 1980; Lange and Nokleberg, 1984; Clint R. Nauman and Steven R. Newkirk, written commun., 1984; Ian M. Lange and Warren J. Nokleberg, written commun., 1984.

P6-18	Willow Creek District	Au	Produced about 18.4 million g Au
61 45	(Gold Cord,	(W, As, Zn, Pb, Te)	from 1909 to 1950. Ore grades
149 30	Independence, Thope, and	Au quartz vein	range from about 17 to 69 g/t Au
	others)		

SUMMARY: Quartz veins with a few percent or less pyrite, chalcopyrite, magnetite, and gold; with minor arsenopyrite, sphalerite, tetrahedrite, gold tellurides, and galena. Veins average 0.3 to 1 m thick, but some up to 2 m thick. Veins occupy east-northeast and north-south-striking shear zones up to 7 m wide. Considerable alteration of wall rocks to sericite, pyrite, carbonate, and chlorite in parallel bands. Locally abundant clay-rich fault gouge along shear zones. Zone of veins in and along southern margin of Jurassic quartz diorite and younger Cretaceous and early Tertiary granitic rocks of the Talkeetna Mountains batholith, and in mica schist at the Thorpe mine. Veins interpreted as coeval with intrusion of early Tertiary adamellite pluton. District consists of several mines and many prospects, most in an area about 12.8 km long and 6.2 km wide along southern portion of batholith. Several thousand meters of underground workings. Nearly continuous mining and development from 1909 through 1942; sporadic activity from 1951 through present. **REFERENCES:** Ray, 1954; Madden-McGuire and others, 1989.

P6-19 61 32 145 09	Bernard Mountain, Dust Mountain	Cr, PGE Podiform Cr	Four large low-grade deposits with 330,000 tonnes Cr_2O_3

SUMMARY: Disseminations and sparse layers and lenses of chromite up to a few tens of meters long and 15 m wide in dunite tectonite. Largest deposit about 3.5 km long and 2.0 km wide, contains about 300,000 tonnes of material with 5% chromite. Sample of high-Fe chromian spinel from Dust Mountain contains up to 21 g/t PGE. Hosted in layered dunite tectonite which is part of the Early Jurassic or older, informally named Border Ranges ultramafic and mafic complex of Burns (1985); faulted at base. Local abundant serpentinite. Structural sequence from south to north composed of dunite, harzburgite, wehrlite, garnet gabbro, norite, and hornblende norite. Sporadic exploration and trenching from about 1940 to present. **REFERENCES:** Foley and others, 1984, 1992; Coleman and Burns, 1985; Burns, 1985; Newberry, 1986; Foley and others, 1988.

P6-20 61 12 146 44	Gold King	Au (Pb, Cu, Zn, Sb) Au quartz vein	Produced about 62,000 g Au. Chip samples with up to 3.4 g/t Au and 1.3 g/t Ag

SUMMARY: Two or more quartz fissure veins up to 1.5 m thick with gold, pyrite, galena, sphalerite, chalcopyrite, and stibnite, mainly in metagraywacke of the Upper Cretaceous Valdez Group. Sulfides compose about 3% of ore. Mineralized vein cuts small granite pluton. Graywacke locally shattered and sheared near veins. About 600 m of underground workings. Production principally between 1911 to 1924. **REFERENCES:** Johnson, 1915; Jansons and others, 1984.

P6-21 61 07 146 33	Cliff (Port Valdez)	Au (Cu, Ag, Pb, Zn, Sb) Au quartz vein	Average grade from 34 to 69 g/t Au. Produced about 1,610,000 g Au from about 25,000 tonnes ore

SUMMARY: Quartz veins up to 3 m thick and 515 m long with gold, pyrite, galena, sphalerite, arsenopyrite, and stibnite in metagraywacke and minor phyllite of the Upper Cretaceous Valdez Group. Veins in complicated system of intersecting faults. Sulfides compose about 3 to 5% percent of ore. A few thousand meters of underground workings. Production mainly from 1906 to 1940. **REFERENCES:** Johnson, 1915; Pickthorn, 1982(?); Jansons and others, 1984.

P6-22 61 12 146 06	Ramsay-Rutherford	Au (As, Cu, Zn, Pb) Au quartz vein	Produced about 172,000 g Au. Grab samples with up to 28g/t Au

SUMMARY: Two main quartz fissure veins up to 2 m thick and 136 m long with sparse gold, silver, pyrrhotite, pyrite, chalcopyrite, sphalerite, galena, and arsenopyrite(?) in metagraywacke of the Upper Cretaceous Valdez Group. Gangue of quartz, carbonates, and crushed country rock. More than 450 m of underground workings. Mined from about 1914 to 1935. **REFERENCES:** Johnson, 1915; Jansons and others, 1984.

P6-23 61 01 146 16	Midas	Cu, Ag, Au, Zn Besshi massive sulfide(?)	Average grade about 3.2% Cu, 13.7 g/t Ag, 2.1 g/t Au. Produced 1.54 million kg Cu, 471,000 g Ag, 79,000 g Au from 44,800 tonnes of ores. Estimated 56,200 tonnes of 1.6% Cu ore remain

SUMMARY: Disseminated to massive stratiform chalcopyrite, pyrite, pyrrhotite, sphalerite, and minor galena in ore body up to 7 m thick and 300 m long. Ore bodies in phyllite and metagraywacke of the Upper Cretaceous Valdez Group. Sulfide layering parallels bedding and is folded with the host sedimentary rocks. Weak to unmineralized quartz stockwork in footwall may be feeder system for main ore body. Extensive underground workings with production between 1911 and 1919. Estimated 44,800 tonnes ore mined. Earlier workers interpreted deposit as epigenetic replacement in shear zones. **REFERENCES:** Johnson, 1915; Moffit and Fellows, 1950; Rose, 1965b; Winkler and others, 1981; Nelson and Koski, 1987; Jansons and others, 1984; Steven W. Nelson, written commun., 1986; Crowe and others, 1992.

P6-24	Ellamar	Cu, Au, Ag	Produced about 7.2 million kg Cu,
60 54		(Zn)	1,457,000 g Au, and 5.96 million g
146 42		Besshi massive sulfide	Ag from 274,000 tonnes ore

SUMMARY: Pyrite, pyrrhotite, chalcopyrite, cubanite, and sphalerite in disseminations and massive sulfide lenses up to 70 m thick and 150 m long in folded and sheared argillite and graywacke of the lower Tertiary Orca Group. Local diabase dikes. Explored and mined from about 1897 to 1920. A few thousand meters of workings. **REFERENCES:** Capps and Johnson, 1915; Jansons and others, 1984; Crowe and others, 1992.

P6-25	Threeman, Standard	Cu, Au, Ag	About 14,500 kg Cu and byproduct
60 51	Copper	(Zn)	Au and Ag produced at Standard
146 33		Cyprus massive sulfide	Copper; 0.5 million kg Cu, 3,141 g
			Au, and 165,000 g Ag at Threeman

SUMMARY: Two deposits of chalcopyrite, pyrrhotite, sphalerite, cubanite, and galena in lenticular masses and disseminations. Lenses up to about 2 m wide and 120 m long. Deposits occur in locally sheared and altered argillite, graywacke, tuff, and pillow basalt of the lower Tertiary Orca Group. Explored and mined from about 1904 to about 1918. A few thousand meters of workings. **REFERENCES:** Capps and Johnson, 1915; Jansons and others, 1984; Crowe and others, 1992.

P6-26	Fidalgo-Alaska, Schlosser	Cu, Zn	Produced about 1.89 million kg Cu
60 46			from 19,440 tonnes ore. Estimated
146 25		Besshi massive sulfide(?)	23,000 tonnes of 3.2% Cu remain

SUMMARY: Chalcopyrite and pyrite, with rare sphalerite and pyrrhotite occur in broad shear zones up to 90 m long. Quartz and calcite gangue. Deposits occur in intensely folded and sheared graywacke, limestone, and argillite of the lower Tertiary Orca Group. Developed and mined from 1913 to about 1920. About 750 m of underground workings. **REFERENCES:** Capps and Johnson, 1915; Jansons and others, 1984; Crowe and others, 1992.

P6-27	Lucky Strike (Palmer	Au	Grab sample with 7 g/t Ag and
60 46	Creek)	(Cu, Pb, Ag)	0.15% Pb. Produced about 172,450
149 33		Au quartz vein	g Au. Estimated 1,800 tonnes ore

SUMMARY: Quartz vein up to 1.7 m thick with sparse gold, pyrite, chalcopyrite, sphalerite, and galena in brecciated and fractured phyllite of the Upper Cretaceous Valdez Group. Fractures normal to cleavage. Extensive development; production mainly between 1916 and 1940. **REFERENCES:** Tysdal, 1978; Jansons and others, 1984.

P6-28	Monarch, Jewel	Au	Produced about 154,000 g Au. Chip
61 02		(Pb, Cu, Zn, As, Mo)	samples range from 10.6 to 36.7 g/t
149 06		Au quartz vein	Au with about 10.6 g/t Ag

SUMMARY: Two or more quartz veins up to 0.3 m thick with calcite, and sparse galena, chalcopyrite, sphalerite, arsenopyrite, molybdenite, gold, and silver in metagraywacke and phyllite of the Upper Cretaceous Valdez Group. Few Tertiary felsic dikes and granodiorite. Over 380 m of underground workings. **REFERENCES:** Johnson, 1915; Jansons and others, 1984.

P6-29 60 57 148 21	Mineral King (Herman and Eaton)	Au (Zn, Pb, Cu, As) Au quartz vein	Produced about 87,000 g Au. Grab samples with up to 5.1 g/t Au and 4.5 g/t Ag. Estimated 450 tonnes ore

SUMMARY: Quartz veins up to 2 m wide form lenses up to 22 m long with calcite, sphalerite, pyrite, galena, chalcopyrite, gold, pyrrhotite, and arsenopyrite in metagraywacke and phyllite of the Upper Cretaceous Valdez Group and in Tertiary granite. About 450 m of underground workings. **REFERENCES:** Tysdal, 1978; Jansons and others, 1984.

P6-30 60 58 148 13	Granite	Au (As, Cu, Pb, Sb, Zn) Au quartz vein	Produced about 776,000 g Au. Estimated 1,700 tonnes ore

SUMMARY: Fissure up to 4 m wide with brecciated phyllite and metagraywacke cemented by quartz with gold, pyrite, arsenopyrite, chalcopyrite, galena, stibnite, and sphalerite in the Upper Cretaceous Valdez Group and in Tertiary granite. Extensive development from about 1914 to about 1940. **REFERENCES:** Tysdal, 1978; Jansons and others, 1984.

P6-31 60 37 149 34	Alaska Oracle, Gilpatrick	Au Au quartz vein	Produced about 106,000 g Au. Estimated 1,800 tonnes ore.

SUMMARY: Quartz veins up to 2 m thick with gold, arsenopyrite, galena, and sphalerite, and some chalcopyrite, molybdenite, and pyrrhotite. Veins in fault zones mainly in phyllite of the Upper Cretaceous Valdez Group. Wall rocks locally altered near veins, with highest grade ore in areas of most alteration. Over 200 m of underground workings. Most production from about 1933 to 1940. **REFERENCES:** Tuck, 1933; Tysdal, 1978; Jansons and others, 1984.

P6-32 60 27 149 18	Crown-Point, Kenai-Alaska	Au (As, Pb, Zn) Au quartz vein	Produced about 97,200 g Au. Estimated 13,600 tonnes ore

SUMMARY: Shear zone up to 900 m long and 12 cm wide in phyllite of the Upper Cretaceous Valdez Group is filled with brecciated phyllite cemented by vuggy quartz that contains gold, arsenopyrite, galena, sphalerite, and calcite. Local quartz lenses and stringers up to 0.75 m wide. Extensive development mainly from about 1909 to 1940; over 500 m of underground workings. **REFERENCES:** Martin and others, 1915; Tysdal, 1978; Jansons and others, 1984.

P6-33 60 20 147 42	Knight Island, Pandora	Cu (Zn) Cyprus massive sulfide	Produced up to a few thousand tonnes ore

SUMMARY: Two major deposits and several smaller deposits with pyrite, pyrrhotite, chalcopyrite, cubanite, sphalerite, and quartz in massive sulfide lenses and disseminations. Lenses up to 9 m thick; average 1.5 m thick. Lenses mainly at sheared contacts with host rocks. Deposits occur in pillow basalt of the lower Tertiary Orca Group. A few hundred meters of underground workings; minor production. **REFERENCES:** Moffit and Fellows, 1950; Tysdal, 1978; Jansons and others, 1984; Crowe and others, 1992.

P6-34 60 21 147 39	Copper Bullion, Rua Cove	Cu (Zn) Besshi massive sulfide	Estimated 1.0 million tonnes of 1.25% Cu

SUMMARY: Lens-shaped body of pyrrhotite with minor chalcopyrite and sphalerite in sheared pillow basalt of the lower Tertiary Orca Group. Lens about 200 m long. No production. **REFERENCES:** Johnson, 1915, 1918; Stafansson and Moxham, 1946; Tysdal, 1978; Koski and others, 1985; Crowe and others, 1992.

P6-35 63 02 147 51	Latouche, Beatson	Cu, Ag, Zn (Au, Pb) Besshi massive sulfide(?)	Produced more than 84.4 million kg Cu from 4.5 million tonnes ore. Average ore grade about 1.7% Cu, 9.3 g/t Ag

SUMMARY: Two major deposits and several smaller ones consisting of massive sulfide lenses and disseminations composed mainly of pyrite and pyrrhotite with minor chalcopyrite, cubanite, sphalerite, galena, silver, and gold. Gangue of quartz, sericite, and ankerite. Zone adjacent to major fault in graywacke and argillite of the lower Tertiary Orca Group. Deposits along a zone up to 120 m thick and 300 long along strike. Developed and produced mainly from about 1903 to 1934. **REFERENCES:** Johnson, 1915; Tysdal, 1978; Jansons and others, 1984; Crowe and others, 1992.

P7-1 63 53 143 28	Mosquito	Cu, Mo Porphyry Cu-Mo	No data

SUMMARY: Disseminated chalcopyrite, molybdenite, and pyrite in hydrothermally altered Late Cretaceous to early Tertiary quartz monzonite and quartz monzonite porphyry. Granitic rocks intrude mid-Paleozoic or older schist of the Yukon-Tanana terrane. **REFERENCES:** Singer and others, 1976.

P7-2 63 39 141 19	Taurus	Cu, Mo Porphyry Cu-Mo	Estimated 126 million tonnes grading 0.30 % Cu, 0.03% Mo, 0.34 g/tonne Au

SUMMARY: At least three areas of mineralization and locally intense potassic, propylitic, and sericitic alteration occur along a zone of hypabyssal plutons about 13 km long and 1.6 km wide. Plutons consist of early Tertiary granite porphyry, granodiorite, and quartz latite porphyry that intrudes middle Paleozoic or older quartz-sericite schist and gneiss of Yukon-Tanana terrane. Numerous faults and shears. Ore consists of chalcopyrite, molybdenite, and pyrite in disseminations and veinlets of quartz-orthoclase-sericite, quartz-magnetite-anhydrite, quartz-sericite-pyrite-clay-fluorite, quartz-orthoclase-biotite, and of solid chalcopyrite. Magnetite-rich cores of the potassic altered, granite porphyries contain sparse sulfides. Higher concentrations of Cu and Mo sulfides occur with periphery that contains phyllic alteration. Sequence of alteration, from oldest to youngest: propylitic, potassic, phyllic, and argillic. Potassic alteration in core of plutons, propylitic and sericite alteration in periphery and adjacent wall rocks. Local tourmaline, fluorite, and replacement of chalcopyrite by chalcocite. **REFERENCES:** Edward R. Chipp, written commun., 1984; Bundtzen and others, 1992b.

P7-3 63 38 141 29	Bluff	Cu, Mo Porphyry Cu-Mo	No data

SUMMARY: Disseminated pyrite, chalcopyrite, molybdenite, and magnetite in hypabyssal Cretaceous or early Tertiary porphyritic granite, granodiorite, and quartz porphyry. Intense hydrothermal alteration. Numerous faults and dikes. Granitic rocks intrude middle Paleozoic or older schist of the Yukon-Tanana terrane. **REFERENCES:** Singer and others, 1976; Eberlein and others, 1977.

P7-4 63 22 142 30	Asarco	Cu, Mo Porphyry Cu-Mo	No data

SUMMARY: Disseminated molybdenite and Cu-sulfides in silicified and leached, Tertiary, hypabyssal, quartz porphyry pluton that intrudes middle Paleozoic or older Yukon-Tanana terrane. **REFERENCES:** Singer and others, 1976; Helen L. Foster, written commun., 1977, in Eberlein and others, 1977.

P7-5 63 09 144 48	Slate Creek	Cu, Ag, Au (Zn) Porphyry Cu(?)	Grab samples with up to 2% Cu, 70 g/t Ag, 2 g/t Au

SUMMARY: Zone with scattered occurrences of disseminated to small masses of chalcopyrite and pyrite, with minor sphalerite and galena in Permian(?) meta-andesite to metadacite hypabyssal porphyries. Zone about 2 km wide and up to 9 km long along strike. Disseminated sulfides locally in adjacent metavolcanic and metasedimentary rocks of the Pennsylvanian and Permian Slana Spur Formation. **REFERENCES:** Lange and others, 1981; Ian M. Lange and Warren J. Nokleberg, written commun., 1984; Nokleberg and others, 1984.

P7-6 62 49 144 10	Chistochina District	Cu, Pb, Ag, Au Porphyry Cu and polymetallic vein	Grab samples with up to 20% Pb, 1.4% Cu, 21 g/t Ag, 1.4 g/t Au

SUMMARY: Several small areas with galena, pyrite, chalcopyrite, tetrahedrite, and gold in quartz veins, small masses, and disseminations in margins of the Pennsylvanian and Permian Ahtell quartz diorite pluton and in adjacent volcanic and sedimentary rocks of the Pennsylvanian and Permian Slana Spur Formation. Quartz veins up to 10 m wide, locally contain massive barite, calcite, and cerussite over an area about 5 km long and 3 km wide. Local, small Cu-Au and Pb-Zn skarns. **REFERENCES:** Richter, 1966; Rainier J. Newberry, written commun., 1985.

P7-7 62 23 143 00	Nabesna, Rambler	Au (Cu, Ag, Pb, Zn, Fe) Fe-Au skarn	Nabesna Mine produced about 1.66 million g Au, minor Ag and Cu. Estimated 18,000 tonnes of 34.3 g/t Au in Rambler mine.

SUMMARY: Nabesna Mine: massive oxide-sulfide bodies, quartz-pyrite veins, and pyrite veins, all with disseminated gold in Upper Triassic Chitistone or Nizina Limestone near contact with Cretaceous monzodiorite pluton. Massive oxide-sulfide bodies chiefly pyrite and magnetite with minor chalcopyrite, galena, sphalerite, arsenopyrite, stibnite, and gold. Pyrite veins formed by replacement of limestone along pre-existing fractures and contain disseminated to small masses of chalcopyrite, galena, sphalerite, magnetite, pyrrhotite, arsenopyrite, stibnite, and gold. Large body of massive auriferous pyrrhotite and pyrite at Rambler Mine. Monzodiorite pluton has K-Ar ages of 109 and 114 Ma. Principal mining at Nabesna from about 1930 to 1941. Several hundred meters of workings. Several episodes of exploration since. **REFERENCES:** Wayland, 1943; Richter and others, 1975; Donald H. Richter, written commun., 1985; Rainer Newberry and T.K. Bundtzen, written commun., 1985.

P7-8 62 07 142 50	Nabesna Glacier and adjacent areas.	Cu, Zn, Au Polymetallic vein(?)	No data.

SUMMARY: Three contiguous areas with: (1) quartz veins and veinlets that contain pyrite, with minor chalcopyrite and sphalerite; (2) a zone of disseminated malachite and azurite; (3) a zone of intense alteration with breccia cemented by quartz, pyrite, chalcopyrite, and galena. Deposits occur in late Paleozoic metavolcanic porphyry and metabasalt flows of the Tetelna Volcanics; may be related to nearby Cretaceous and Tertiary granitic plutons and dikes. **REFERENCES:** Richter, 1975.

P7-9 62 12 142 45	Orange Hill, Bond Creek	Cu, Mo, Au Porphyry Cu-Mo and Cu-Au skarn	Estimated 320 million tonnes of 0.35% Cu and 0.02% Mo at Orange Hill. 500 million tonnes of 0.30% Cu and 0.02% Mo at Bond Creek.

SUMMARY: Two similar deposits with pyrite, chalcopyrite, and minor molybdenite in quartz veinlets in the Cretaceous Nabesna pluton, a complex intrusion of granodiorite and quartz diorite intruded by granite porphyry.

Abundant biotite-quartz, quartz-sericite, and chlorite-sericite-epidote alteration; late anhydrite veins. Altered areas about 1,000 by 3,000 m at Orange Hill, and 2,000 by 3,000 m at Bond Creek. Associated skarns with pyrite, chalcopyrite, bornite, and magnetite at Orange Hill, and sphalerite, pyrite, pyrrhotite, and chalcopyrite in adjacent areas. Pluton intrudes upper Paleozoic metavolcanic rocks and marble, and Upper Triassic limestone and Nikolai Greenstone. **REFERENCES:** Van Alstine and Black, 1946; Richter and others, 1975..

P7-10 62 05 141 13	Baultoff, Horsfeld, Carl Creek	Cu (Mo) Porphyry Cu	Estimated 240 million tonnes of 0.2% Cu and <0.01% Mo; trace Au

SUMMARY: Three separate areas with pyrite and chalcopyrite in veinlets and disseminated in altered Cretaceous granitic plutons composed of quartz diorite, quartz diorite porphyry, or granite porphyry. Altered areas up to 1,000 by 2,000 m with chlorite, sericite, albite, and pyrite. Local actinolite veins and disseminations. Host rocks part of the Cretaceous Klein Creek batholith and associated granitic rocks which intrude Upper Jurassic and Lower Cretaceous flysch of Gravina-Nutzotin belt. **REFERENCES:** Richter and others, 1975.

P7-11 61 39 143 43	Nugget Creek	Cu, Ag Cu-Ag quartz vein	Grab sample with >200 g/t Ag, and >2% Cu. Produced 145 tonnes ore and concentrate

SUMMARY: Quartz vein more than 1 m thick with bornite, chalcopyrite, and pyrite. Vein occurs along fault in Upper Triassic Nikolai Greenstone. Slablike copper nugget weighing several tonnes found as float in Nugget Creek. Development and production from 1916 to 1919. More than 1,200 m underground workings. Grade decreases at depth. **REFERENCES:** MacKevett, 1976.

P7-12 61 34 143 43	London and Cape	Cu, Mo, Ag Porphyry Cu-Mo	Grab samples with up to 10% Cu, 0.007% Mo, 1.5 g/t Ag. Average grade of about 0.1% Cu

SUMMARY: Pyrite and chalcopyrite in veinlets and disseminations in locally altered Jurassic(?) granodiorite and quartz diorite. Granitic rocks intrude Lower Cretaceous sedimentary rocks. Short adit. **REFERENCES:** Moffitt and Mertie, 1923; MacKevett, 1976.

P7-13 61 33 143 47	Midas (Berg Creek)	Au, Cu, Ag Cu-Au skarn	Grab samples with up to 8g/t Au, 10 g/t Ag, and 20% Cu

SUMMARY: Disseminated to small masses of magnetite, pyrite, and chalcopyrite in quartz veins and skarns in metamorphosed Triassic Nizina Limestone adjacent to Jurassic granodiorite to quartz monzodiorite pluton. Skarn composed of magnetite and epidote with local pyrite, chalcopyrite, and gold. Two short adits. **REFERENCES:** MacKevett, 1976.

P7-14 61 16 50 144 15 25	Spirit Mountain	Ni, Cu, Co, Ag Gabbroic Ni-Cu	At least 11,000 tonnes ranging up to 6.2 % Ni and 3.4 % Cu and 0.04 % Co. (Average 0.88 % Ni and 0.9 % Cu)

SUMMARY: Disseminated and locally massive pyrrhotite, pyrite, chalcopyrite, pentlandite, and ullmannite (a sulphantimonide of nickel), bravoite, and minor to trace galena and sphalerite in gabbro, peridotite, and hornblendite sills and dikes that cut Mississippian Strelna Formation with an east-west trend. Ultramafic and mafic rocks may be part of the Early Jurassic or older, informally named Border Ranges ultramafic and mafic complex of Burns (1985). The sills and dikes are believed to intrude along a major thrust fault that juxtaposes a foliated quartz diorite pluton and the upper Paleozoic rocks. Deposit(s) occur as a series of lenses 1-3 m thick that extend along strike for about 2 km. Explored with trenches, pits, and two short tunnels. **REFERENCES:** Kingston and Miller, 1945; Herreid, 1970.

P7-15 61 31 142 50	Kennecott District	Cu, Ag Kennecott-type Cu	Produced about 544 million kg Cu and 280 million g Ag from 4.3 million tonnes ore

SUMMARY: Mainly chalcocite and covellite, with minor enargite, bornite, chalcopyrite, luzonite, and pyrite. Tennantite, sphalerite, and galena extremely rare. Local surface oxidation of sulfides to malachite and azurite. Sulfides occur mainly as large, irregular, massive, wedge-shaped bodies, mainly in dolomitic parts of the Upper Triassic Chitistone or Nizina Limestone; generally less than 100 m above the Middle and(or) Upper Triassic Nikolai Greenstone. Largest ore body (Jumbo) consists of an almost pure chalcocite and covellite mass about 110 m high, up to 18.5 m wide, and that extends 460 m along plunge. One of the most productive group of mines in Alaska from 1913 until 1938 when the ore was exhausted. More than 96 km of underground workings. Major mines in district are Jumbo, Bonanza, Erie, Mother Lode, and Green Butte. Deposits interpreted by Armstrong and MacKevett (1982) as having formed by mobilization of Cu from the underlying Nikolai Greenstone and deposited during regional metamorphism in fossil karsts of a dolomitic sabkha interface in overlying limestone. Age of deposition interpreted as Cretaceous(?). **REFERENCES:** Bateman and McLaughlin, 1920; MacKevett, 1976; Armstrong and MacKevett, 1982; Edward M. MacKevett, Jr., written commun., 1986.

P7-16 61 28 142 41	Nikolai	Cu, Ag Cu-Ag quartz vein	Grab sample with 1% Cu

SUMMARY: Two quartz veins, each less than 1 m thick, with bornite, chalcopyrite, bornite, pyrrhotite, and secondary copper, and iron minerals. Quartz-calcite gangue. Veins in shear zone near top of the Middle and (or) Upper Triassic Nikolai Greenstone. Deposit known to natives in late 1800's. More than 100 m of underground workings. Developed in 1899 but little work since. **REFERENCES:** Moffit and Capps, 1911; Miller, 1946; MacKevett and Smith, 1968.

P7-17 61 27 142 23	Nelson (Glacier Creek)	Cu, Ag Kennecott-type Cu	Abundant Cu; grab samples with >2% Cu, 50 g/t Ag, 0.3% As

SUMMARY: Stringers and discontinuous masses of disseminated to massive chalcocite and covellite with minor enargite, bornite, malachite, chalcopyrite, native copper, and pyrite in basal parts of fault block of the Upper Triassic Chitistone Limestone. Local faulting and shearing. Minor production from 1929 to 1930. Several pits, five short adits, and a few hundred meters of underground workings. Similar to Kennicott deposit. **REFERENCES:** Miller, 1946; Sainsbury, 1951; MacKevett and Smith, 1968; MacKevett, 1976; Still and others, 1991.

P7-18 61 25 142 15	Erickson	Cu, Ag Basaltic Cu	Grab samples with >2% Cu, 70 g/t Ag

SUMMARY: Massive to disseminated native copper, tenorite, cuprite, and minor amounts of other Cu minerals in irregular masses, thin veins, and stringers in rubbly upper parts of flows, and to lesser extent, in amygdules and quartz-epidote veins in the Middle and (or) Upper Triassic Nikolai Greenstone. Most of copper fine-grained; copper masses to 27 kg. Minor production in 1917. About 100 m of underground workings. **REFERENCES:** Miller, 1946; MacKevett and Smith, 1968; MacKevett, 1976.

P7-19 61 24 142 30	Westover	Cu, Ag Kennecott-type Cu	Channel samples with abundant Cu, 50 g/t Ag, 0.2% As. Grab sample with >2% Cu, 50 g/t Ag, 0.2% As

SUMMARY: Wedge-shaped pods and veins of disseminated to massive bornite-rich ore, with minor chalcocite, malachite, and chalcopyrite; in lower part of the Upper Triassic Chitistone Limestone. Largest pod 10 m long and 3 m wide. Limestone locally silicified near ore. More than 400 m of underground workings. Development and minor production from 1911 to 1920. Similar to Kennecott deposit. **REFERENCES:** Moffit and Capps, 1911; Moffit, 1918; Miller, 1946; MacKevett and Smith, 1968; MacKevett, 1976.

Q3-1 67 54 163 40	Iyikrok Mountain	Cr Podiform Cr	Grab samples with up to 33% Cr, and 0.2 g/t PGE. Estimated 130,000 to 350,000 tonnes chromite

SUMMARY: Disseminated fine- to medium-grained chromite in Jurassic or older dunite and peridotite tectonite that has been locally serpentinized. Platinum observed in one sample. Zones with chromite up to 90 m wide and 305 m long in dunite. Host rocks part of the Misheguk igneous sequence. Mafic and ultramafic rocks floored by major thrust fault. **REFERENCES:** Mayfield and others, 1983; Foley and others, 1985, 1992, Foley, 1988.

Q3-2 65 56 166 12	Ear Mountain area, (Winfield)	Sn, Cu, Ag, Pb, Zn Sn skarn	Produced several hundred tonnes Sn

SUMMARY: Cassiterite, stannite, and chalcopyrite in skarn and sparse cassiterite-quartz veins along margin of Late Cretaceous multistage biotite granite stock intruded into argillaceous limestone. Highly variable contact metamorphic silicate and sulfide mineral assemblages. Tourmaline-quartz greisen veins in upper part of granite. Local occurrence of U in oxidized tourmalinized mafic dike and adjacent biotite granite. Deposit associated with with late-magmatic stage of Late Cretaceous granite about 76.7 Ma. **REFERENCES:** Killeen and Ordway, 1955; Mulligan, 1959; Sainsbury, 1972; Hudson and others, 1977; Bond, 1983; Hudson and Arth, 1983; Swanson and others, 1988.

Q3-3 65 35 168 00	Cape Mountain	Sn (W) Sn vein	Produced about 940 tonnes of Sn, mainly from placers; but very minor production from lodes

SUMMARY: Occurrences of cassiterite, tourmaline, pyrite, pyrrhotite, fluorite, scapolite, sphalerite, and scheelite along margin of Cretaceous granite. Deposits occur in periphery of pluton, in dikes, in contact-metamorphosed and contact-metasomatized wall rocks, and in quartz veins in pluton. Cassiterite also occurs as replacement of limestone near intrusive contact. Granite intrudes Mississippian limestone, dolomitic limestone, and shale. Age of granite 78.8 Ma. Several small lode prospects and one small lode mine whose main production was from 1903 to 1909. About 9 tonnes cassiterite concentrate shipped in 1905. Probable source for Goodwin Gulch and Tin City cassiterite placer deposits. Strong cassiterite production from placers in Cope Creek and Goodwin Gulch from the mid-1970's to 1989 when placers were exhausted. Total production during this period was about 2.07 million pounds of tin. **REFERENCES:** Knopf, 1908; Steidtman and Cathcart, 1922; Mulligan, 1966; Hudson and Arth, 1983; Bundtzen and others, 1990.

Q3-4 65 38 167 35	Potato Mountain	Sn Sn vein	Up to a few percent Sn

SUMMARY: Scattered veins and veinlets of quartz, clay, cassiterite, pyrite, and arsenopyrite associated with hornfelsed tin- and tourmaline-bearing Precambrian or lower Paleozoic carbonaceous phyllite, metasiltstone, and slate, all part of the slate-of-the-York region of Sainsbury. Gravity data indicate an intrusive body lying within 0.5 km of surface. One granitic dike exposed. A small dredge recovered cassiterite for many years and nonfloat placer mining continued in several creeks in the vicinity until the mid-1950's (Cobb, 1973). Limited exploration over the years including an unsuccessful attempt to drill into the top of the buried pluton in 1990. **REFERENCES:** Steidtman and Cathcart, 1922; Sainsbury, 1969; Hudson and others, 1977; Bruce M. Gamble, written commun., 1986.

Q3-5	Lost River	Sn, W, F, Be	Reserves of 25 million tonnes
65 28		(Zn Cu, Pb, Ag)	grading 0.15% Sn, 0.03% WO_3,
167 10		Sn-W skarn, Sn greisen,	16.3% CaF_2. Produced 320 tonnes
		Carbonate-replacement Sn(?)	Sn

SUMMARY: Several deposits and one mine in veins, skarns, greisens, and intrusion breccia formed above a shallow Late Cretaceous granite stock intruding thick sequence of Lower Ordovician limestone and argillaceous limestone. Early-stage andradite-idocrase skarn and later fluorite-magnetite-idocrase vein skarns altered to chlorite-carbonate assemblages that are contemporaneous with greisen formation and cassiterite deposition. Major ore minerals in skarns and greisen are cassiterite and wolframite, with lesser stannite, galena, sphalerite, pyrite, chalcopyrite, arsenopyrite, and molybdenite, and a wide variety of other contact metamorphic and alteration minerals. Age of granite 80.2 Ma. Production mostly from 1952 to 1955 from underground workings a few hundred meters deep along the Cassiterite dike. This dike is a near-vertical rhyolite dike, extensively altered to greisen over the buried granite. Similar smaller deposits nearby include tin-greisen and veins near the Tin Creek Granite and various polymetallic veins and skarns near the Brooks Mountain Granite. Large beryllium deposits peripheral to the skarns replace limestone as fluorite-white mica veins that contain diaspore, chrysoberyl, and tourmaline; probably associated with early stages of granite intrusion. Potential for carbonate-replacement tin deposit. Some placer tin recovered from creek below Lost River mine but placers now exhausted. Major exploration program in early 1970's drilled out several large Sn-W-fluorite-Be ore bodies but depressed metal prices caused cancellation of the program short of development. **REFERENCES:** Steidtman and Cathcart, 1922; Sainsbury, 1963, 1964, 1965, 1969; WGM, Incorporated, Anchorage, written commun., 1973; Dobson, 1982; Hudson and Arth, 1983; Reed, Menzie, and others, 1989.

Q3-6	Kougarok	Sn, Ta, Nb	Grades average about 0.5% Sn;
65 41			0.01% Ta and 0.01% Nb
165 14		Sn greisen with Ta and Nb	

SUMMARY: Occurs in association with a buried Cretaceous granitic complex, mainly as disseminated cassiterite in quartz-tourmaline-topaz greisen, associated with disseminated tantalite-columbite in quartz-white mica greisen. Sn deposits occur in steep cylindrical pipes of greisenized granite, greisenized dikes, in greisen along roof zone of subhorizontal granite sills, and as stockwork veinlets in schist. Late Cretaceous granite dikes, sills, and plugs above the buried pluton are interpreted as subvolcanic analogues to topaz rhyolite. Granitic rocks intrude poly-deformed graphitic and calcareous quartz schist, part of the undifferentiated Nome Group of Sainsbury (1972), and probably equivalent to the pelitic schist unit of Till (1984). Extensive drilling of properties, 1979 to 1983; dormant since. **REFERENCES:** Hudson and Arth, 1983; Christopher C. Puchner, written commun., 1984; Puchner, 1985, 1986; Reid, 1987.

Q3-7	Serpentine Hot Springs	Pb, Zn, As, Ag, Au, Sn	No data
65 48			
164 32		Polymetallic vein	

SUMMARY: Quartz veins and stringers, with disseminated limonite and pyrite, and possibly minor chalcopyrite and argentiferous galena, cut Paleozoic(?) schist composed of varying proportions of quartz, muscovite, chlorite, chloritoid, graphite, pyrite, pyrrhotite, and albite at Midnight, Humboldt, and Ferndale Creeks. Schist part of the mixed unit of Till (1984). Few thin granitic to rhyolitic dikes contain disseminated pyrite and fluorite. Deposit about 5 km from southeast margin of the Sn-bearing Cretaceous Oonatut Granite Complex. Limited exploration. Deposit exposed in trenches cut along northwest- or east-trending faults. **REFERENCES:** Hudson and others, 1977; Joseph A. Briskey, written commun., 1985.

Q3-8 Hannum Creek Pb, Zn, Ag Up to 10% Pb, 2.2% Zn, 1.4g/t Au, and 60.4 g/t Ag
65 56
163 21 Metamorphosed sedimentary exhalative Zn-Pb?

SUMMARY: Blebs, stringers, massive boulders, and disseminations of galena, pyrite, sphalerite, and barite with gangue of quartz, calcite, and limonite gangue; occurs in Paleozoic micaceous quartzite, marble, and quartz-mica-graphitic schist, all within or near exposures of crudely banded micaceous quartzite enclosed in an isolated lens of marble. Marble interbedded with early Paleozoic quartz-mica-graphite schist, part of mixed unit of Till (1984). Deposit is highly oxidized; exposure is poor. Zones of blebs, stringers, and disseminations appear conformable with bedding and banding in quartzite. Zones up to 90 m wide and extend for about 2 km along northwest-southeast trend. Two km farther southeast along strike are oxidized stringer zones or lenses of limonite, quartz, and chlorite are cut by veins and stockworks of quartz and chlorite. The stringer zones and lenses composed of interlayered marble and calcareous quartz-muscovite schist. Quartzite is interpreted as metamorphosed laminated exhalite, possibly a sedimentary exhalative Zn-Pb deposit. The thin lenses of marble are interpreted as former limestone mounds that formed near exhalative vents. **REFERENCES:** Herreid, 1965b; Joseph A. Briskey, written commun., 1985.

Q3-9 Independence (Innoko) Pb, Ag Samples contain up to 30% Pb, 5,145 g/t Ag, 3.4 g/t Au. Dump specimens average about 20 % Pb and 686 g/t Ag. Produced a few hundred tonnes ore
65 41
162 28 Polymetallic vein

SUMMARY: Oxidized pyrite, galena, sphalerite, and minor tetrahedrite in a vein now composed primarily of limonite and sheared calcite. Vein localized in a fault zone trending nearly north-south. Host rocks are sheared and schistose, micaceous and banded, Paleozoic marble, a Cretaceous granitic pluton crops out about 4 km to the northwest. Deposit exposed in open cuts 2-4 m wide over a length of 600 m. Small production in 1921 and 1922, and limited exploration during several periods since. A few hundred meters of underground workings. **REFERENCES:** Hudson and others, 1977; Joseph A. Briskey, written commun., 1985.

Q3-10 Windy Creek Mo (Pb, Zn) Grab samples with up to 0.15% Mo, 0.05% Sn, 0.05% W, 0.15% Pb
65 10
162 37 Porphyry Mo

SUMMARY: Veins and stringers of quartz, pyrrhotite, pyrite, fluorite, molybdenite, galena, and sphalerite in hornblende granite of the Cretaceous(?) Windy Creek pluton. Molybdenite reported in skarn along pluton margin. Sporadic stringers and veinlets of quartz containing pyrrhotite, pyrite, and fluorite occur near dikes of altered biotite granodiorite intruding the granite. Wall rocks part of the lower Paleozoic mafic schist, and schist and marble of the mixed unit of Till (1984). Little, if any, exploration. **REFERENCES:** Miller and others, 1971; Hudson and others, 1977; Joseph A. Briskey, written commun., 1984.

Q3-11 Death Valley U Average grade of 0.27 % U_3O_8. Estimated 450,000 kg uranium oxide
65 03
162 15 Sandstone U

SUMMARY: Mainly meta-autunite in Paleocene continental sandstone. Sandstone occurs in marginal facies of a Tertiary sedimentary basin where nearshore coarse arkosic clasts are interbedded with coal and lacustrine deposits. Interpreted as forming when uranium-bearing oxidized groundwater moved down from Cretaceous granitic plutons to west along hydrologic gradient. U precipitated in reducing environment of coal layers. Age of deposit estimated at middle or late Tertiary. **REFERENCES:** Dickinson and Cunningham, 1984; Dickinson and others, 1987.

Q3-12 65 02 162 41	Omilak area	Pb, Ag, Sb (Au, Cu, Sn, As) Polymetallic vein	About 300 tonnes Au-Pb ore averaging about 73% Pb and 5,000 g/t Ag produced from Omilak mine

SUMMARY: Contains the Omilak Mine and two nearby prospects, the Foster and Omilak East. Deposits consist of lenses and gossans of argentiferous galena associated with cerussite, anglesite, pyrite, arsenopyrite, unknown tin sulfosalts(?), and traces of chalcopyrite, with highly variable amounts of calcite, dolomite, tremolite, wollastonite, and other calc-silicate minerals. Veinlets and flat lenses of stibnite also occur at the Omilak mine. Veins and gossan occur along axes and limbs of northwest-plunging folds in Paleozoic(?) marble, and in graphitic, pyrite-feldspar schist, and micaceous schist. Bleaching and silicification associated with veins and gossan. Similar small occurrences are found in an area extending about 12.6 km north from Omilak to the Windy Creek pluton. Omilak mine consist of 55-m-deep shaft, 150-m-long adit, and two working levels. Limited underground exploration prior to 1930; only limited surface trenching since. Production between 1881 and 1890. **REFERENCES:** Smith and Eakin, 1911; Herreid, 1965b; Mulligan, 1962; Hudson and others, 1977; Joseph A. Briskey, written commun., 1985; Bruce M. Gamble and Alison B. Till, written commun., 1986.

Q3-13 64 40 165 28	Nome district, Mt. Distin	Au Au quartz vein	Grab samples with up to 120 g/t Au, 10 g/t Ag, >0.2% As, >0.1% Sb

SUMMARY: Quartz veins along high-angle faults with sparse disseminated gold, arsenopyrite, and sparse pyrite in gangue of quartz, minor carbonate, and plagioclase. Minor chalcopyrite, sphalerite, galena, stibnite, tetrahedrite, and scheelite. Veins range from 2 cm to 1 m wide, most less than 10 cm wide. Several veins contain up to 50 percent stibnite and minor pyrite. Veins occur along thrust faults in zone with strike length of about 6 km and up to 600 m wide. District includes MacDuffie, Sliscovitch, California Gulch, and Stipec, and Kotovic deposits in the Nome district, and many deposits in the Mt. Distin area. Faults in two regional sets trending northeast and northwest. Veins and faults occur in metasedimentary rocks of the Paleozoic mixed unit of Till (1984) and Gamble and others (1985) and in mafic schist of the Nome Group. Late Jurassic or Early Cretaceous age estimated for regional metamorphism, with vein formation during waning stages of metamorphism. **REFERENCES:** Smith, 1910; Cathcart, 1922; Gamble and others, 1985; D.L. Stevens, written commun., 1991.

Q3-14 64 35 165 29	Rock Creek	Au, Ag, W Polymetallic (metamorphic) vein	6.04 million tonnes 2.4 g/tonne Au; up to 0.3% W

SUMMARY: Arsenopyrite, scheelite, galena, stibnite, and pyrite in northeast-trending sheeted quartz vein system. Surface exposures indicate mineralization extends for 1200 meters along strike and average 70 meters wide and up to 150 meters deep. Host lithologies are phyllite and schist of Paleozoic Nome Group. Fluid inclusion studies indicate ore deposition occurred in the mesothermal range (240°C-320°C). Ore minerals emplaced along selvages of quartz-host rock contacts. Deposit is believed to have formed by hydrofracturing and dewatering event during waning stages of mid-Cretaceous metamorphic event. **REFERENCES:** Ted Eggelston, and R.V. Bailey, written commun., 1990-1991; Apodaca, 1992.

Q3-15 64 39 164 14	Big Hurrah	Au Au quartz vein	Recent assays of 25 to 65 g/t Au. Produced about 155,500 g Au, averaging about 34.3 g/t Au

SUMMARY: Four major quartz veins, and zones of ribbon quartz 1 to 5 m thick and a few hundred meters long contain sparse gold, pyrite, and arsenopyrite, with minor scheelite, chalcopyrite, and sphalerite, in gangue of quartz, carbonate, and feldspar. Intermixed with older, concordant, non-Au-bearing, metamorphic quartz veins. Au-bearing veins range from discordant tension veins to discontinuous quartz lodes that occur in shear zones crossing foliation. Au-bearing veins range from 0.5 to 5 m wide, and extend to a depth of at least 90 m. Most veins are less than 1 m wide. Veins and zones occur in quartz-rich, Paleozoic, graphitic, quartz-mica schist or quartzite of the Nome Group (the mixed unit of Till, 1984). Up to 15 percent arsenopyrite occurs in one vein. Veins interpreted to have formed during shearing and uplift associated with metamorphic dehydration. Late Jurassic or Early Cretaceous age estimated from regional metamorphism. Production from 1903 to 1909, and 1953-1954. Shaft 75 m deep; about 550 m of underground workings. Periodically re-examined and considerable exploration during the 1980's. **REFERENCES:** Collier and others, 1908; Cathcart, 1922; Asher, 1969; Mullen, 1984; Gamble and others, 1985; Read, 1985; Read and Meinert, 1986.

Q3-16 64 34 163 44	Daniels Creek, (Bluff)	Au, Ag (As, Sb) Au quartz vein	At least 5.9 million tonnes grading 3.4 g/tonne Au. Grab samples with 4 to 40g/t Au, 10 g/t Ag, 4.8% As, >0.1% Sb

SUMMARY: Sulfide poor, arsenopyrite, scheelite, and pyrite bearing, auriferous quartz pods and veins extend for about 2 km strike length in three separate mineralized zones: Daniels Creek, Koyana Creek, and the Saddle Prospect. Sheeted veins up to 75 cm wide hosted in Paleozoic marble and quartz-mica-feldspar schist of the Nome Group. Interstitial native gold in arsenopyrite-rich fractions. Two quartz veins contain up to 60 percent arsenopyrite. Mineralization was originally thought to be one or several strata-bound gold-bearing schist units; however drilling has shown that best auriferous mineralization occurs in deformed rocks along two en echelon thrust faults. Regional metamorphism probably of Late Jurassic or Early Cretaceous age; veins formed in waning stages of metamorphism. Minor underground workings; negligible production. Probable source of gold in nearby Daniels Creek placer deposit and some marine placers of the Solomon District. **REFERENCES:** Herreid, 1965a; Mulligan, 1971; Hudson and others, 1977; Gamble and others, 1985; Richard Heinze, written commun., 1990; Don Stevens, written commun., 1991.

Q3-17 64 42 162 46	Eagle Creek	U, Th, REE Felsic plutonic U	Grab samples of float with up to 0.15% U_3O_8, 1.05% Th, and 2% REE

SUMMARY: U-, Th-, and REE-minerals disseminated along margins of alkaline (pulaskite) dikes intruded into Cretaceous Kachauik granitic pluton, marble, and schist. Idocrase principal U-, Th-, and REE-bearing mineral. Local numerous occurrences of U- and Th-minerals in stream-sediment samples underlain by the nearby Darby pluton (granite). **REFERENCES:** West, 1953; Miller and others, 1976; Miller and Bunker, 1976.

Q4-1 67 30 161 50	Omar	Cu, Pb, Zn, Ag, Co Kipushi Cu-Pb-Zn	Grab samples with 15.3% Cu, 0.14% Pb, 0.95% Zn, and 20 g/t Ag

SUMMARY: Disseminated to massive chalcopyrite, bornite, lesser chalcocite, minor tennantite-tetrahedrite, very minor galena, supergene copper carbonates, and iron-oxide minerals occur in veinlets, irregular stringers, or as blebs in brecciated dolomite. Gangue dolomite, calcite, and quartz with anomalously high Zn and Co. Sulfide zone about 3 km long occurs along north-northwest trending fractures. Local solution breccia and faulted and brecciated gossan. Local remobilization of sulfides into fractures. Host rocks are Ordovician to Devonian dolomite and limestone of the Baird Group; part of Kelly River allochthon. Host rocks strike north-northeast to south-southeast; dips vary from gentle to vertical. Few minor isoclinal folds. **REFERENCES:** Degenhart and others, 1978; Jansons, 1982; Mayfield and others, 1983; Inyo F. Ellersieck, written commun., 1985; Folger and Schmidt, 1986.

Q4-2 67 28 161 35	Frost	Cu, Zn, Pb, barite (Cu-Zn-Pb-Ba vein)	Estimated to contain 0.9 million tonnes barite; and possibly as much as nine million tonnes. One vein with 13.2% Zn, 0.5% Cu, and 21% barite

SUMMARY: Chalcopyrite and galena in undulating quartz-calcite-barite veins, and lenses and pods of barite at least 30 m long by 10 m thick. Veins, lenses, and pods crosscut Ordovician to Devonian dolomite and limestone of the Baird Group for at least 1.6 km. Some calcite-barite veins surround barite lenses. **REFERENCES:** Degenhart and others, 1978; Inyo F. Ellersieck and J.M. Schmidt, written commun., 1985.

Q4-3 67 18 157 12	Smucker (Ambler)	Cu, Zn, Pb, Ag Kuroko massive sulfide	More than 8 million tonnes with 0.8% Cu, 2.3% Pb, 6.8% Zn, 6.4 oz/t Ag, minor Au

SUMMARY: Stratiform, disseminated fine- to medium-grained pyrite, sphalerite, galena, chalcopyrite, and owyheeite in a quartz-calcite-pyrite matrix occur over a strike length of 1,000 m and widths of up to 60 m. Deposit occurs on limb of recumbent, asymmetric antiform. Host rocks: a mafic and felsic metavolcanic sequence composed of quartz-muscovite-feldspar schist, quartz-chlorite-calcite phyllite, and porphyroclastic quartz-feldspar-muscovite schist; and an interlayered metasedimentary sequence composed of quartz-muscovite-chlorite phyllite, calc-schist, and marble. Host rocks part of the Devonian and Mississippian Ambler sequence derived from bimodal calcic and calc-alkaline volcanic rocks and impure clastic and calcareous sedimentary rocks. Deposit and host rocks subjected to greenschist-facies metamorphism. Host rocks strike west-northwest, dip moderately south, and contain abundant south-dipping, tight to isoclinal folds. **REFERENCES:** Charles M. Rubin, written commun., 1984; Rubin, 1984; Hitzman and others, 1986.

Q4-4 67 11 156 22	Arctic (Ambler)	Zn, Cu, Pb, Ag, Au Kuroko massive sulfide	37 million tonnes with 4.0% Cu, 5.5% Zn, 0.8% Pb, 47 g/t Ag, 0.62 g/t Au

SUMMARY: Stratiform, semimassive to massive chalcopyrite and sphalerite with lesser pyrite, minor pyrrhotite, galena, tetrahedrite, arsenopyrite, and traces of bornite, magnetite, and hematite. Deposit occurs in thick horizon with areal extent of about 900 by 1,050 m, and in two thinner horizons above main horizon. Sulfides form multiple lenses up to 15 m thick over stratigraphic interval of 6 to 80 m. Main horizon hosted in mainly graphitic pelitic schist and metarhyolite porphyry derived from submarine ash-flow tuff. Host rocks part of the Devonian and Mississippian Ambler sequence. Gangue mainly calcite, dolomite, barite, quartz, and mica. Locally abundant chlorite, phlogopite-talc-barite, and pyrite-calcite-white mica occur in hydrothermally-altered wall rocks overlying, underlying, and interlayered with sulfide mineralization. Alteration interpreted as occurring during rapid influx of cold seawater into a hot hydrothermal vent system. **REFERENCES:** Wiltse, 1975; Sichermann and others, 1976; Hitzman and others, 1982; Schmidt, 1983; Jeanine Schmidt, written commun., 1984; Schmidt, 1986, 1988; Hitzman and others, 1986.

Q4-5 67 04 156 59	Ruby Creek, (Bornite) (Ambler)	Cu, Co, Zn, Ag Kipushi Cu-Pb-Zn	91 million tonnes grading 1.2% Cu; 4.2 million tonnes of up to 4% Cu

SUMMARY: Strata-bound disseminated to massive chalcopyrite, bornite, chalcocite, pyrite, and minor sphalerite in brecciated dolomite and metamorphosed calcareous sedimentary rocks, part of the Devonian Bornite Marble (Hitzman and others, 1982). Local sparse carrollite, chalcopyrite, reinerite, galena, pyrrhotite, and marcasite. Large masses of dolomite breccia in matrix of dolomite, calcite, or fine-grained pyrite. Matrix of pyrite breccia locally replaced by Cu-, Zn-, and Co-sulfides. Individual zoned sulfide bodies with interior containing bornite, chalcocite, and carrollite, middle containing bornite, and chalcopyrite, and exterior containing chalcopyrite, pyrite, and peripheral pyrite. Hydrothermal mineralization extensive in dolostone bodies of biohermal and back-reef facies. Clasts of hydrothermal dolostone in breccias, possibly synsedimentary, indicate possible coeval mineralization and sedimentation. Three major hydrothermal dolomite formation events. Subsequent intense polymetamorphism to greenschist facies, and broad folding. **REFERENCES:** Runnells, 1969; Sichermann and others, 1976; Hitzman and others, 1982; Hitzman, 1983; M.W. Hitzman, written commun., 1984; Bernstein and Cox, 1986; Hitzman, 1986.

Q4-6 67 01 156 50	Asbestos Mountain	Asbestos, jade, asbestos, talc Serpentine-hosted asbestos	No data

SUMMARY: Serpentinite with veins of cross- and slip-fiber tremolite and chrysotile; small deposits of talc, soapstone, and nephrite. About 35 tonnes tremolite mined from 1940 to 1945. Probably source of nephrite jade boulders in Dahl Creek. Part of dismembered Jurassic or older ophiolite, exposed discontinuously in klippe in the Jade Mountains-Cosmos Hills area, along the northern flank of Yukon-Koyukuk basin. **REFERENCES:** Coats, 1944; Heide and others, 1949; Roeder and Mull, 1978; Loney and Himmelberg, 1985b.

Q4-7 66 16 157 20	Wheeler Creek (Purcell)	U Felsic plutonic U	Grab samples with up to 0.0125% U

SUMMARY: Uranothorianite and gummite in small, altered, smoky quartz-rich veinlets, and in altered areas in Late Cretaceous alaskite. Deposit about 500 m long by 50 m wide. **REFERENCES:** Eakins and Forbes, 1976; Miller, 1976; Jones, 1977.

Q4-8 66 16 155 50	Clear Creek (Purcell)	U Felsic plutonic U	Grab samples with up to 0.04% U, and 0.055% Th

SUMMARY: Uraniferous nepheline syenite and bostonite dikes in Late Cretaceous andesite. Dikes within contact aureole of Late Cretaceous monzonite to granodiorite pluton of Zane Hills. **REFERENCES:** Eakin and Forbes, 1976; Miller, 1976; Jones, 1977.

Q4-9 66 10 155 55	Zane Hills (Purcell)	U, Th Felsic plutonic U	Grab samples with up to 0.027% Th

SUMMARY: Uranothorianite, betafite, uraninite, thorite, and allanite in veinlets in foliated monzonite border phase of the Late Cretaceous Zane Hills pluton. Border phase grades to syenite; biotite-hornblende granodiorite in core of pluton. **REFERENCES:** Eakin and Forbes, 1976; Miller, 1976; Jones, 1977; Miller and Elliott, 1977.

Q4-10 65 30 161 26	Quartz Creek	Pb, Zn, As, Ag Polymetallic vein	Up to 15% combined Pb and Zn, and 340 g/t Ag

SUMMARY: Disseminated to massive sulfides scattered over zone 3.2 to 8 km wide and over 29 km long in altered andesite and granite of Jurassic or Cretaceous age. Mainly argentiferous galena, sphalerite, pyrite, and arsenopyrite. Local realgar, orpiment, and tourmaline also present. Considerable exploration, including drilling, in early 1970's. **REFERENCES:** Miller and Elliott, 1969; Bundtzen and others, 1984.

Q4-11 64 45 157 30	Perseverance	Pb, Ag, Sb Polymetallic vein(?)	Produced 231 tonnes of ore with average grade of 73% Pb, and 124 g/t Ag.

SUMMARY: Coarse-grained galena, tetrahedrite, and traces of fibrous jamesonite in veins crosscutting bedding and schistosity of Paleozoic(?) chlorite-mica schist. Gangue of dolomite and minor quartz. Vein strikes northeast-southwest and dips southeast. Oxidized zones of vein contain cerussite, azurite, malachite, and stibiconite(?). Mined from 1920 to 1927, and 1981. Age of deposit unknown. **REFERENCES:** Brian K. Jones, written commun., 1984.

Q4-12 64 05 158 00	Illinois Creek	Cu, Ag, Au, Pb, Zn Manto-replacement deposit (polymetallic Pn-Zn, Au)	Contains 1.54 million tonnes grading, 2.4 g/tonne Au and 70 g/tonne Ag

SUMMARY: High-grade galena-sphalerite veins near contact between altered Cretaceous granite porphyry, and massive, pipe-like gossan in marble. Most of the deposit was originally a massive sulfide body in Paleozoic quartzite, now completely oxidized. Illinois Creek is one of 3 polymetallic gold-bearing gossans aligned along a 12 km long trend parallel to the Kaltag Fault, a major transcurrent fault in Western Alaska. Most of the deposit is a completely oxidized massive sulfide body in Paleozoic quartzite. Abundant sericite alteration in nearby granitic plutons which contain stockwork veinlets with chalcopyrite, galena, and detectable precious metals. Other areas with epigenetic replacement, veins, and skarn with base-metal sulfides. Area is poorly exposed. The plutonic rocks intrude middle Paleozoic and older greenschist, quartzite, limestone, and orthogneiss. **REFERENCES:** Gillerman, 1988; William W. Patton, Jr., written commun.; G. Booth, written commun., 1991.

Q4-13 64 10 156 40	Kaiyuh Hills (Yuki River)	Cr Podiform Cr	Estimated 15,000 to 34,000 tonnes Cr_2O_3 in one deposit. Largest deposit averages 60% Cr_2O_3 on surface

SUMMARY: Banded and disseminated chromite from 1 cm to 1 m thick in fresh and serpentinized Jurassic(?) dunite of Kaiyuh Hills ultramafic belt. Dunite interlayered with harzburgite tectonite. Largest deposit, 1 m by 100 m, consists of massive chromite with estimated 5,000 tonnes Cr_2O_3. Lesser occurrences of banded nodular pods of chromite. Metallurgical grade chromite with 46% Cr_2O_3 present. Dunite and harzburgite tectonite faulted at base; interpreted as part of complexly deformed and dismembered ophiolite, part of Rampart ophiolite belt. **REFERENCES:** Loney and Himmelberg, 1984; Foley and others, 1984, 1992.

Q5-1 67 15 to 37 154 00 to 154 15	Mount Igikpak and Arrigetch Peaks	Cu, Pb, Zn, Ag, Au, Sn, W, As Polymetallic vein, Au quartz vein, Sn skarn, Cu-Pb-Zn skarn	Grab samples with up to 55 g/t Au, 150 g/t Ag, >0.18% Sn, with commonly substantial Cu, Pb, Zn, and W values

SUMMARY: Numerous small polymetallic vein, Au quartz veins, and skarn deposits in metasedimentary rocks adjacent to schistose Devonian granitic plutons. Wall rocks mainly Silurian and Devonian Skajit Limestone or older metasedimentary rocks. Most common deposits are: (1) quartz veins with varying amounts of galena, sphalerite, and chalcopyrite; (2) Sn skarns with disseminated cassiterite, magnetite, chalcopyrite, and arsenopyrite, in gangue of garnet, diopside, hornblende, clinozoisite, and idocrase; (3) Cu-Pb-Zn skarns with vein or sparse disseminated pyrrhotite, pyrite, chalcopyrite, galena, sphalerite, arsenopyrite, and fluorite with similar gangue as Sn skarns; and (4) areas of Fe-stained wall rocks with molybdenite and fluorite. **REFERENCES:** Grybeck and Nelson, 1981; Newberry and others, 1986.

Q5-2 67 25 152 50	Ann, (Ernie Lake) (Wiseman Quad.)	Pb, Zn, Ag Polymetallic vein (metamorphosed)	No data

SUMMARY: Vein and stratabound massive galena with lesser sphalerite, bornite, chalcopyrite, and secondary malachite and azurite in marble, calc-schist, and pelitic schist. Occurs in Late Proterozoic(?) banded schist and paragneiss. Deposit occurs adjacent to the granite pluton of Ernie Lake, as do similar smaller occurrences nearby, around periphery of pluton. Deposit may be polymetallic vein, or remobilized stratabound deposit. **REFERENCES:** Grybeck, 1977; John T. Dillon, oral commun., 1986.

Q5-3 67 19 151 14	Michigan Creek	As, Au, Ag, Cu, Zn, Pb Kuroko massive sulfide	Grab samples with up to 8.2% As, 8.3 g/t Au, 3.9 g/t Ag, 0.14% Cu, 0.03% Zn, 0.014% Pb

SUMMARY: Disseminated to massive chalcopyrite and argentiferous galena in layers up to 0.1 m thick in felsic schist and in cross-cutting pyrite veins. Occurs in felsic schist, marble, and phyllite of the Devonian and Mississippian Ambler sequence. **REFERENCES:** Dillon and others, 1981; William P. Brosge and John T. Dillon, oral commun., 1986.

Q5-4 67 08 155 52	BT, Jerri Creek (Ambler)	Cu, Zn, Pb, Ag Kuroko massive sulfide	BT: 3-4 million tonnes with 1.7% Cu, 2.6% Zn, 0.9% Pb, and 40 g/tonne Ag

SUMMARY: BT deposit: disseminated to massive pyrite, chalcopyrite, sphalerite, galena, and gossan in layers 5 to 12 cm thick. Sparse tennantite and possible enargite. Gangue is quartz, muscovite, and barium feldspar. No vertical zonation. Hosted in Devonian and Mississippian pelitic schist, calc-schist, and metarhyolite ("button") schist, part of the Ambler sequence. Strike length of 2,000 m; average width of 1.5 m. Layering strikes east-west and dips 50° to 70° south. Similar occurrences in zone up to 10 km long to west, along same stratigraphic horizon. Jerri Creek deposit: Mainly disseminated and sparse massive pyrite, sphalerite, and minor chalcopyrite in layers up to 2 cm thick. Hosted in muscovite-quartz schist, actinolite-garnet-quartz schist, and marble adjacent to metarhyolite, all part of the Devonian and Mississippian Ambler sequence. Strike length of 20 km. **REFERENCES:** Hitzman, 1978, 1981; Hitzman and others, 1986.

Q5-5 67 04 155 01	Sun, (Picnic Creek) (Ambler)	Cu, Zn, Pb, Ag, Au Kuroko massive sulfide	Less than 3 million tonnes of ore determined by drilling. Average grades of 1 to 4% Pb, 6 to 12% Zn, 0.5 to 7% Cu, 103 to 343 g/t Ag. Single quartz-barite bed with 685 to 1,029 g/t Ag

SUMMARY: Stratiform, disseminated to massive sphalerite, chalcopyrite, galena, and argentiferous tetrahedrite with pyrite, arsenopyrite, and barite. Deposit occurs in at least three horizons. Upper horizon is Zn-Pb-Ag rich; middle is mainly Cu-rich; and lower is Cu-Zn rich. Host rock is metarhyolite, muscovite-quartz-feldspar schist, micaceous calc-schist, marble, and greenstone, all part of the Devonian and Mississippian Ambler sequence. Host rocks generally strike northeast and dip moderately southeast. Locally well-developed layering in metarhyolite may represent original bedding in tuff protolith. Bulk of sulfides in felsic schist; thin concordant beds of sulfides in metarhyolite. Small- and large-scale isoclinal folds in host rocks and sulfide layers. **REFERENCES:** Zdepski, 1980; Christopher D. Maars, written commun., 1984; Hitzman and others, 1986.

Q5-6 67 10 152 30	Roosevelt Creek	Cu, Zn, Pb, Ag, Au Kuroko massive sulfide	No data

SUMMARY: Disseminated(?) and massive sulfides, probably mainly chalcopyrite, sphalerite, and galena, in metavolcanic rocks and pelitic schist and marble of the Devonian and Mississippian Ambler sequence. **REFERENCES:** Grybeck, 1977; William P. Brosge and John T. Dillon, oral commun., 1986.

Q5-7 66 05 150 55	Caribou Mountain, Lower Kanuti River, Holonada	Cr Podiform Cr	Estimated 2,300 tonnes Cr_2O_3 at Caribou Mountain, 730 tonnes at Lower Kanuti River, and up to 25,000 tonnes at Holonada

SUMMARY: Elongate belt over 100 km long contains podiform Cr deposits in Jurassic or older dunite and peridotite tectonite. Largest deposits are at Caribou Mountain, lower Kanuti River, and Holonada. Caribou Mountain: ten chromite occurrences; three containing bands of massive chromite, and magnesian chromohercynite in layers up to 3 m thick and 20 m long. Lower Kanuti River: one layer about 1.5 m wide and at least 25 m long with high-chromium chromite contains 7.5% Cr_2O_3. Holonada: ten occurrences of bands of disseminated to massive chromite several meters thick and long. One occurrence 1.5 to 3 m thick with exposed strike length of 130 m, with average grade of 20% Cr_2O_3. Four other occurrences with about 1,000 tonnes averaging 4% to 8% Cr_2O_3. Deposits at all three areas interpreted as part of complexly deformed and disrupted ophiolite, part of Yukon-Koyukuk ophiolite belt. **REFERENCES:** Patton and others, 1976; Foley and McDermott, 1983; Foley and others, 1985; Loney and Himmelberg, 1985a.

Q5-8 66 37 150 01	Bonanza Creek	W, Ag, Cu W skarn	Grab samples with up to 0.89% W, 300 g/t Ag, 0.65%Cu

SUMMARY: Scheelite, chalcopyrite, and pyrrhotite in skarn adjacent to intrusive contact with biotite granite pluton. Scheelite occurs mainly as sparse disseminated grains, associated with very sparse sulfides in garnet-pyroxene skarn and on fracture surfaces in calc-silicate schist. Local limonite staining. Local quartz-scheelite veins in calc-silicate schist, and quartz-molybdenite veins in biotite granite. Granite pluton part of the Kanuti batholith with K-Ar age of 90.6 Ma. Wall rocks include middle Paleozoic or older pelitic schist, quartz-mica schist, quartz-feldspar schist, quartzite, and calcareous quartz-mica schist. Deposit associated with marble layer, about 15 m thick, interlayered with pelitic schist. Exploration limited to several trenches. **REFERENCES:** Clautice, 1980.

Q5-9 66 30 150 10	Upper Kanuti River	Pb, Zn, Ag Polymetallic or epithermal vein	Grab samples with up to 2% Pb, 0.3% Zn, and 30 g/t Ag

SUMMARY: Disseminated pyrite, galena, and sphalerite in masses up to 5 mm in diameter occur in extensive altered gossan zone about 100 m long in silicified, locally brecciated, early Tertiary rhyolite porphyry. Rhyolite caps and probably intrudes a Cretaceous pluton of the Kanuti batholith. **REFERENCES:** Patton and Miller, 1970.

Q5-10 65 16 150 25	Avnet (Buzby)	Mn, Ag (Mn-Ag vein)	Grab samples contain 0.6 to 34% Mn and up to 9.6 g/t Ag

SUMMARY: Irregular masses of psilomelane up to almost 8 cm long occur in latticework of thin seams of quartz, and as thin surface coatings on fractured lower and middle Paleozoic chert, quartzite, limestone, dolomite, and greenstone. Exploration consists of one trench and two pits. **REFERENCES:** Thomas, 1965.

Q5-11 65 02 150 45	Hot Springs Dome	Pb, Ag, Zn, Au (Cu, Co) Polymetallic vein	Grab samples contain about 5.8 g/t Au, up to 274 g/t Ag, 3.7% Pb, and 0.32% Zn

SUMMARY: Six, east-west-striking veins, possibly in shear zones, in contact-metamorphosed argillite, graywacke, conglomerate, and minor conglomerate; part of Jurassic and Cretaceous flysch sequence. Veins at surface contain galena coated with anglesite and limonite. At depth, veins also contain siderite, copper carbonates, chalcopyrite, pyrrhotite, pyrite, and erythrite. Zone up to 600 m long and 9 m wide. Numerous quartz veinlets. Deposit is at contact with early Tertiary biotite granite. Exploration consists of three shallow shafts. **REFERENCES:** Maloney, 1971.

Q5-12 64 45 155 30	Beaver Creek	Ag, Pb, Zn Polymetallic vein	Estimated 14,000 tonnes grading 103 g/t Ag, 0.8% Zn and 0.5% Cu; additional 19,000 tonnes grading 26.1 g/t Ag, 4.2% Pb, 0.16% Zn, 0.2% Cu

SUMMARY: Highly oxidized zones with limonite, goethite, argentiferous galena, quartz, and sphalerite; surface occurrences of massive galena and limonite-cerussite gossan. Two zones occur for 300 m along strike, and range from 2.5 to 5 m thick. Zones separated by fractured schist and marble occur in middle Paleozoic(?) muscovite schist trending northeast-southwest and dipping steeply northwest. Deposition of sulfides controlled by metamorphic structures in host rocks. Age of deposit unknown. **REFERENCES:** Brown, 1926; Thomas, 1963; Brian K. Jones, written commun., 1984.

Q6-1 67 45 149 05	Jim-Montana	Cu, Zn, Ag, Pb Cu-Zn skarn	No data

SUMMARY: Disseminated chalcopyrite, sphalerite, with minor galena, tennantite, and malachite stain in skarn developed in marble of the Silurian and Devonian Skajit Limestone. **REFERENCES:** Grybeck, 1977; DeYoung, 1978. .

Q6-2 67 36 149 50	Sukakpak Mountain	Au, Sb, Mo (Hg) Sb-Au vein	Grab samples with up to 560 g/t Au, 4.5 g/t Ag, 54% Sb, 1.7% Mo, and 0.50% Hg

SUMMARY: Disseminated stibnite, with sparse cinnabar, gold, and molybdenite(?) in three calcite-stibnite quartz veins along a high-angle fault that cuts Devonian marble, dolomite, graphitic and calcareous quartz schist. Stibnite forms up to 60 percent of vein. Zone of veins extends for about 1 km with maximum zone width about 100 m. Local slickensides and boudins in veins suggest emplacement during movement on fault. **REFERENCES:** Dillon, 1982.

Q6-3 67 38 149 20	Victor, Venus, Evelyn Lee, and Ebo	Cu, Ag, Mo Porphyry Cu and Cu skarn	Zones in granitic rocks up to 30 m wide contain up to 0.4% Cu. Grab samples of skarn contain up to 5.5% Cu, 0.41 g/t Au, and 0.29 g/t Ag

SUMMARY: Veinlet and disseminated chalcopyrite, bornite, molybdenite, and pyrite in schistose Devonian granodiorite porphyry intruding Silurian and Devonian Skajit Limestone or older marble, calc-schist, and pelitic schist. Skarn in marble adjacent to plutons contain vugs with interstitial bornite, chalcopyrite, bornite, chalcocite, pyrite, magnetite, and some digenite. Skarn consists mainly of garnet, magnetite, diopside, and retrograde vein and replacement epidote, amphibole, chlorite, calcite, and quartz. Skarns were subsequently regionally metamorphosed. **REFERENCES:** DeYoung, 1978; Donald Grybeck, written commun., 1984; Newberry and others, 1986.

Q6-4 67 41 148 49	Geroe Creek	Cu, Mo Porphyry Cu-Mo	Zones in plutons up to several m thick with up to 0.6% Cu, 0.02% Mo, and 0.1 g/t Au.

SUMMARY: Veinlet, stockwork, and disseminated molybdenite, chalcopyrite, and pyrite with quartz, sericite, and chlorite in the Devonian Horace Mountain and Baby Creek plutons composed of metaluminous biotite-hornblende granite with local porphyritic phases. Wall rocks mainly the Silurian and Devonian Skajit Limestone and older calcareous metasedimentary rocks. **REFERENCES:** DeYoung, 1978; Newberry and others, 1986.

Q6-5 67 32 148 15	Chandalar district (Mikado, Little Squaw) (Chandalar)	Au Au quartz vein	12,000 tonnes with 75 g/t Au at Mikado and Little Squaw mine. Estimated 45,000 tonnes grading 80 g/t Au for district

SUMMARY: Scattered, minor arsenopyrite, galena, sphalerite, stibnite, and pyrite with gold in several quartz veins up to 3 m thick in a zone about 4.0 km long and 1.6 km wide. Veins occur along steeply dipping normal faults in Devonian or older quartz-muscovite schist, phyllite, and quartzite. Veins interpreted to have been emplaced during fault movement. More than 1,000 m of underground workings at Little Squaw and Mikado mines. Minor production and several episodes of exploration activity, notably during the 1920's and 1960's. **REFERENCES:** Chipp, 1970; DeYoung, 1978; Dillon, 1982; Ashworth, 1983; John T. Dillon, oral commun., 1986; Rose and others, 1988.

Q6-6 65 23 149 30	Sawtooth Mountain	Sb (Au, Ag) Sb-Au vein	Grab samples from dump contains up to 46.2% Sb, 0.7 g/t Au, and 15.1 g/t Ag. Produced about 590 tonnes with 58% Sb_2S_3 through 1970

SUMMARY: Massive stibnite in a vertical cylindrical lens about 3 m wide. Hosted in argillite of Late Jurassic or Early Cretaceous flysch near contact with Cretaceous granite with K-Ar age of 88.3 Ma. One shaft about 30 m deep. Most production occurred during Korean War. Minor production in 1970 and 1985. **REFERENCES:** R.M. Chapman, written commun., 1985.

Q6-7 65 31 148 30	Gertrude Creek, Griffen, Ruth Creek	Au, Sb (Ag, Pb) Sb-Au vein	Grab samples with up to 15% Sb and 3.9 g/t Au

SUMMARY: Quartz stringers up to 8 cm wide with pyrite, arsenopyrite, stibnite, and gold in altered diorite and silica-carbonate rock that consists of dolomite, calcite, and quartz. Hosted in middle Paleozoic greenstone, slate, calc-schist, and Cretaceous monzonite. Mineralized quartz stringers also in shear zone adjacent to serpentinite. Exploration limited to short adit and a few pits scattered across Amy Dome area. **REFERENCES:** Foster, 1968a, b; Allegro, 1984a.

Q6-8 65 30 148 22	Hudson Cinnabar	Hg (Hg quartz vein)	Possibly minor Hg produced

SUMMARY: Cinnabar in disseminations and quartz veins in altered Late Cretaceous to early Tertiary granite dikes and plutons intruding Ordovician to Devonian siltstone and argillite. Minor exploration over years but long dormant. **REFERENCES:** Robinson and others, 1982.

Q6-9 65 37 146 43	Lime Peak	Sn, Ag, Zn, U, W Sn greisen and Sn vein	Grab samples with up to 0.16% Sn, 0.5% Cu, 0.2% Pb, 1.8% Zn, 14 g/t Ag. Estimate 50% probability of 320,000 tonnes of Sn and 10 million ounces Ag

SUMMARY: Areas of veinlets, breccia zones, and pods of black tourmaline, and areas of chlorite, sericite, green tourmaline, and quartz alteration in early Tertiary hypabyssal, peraluminous, biotite granite pluton. Granite pluton cut by numerous felsic and minor intermediate dikes. Veins up to 0.5 m wide. Areas of veinlets, breccia zones, and tourmaline pods interpreted as deuteric alteration; areas of chlorite, sericite, and quartz interpreted as hydrothermal alteration. Anomalous high values of Sn and associated pathfinder elements (Ag, B, Bi, Mo, Pb, Zn) found in rock samples from and around pluton. Rare fluorite, topaz, pyrite, chalcopyrite, and molybdenite in altered areas. Placer cassiterite in surrounding area. Two main phases to pluton: older coarse-grained equigranular biotite granite; younger porphyritic biotite granite with fine-grained groundmass. Local miarolitic cavities in pluton. K-Ar ages of 57-66 Ma for granites associated with mineralization; intrude Cambrian(?) sandstone, shale, slate. **REFERENCES:** Menzie and others, 1983; Burton and others, 1985; W. David Menzie, written commun., 1985; Smith and others, 1987.

Q6-10 65 29 147 05	Roy Creek (former Mount Prindle)	U, Th Felsic plutonic U	Drill core with up to 5 to 10% REE by volume

SUMMARY: Thin veins with allanite, bastnaesite, monazite, thorianite, thorite, uraninite, and xenotime cut Cretaceous porphyritic biotite syenite and alkali granite. Deposit contains significant La, Ce, Nd, Pr, Y, and fluorite. Marked by hematitic alteration of wall rocks and leaching of magnetite in host rocks. Deposit and granitic rocks occur about 25 km west of Mount Prindle and intrude Cambrian(?) sandstone, quartzite, argillite, and chert. **REFERENCES:** Burton, 1981.

Q6-11 65 00 147 49	Scrafford (Fairbanks)	Sb, Au Sb-Au vein	Footwall chip samples contain 1.4 to 5.7 g/t Au. Produced 906,000 kg Sb from 2,500 tonnes ore, averaging 36% Sb.

SUMMARY: Massive stibnite along east-west-striking shear zone. Also disseminated quartz stockwork and veinlets with arsenopyrite and stibnite in feldspathic quartzite and quartz mica schist in footwall of shear zone. Barren pelitic schist and quartzite in hanging wall. Host rocks part of the upper Precambrian(?) Cleary sequence, part of the mid-Paleozoic or older Yukon-Tanana terrane. Several periods of active mining when Sb prices have been high. **REFERENCES:** Chapin, 1914, 1919; Metz and Halls, 1981; Robinson and Bundtzen, 1982; Thomas E. Smith and Paul A. Metz, written commun., 1984; Metz, 1991.

Q6-12 65 04 147 25	Cleary Summit area (Fairbanks)	Au, Ag (Pb, Zn, Sb, As, W, Sn) Polymetallic veins, Au-quartz veins	Total production estimated as 145,000 tonnes containing 10 to 55 g/t Au

SUMMARY: Quartz fissure veins from a few centimeters to a few meters thick with various proportions of gold, boulangerite, jamesonite, galena, stibnite, pyrite, arsenopyrite, tetrahedrite, and minor scheelite. Most productive veins strike northwest-southeast and dip variably to south. Cleary summit region includes 78 known lode occurrences, 30 with production. Veins in interlayered mica quartzite, graphitic schist, pelitic schist, chlorite-actinolite greenschist, calc-schist, and marble of the upper Precambrian(?) Cleary sequence, part of the mid-Paleozoic or older Yukon-Tanana terrane. Several theories of origin have been proposed. The older is that the veins are related to Cretaceous intermediate composition plutons, several of which are exposed or are proposed under the Cleary anticline. More recently, several workers have proposed that the metals and the veins were remobilized from the Cleary Sequence. The veins are the source of rich placers in creeks that drain the area. Several periods of active mining, mostly before 1941. The largest producers were the Cleary Hill and Hi-Yu mines. Persistent, though somewhat erratic, exploration since before World War I, including several major exploration projects in the 1980's. **REFERENCES:** Chapman and Foster, 1969; Metz and Halls, 1981; Smith and others, 1981; Newberry and Burns, 1988; Robinson and others, 1990; Metz, 1991.

Q6-13 62 45 151 50	Fort Knox (Fairbanks)	Au, Ag, Mo (Bi) Granitoid-related gold	125 million tonnes 1.6 g/tonne Au

SUMMARY: Free gold, bismuthinite, and minor to trace molybdenite and chalcopyrite in sulfide-poor, quartz vein stockwork. Gold is remarkable pure (980 fine) which is extremely unusual. Mineralization hosted in porphyritic granodiorite and preferentially emplaced along a steeply dipping fracture system trending North 70 degrees West. Deposit is at least 1500 meters long, 300 meters wide, and 250 meters deep and open ended at depth. Chemically, the Fort Knox pluton, which hosts the mineralization, is alkali-calcic and peraluminous. Mineralization may have occurred during late stages of emplacement of the nearby Gilmore Dome stock which is radiometrically dated at 92 Ma., or alternatively, during a younger heating event that post-dates early Mo-Bi mineralization. **REFERENCES:** Robinson and others, 1990; Arne Bakke, written commun., 1991.

Q6-14 64 59 147 21	Stepovich Lode (Fairbanks)	W, Au W skarn	Estimated 20,000 tonnes grading 0.5 to 3.6% WO_3. Produced about 4,000 units WO_3

SUMMARY: Scheelite in layered skarn, or locally in zoned veins crosscutting skarn. Skarn types include scheelite-amphibole-quartz-calcite, pyroxene-garnet-scheelite, and quartz-amphibole-calcite-scheelite varieties. District includes 15 known lode tungsten prospects, four with significant production. Skarns form discontinuous bodies near, and at contact with the Gilmore Dome (granite) pluton of Late Cretaceous age. Deposit occurs in calc-schist and marble of the Cleary sequence and in interlayered amphibolite, all part of the middle Paleozoic or older Yukon-Tanana terrane. Includes Spruce Hen, Yellow Pup, and Stepovitch mines. Production between 1916-1919, 1941-1945, and 1951-1955. **REFERENCES:** Byers, 1957; Metz and Halls, 1981; Robinson, 1981; Allegro, 1984b; Robinson and others, 1990; Metz, 1991.

Q6-15 64 52 148 05	Ester Dome (Fairbanks)	Au, Ag Polymetallic vein(?)	Has produced 194,000 tonnes of ore with grades of 3.0 to 80.0 g/tonne Au

SUMMARY: Quartz fissure veins from a few centimeters to 5.5 m thick and up to 1,200 m long with gold, pyrite, arsenopyrite, and stibnite, and minor jamesonite, argentite, chalcocite, and covellite. Area includes 58 known lode occurrences, 27 with production. The largest deposits include Ryan Lode and the Grant and Mohawk deposits. Steeply dipping quartz veins up to a few meters thick most common; local sheared veins up to 22 m thick. Multiple episodes of quartz deposition. Veins occur in micaceous quartzite, graphitic schist, calc-schist, and marble of mid-Paleozoic or older Yukon-Tanana terrane. About 26 producing vein deposits in area. The Silver Dollar and Mohawk deposits contain an estimated 900,000 tonnes grading 3.0 g/tonne Au and 6.0 g/tonne Ag. Grant deposit has estimated 300,000 tonnes grading 6.9 to 27 g/t Au. Ryan Lode deposit has estimated 9.1 million tonnes ranging from 2.0 to 15.0 g/t Au. Several periods of production, notably in the 1930's and the 1980's. The most prominent properties are the Ryan Lode and the Grant mine; both of which are currently active. Ester Dome undoubtedly is the source for some of the rich placers located radially around it. **REFERENCES:** Hill, 1933; Thomas, 1973; R.C. Burggraf, written commun., 1989, Robinson and others, 1990.

Q6-16 65 21 146 33	Dempsey Pup	Sb, Au(?) Sb-Au vein or polymetallic vein(?)	Grab samples with up to 28% Sb. Produced a few hundred tonnes of low-grade ore.

SUMMARY: Quartz vein with small lenses and stringers of stibnite and possibly gold. Hosted in middle Paleozoic or older quartz schist, mica schist, and marble of Yukon-Tanana terrane. Several short tunnels. **REFERENCES:** Killeen and Mertie, 1951.

Q6-17 65 29 145 53	Table Mountain	Au (Sn, Be, W) Sn-polymetallic vein	Grab samples with up to 140 g/t Au and 0.15% Be

SUMMARY: A variety of types of deposits, all(?) associated with felsic igneous rocks. Pyrrhotite, arsenopyrite, minor chalcopyrite, rare enargite and sphalerite, and high Au values occur in black biotite schist and in quartz veins adjacent to fault zone intruded by a hypabyssal felsic dike. About 5 km northeast, low Au values in in felsic dikes and in country rocks adjacent to early Tertiary granite pluton, and in felsic dikes in granite. Granite pluton crops out over 2 sq km area. Granite and adjacent biotite schist contain high Be values. Small skarns with high W-Au values. Local quartz-tourmaline veins with pyrrhotite, arsenopyrite, scheelite, stibnite, and carbonate veins. **REFERENCES:** Burack, 1983; Foster and others, 1983; W. David Menzie, written commun., 1985; Newberry and Burns, 1988.

Q6-18 65 27 144 50	Bedrock Creek	Cu, W, Th Porphyry Cu(?)	No data

SUMMARY: Disseminated monazite with minor scheelite, pyrrhotite, garnet, ilmenite, zircon, biotite, topaz, and malachite in early Tertiary granite of the Circle pluton (K-Ar age of 60.5 Ma). Pluton intrudes middle Paleozoic or older schist of Yukon-Tanana terrane. **REFERENCES:** Nelson and others, 1954.

Q6-19 65 33 145 15	Miller House	Au (Au-As vein)	Grab samples with up to 3.9 g/t Au

SUMMARY: Massive to disseminated arsenopyrite in four large and four small, iron-stained shear zones over 150 m long that cut mid-Paleozoic or older schist of Yukon-Tanana terrane. Intense alteration along zones. Possibly Early Tertiary age interpreted for deposit. **REFERENCES:** Tripp and others, 1982; Menzie and others, 1983.

Q6-20	Democrat (Mitchell Lode)	Au, Ag, Pb, Sb	1989 test output was 88,000 tonnes
64 20	(Fairbanks)		at 2.2 g/tonnes Au; 5.0 g/tonnes Ag
146 22		Granitoid-related gold	

SUMMARY: Tetrahedrite, galena, acanthite, owyheeite, and other silver sulfosalts, and free gold with quartz in hydrothermally altered granite porphyry. Granite yields K-Ar age of 89 Ma. Strong sericite alteration halo surrounds stock, which intrudes sillimanite bearing schists of Yukon-Tanana terrane. Granite porphyry is part of 35 km long sill complex that intrudes along Richardson Lineament. Gold bullion occurs as interlocking alloys of native silver and high fineness gold that averages 67% gold and 33% silver. Silver sulfosalts locally abundant with 'bonanza' grades of up to 66,000 g/tonne silver obtained in localized mineral zones. Mineralization believed to have formed during high level emplacement of granite porphyry along Richardson Lineament. **REFERENCES:** Bundtzen and Reger, 1977; T.K. Bundtzen and R.B. Forbes, written commun., 1990.

Q6-21	Blue Lead, Tibbs Creek,	Au, Ag, Sb	Produced 905 g Au and 707 g Ag
64 20	Gray Lead		from 136 tonnes ore
144 14		Polymetallic vein or Sb-Au vein	

SUMMARY: Group of quartz veins with gold, pyrite, arsenopyrite, and stibnite. Veins pinch and swell; width ranges from 1 cm to 2.4 m, with average of 1 m. Masses of nearly pure stibnite up to 0.6 m thick and 30 m long. Veins occur in Cretaceous(?) granitic rocks intruding mid-Paleozoic or older metasedimentary rocks of the Yukon-Tanana terrane. Abundant faults and shear zones. About 240 m underground workings. Explored from about 1935 to 1941. Minor production in 1970's. **REFERENCES:** Thomas, 1970; Menzie and Foster, 1978; Robinson and others, 1982.

Q6-22	Liberty Bell	Au, Ag, Cu, Bi	Estimated 91,000 tonnes with 34.3
64 37			g/t Au, 10% As, 2.0% Cu
148 51		Kuroko massive sulfide(?) or polymetallic gold vein	

SUMMARY: Fine-grained arsenopyrite, chalcopyrite, pyrrhotite, and bismuthite in stringers and laminations that occur parallel to foliation. The sulfide zone reaches a maximum thickness of 10 m and is 200 m long. Layering ranges from a few centimeters to 1 m thick. Lenses and laminations parallel foliation in siliceous metavolcanic phyllite of the California Creek Member of the Mississippian(?) Totatlanika Schist, but are locally folded. Quartz-tourmaline-sulfide veins, locally with symmetrical wall rock alteration, are from 10 cm to 1 m thick and crosscut sulfide zones and adjacent schist. The sulfides occur immediately adjacent to a metamorphosed porphyry interpreted as a Paleozoic igneous plug that was contemporaneous with the volcanic rock protoliths of the Totatlanika Schist. White mica from plug yields K-Ar age of 90 Ma, which indicates the age of a regional metamorphic event in the Yukon-Tanana terrane. Quartz veins may represent either remobilized stratiform sulfides, or polymetallic veins associated with nearby Tertiary(?) plutonic rocks. Gold produced in 1930's. **REFERENCES:** Hawley, 1976; E.R. Pilgram, written commun., 1976; Gilbert and Bundtzen, 1979; Bundtzen and Gilbert, 1983; Thomas K. Bundtzen, written commun., 1985, 1989.

Q7-1	Ketchem Dome	Sn	Grab samples with up to 0.51% Sn
65 29			
144 41		Sn greisen	

SUMMARY: Greisen zones, up to 4 cm wide, and quartz veins in intensely altered, chloritic breccia along northern margin of the multi-phase early Tertiary, Circle (granite) pluton (K-Ar age of 60.5 Ma). Pluton intrudes mid-Paleozoic or older schist of the Yukon-Tanana terrane. Limited exploration in 1978 and 1981. **REFERENCES:** Foster and others, 1983; Menzie and others, 1983; W. David Menzie, written commun., 1984.

Q7-2 65 12 141 12	Three Castle Mountain	Pb, Zn (Ba) Sedex Pb-Zn (Ba)	Grades of up to 17% Zn and 2% Pb in 3 separate deposits

SUMMARY: Disseminated to massive galena, sphalerite, and barite in middle to lower Upper Devonian chert, shale, and limestone of the McCann Hill chert. At least three deposits: Three Castle Mountain, Pleasant Creek, and VABM Casca have been prospected, and other occurrences are also known. Sulfides and barite occur as disseminated to massive layers 3-100 cm thick in mudstone, and also locally as coarser grained, sphalerite-dominated masses in carbonate breccia. Thought to be "Sed-ex" mineralization similar to mid-Paleozoic examples in western Brooks Ranges or western-most Alaska Range (eg: Gagaryah deposit). **REFERENCES:** Brabb and Churkin, 1969; Bundtzen and others, 1982; T.K.Bundtzen, written commun., 1992.

Q7-3 65 07 144 38	Salcha River	W W skarn	No data

SUMMARY: Scheelite occurs in discontinuous idocrase-garnet skarn, in layered calc-silicate schist, and in impure marble along contact with early Tertiary granite pluton. Schist and marble part of mid-Paleozoic or older Yukon-Tanana terrane. **REFERENCES:** Foster and others, 1983; Menzie and others, 1983; W. David Menzie, written commun., 1984.

Q7-4 64 34 142 11	Eagle C3	PGE Podiform Cr(?)	Grab samples contain up to 3 g/t Pt, 1.5 g/t Pd, and 0.03 g/t Rh

SUMMARY: Anomalous PGE in two lenses of clinopyroxenite in small ultramafic body that appears to be pendant in a small Mesozoic(?) granodiorite pluton. Pyroxenite intruded by coarse-grained, irregular felsic dikes. Local hydrothermal alteration associated with felsic dikes. Anomalous PGE in altered zone and in clinopyroxenite. Only one of the 32 separate ultramafic bodies in area exhibits significant values of PGE. Clinopyroxenite may be part of deformed ophiolite of Seventymile terrane, or part of zoned mafic-ultramafic pluton. **REFERENCES:** Foster and Keith, 1974; Foster, 1975; Keith and others, 1987.

Q7-5 64 31 142 30	Slate Creek (Fortymile)	Asbestos Serpentine-hosted asbestos	Estimated 58 million tonnes grading 6.4% fiber

SUMMARY: Antigorite with minor clinochrysotile, chrysotile, magnetite, brucite, and magnesite in serpentinized harzburgite. Chrysotile asbestos occurs in zones of fracturing near centers of thicker serpentinite, primarily as cross-fiber asbestos in randomly oriented veins about 0.5 to 1 cm thick. Veins contain alternating zones of chrysotile and magnetite, and commonly exhibit magnetite selvages. Some chrysotile altered to antigorite. Harzburgite occurs as tabular tectonic lenses, generally from 60 to 150 m thick and up to 800 m long. Ultramafic rocks part of deformed ophiolite of Seventymile terrane. **REFERENCES:** Foster and Keith, 1974; Robert K. Rogers, written commun., 1984.

Q7-6 64 07 141 55	Purdy	Au Au quartz vein	Minor production

SUMMARY: Small deposit notable for large quartz-calcite fissure vein and veinlets with spectacular "lace" gold. Large vein extends about 2 m; terminated at one end by fault. Large vein completely mined-out by 1960. Vein and veinlets cut mid-Paleozoic or older metasedimentary schists of Stikinia(?) terrane. Small veins and veinlets mined in 1969 and early 1970's. **REFERENCES:** Helen L. Foster, written commun., 1984; W. David Menzie, written commun., 1985.

R3-1 68 12 163 07	Lik	Zn, Pb, Ag, Barite Sedimentary exhalative Zn-Pb-Barite	25 million tonnes of 8.8% Zn, 3.0% Pb, and 38 g/t Ag

SUMMARY: Disseminated and massive sphalerite, galena, pyrite, marcasite, and sparse barite in Mississippian and Pennsylvanian shale, chert, and quartz-exhalite of Kuna Formation. Main deposit in zone about 2,000 m long that extends up to 500 m downdip. Ore zones open along strike to north and south. Sulfide horizon varies from tabular to complexly folded. Long and sinuous zone of complex and brecciated textures, possibly a line of vents, occurs within center of deposit, parallel to strike. Host rocks and deposit extensively structurally imbricated with many subhorizontal thrust faults. **REFERENCES:** Forrest, 1983; Forrest and others, 1984; Forrest and Sawkins, 1987.

R3-2 68 04 162 50	Red Dog	Zn, Pb, Ag, Ba Sedimentary exhalative Zn-Pb-Barite	85 million tonnes of 17.1% Zn, 5% Pb, and 82 g/t Ag

SUMMARY: Disseminated and massive sphalerite, galena, pyrite, and barite in Mississippian and Pennsylvanian shale, chert, and silica exhalite of the Kuna Formation. Deposit is 1,600 m long and up to 150 m thick. Occurs near base of formation which is locally subdivided into upper ore-bearing Ikalukrok unit and lower calcareous Kivalina unit of this locality. Latter forms stratigraphic footwall for deposits. Barite-rich lenses up to 50 m thick locally cap deposit. Deposit may consist of disseminated sulfides in organic-rich siliceous shale, coarse-grained sulfide veins, fine-grained fragmental-textured to indistinctly bedded sulfides, and silica exhalite lenses. Minor hydrothermal alteration marked by silicification and decarbonatization of shale. Small propylitically altered dioritic plug or hydrothermally altered pyroxene andesite flow occurs at north end of deposit. Host rocks and deposit extensively structurally imbricated with many subhorizontal thrust faults. Graywacke of the Cretaceous Okpikruak Formation structurally underlies deposit. **REFERENCES:** Tailleur, 1970; Plahuta, 1978; Booth, 1983; Joseph T. Plahuta, L.E. Young, J.S. Modene, and David W. Moore, written commun., 1984; Lange and others, 1985; Moore and others, 1986; Schmidt and Zierenberg, 1988.

R4-1 68 20 161 52	Avan	Cr, PGE Podiform Cr	Grab samples with up to 43% Cr and 0.48 g/t PGE. Estimated 290,000 to 600,000 tonnes chromite

SUMMARY: Disseminated fine- to medium-grained chromite in Jurassic or older dunite and harzburgite tectonite, locally serpentinized. Part of dismembered ophiolite. Zones of chromite up to a few meters wide and a few hundred meters long in dunite. Intense minor folding of dunite and harzburgite layers. Host rocks part of the Misheguk igneous sequence. Mafic and ultramafic rocks floored by major thrust fault. **REFERENCES:** Roeder and Mull, 1978; Degenhart and others, 1978; Zimmerman and Soustek, 1979; Mayfield and others, 1983; Foley and others, 1985, Foley, 1988.

R4-2 68 15 161 05	Misheguk Mountain	Cr, PGE Podiform Cr	Grab samples with up to 27.5% Cr and 0.31 g/t PGE. Estimated 110,000 to 320,000 tonnes chromite

SUMMARY: Disseminated fine- to medium-grained chromite in Jurassic or older dunite and peridotite tectonite, locally serpentinized. Part of dismembered ophiolite. Zones with chromite up to 31 by 107 m. Intense minor folding of dunite and harzburgite layers. **REFERENCES:** Roeder and Mull, 1978; Degenhart and others, 1978; Zimmerman and Soustek, 1979; Foley and others, 1985, Foley, 1988.

R4-3 68 24 159 54	Nimiuktuk	Barite Bedded barite exhalative	About 1.5 million tonnes barite

SUMMARY: Massive, nearly pure barite in small isolated hill about 7 to 10 m high, 40 m wide, and 60 m long. Stratigraphic contacts not exposed; nearest units are dark shale and chert of the Mississippian and Pennsylvanian Kuna Formation and shale and graywacke of the Lower Cretaceous Okpikruak Formation. Altered Mississippian(?) andesite crops out about 180 m from barite. Size of deposit determined with model developed by gravity survey. **REFERENCES:** Mayfield and others, 1979; Barnes and others, 1982.

R4-4 68 34 158 41	Drenchwater	Zn, Pb, Ag Sedimentary Zn-Pb and (or) kuroko massive sulfide	Grab samples with more than 1% Zn, 2% Pb, and 150 g/t Ag

SUMMARY: Disseminated and massive sphalerite, galena, pyrite, and barite in Mississippian shale, chert, tuff, and quartz-exhalite of the Kagvik sequence. Volcanic sandstone and keratophyre locally abundant. Sulfides occur as disseminations in chert, disseminations and massive aggregates in quartz-exhalite, and as sparse, remobilized disseminations in sulfide-quartz veins crosscutting cleavage in shale and chert. Locally extensive hydrothermal alteration of chert and shale with extensive replacement by kaolinite, montmorillonite, sericite, prehnite, fluorite, actinolite, chlorite, calcite, and quartz. Deposit up to 1,800 m long and up to 50 m thick. Host rocks and deposit extensively faulted and structurally imbricated with many thrust faults dipping moderately south. **REFERENCES:** Tailleur and others, 1977; Nokleberg and Winkler, 1982; Lange and others, 1985.

R4-5 68 20 158 30	Siniktanneyak Mountain	Cr, Ni, PGE Podiform Cr	Grab samples with up to 21% Cr, 0.2% Ni, 0.07 g/t Pt, and 0.1 g/t Pd.

SUMMARY: Disseminated fine-grained chromite in discontinuous layers, pods, and wispy layers in Jurassic or older dunite and peridotite tectonite, locally serpentinized. Intense minor folding of dunite and peridotite layers. Host rocks part of the Misheguk igneous sequence. Mafic and ultramafic rocks floored by major thrust fault. **REFERENCES:** Jansons and Baggs, 1980; Nelson and Nelson, 1982; Mayfield and others, 1983.

R4-6 68 22 157 56	Story Creek	Pb, Zn, Ag, Au Pb-Zn-Au-Ag vein	Grab samples with up to 1.5 to 34% Pb, 1.5 to 50% Zn, 35 to 940 g/t Ag, and 1.2 g/t Au.

SUMMARY: Crustified sphalerite and galena in cross-cutting quartz veins in tightly folded and faulted sandstone, siltstone, and shale of the Mississippian Kayak Shale; part of Brooks Range allochthon. Maximum width of float zone about 30 to 40 m. Discontinuous mineralized float and outcrops along a linear trend about 3,000 m long across tightly folded strata, indicating origin by replacement in Late Jurassic or younger time. **REFERENCES:** Ellersieck and others, 1982; Mayfield and others, 1983; Jeanine M. Schmidt and Inyo F. Ellersieck, written commun., 1985.

R4-7 68 14 157 51	Whoopee Creek	Zn, Ag, Au (Zn-Ag-Au vein)	Grab samples with up to 44% Zn, 458 g/t Ag, and 4.4 g/t Au

SUMMARY: Fracture zones contain siltstone breccia with matrix of galena, sphalerite, quartz and minor carbonate occurs in tightly folded and faulted sandstone, siltstone, and shale of the Mississippian Kayak Shale. Fracture zone about 6 m long. Discontinuous float or outcrops along a linear trend with minimum length of 1,500 m across tightly folded strata, indicates replacement origin in Late Jurassic or younger time. **REFERENCES:** Ellersieck and others, 1982; Inyo F. Ellersieck, written commun., 1985.

R6-1	Esotuk Glacier	Pb, Zn, Sn, Cu, W	Grab samples with up to 0.03% Sn,
69 18			0.15% W
145 15		Pb-Zn skarn and fluorite vein	

SUMMARY: Scattered, minor galena, sphalerite, malachite, cassiterite, and axinite in skarn in Devonian or older marble and calc-schist near periphery of Devonian gneissose granite. Few quartz-tourmaline veins. **REFERENCES:** Grybeck, 1977; W.P. Brosge, oral commun., 1984; Rainer Newberry, written commun., 1985.

R6-2	Porcupine Lake	Cu, Zn, Ag, F	Grab samples with up to 4.8% Cu,
68 48			0.6% Zn, and 0.2% Ag
146 27		Polymetallic vein(?)	

SUMMARY: Veins and replacement bodies with tetrahedrite, enargite, and fluorite in a silica gangue. Occur in tuffaceous silicified limestone and minor chert breccia of the Mississippian and Pennsylvanian Lisburne Group, about 80 m below contact with the overlying Sadlerochit Group. Distribution of veins and replacement bodies in breccias is highly variable. Areas of densest veins and most mineralization occur intermittently along strike for nearly 1.6 km, and are up to about 2.4 m thick. Veins crosscut bedding at low angles. About 3 to 5 km to north, strata-bound, disseminated fluorite occurs in veins and replacement bodies for several kilometers along strike. Veins are up to 0.9 m thick and grade from 1 percent up to nearly solid fluorite. The fluorite bodies occur within a few meters of top of the Lisburne Group, near contact with the overlying Sadlerochit Group. **REFERENCES:** Barker, 1978, 1981.

R7-1	Romanzof Mountains	Pb, Cu, Zn, Mo, Sn, Ag, F	Grab samples with up to 0.15% Sn
69 18		(U)	
143 50		Polymetallic vein, Pb-Zn and possibly Sn skarn	

SUMMARY: Numerous scattered mineral occurrences of polymetallic sulfides in Devonian(?) granite, Pb-Zn skarns, and quartz veins. Some fluorite greisen. Skarn and quartz veins occur in Precambrian marble and calc-schist of the Neruokpuk Quartzite at the periphery of the Silurian or Early Devonian Okpilak (granite) batholith. The common types of deposits are: (1) zones of disseminated galena, sphalerite, chalcopyrite and pyrite, locally with Au and Ag, in granite; (2) skarn in marble with disseminated magnetite, pyrite, pyrrhotite, sphalerite, and galena in gangue of carbonate, clinopyroxene, epidote, amphibole, beryl, tourmaline, and fluorite; (3) disseminated galena, sphalerite, chalcopyrite, and (or) molybdenite in quartz veins along sheared contact in granite; and (4) fluorite greisen in granite. **REFERENCES:** Brosge and Reiser, 1968; Grybeck, 1977; Sable, 1977; W.P. Brosge, oral commun., 1984; Newberry and others, 1986.

R7-2	Bear Mountain	Mo, W	Grab samples with up to 0.8% Mo
68 23			and 0.6% W
142 11		Porphyry Mo	

SUMMARY: Molybdenite-wolframite-bearing, Tertiary rhyolite porphyry stock with cylindrical core of intrusive breccia intrudes Devonian and Mississippian sedimentary rocks, and Devonian or older metasedimentary rocks of the Neruokpuk(?) Quartzite. Stock located near perimeter of the early Tertiary granite pluton of Bear Mountain. Local rhyolite porphyry dikes and quartz porphyry and some gossan with molybdenite and galena. Zonal alteration pattern with core of sericitic and argillic alteration and outer zone of silicification. Local halo of pyrite and propylitic alteration along margin of porphyry. Exposed area approximately 1 km in diameter. **REFERENCES:** Barker and Swainbank, 1986.

R7-3	Galena Creek	Cu, Zn, Pb, Ag	Grab samples with up to 21% Cu,
68 23			3.5% Zn, 1.3% Pb, 170 g/t Ag
142 02		Polymetallic vein	

SUMMARY: Disseminated galena, sphalerite, malachite, and barite in quartz veinlets and replacement bodies in phyllite, siltstone, and greenstone of Neruokpuk(?) Quartzite of Devonian or older age. Area of veinlets and mineralization is about 760 by 1,060 m on ridge west of creek. Vein system on east side of creek up to about 2 m wide and 454 m long. Local alteration of phyllite to chlorite, epidote, and calcite. Local malachite staining in greenstone and many early Tertiary rhyolite dikes locally. Granite pluton and rhyolite breccia to east contain scattered hematite alteration and rare kaolinitization. **REFERENCES:** Brosge and Reiser, 1968; R.C. Swainbank, in Barker, 1981.

Index to to significant lode deposits of mainland Alaska

TABLE 2. SIGNIFICANT PLACER DISTRICTS OF MAINLAND ALASKA

By
Thomas K. Bundtzen[1] and Richard D. Koch[2]

[1]Alaska Division of Geological and Geophysical Surveys
[2]U.S. Geological Survey

Site No. Latitude Longitude	Deposit Name (District)	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
O4-1 59 00 161 10	Goodnews Bay	Pt, Au (Cr) Placer PGE-Au	Over 20,200 kg PGE, 1015 kg gold produced, 1900-1983

SUMMARY: Most extensive platinum placer deposits are in the Salmon River drainage; smaller productive placers also occur in Wattamuse, Fox, Butte, and Kowkow Creeks and in Snow Gulch; all northwest of Goodnews Bay. This latter area is sometimes referred to as the Bethel district. Platinum and gold mined mainly by bucketline dredges. Production mainly from 1934 to 1982, a major portion of the primary U.S. platinum production. Average percentages in placer concentrates are 73.6% Pt, 9.9% Ir, 1.9% Os, 0.15% Rh, 1.2% Ru, 0.34% Pd, 2.1% Au, and 10.9% impurities. In Salmon River drainage, Pt, Cr, and some Au, are apparently derived from the nearby informally named Middle Jurassic Goodnews Bay ultramafic complex of Southworth and Foley (1986), composed of dunite, pyroxenite, and hornblendite, with anomalous PGE concentrations associated with sparse chromite segregations. In both areas preglacial ancestral channels and reworked till forms main placer deposits. Gold in Wattamuse, Fox, Butte, and Kowkow Creeks (Bethel district) probably derived from monzonite plutons. Magnetic surveys indicate possible 5-km offshore extension of Goodnews Bay complex. Fineness values range from 854 to 893 for Wattamuse, Butte, Fox, and Kowkow Creeks. **REFERENCES:** Mertie, 1940, 1969; 1976; Berryhill, 1963; Cobb, 1973; Southworth and Foley, 1986; Barker and Lamal, 1989; Zelenka, 1988.

Site No. Latitude Longitude	Deposit Name (District)	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
O5-1 57 45 153 30	Kodiak	Au, Ag, Cr, Pt Placer Au	149 kg Au produced intermittently, 1895-1920

SUMMARY: Gold is concentrated in beach deposits and in sand dunes that are derived from glacial outwash and tills. Pre-glacial placers removed during Pleistocene glaciation. Heavy minerals include magnetite, pyrite, chromite, and platinum. Gold fineness averages 837 from eight analyses of strandline deposits. Gold probably derived from Au-bearing quartz vein deposits in graywacke and argillite of the Upper Cretaceous Kodiak Formation. Platinum probably derived from the Jurassic or older, informally named, Border Ranges ultramafic and mafic complex of Burns (1985). Local bedrock is Late Cretaceous graywacke, granitic plutons, and Tertiary sandstone. **REFERENCES:** Capps, 1937; Cobb, 1973.

Site No. Latitude Longitude	Deposit Name (District)	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
P4-1 63 30 156 30	Innoko	Au, Ag, Hg, Pt, Sn, W Placer Au	18,103 kg Au produced 1906-1991

SUMMARY: Bulk of gold from placers on bedrock benches on easterly or northerly hill slopes. Minor platinum and about 1% of gold content recovered from Boob Creek. Some dredging. Gold fineness ranges from 825 to 910 and averages about 870. Major heavy minerals include chromite, scheelite, and arsenopyrite. Most of district not glaciated. Gold derived from mineralized rhyolite and basalt dike swarms and small monzonite plutons intruding the Kuskokwim Group in the Yankee Creek, Ophir Creek, and Spruce Creek areas. Largest dike swarm located along Ganes-Yankee Creek fault zone which parallels Iditarod Nixon Fault. Local bedrock is Cretaceous metasedimentary and metavolcanic rocks, chert, basalt, and felsic dikes. **REFERENCES:** Harrington, 1919;

Mertie, 1936; Cobb, 1973; Bundtzen and Laird, 1980; Bundtzen and others, 1985; Bundtzen and others, 1987.

P4-2 61 55 161 30	Marshall	Au, Ag, Pt (Ag, W, Hg) Placer Au	3,733 kg Au produced, 1913-1991

SUMMARY: Productive placers on Willow, Montezuma, Elephant, and Wilson Creeks near Marshall, and Kako Creeks and Stuyahok River near Russian Mission. Most of area not glaciated. Heavy minerals include gold, platinum, magnetite, hematite, ilmenite, scheelite, and cinnabar. District is characterized by relatively low gold fineness, averaging 802. Gold probably derived from vein lode deposits associated with Cretaceous hypabyssal alaskite intruding Mesozoic greenstone belt, or alternatively mother lode veins within the greenstone belt. **REFERENCES:** Harrington, 1918; Hoare and Cobb, 1972, T.K.Bundtzen, unpublished data, 1991.

P4-3 62 30 158 30	Iditarod	Au, Hg, Sb, Sn, W, Cr, REE, Ag Placer Au	48,272 kg Au produced, 1910-1991

SUMMARY: Gold placer deposits in modern stream gravels, residual concentrations, and benches. All mining within 14 km of Flat. Heavy minerals include chromite, scheelite, cassiterite, arsenopyrite, ilmenorutile, and heavy concentrations of cinnabar. Gold fineness ranges from 830 to 905 and averages 870. Extensive dredging. Nonglaciated highlands are mantled by residual material, colluvium, and silt; lowlands are covered by thick alluvium. Placer deposits on Flat, Chicken, Prince, Happy, Slate, and Willow Creeks are radially distributed around Chicken Mountain. Gold derived from polymetallic vein lode deposits in Late Cretaceous monzonitic stocks such as the Golden Horn and Chicken Mountain deposits, and from other mineralized contact zones in sedimentary and volcanic rocks of the Cretaceous Kuskokwim Group. Local bedrock of Proterozoic schist, Mesozoic clastic and volcanic rocks, and Cretaceous granitic plutons. **REFERENCES:** Cobb, 1973; Bundtzen and others, 1985, 1988, 1992a; Miller and Bundtzen, 1993.

P4-4 61 00 158 00	Aniak	Au, Ag, W, Cr, Hg, Pt Placer Au and Hg	16,356 kg Au produced, 1908-1991

SUMMARY: Placer gold mined from modern streams and benches; Nyac area and Crooked Creek basin most productive. Placer deposits in Nyac area distributed in glacio-fluvial outwash below terminus of Early Wisconsin and pre-Wisconsin glacial deposits. Older bench levels in Donlin area are probably Late Tertiary in age. Heavy minerals include gold, magnetite, garnet, scheelite, cassiterite, pyrite, cinnabar, stibnite, and monazite. Placer cinnabar mined from Cinnabar Creek. High gold fineness from Tuluksak River drainage, averaging 925; from Aniak River drainage it averages 880. Gold probably derived from polymetallic vein lode deposits in contact zones in graywacke of the Cretaceous Kuskokwim Group intruded by Cretaceous hypabyssal granitic plutons. Local bedrock is Cretaceous sedimentary and volcanic rocks, and granitic plutons. **REFERENCES:** Cady and others, 1955; Cobb, 1973; T.K.Bundtzen, unpublished data, 1992.

P5-1 63 40 150 50	Kantishna	Au, Ag, Sb, Pb, W, Mn Placer Au	3,088 kg Au produced 1905-1986; also minor Sb, Ag, W

SUMMARY: Placer deposits in modern streams and benches. Highlands glaciated. Lowlands covered by glaciofluvial and eolian deposits. Most mining on streams near Kantishna. Scheelite and nuggets of native silver recovered. Heavy minerals are very numerous, including: magnetite, scheelite, galena, sphalerite, stibnite, arsenopyrite, and minor cassiterite. Gold fineness has a tremendous range from 550 to 900, averaging about 725. The widest fineness range of all Alaskan placer districts. Gold in district probably derived from polymetallic or Au-bearing quartz vein lode deposits that formed during Cretaceous regional metamorphism and(or) plutonism in Yukon-Tanana terrane. Local bedrock is mainly middle Paleozoic or older metasedimentary and metavolcanic rocks, and Cretaceous granitic plutons. **REFERENCES:** Capps, 1919; Cobb, 1973; Bundtzen, 1981, 1983a.

P5-2 62 45 155 00	McGrath	Au, Sn, W, Bi, REE, Hg, Cu, Pb Placer Au, Hg	5,910 kg Au produced, accessory Hg and Ag, 1910-1990

SUMMARY: Stream and bench placers mined by hydraulic methods and one dredge. Productive areas include Hidden Creek and tributaries of Nixon Fork, Carl and Candle Creeks in the Candle Hills, and Alder Gulch on Vinasale Mountain. Candle Creek area most productive and contained gold nuggets up to 62 g. Heavy minerals include gold, cinnabar, bismuthinite, chromite, zircon, magnetite, pyrite, and scheelite; with trace ferro-platinum. Gold fineness in Candle Creek averages about 910; in the Nixon Fork area about 860. Gold in district probably derived from polymetallic vein, and related lode deposits in Late Cretaceous hypabyssal monzonite plutons. Placers from Hidden Creek and Nixon Fork area probably derived from Nixon Fork gold skarn deposits. Local bedrock is Paleozoic limestone, Cretaceous sandstone, shale, and granitic rocks. **REFERENCES:** Mertie, 1936; Cobb, 1973; Bundtzen and Laird, 1983b; Bundtzen, 1986; Bundtzen and others, 1987.

P5-3 62 20 151 00	Yentna	Au, Cu, Ag, Pt Placer Au	6082 kg Au produced, 1905-1991

SUMMARY: Placers consist of stream and bench deposits, Pleistocene glaciofluvial deposits, and Tertiary conglomerates. Glacial and alluvial deposits blanket much of area. Most production in Cache Creek area from dredging operations. Heavy minerals include gold, platinum, cassiterite, scheelite, native copper, sulfides, and uranium and thorium minerals. Gold fineness ranges from 835 to 870, averaging 850. Gold in district probably derived from Au-bearing quartz and polymetallic vein lode deposits associated with granitic plutons and dikes, and Upper Jurassic and Lower Cretaceous clastic rocks. Local bedrock is Late Jurassic and Early Cretaceous flysch, Cretaceous granitic plutons, and Tertiary conglomerate. **REFERENCES:** Capps, 1913; Mertie, 1919; Cobb, 1973.

P6-1 64 00 148 30	Bonnifield	Au, Ag, Hg, Pt, Sn, W Placer Au	2,136 kg Au produced, 1903-1991

SUMMARY: Gold from streams and a few benches. Thick glaciofluvial deposits and loess cover much of district. Heavy minerals include various sulfides, scheelite, cassiterite, and cinnabar; PGE are found in Daniels Creek. Gold fineness ranges from 825 to 900, averaging 855. Gold in district probably derived from Cretaceous or early Tertiary Au-bearing quartz or polymetallic vein lodes and middle or older kuroko massive sulfide deposits in Yukon-Tanana terrane, with probable recycling through Tertiary gravels. Local bedrock is Paleozoic or older metasedimentary and metavolcanic rocks of the Yukon-Tanana terrane, and Cretaceous granitic plutons. **REFERENCES:** Capps, 1912; Cobb, 1973; Gilbert and Bundtzen, 1979.

P6-2 63 00 143 30	Valdez Creek	Au, Cu, Pb Placer Au	7,930 kg Au produced 1905-1991

SUMMARY: Complex Pleistocene history. Gold produced from modern stream gravels and from channels ancestral to Valdez Creek, now buried by up to 60 m of till and glacio-fluial deposits. Main pay channels considered to be Sangamon (mid Pleistocene) in age. Mined by open pit and sluice methods. Heavy minerals include gold, magnetite, pyrite, zircon, sphene, sillimanite, kyanite, galena, realgar, orpiment, hessite (a silver telluride). Placer gold exhibits remarkably consistent fineness of 852. Gold in district probably derived from polymetallic vein deposits associated with Cretaceous granitic rocks. Extensive recent mining; currently the largest placer mine in Alaska. Local bedrock is Late Jurassic or older metasedimentary rocks, Mesozoic graywacke, and Cretaceous and early Tertiary granitic plutons. **REFERENCES:** Chapin, 1918; Capps, 1919; Tuck, 1938; Smith, 1970; Cobb, 1973; Bressler and others (1985); Fechner and Herzog, 1990; Reger and Bundtzen, 1990.

P6-3 63 20 146 00	Delta River	Au Placer Au	149 kg Au produced, 1903-1991

SUMMARY: Gold probably derived from numerous occurrences and prospects of polymetallic vein and porphyry Cu deposits associated with late Paleozoic porphyries and Mesozoic granitic plutons intruding upper Paleozoic sedimentary and submarine volcanic rocks of the Slana Spur and Eagle Creek Formations and from mineralization in the Yukon-Tanana terrane. Gold fineness averages 825. Glacial and glaciofluvial deposits cover most of district. Local bedrock is late Paleozoic sedimentary and volcanic rocks, mafic to ultramafic sills, and Cretaceous granitic plutons on the southern portion; and Yukon-Tanana terrane in the northern portion. **REFERENCES:** Rose, 1965a; Cobb, 1973; Ian M. Lange and Warren J. Nokleberg, written commun., 1984.

P6-4 63 00 144 30	Chistochina	Au, Pt, W, Cr, Zn, Hg, Pb Placer Au	5,593 kg Au produced, 1898-1991. 0.51 g/m^3, Round Wash; 1.12 g/m^3, Quartz Creek

SUMMARY: Most placer mining in the extreme headwaters of Chistochina River on Miller Gulch and Slate Creek. Gold occurs in Tertiary conglomerate named "Round Wash". Source not known for either lode gold or rock clasts in Tertiary conglomerate; source presumably offset along nearby Denali fault. Placer gold also produced from glacial drift in valleys in area. Heavy minerals include gold, platinum, magnetite, pyrite, chromite, native copper, native silver, galena, cinnabar, garnet, and scheelite. Gold fineness has a narrow range of 862 to 887, indicating a single lode source. Local bedrock is late Paleozoic sedimentary, volcanic, and granitic plutonic rocks. **REFERENCES:** Rose, 1967; Cobb, 1973; Yeend, 1981a, b; Foley and Summers, 1990.

P6-5 61 40 149 00	Willow Creek	Au, Cu, W, Pt Placer Au	1,729 kg Au produced

SUMMARY: Bulk of placer gold produced from Grubstake Gulch and Willow Creek. Heavy minerals include gold, chalcopyrite, and platinum. Placers derived from polymetallic vein or Au-bearing quartz vein deposits in the Jurassic Talkeetna Mountains batholith, adjacent schist, or recycled in Tertiary conglomerate. Local bedrock is Jurassic granitic rocks, and Tertiary conglomerate. **REFERENCES:** Capps, 1915; Jasper, 1967b; Cobb, 1973.

P6-6 61 40 145 00	Nelchina	Au, Pt, W Placer Au	400 kg Au produced, 1912-1990

SUMMARY: Gold occurs in stream gravels and low benches in Busch, Yako, and Alfred Creeks. Fine gold occurs in glacial and glaciofluvial deposits of Wisconsin age. Much of gold within 1 m of bedrock and on bedrock surface. Scheelite and platinum in some samples. Gold fineness ranges 812 to 819. Gold probably derived from auriferous deposits in the Talkeetna Formation and Tertiary continental deposits. **REFERENCES:** Moffit and Capps, 1911; Chapin, 1918; Jasper, 1967b; Cobb and Matson, 1972; T.K.Bundtzen, unpublished data, 1991.

P6-7 61 10 149 30	Hope	Au, Cu, Sb, Hg, Pb Placer Au	2,001 kg Au produced, 1888-1991

SUMMARY: Gold occurs in streams and bench gravels; recycled in part from glacial and glaciofluvial deposits. Mills and Canyon Creeks are most productive streams. Mining with small dredges and hydraulic systems. Heavy minerals include gold, native silver, native copper, sulfides, scheelite, and cinnabar. Gold fineness ranges from 812 to 856. Largest deposit at Crow Creek placer: estimated 1,200,000 m^3 grading 1.1 g/m^3; gold in blue or yellow clays near false bedrock; most production from bench gravels. Gold in district mostly derived from Au-bearing quartz vein deposits in metagraywacke and phyllite of the Upper Cretaceous Valdez Group. Local bedrock is Upper Cretaceous graywacke and phyllite. **REFERENCES:** Moffit, 1906; Martin and others, 1915; Cobb and Richter, 1972; Jansons and others, 1984; Winkler and others, 1984.

P7-1 62 15 142 00	Chisana	Au, Ag Placer Au	1,588 kg Au produced, 1910-1981

SUMMARY: Placer deposits are generally within a few kilometers of Bonanza Creek area. Most gold derived from Tertiary gravel. Heavy minerals are: native copper, native silver, galena, cinnabar, and molybdenite. Gold fineness ranges from 797 to 866, averaging about 830. Most placer deposits in Tertiary conglomerate near or deposited on volcanic and sedimentary rocks of the Lower Cretaceous Chisana Formation. Unconsolidated glacial and fluvial deposits cover most lowlands. Local bedrock is Early Cretaceous volcanic rocks and flysch. **REFERENCES:** Capps, 1916; Richter and Matson, 1972.

P7-2 61 20 142 45	Nizina	Au, Ag, Sb, Cu, Pb, Mo Placer Au	4,618 kg Au produced

SUMMARY: Placer deposits in Quaternary sediments in valley fills and on benches. Native copper produced from some placers. One 3-tonne native copper nugget recovered. Heavy minerals include gold, native copper, native silver, and galena. Gold fineness has narrow range of 894-903, averaging 900. Gold probably derived from vein deposits in Cretaceous or early Tertiary granitic plutons. Some gold possibly derived from Cu-Ag vein deposits in the Nikolai Greenstone. Local bedrock is Late Jurassic and Early Cretaceous flysch, and Cretaceous and early Tertiary granitic plutons. **REFERENCES:** Moffit, 1914; Cobb and Matson, 1972; Cobb and MacKevett, 1980; T.K.Bundtzen, unpublished data, 1991.

P7-3 60 05 142 00	Yakataga	Au, Ag, Cr, Cu Placer Au	555 kg Au produced, 1898-1986

SUMMARY: Gold occurs in beach deposits along coastal plain extending east-southeast from mouth of Copper River. Gold also occurs in bench and streams of White River. Heavy minerals include gold, magnetite, zircon, chromite, rutile, and native copper. Gold fineness has a very narrow range of 892 to 896; suggesting a single lode source for the placer. Probably derived from variety of bedrock sources drained by Copper River, including: (1) graywacke and argillite of lower Tertiary Orca Group and associated mafic extrusive rocks and mafic and granitic plutons, and (2) metagraywacke and phyllite of the Upper Cretaceous Valdez Group, and associated mafic extrusive rocks and granitic plutons. Possible recycling in glacial deposits in region. **REFERENCES:** Maddren, 1914; Cobb, 1973.

Q3-1 65 40 166 30	Port Clarence	Sn, Au, REE, W, Cr, Pb, Ag, Hg, Pt Placer Au and Sn	1,256 kg Au produced, 1898-1990; about 1300 tonnes of placer Sn produced

SUMMARY: Gold recovered from creeks and benches as much as 60 m above present-day streams. Dredges produced bulk of gold. Gold in district probably derived from low-sulfide Au-bearing quartz veins in metamorphic rocks of the Nome Group. Sn province occurs in western part of the district; about 1300 tonnes of combined placer and lode tin produced. Cape Creek placer deposit in Cape Prince of Wales area produced an average 100,000 kg tin in cassiterite concentrate each year from 1979 to 1990; when creek placer was apparently exhausted. Tin placers on streams draining contact zones around Cretaceous Sn-bearing granitic rocks and associated vein deposits. Heavy minerals in both gold and tin placers are: gold, cassiterite, scheelite, cinnabar, monazite, xenotime, zircon, columbite, tantalite, and wolframite. Gold fineness in placer deposits ranges from 880 to 902; similar to fineness in Nome District. Local bedrock is slate and schist of the Nome Group, and granitic plutons. **REFERENCES:**

Brooks, 1901; Collier and others, 1908; Mulligan, 1959; Cobb and Sainsbury, 1972; T.K.Bundtzen, unpublished data, 1992.

Q3-2	Kougarok	Au, Sn, W	5,150 kg Au produced, 1900-1991
65 45			
164 50		Placer Au and Sn	

SUMMARY: Large gold resources in Quaternary(?) glacial outwash gravels of the Tertiary and Quaternary(?) Kougarok Gravels. Buried Tertiary gravels and conglomerates may be gold source. Most mining by dredging. Heavy minerals include: gold, pyrite, magnetite, hematite, cassiterite, scheelite, cinnabar, and lead sulfides. Gold fineness ranges from 857 to 931. Richest areas in Iron and Taylor Creeks and near Coffee Dome. Derived mainly from low-sulfide Au-bearing quartz veins in metamorphic rocks and from Sn lode deposits associated with Cretaceous granitic plutons. Local bedrock is schist, slate, marble, and granitic rocks. **REFERENCES:** Collier and others, 1908; Cobb, 1973; Eakins, 1981.

Q3-3	Nome	Au, Ag, W, Sb	148,322 kg Au produced 1902-1991
64 30			
165 30		Placer Au	

SUMMARY: Bulk of gold from ancient beach gravels developed in till. Up to five separate elevated beaches and several submerged beaches. Modern stream gravels, and low and high alluvial benches also contain gold. Beach strandlines contain inferred (drilled) reserves of 80 million m^3 grading 0.4 g/tonne Au. Heavy mineral concentrates dominated by arsenopyrite and scheelite. Gold fineness ranges from 845 to 902. Placers known for exceptionally large gold nuggets, mostly found in elliptical deposits on Anvil Mountain. Gold in district probably derived from Au-bearing quartz vein lode deposits, such as Rock Creek, and at Sophie Gulch north of Nome. Local bedrock is Paleozoic metasedimentary and lesser metavolcanic rocks of Nome Group, with Au-bearing quartz veins. **REFERENCES:** Collier and others, 1908; Moffit, 1913; Cobb, 1973; Eakins, 1981; R.V.Bailey, written commun., 1991.

Q3-4	Council (Includes	Au, W, Hg, Cu	32,400 kg Au produced, 1989-1991.
64 45	Solomon)		Reserve of 0.4 to 0.7 g/m^3, known
163 30		Placer Au	in Spruce Creek

SUMMARY: Beach, modern stream, and rare bench gold placers. Heavy minerals dominated by arsenopyrite, magnetite, and scheelite. Mined mainly by dredging and sluicing. Gold fineness in Solomon River drainage ranges from 826 to 870, averaging about 865; gold from Fish River drainage ranges from 902-960. Gold in district probably derived from Au-bearing quartz vein deposits in metamorphic rocks of the Nome Group, such as the Big Hurrah Gold-Tungsten deposit. Local bedrock is schist, marble, dolomite, and thin quartz veins. **REFERENCES:** Collier and others, 1908; Smith, 1910, Smith and Eakin, 1911; Cobb, 1973.

Q4-1	Kiana	Au, nephrite	1,263 kg Au, 1898-1968
67 10			
160 15		Placer Au	

SUMMARY: Gold mined principally from tributaries of Squirrel River. Coarse gold, some nuggets with quartz attached. Magnetite common in concentrates. Gold fineness ranges from 888 to 913. Gold and magnetite probably derived from Au-bearing quartz vein lode deposits in metamorphic rocks. Local bedrock is marble and schist. **REFERENCES:** I. M. Reed, written commun., 1931; Cobb, 1973.

Q4-2	Shungnak	Au, Cu, Ag, Cr, Cd	465 kg Au, 1898-1988
67 00			
157 00		Placer Au	

SUMMARY: Placer deposits in streams draining Cosmos Hills. Gold source mostly Au-bearing quartz veins in metasedimentary and metavolcanic rocks. Most placer production was from Dahl Creek. Heavy minerals include gold, magnetite, chromite, native copper, and silver. Gold fineness ranges from 772 to 803. Nephrite and serpentinite boulders collected from creek gravels and tailings piles. Large numbers of quartz crystals recovered from placer operations. Local bedrock is metasedimentary and metavolcanic rocks. **REFERENCES:** Smith, 1913b; Anderson, 1945; Cobb, 1973.

Q4-3	Fairhaven (Includes	Au, Pb, W, Pt, Ag	18,186 kg Au, 1900-1991
65 45	Candle and Inmachuk)		
161 41		Placer Au	

SUMMARY: Rich placer gold areas on Candle Creek and Inmachuk River. Major streams extensively dredged; substantial resources remain unmined in buried drainages in northern part of district. Buried gold-rich channel gravel in vicinity of Mud Creek. Most production on Candle Creek was from left limit bench (Paleo-Candle Creek) about 600 m wide and 6 km long. Placers in Kiwalik Flat at mouth of Paleo-Candle Creek were partially reworked by marine conditions. Auriferous bench deposits 30 m above Inmachuk River overlain by 5.7 Ma basalt flow. Heavy minerals include galena, magnetite, scheelite, sphalerite, and trace platinum metals. Gold fineness ranges 847 to 898. Gold may have been derived from polymetallic vein lode deposits associated with Cretaceous granitic plutons or alternatively from Au-bearing quartz veins in metamorphic rocks, or alternatively from Au-bearing quartz veins in metamorphic rocks. Local bedrock is schist, marble, granitic plutons, and Tertiary basalt. **REFERENCES:** Henshaw, 1909; Cobb, 1973, T.K.Bundtzen, unpublished data, 1991.

Q4-4	Koyuk	Au, Sb, W, Pt, Bi	2,466 kg Au produced, 1915-1990.
65 00			About 10 kg byproduct Pt
161 20		Placer Au, Pt	producedproduced.

SUMMARY: Mining in creek and bench placers in areas of Bonanza, Dime, and Sweepstakes Creeks. Nuggets with vein quartz attached have been recovered. Mining by sluicing, dredging, and drifting. Heavy minerals include gold, magnetite, ilmenite, scheelite, stibnite, bismuthinite, wolframite, platinum, chromite, rutile, garnet, uranothorianite, hydrothorite, hematite, chrome spinel, iron and copper sulfides, galena, sphalerite, and molybdenite. Gold fineness on Dime Creek is extremely high (950-966); fineness values average 840 and 920 in Sweepstakes and Ungalik Creeks respectively. Gold probably derived from polymetallic vein and other lode deposits associated with Cretaceous granitic plutons. Altered ultramafic rocks found in Dime Creek drainage may be platinum source. Local bedrock is schist, marble, granitic plutons, and Cretaceous sedimentary rocks. **REFERENCES:** Smith and Eakin, 1911; Harrington, 1919; Cobb, 1973, T.K.Bundtzen, unpublished data, 1991.

Q5-1	Noatak	Au	1,20 kg Au produced, 1898-1986
68 00			
156 00		Placer Au	

SUMMARY: Gold mined from Lucky Six Creek. Nearby lode deposit contains sulfides and gold. Gold probably derived from Au-bearing quartz or polymetallic vein deposits. Local bedrock is marble, metasedimentary, and metavolcanic rocks. **REFERENCES:** Smith, 1913b; Cobb, 1973.

Q5-2	Wiseman, (Koyukuk)	Au, Bi, Cu, W, Pb	9,899 kg Au produced, 1893-1991
67 15			
150 45		Placer Au	

SUMMARY: Glaciation in parts of area has caused disarrangements of drainage, resulting in complex placer deposits. Gold-rich gravels in modern streams and bench deposits on bedrock. Large nuggets more common than elsewhere in Alaska. Heavy minerals include gold, stibnite, native silver, native copper, native bismuth, scheelite, pyrite, chalcopyrite, cinnabar, rutile, cassiterite, monazite, andalusite, and kyanite. Gold has high fineness, ranging 925 to 975. Larger deposits at Hammond River and Nolan Creek. Hammond River: estimated 210,000 m^3 grading

5.1 g/m^3 Au and 0.32 g/m^3 Ag; total production of up to 1.84 million g Au; estimated production of 3.1 million g Ag; drift and sluice mining; placer deposit mostly occurs within lower 5 km of mouth of Koyukuk River; placer mining from 1900 until 1942. Nolan Creek: estimated 146,000 m^3 grading 12 g/m^3 Au; drift mining; local stibnite veins in metamorphic and granitic rocks. Deposits in district probably derived from Au-bearing quartz vein and Sb-Au vein deposits. Local bedrock is metasedimentary rocks, granitic plutons, and Cretaceous sedimentary rocks. **REFERENCES:** Maddren, 1913; I.M.Reed, written commun., 1938; Brosge and Reiser, 1960; Cobb, 1973; Dillon, 1982.

Q5-3 65 50 155 00	Hughes	Au, Cu, Pb, Ag, Sn, Pt, Zn Placer Au	6,877 kg Au produced, 1910-1991

SUMMARY: Gold derived from streams draining contact zones around Cretaceous granitic plutons near Indian Mountain and in southern Zane Hills. Recent dredging on Bear Creek, where most production occurred. Most of area not glaciated. Gold probably derived from polymetallic vein and other lode deposits associated with Cretaceous granitic plutons. Local bedrock is Jurassic and Cretaceous clastic and volcanic rocks, and granitic plutons. **REFERENCES:** Eakin, 1916; Miller and Ferrians, 1968; Cobb, 1973; T.K. Bundtzen, written commun., 1990.

Q5-4 65 30 152 30	Melozitna (Tanana)	Au, Sn, Pb, Ag, Zn, Cu Placer Au	294,114 g Au produced, 19097-1991

SUMMARY: Gold occurs in thin bench deposits and shallow-stream gravels in Grant, Illinois, and Mason Creeks; small tributaries of Yukon River. Heavy minerals include gold, cassiterite, magnetite, ilmenite, hematite, garnet, and tourmaline. Single gold fineness value of 895 recorded. Placers within a few kilometers of known or inferred granitic plutons. No known lode deposits. Gold in district probably derived from polymetallic vein and skarn deposits associated with Cretaceous hypabyssal granitic plutons. Local bedrock is metasedimentary and metavolcanic rocks, and Cretaceous clastic and granitic rocks. **REFERENCES:** Eakin, 1912; Chapman and others, 1963; Cobb, 1973.

Q5-5 65 10 151 00	Hot Springs	Au, Sn, Cr, REE, Cu, Pb, Ag, Ni, Hg, W, Bi, Nb Placer Au, Sn, and Nb	16,917 kg Au and about 400,000 kg of Sn produced, 1898-1991

SUMMARY: Nearly all placer deposits consist of buried bench gravels on old terraces or buried stream deposits derived from older bench gravels. Thick deposits of frozen silt conceal ore deposits and make exploration difficult. Area not glaciated. Principal deposits explored were those on Sullivan Bench. Gold fineness ranges from 740 to 875. Glen Creek: estimated 600,000 m^3 grading 2.5 g/m^3; over 1.50 million g produced by 1931; gravels derived from local slate and quartzite with quartz veinlets. American Creek: estimated 410,000 m^3 grading 5.3 g/m^3; total production at least 2.18 million g Au; gold occurs in lower 1.1 m of gravels and upper 1 m of bedrock; gold in quartz-carbonate veins associated with east-west-trending shear zone. Gold in district possibly related to granitic plutons in area. Niobium-bearing columbite and aeschynite occurs in tailings of drift placer mines near Tofty; concentrates of tailings contain between 0.2 and 4.5% Nb. Estimated 45,400 kg recoverable Nb_2O_5 in placer deposits near Tofty. Local bedrock is Cretaceous sedimentary rocks and Tertiary granitic plutons. **REFERENCES:** Mertie, 1934; Wayland, 1961; Heiner and Wolff, 1968; Cobb, 1973; Southworth, 1984; Warner, 1985; Warner and Southworth, 1985; Warner and others, 1986.

Q5-6 65 30 150 00	Rampart	Au, Ag, Bi, W, Sn Placer Au	5,646 kg Au produced, 1882-1991

SUMMARY: Bulk of gold production from drainages of Minook and Troublesome Creeks. Area not glaciated. At least 4 prominent terraces in Minook Creek, about 3 to 900 m above sea level. Pliocene(?) gravel in highest terrace is up to 20 m thick and auriferous, but not generally commercial. More than half of produced gold in district from Little Minook Creek. Heavy minerals include gold, garnet, barite, chrome spinel, pyrite, cinnabar, native bismuth, and tetrahedrite. Placer gold throughout district exhibits high fineness, ranging 900 to 955. Larger deposits at Ruby Creek, Hunter-Dawson Creek, Morelock Creek, Hoosier Creek, and Little Minook Creek. Ruby Creek: estimated 290,000 m^3 grading 0.67 g/m^3; mined mainly by open-cut and drift methods. Hunter-Dawson Creek: estimated 250,000 m^3 grading 2.6 g/m^3; hydraulic and drift mining; gold found in lower 1 m of gravel and upper 1.1 m of bedrock; local bedrock of shear zone with sulfide minerals and quartz-calcite veins. Morelock Creek: estimated 150,000 m^3 grading 3.6 g/m^3; sluice mining; gold occurs in lower few centimeters of gravel and upper few centimeters of irregular bedrock surface. Little Minook Creek: estimated 120,000 m^3 grading 13 g/m^3 Au, 1.1 g/m^3 Ag; estimated total production of 2.02 million g Au; gravels vary from 2 to 4 m thick with gold at base and in upper 0.2 m of bedrock. Gold in district probably derived from polymetallic vein lode deposits associated with mid to Late Cretaceous monzonitic stocks. Local bedrock is Paleozoic sedimentary and volcanic rocks, and Tertiary granitic plutons. **REFERENCES:** Mertie, 1934; Waters, 1934; Chapman and others, 1963; Heiner and Wolff, 1968; Cobb, 1973.

Q5-7 64 25 154 20	Ruby	Au, Sn, Bi, REE, Pb, W, Pt Placer Au	14,219 kg Au produced, 1907-1991

SUMMARY: Complex geomorphic history. Vein quartz, chert, and other resistant rocks common in placers. Several cycles of erosion and deposition. Placers generally buried; mined with shafts and drifts. Region not glaciated. Heavy minerals include gold, cassiterite, platinum, scheelite, allanite, and native bismuth. Gold fineness ranges from 800 to 890. Largest deposit at Midnight Creek produced about 114 kg Au from 1940 to 1942; bedrock is local quartz veins in schist in or near granite; minor Sn placer deposits. Gold in district probably derived from polymetallic vein and skarn deposits associated with Cretaceous hypabyssal granitic plutons. Local bedrock is limestone, schist, volcanic rocks, and granitic plutons. **REFERENCES:** Eakin, 1918; Mertie and Harrington, 1924; Cass, 1959; Chapman and others, 1963; Cobb, 1973.

Q6-1 67 50 148 00	Chandalar	Au, Sb, Ag, W Placer Au	1,353 kg Au produced, 1905-1991

SUMMARY: Complicated placer deposits resulting from complicated glacial history. Two generations of placer deposits on Little Squaw Creek, one preglacial, one postglacial. Placers located in streams draining Au-bearing quartz vein lode deposits. Heavy minerals include gold, monazite, magnetite, hematite, rutile, pyrite, arsenopyrite, chalcopyrite, galena, stibnite, molybdenite, scheelite, and uranothorianite. Largest deposit at Little Squaw and Tobin Creeks. Small placer occurs on Hodzana River, south of the Chandalar Lake area. Deposits are both preglacial and postglacial. Significant production. Local Au-bearing quartz veins in schist. Placers are found downstream from Au-bearing quartz vein deposits which are near the head of Little Squaw Creek drainage. Local bedrock is metasedimentary and metavolcanic rocks. **REFERENCES:** Mertie, 1925; Cobb, 1973; Dillon, 1982.

Q6-2 65 30 148 10	Tolovana	Au, Sn, Cu, Pb, Hg, W, Cr, Sb, REE, Bi Placer Au	14,630 kg Au produced, 1917-1991; 1.22 g/m^3, Livengood Creek

SUMMARY: Auriferous stream and bench placers. Mature erosion surface largely buried by later sediments. Steam capture common. Rich buried bedrock benches, not completely exhumed. One of most recently discovered placer districts in Alaska. Heavy minerals include gold, magnetite, hematite, ilmenite, limonite, chromite, spinel, cinnabar, stibnite, scheelite, cassiterite, monazite, and REE minerals. Gold in Livengood Creek and around Amy Dome has narrow fineness range of 897 to 905. Largest deposit at Livengood on Tertiary bench level, may contain 30 million m^3 grading 1.44 g/m^3 Au. Gold possibly derived from polymetallic vein deposits associated with

Cretaceous granitic plutons. Local bedrock is schist, Cretaceous sedimentary rocks, and granitic plutons. **REFERENCES:** Foster, 1966, 1969; Mertie, 1937b; Cobb, 1973; Eakins, 1981.

Q6-3 65 30 144 45	Circle	Au, Ag, Sn, Sb, W, Pb, REE, Mo, Hg Placer Au	33,075 kg Au produced, 1893-1991

SUMMARY: Gold concentrated in alluvial and colluvial deposits (2 to 5 m thick), frequently overlain by 1 to 2 m of muck. Non-glaciated, broad upland of nearly accordant ridge crests. Large gold resource may be present in lower reaches of Crooked and Birch Creeks, and in the topographic trough south of Crazy Mountains. Larger deposits at Mammoth Creek, Deadwood Creek, Eagle Creek, and Coal Creek. Mammoth Creek: estimated 4.0 million m^3 grading 1.9 g/m^3 Au, 0.45 g/m^3 Ag; estimated production of up to 4.7 million g Au through 1926; mining by hydraulic and dredge methods; local quartz veins in bedrock; Deadwood Creek: estimated 1.44 million m^3 grading 2.3 g/m^3 Au and 0.49 g/m^3 Ag; estimated total production of over 93.3 million g Au; mined by dredge and hydraulic methods. Coal Creek: estimated 810,000 m^3 grading 0.38 g/m^3 Au, 0.041 g/m^3 Ag; estimated 311,000 g Au produced; dredge mining. Eagle Creek: estimated 760,000 m^3 grading 1.2 g/m^3 Au, 0.16 g/m^3 Ag; about 0.9 million Au g produced through 1906; recent production in 1985. Gold in district probably derived from Cretaceous or early Tertiary Au-bearing quartz vein, polymetallic vein, skarn, porphyry lode, and volcanogenic massive sulfide deposits in region in mid Paleozoic or older metamorphic rocks of Yukon-Tanana terrane, with recycling through Tertiary conglomerates. Fineness varies widely, depending on drainage system; ranging from 720 to 920. Alluvial diamonds found in placer concentrate during the 1980s. Local bedrock is mid Paleozoic or older metasedimentary rocks of Yukon-Tanana terrane, and Cretaceous granitic plutons. **REFERENCES:** Prindle, 1913; Mertie, 1938; Heiner and Wolff, 1968; Cobb, 1973; Yeend, 1982; Menzie and others, 1983; Lasley, 1985; Yeend, 1987, 1991.

Q6-4 64 55 146 30	Fairbanks	Au, Sb, W, Sn, Ag , Bi Placer Au	245,868 kg Au produced from placers, 1902-1991

SUMMARY: Placer deposits found in streams that radially drain three mineralized areas in Fairbanks District: 1) Ester Dome Region; 2) Cleary-Pedro Dome area; and 3) Gilmore Dome. Nearly all placers consist of buried streams ancestral to Cleary, Goldstream, Fairbanks, Engineer, Dome, Eldorado, Treasure, Little Eldorado, Ester, Cripple, Gilmore, and Smallwood drainage basins. Largest placers were mined in Cleary, Fairbanks, Goldstream and Cripple Creek drainages. Deposits buried by thick sections of frozen loess and mud. Recent stratigraphic and radiometric age studies suggest most bench deposits in district are Pliocene in age. Over 30 heavy minerals have been identified. The most abundant include: stibnite, scheelite, bismuthinite, native bismuth, and galena. Gold fineness in district ranges from 830 to 900, averaging 875. Stibnite and scheelite have been commercially recovered from placers. Early drift mining accounted for about 55% of gold production or 133 million grams. About 40% of production or 96.1 million grams was recovered from 9 bucket line stacker dredges that operated from 1920 to 1964. The remaining 5% of production was from large open cut mines, mainly from 1975 to the present. The Goldstream Creek pay streak is over 1 km wide and 13 km long, and produced 62 million grams from dredge and drift mining methods. On the richest creek, Cleary Creek, drift miners recovered 2.9 million m^3 of pay grading 14 g/m^3 or 35.1 million grams from 1903 to 1920. Gold in the district was derived from: 1) several hundred mineralized veins in Ester Dome and in the Cleary Hill-Pedro Dome area; 2) from auriferous skarns in the Gilmore Dome area; and 3) from mineralized Cretaceous plutons at Melba Creek, on Pedro and Gilmore Domes, and on Ester Dome. **REFERENCES:** Smith, 1913a; Prindle and Katz, 1913; Mertie, 1918; Heiner and Wolff, 1968; Cobb, 1973; Light and others, 1987; Metz, 1987, 1991; Metz and Hamil, 1986; T.K.Bundtzen, unpublished data, 1991.

Q6-5 64 30 145 10	Richardson	Au, Ag (Hg, Sn) Placer Au, Ag	3,564 kg Au produced and 2,550 kg Ag, 1905-1991

SUMMARY: Modern stream, bench, and classic residual auriferous placer deposits downslope or downstream from mineralized zones in or near Richardson Lineament. Granite porphyry bodies containing gold-silver sulfosalt mineralization at Mitchell Lode are probably the source of gold placers in Democrat Creek. Gold in Tenderfoot Creek, the district's largest producer, derived from a similar mineralized granite porphyry sill intruded along Richardson Lineament. Deposit of gold-silver alloys mined on Hinkley Bench is residual accumulation above hydrothermally altered schist and granite porphyry sill. Placer gold is of two types: 1) high-fineness gold averaging 900 fine; and 2) low-fineness electrum averaging 670 fine and frequently alloyed with native silver. Latter bullion type predominates. Heavy minerals are diverse and include: cinnabar, cassiterite, wolframite, silver sulfosalts, and radioactive monazite. Placers are deeply buried by 10 to 45 m of wind-blown and reworked loess. Early placer developments (pre-WWI) were drifts that frequently encountered artesian water flow. At least two pay streaks were identified in Tenderfoot Creek, including a false bedrock pay streak 10 m above bedrock. **REFERENCES:** Reger and Bundtzen 1977, and T.K.Bundtzen, unpublished data, 1991.

Q7-1	Eagle	Au, Ag, Cr, Pt	1,617 kg Au produced, 1895-1991
65 00			
142 00		Placer Au	

SUMMARY: Gold recycled in part through Cretaceous and Tertiary conglomerates. Heavy minerals include gold, platinum, cinnabar, cassiterite, chromite, and native silver. Gold fineness ranges from 844 to 880, averaging 871. Most of area not glaciated during Pleistocene time. Gold in district probably derived from combination of Au-bearing quartz vein, polymetallic vein, skarn, and porphyry Cu lode deposits associated with Cretaceous or Tertiary plutons intruding middle Paleozoic or older metamorphic rocks of Yukon-Tanana terrane,. Local bedrock is mainly metasedimentary and volcanic rocks, and Cretaceous granitic plutons. **REFERENCES:** Mertie, 1938; Cobb, 1973.

Q7-2	Fortymile	Au, REE, Pb, Sn, W, Hg	16,263 kg Au produced 1886-1991
64 20			
142 00		Placer Au	

SUMMARY: Stream and bench placer deposits common. Most of area not glaciated during Pleistocene time. Loess mantles much of area. Gold was only commodity recovered commercially. One 778-g nugget recovered from Wade Creek deposit. Gold fineness ranges widely depending on which drainage, from 620 to 890; with highest fineness in Walker Fork and lowest fineness in South Fork of Fortymile River. Bedrock source of Au is probably polymetallic quartz-pyrite veins. Mined by hydraulic, drift, dredge, and open cut methods. Gold in district derived from a combination of Au-bearing quartz and polymetallic vein deposits in metamorphic rocks near contacts with Cretaceous or early Tertiary felsic plutons intruding mid Paleozoic or older metamorphic rocks of Yukon-Tanana terrane. Local bedrock is mainly metasedimentary rocks, Cretaceous granitic plutons, ultramafic and mafic plutonic rocks, and Tertiary sedimentary rocks. **REFERENCES:** Mertie, 1938, Cobb, 1973.

Index to to significant placer districts of mainland Alaska

TABLE 3. SIGNIFICANT LODE DEPOSITS OF THE RUSSIAN NORTHEAST

By
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Site No. Latitude Longitude	Deposit Name (District)	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
O55-1 59 21 146 59	Ikrimun	Cu, Mo Porphyry Cu-Mo	Small.

SUMMARY: A stockwork of sulfide veinlets with abundant disseminated sulfides and rare quartz veins occurs in the middle of the Ikrimun granitic pluton of Early Cretaceous age; which intrudes Early Cretaceous rhyolitic to basaltic volcanic rocks. Ore minerals are pyrite, chalcopyrite, arsenopyrite, and magnetite; with subordinate molybdenite, ilmenite, and sphalerite. Deposits occur in silicified, sericitized, and propylitized quartz diorite, tonalite, extrusive breccia, and plagiogranite porphyry. Plutonic rocks are spatially related to a plagiogranite porphyry dike. **REFERENCES:** Skibin, 1982.

O56-1 59 44 150 16	Osennee, Oksa, Usinskoe	Mo, Cu (W, Ag) Porphyry Cu-Mo	Small to medium. Ranges 0.1 to 0.33% Mo and up to 0.1% Cu. Up to 5 g/t Ag.

SUMMARY: Osennee: Crescent-shaped ore body in a north-south-trending fractured and foliated zone within the granitic rocks of the Cretaceous Magadan batholith. Ore body is more than 400 m long and about 30 m thick, with dips of 35°-65°. Host rocks are gabbro, granodiorite, subalkalic granite and syenite, granite porphyry, and lamprophyre. Molybdenite is accompanied by pyrite and lesser pyrrhotite, sphalerite, chalcopyrite, and scheelite. Molybdenite occurs in quartz, quartz-feldspar, and quartz-tourmaline veinlets and veins; disseminated in porphyry; and in veinlets in silicified, sericitized, chloritized, K-feldspathized, and pyritized rocks within a fault and in adjacent areas. Oksa: Molybdenite is disseminated in quartz and in quartz-feldspar veinlets cutting silicified and sericitized granite porphyry and adjacent amphibole-biotite granodiorite of the Magadan batholith. Associated minerals are pyrite, with rare chalcopyrite, sphalerite, and pyrrhotite. Gold is present in the ore, and there is up to 5 g/t silver. Deposit is controlled by a zone of fracturing and schistosity that trends northwest to about north-south. Usinskoe: Quartz, feldspar-quartz, and pegmatite veinlets contain molybdenite and locally scheelite. These minerals also occurs in veinlets and disseminated in the K-feldspathized and tourmalinized granitic rocks of the Magadan batholith. Mineralization is confined to a nearly north-south fault which controls the porphyry intrusions. **REFERENCES:** Firsov and Soboleva, 1952, written commun.; Sendek, 1965, written commun.

O56-2 59 25 154 52	Yapon	Cu Porphyry Cu	Small. Ag to 1-2%.

SUMMARY: Stockwork zone more than 20 m wide is composed of a dense network of quartz and quartz-epidote veinlets with pyrite and chalcopyrite that cut sulfidized, Middle Jurassic basalt and andesite-basalt. Disseminated veinlets contain native gold and 1-2 g/t silver. **REFERENCES:** Yaskevich and Yudina, 1972, written commun.

O56-3 59 25 153 29	Nakhtandjin	Cu Porphyry Cu	Small.

SUMMARY: A stockwork of sulfide, sulfide-quartz, and sulfide-chlorite-quartz veinlets associated with disseminated sulfides occurs along east-, northeast-, and northwest-trending fault zones at the southeast contact of Srednin granitic pluton. Pluton intrudes Triassic-Jurassic and Early Cretaceous volcaniclastic and volcanic rocks. Early Cretaceous tonalite, granodiorite, and explosive breccias that host the deposit are weakly sericitized and propylitized. Ore minerals are pyrite and chalcopyrite, with subordinate magnetite and ilmenite. Deposit is closely associated with a pipe of explosive breccias. **REFERENCES:** Skibin, 1982.

O56-4 58 58 152 34	Viking	Cu, Mo Porphyry Cu-Mo	Small.

SUMMARY: A stockwork of sulfide, sulfide-quartz, and sulfide-feldspar-quartz veins, veinlets, and zones of disseminated sulfides, occurs in Early Cretaceous hydrothermally altered tonalite, plagiogranite, and less commonly in quartz monzonite porphyry. Granitic rocks form the core of a concentrically zoned dome made up mostly of Jurassic volcanic rocks. The ore body extends several hundred meters along strike, with a vertical extent of 350-400 m; and is parallel to the contact of a porphyry stock. An inner alteration zone consists of a podiform zone of potassic alteration; quartz-sericite and epidote-chlorite alteration occurs in the outer zone. Main ore minerals are chalcopyrite, molybdenite, magnetite, and ilmenite; with minor pyrite and chalcocite. **REFERENCES:** Skibin, 1982.

P55-1 63 45 148 45	Uochat	Hg Carbonate-hosted Hg	Small.

SUMMARY: Disseminated, cinnabar-bearing veinlets occur in brecciated Lower(?) Devonian dolomite along a major north-south trending fault that separates a Devonian carbonate sequence from a Carboniferous and Permian clastic sedimentary sequence. Ore body is about 20 m long and 4 to 7 m thick. Main ore mineral is cinnabar, which occurs with calcite in masses and irregular veinlets more than 3 mm thick. Pyrite, quartz, sphalerite, and anthraxolite are present. Mineralization consisted of several stages: (1) pre-ore silicification; (2) pre-ore calcitization; (3) deposition of cinnabar and calcite; and (4) post-ore calcite. Only magmatic rocks in vicinity are Late Paleozoic diabase bodies interlayered in Carboniferous and Permian clastic sedimentary rocks. **REFERENCES:** Babkin, 1975.

P55-2 63 40 148 42	Urultun	Pb, Zn Mississippi Valley Pb-Zn	Medium to large. Average grade about 2.85% Pb and 6.74% Zn.

SUMMARY: Disseminated veinlets and brecciated ore occur in Lower Devonian (upper Emsian) dolomite overlain with Middle Devonian (Givetian) marl. Ore bodies are composed of dolomite, calcite, fluorite, galena, sphalerite, and anthraxolite. Barite, pyrite, and cinnabar are present locally. Quartz is absent. Mineralization formed in two stages: (1) an early sphalerite-fluorite stage which resulted in disseminated metasomatic ore, and (2) a galena-fluorite-calcite stage which resulted in brecciated and veinlet ores. Fracturing occurred between these stages. The ore-bearing dolomite sequence is up to 240 m thick along a synclinal limb of a fold that generally trends northwesterly and dips 50-70° to the northeast. The limbs of the fold are subhorizontal south of the deposit. From two to five conformable ore horizons, varying in thicknesses from 1 to 10 m, are known within this dolomite sequence; but ore bodies are sporadic within a given horizon. Ore zone extends over an area of about 20 by 4 km. **REFERENCES:** Shpikerman, 1987.

P55-3 63 36 144 010	Aida	Ag, Au Epithermal vein	Small.

SUMMARY: Adularia-carbonate-quartz veins with pyrite, chalcopyrite, sphalerite, galena, freibergite, pyrargyrite, miargyrite, stephanite, küstelite, and native silver. Conjugate to linear zones of quartz-adularia-sericite, quartz-chlorite-kaolinite, and quartz-chlorite-carbonate altered rocks up to 30-40 m thick. Ore bodies are associated with major east-west trending faults and conjugate northeastern fissures, in hypersthene andesite of the southeastern Taryn volcanic complex. **REFERENCES:** Gamyanin, 1974.

P55-4 63 33 148 55	Terrassnoe	Pb, Zn (Cu, Ag) Pb-Zn skarn	Small. Average grade about 1% Pb, 5% Zn, and 140 g/t Ag.

SUMMARY: Metasomatic skarn with sulfide occurrences along the tectonic contact between Upper Devonian (Frasnian) limestone and Upper Paleozoic aluminous-siliceous sedimentary rocks. Deposit extends for 700 m. Occurs in the bottom of a late Jurassic volcanic depression intruded by hypabyssal dikes overlying a buried Late Mesozoic granitic intrusion. Skarn is composed of hedenbergite (indicating low temperature), garnet (andradite-grossular), and ilvaite. Sphalerite is related to the skarn-forming processes. Silver-polymetallic minerals predominate. Main ore minerals include: sphalerite, galena, chalcopyrite, and magnetite. Silver occurs mainly with the sulfides, and silver mineralization was later than the skarn formation. **REFERENCES:** Shpikerman, 1987.

P55-5 63 29 149 33	Prizovoe	Ba Bedded barite	Small.

SUMMARY: Conformable, sheet-like, steeply-dipping deposit of massive white barite in siliceous argillite and siltstone of Lower to Middle Carboniferous age. Deposit is more than 300 m long and about 30 m wide. Barite exhibits a relic sedimentary structure in the middle of the deposit. Ore horizons show evidence of bed-by-bed metasomatic replacement of the host rocks. Barite-bearing, siliceous clastic sedimentary rocks are intensely deformed and contain numerous interlayers of Late Paleozoic diabase. Host rocks have an anomalously high background content of manganese, zinc, copper, silver, and barium. **REFERENCES:** Shpikerman, 1989, written commun.

P55-6 63 30 149 18	Prolivnoe	Pb, Zn Mississippi Valley Pb-Zn	Small.

SUMMARY: Disseminated veinlets, brecciated and banded ores, in dark-gray, diagenetic dolomites of Lower Devonian (Emsian) age. Ore minerals are galena, sphalerite, and fluorite. Two stages of mineralization can be distinguished: (1) sphalerite, which subsequently underwent strong deformation; and (2) coarsely crystalline white dolomite, calcite, fluorite, galena, and large masses of anthraxolite. Mineralized dolomite sequence is more 200 m thick and includes two conformable mineralized horizons that trend east-west. Dolomite is overlain by black carbonaceous shales of late Emsian age. **REFERENCES:** Shpikerman, 1987.

P55-7 63 25 149 42	Batko	Cu (Ag, Ba) Basaltic Cu	Small.

SUMMARY: Disseminated and irregular masses of sulfides occur in subalkalic, amygdaloidal basalt flows up to 200 m thick, within folded red beds of Middle Devonian (Givetian) age. Ore minerals are bournonite, chalcocite, and covellite. Mineralization is confined to the tops of the basalt flows. Adjacent trachybasalt is intensely epidotized and carbonatized. Silver and barium are associated with the copper. Upper mineralized horizon is no more than 2-3 m thick. **REFERENCES:** Shpikerman and others, 1991.

P55-8 63 15 146 14	Verkhne-Khakchan	Au Au quartz vein	Medium. Ranges 0.2 to 7.8 g/t Au.

SUMMARY: Occurs as linear zones in brecciated and silicified, Upper Permian siltstone and shale. Ore zones are controlled by northwest- and approximately east-west-trending fractures, which have diverse orientation near fault intersections. Ore bodies include lenticular and stockwork-like occurrences; areas of near-total silicification; and short, narrow quartz veins. Quartz makes up 98% of the veins with albite, carbonates, chlorite, tourmaline, sericite, pyrite, arsenopyrite, sphalerite, chalcopyrite, galena, ilmenite, tetrahedrite-tennantite, and gold (700-850 fine). Deposit is located in the vicinity of the Chai-Yurya strike-slip fault. Geology and structure are similar to that in the Natalka deposit. **REFERENCES:** Panychev, 1977, written commun.

P55-9 63 13 146 55	Kontrandya	Au Au quartz vein	Small. Ranges 1.2 to 2500 g/t Au.

SUMMARY: Associated with a northwesterly-trending altered rhyolite dike 6 to 23 m thick. Deposit occurs in steeply folded sandstone and shale of Early Jurassic age; and is related to the Chai-Yurya strike-slip fault. Gold ore bodies occur in steeply dipping quartz veins 10-15 cm thick, which cut the dike obliquely over an area approximately 150 m long. Besides quartz, the veins contain albite, arsenopyrite, pyrite, boulangerite, and gold. **REFERENCES:** Filippov, 1944, written commun.; Skornyakov, 1953, written commun.

P55-10 63 03 144 19	Kuranakh-Sala	Sn Sn silicate-sulfide vein	Small.

SUMMARY: Steeply dipping, quartz-tourmaline veins up to 1.5 m thick in a Lower Cretaceous granitic pluton are composed of cassiterite, magnetite, pyrite, arsenopyrite and chalcopyrite. **REFERENCES:** Lugov, 1986.

P55-11 63 04 148 16	Taboga	Au Au quartz vein	Small to medium. Mineralized zones contain traces to 78.9 g/t Au and quartz veins contain up to 3652 g/t Au.

SUMMARY: About 30 mineralized zones of variable size. They are located in two en echelon structures related to the Taboga strike-slip fault zone. Quartz veinlets cement fractured Lower and Middle Jurassic shale, siltstone, and sandstone. Distinct veins are rare. Mineralized zones are several hundreds of meters long and several meters thick. They are composed of about 98% quartz with albite, carbonates, barite, arsenopyrite, pyrite, pyrrhotite, galena, bismuthite, gold and native silver. Fault which controls the deposit cuts diagonally across a northwest-trending fold structure in the sedimentary sequence, and is parallel to the western contact of a large granitic pluton. **REFERENCES:** Veldyaksov and others, 1973, written commun.

P55-12 63 06 147 48	Stakhanov	Au Au quartz vein	Small. Ranges 0.2 to 3800 g/t Au.

SUMMARY: Lenticular quartz veins and zones of quartz veinlets occur along the walls of gently dipping dikes of hydrothermally altered rhyolite, and are partially in the dikes themselves. The two known ore bodies extend for 400-450 m. The sandstone and shale intruded by the dikes is intensely deformed and hornfelsed; deformation probably related to the Burganda strike-slip fault. Folds and dikes trend northwest. Quartz veins contain albite, ankerite, chlorite and sericite. Ore minerals are arsenopyrite, pyrite and more rarely, scheelite, galena, sphalerite, pyrrhotite, and gold, with rare cassiterite and molybdenite. Gold is associated with galena and arsenopyrite. Gold nuggets up to 2 g occur. **REFERENCES:** Skiornyakov, 1953, written commun.

P55-13 62 56 14814	Maldyak	Au Au quartz vein	Small. Ranges from traces to hundreds of g/t Au.

SUMMARY: A set of gold-bearing dikes, and zones of veins and veinlets occur in sedimentary rocks near a straight section of the Burganda strike-slip fault. The Lower Jurassic sandstone and shale host rock is deformed into small steep folds that trend northwest. Thin, en echelon dikes occur in diagonal shears. Transverse, extension fractures are filled with short and morphologically complex quartz veinlets and lenses up to 10 m thick. Major dike is up to 5 km long and is composed of propylitized and albitized basalt and rhyolite. It is cut and locally offset by an oblique set of shear fractures, which host lenticular quartz veins and reticulate albite-quartz veinlets with sulfides and rich gold ore bodies. Ore bodies are composed of quartz, albite, ankerite, calcite, sericite, chlorite, apatite, pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, tetrahedrite-tennantite, and gold. **REFERENCES:** Aleinikov, 1945, written commun.; Fedotov, 1960a.

P55-14 62 50 148 01	Dorozhnoe	Au Au quartz vein	Small. Ranges 0.5 to 30,150 g/t Au.

SUMMARY: Steeply dipping, subparallel, gold-bearing quartz veins occur for about 100-120 m in a granitic pluton which is exposed over an area about 9 km long and up to 1.5 km wide. Stock (K-Ar age of 131-134 Ma) is composed of granodiorite, biotite granite, and granite porphyry. Stock trends about east-west, across the strike of the Lower Jurassic sandstone-shale sequence it intrudes. Veins trend northeast, are complicated in form, and vary in thickness from about 0.1-2 m. Veins branch and wedge out on entering the hornfels around the granite. Ore bodies are composed of quartz, sericite (muscovite), albite, calcite, ankerite, chlorite, apatite, arsenopyrite, pyrite, galena, sphalerite, chalcopyrite, electrum; and rare high-grade gold, tetrahedrite-tennantite, and scheelite. Gold nuggets up to 800 g have been found. Gold characteristically occurs with mica and galena as linear bands parallel to vein contacts. **REFERENCES:** Firsov, 1959.

P55-15 62 46 145 29	Kyurbelykh	Sn (Ag) Sn silicate-sulfide vein and Sn polymetallic vein	Small.

SUMMARY: Steeply dipping, tin-bearing veins, less common linear zones of veinlets, and metasomatically altered rocks, occur near the northeastern contact of the Early Cretaceous(?) Tass-Kystabyt granitic pluton that intrudes Upper Triassic sandstone and sandy shale. Mineralized fissures generally strike east-west and north-west and are several hundreds of meters long and up to 1 m thick. Ore bodies are accompanied by weak contact metamorphism, sericitization, chloritization and, more rarely, tourmalinization. Veins are composed of quartz, tourmaline, cassiterite, arsenopyrite, pyrite, marcasite, pyrrhotite, chalcopyrite, and sphalerite, with minor galena, tetrahedrite-tennantite, argentite, stannite, bismuthinite, magnetite, hematite, ankerite, and calcite. Amount of sulfides increases away from the contact of the granitic rocks. Ore bodies are widely dispersed over the area, sometimes in clusters of 10-15 veins. **REFERENCES:** Chaikovsky, 1960; Lugov, 1986.

P55-16 62 47 149 46	Shturm	Au Au quartz vein	Small to medium. Averages about 10-12 g/t Au.

SUMMARY: Deposit consists of sets of auriferous quartz veinlets hosted by a complicated, propylitized, albitized, silicified, and sulfidized basalt-rhyolite dike averaging 4.5 m thick and extending for over 5.5 km. Gold-quartz stockworks, irregular masses, and reticulate ore bodies are best developed where the dike is crossed by shear fractures that parallel folds in the Lower and Upper Jurassic clastic sequence intruded by the dike. Dike is broken into small blocks shear zones, and is less altered and mineralized between shear zones. Ore minerals are quartz, albite, ankerite, sericite, paragonite, actinolite, chlorite, apatite, tourmaline, arsenopyrite, pyrite, pyrrhotite, boulangerite, gold, sphalerite, galena, chalcopyrite, scheelite, and rutile. Gold is 900-940 fine and associated with arsenopyrite, sphalerite, and galena. Gold nuggets up to 300 g have been found. Deposit is located within the Srednekan-Shturm strike-slip fault zone. **REFERENCES:** Skornyakov, 1953, written commun.

P55-17 62 45 148 06	Daika Novaya	Au Au quartz vein	Medium. Typically ranges 0.2 to 21 g/t Au with values up to 1385 g/t Au.

SUMMARY: Steeply dipping dike of diorite porphyry has been hydrothermally altered. Dike is sulfidized and cut by an orthogonal system of subhorizontal and subvertical quartz veinlets that contain carbonates, feldspars, disseminated arsenopyrite, pyrite, sphalerite, and gold. Dike trends northeast across a folded Jurassic sandstone-shale sequence. **REFERENCES:** Shakhtyrov, 1991, oral commun.

P55-18 62 44 147 52	Svetloe, Kholodnoe	Au Au quartz vein	Small to medium. Ranges 1.0 to 100 g/t Au.

SUMMARY: Subparallel quartz veins 600-1500 m long average 0.2-0.5 m thick, and 20-80 m apart. Veins occur as conformable bodies or in acute fractures in the limbs of an asymmetric anticline. Veins dip 70° to 85°. Ore bodies trend mainly northwest, but range from east-west to north-south. Upper Triassic and Lower Jurassic sandstone and shale is intruded by a transverse set of dikes of felsic and intermediate composition that host the auriferous quartz veinlets. Ore minerals are mainly arsenopyrite, pyrite, and galena containing gold (858 fine). Subordinate ore minerals are: sphalerite, chalcopyrite, scheelite, pyrrhotite, and native gold. Kholodnoe deposit, which occurs to the south, is made up of three sets of quartz veins and mineralized fracture zones with a northwest trend. Some veins occur within the dikes. Gold is present as very small inclusions or irregular masses. **REFERENCES:** Skornyakov, 1953, written commun.; Fedotov, 1960b, 1967.

P55-19 62 41 147 24	Chai-Yurya	Au (Bi) Au quartz vein	Small. Veins contain 0.4 to 425 g/t Au; mineralized zones average about 5 g/t Au.

SUMMARY: Altered dikes of felsic to intermediate composition are cut by sets of gold-bearing quartz veins. Lenticular quartz veins occur in silicified and mineralized zones in sedimentary rocks near the dikes. Quartz veins contain albite, potassium feldspar, carbonates, and biotite. Ore minerals are pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, pyrrhotite, gold, bismuthinite, tetrahedrite, and boulangerite. Deposit occurs in Middle and Upper Triassic sandstone and shale. Ore bodies are controlled by diagonal fractures that acutely intersect the Chai-Yurya strike-slip fault zone. Veins are numerous, but they are scattered over a large area and are not large. **REFERENCES:** Skornyakov, 1953, written commun.

P55-20 62 37 148 02	Chelbanya	Au Au quartz vein	Small. Veins contain 1 to 32 g/t Au.

SUMMARY: Steep, transverse and oblique quartz veins and veinlets occur near and in dikes of propylitized rhyolite and andesite that intrude a Lower Jurassic sandstone-shale sequence. Veins are mainly composed of quartz, albite, carbonates, and sericite; with minor arsenopyrite, pyrite, galena, gold, sphalerite, chalcopyrite, pyrrhotite, löellingite, scheelite, hematite, fluorite, ilmenite, rutile, sphene, apatite, tourmaline, cassiterite, and epidote. Gold is present as tiny disseminations and in particles up to 5-10 mm in size. At least one vein 50 m long and 0.3 m thick, which cross cuts a dike, is economic. **REFERENCES:** Skornyakov, 1953, written commun.

P55-21 62 36 149 45	Verkhne-Khatynnakh	Sn (Au, Ag) Sn quartz vein	Small.

SUMMARY: Northeast-trending steeply-dipping quartz veins and veinlets form productive zones that range in thickness from 5 cm up to 0.5 m. Mineralized area is made up of intensely hornfelsed Middle Jurassic shale and sandstone, but the intrusive body responsible for alteration of the host rocks is not exposed. Ore bodies are accompanied by halos of tourmalinization, sericitization, carbonatization, and abundant disseminated arsenopyrite. Gangue minerals include quartz, tourmaline, sericite, albite, apatite, fluorite, calcite, and chlorite. Ore minerals are cassiterite, scheelite, arsenopyrite, pyrite, sphalerite, chalcopyrite, galena, gold, and sulfosalts of lead and silver. **REFERENCES:** Buryanov, 1940, written commun.

P55-22 62 36 149 04	Burkhala	Au Au quartz vein	Small to medium. Ranges 0.1 to 5261 g/t Au.

SUMMARY: Mineralized fracture belts and folded zones up to 5 m thick, contain quartz and quartz-carbonate veins and veinlets with arsenopyrite, pyrite, and gold; and minor galena, sphalerite, pyrrhotite, and scheelite. Late veinlets contain cassiterite, topaz, and tremolite. Mineralized area is up to 2 km long and several tens of meters wide. Deposits are related to the Debin strike-slip fault zone. Structure of the deposit consists of en echelon fractures that cut the intensely deformed and sulfidized Lower and Middle Jurassic sedimentary rocks. **REFERENCES:** Skornyakov, 1953, written commun.

P55-23 62 26 145 14	Tektonicheskoe	Pb, Zn, Ag, Sn Pb-Zn-Ag vein	Small. Contains 0.2 to 22.7% Pb, 0.2 to 8.9% Zn, 12 to 1276 g/t Ag, 0.05 to 0.3% Sn.

SUMMARY: Quartz and ankerite-quartz veins of variable thickness are confined to steeply dipping fractured zones in Upper Triassic sedimentary rocks. Main ore body trends northwest for 900 m, and is 0.4-5 m thick. Ore minerals are mainly disseminated, and valued for their silver content. Veins contain galena, sphalerite, cassiterite, pyrite, arsenopyrite, pyrrhotite, chalcopyrite, jamesonite, tetrahedrite-tennantite, and argentite. **REFERENCES:** Fursikov, 1952, written commun.

P55-24 62 22 149 03	Djelgala-Tyellakh	Au Au quartz vein	Small. Ranges 1 to 100 g/t Au.

SUMMARY: Late Jurassic silicified dikes along a set of parallel shear fractures are cut by a system of ladder and reticulate gold-bearing quartz veinlets. Deposit extends for 1-1.5 km and consists of a set of saddle-veins in the cores of anticlines composed of fine-grained sandstone. Dikes are from 100 m to 8 km long with a northwest to generally east-west trend. Individual ore bodies extend for hundreds of meters. Veins and veinlets contain albite, ankerite, tourmaline, disseminated pyrite, arsenopyrite, galena, scheelite, bismuth minerals, and gold. Area is within the hornfels zone of the Bolshoy Annachag granitic body. **REFERENCES:** Panychev, 1977, written commun.

P55-25 62 18 145 42	Bulunga	Pb, Zn, Ag Pb-Zn-Ag vein or skarn	Small. Contains 2.3 to 8.9% Pb, 0.57 to 4% Zn, 30 to 780 g/t Ag.

SUMMARY: Steeply dipping, single and branching veins up to 200 m long occur in contact-metamorphosed Middle Triassic sedimentary rocks that have been intruded by a small quartz diorite stock. Ores are composed of galena, sphalerite, chalcopyrite, pyrite, arsenopyrite, tetrahedrite-tennantite, argentite, and gold. Veins also contain anomalous tin, cadmium, indium, cobalt, and bismuth. Gangue minerals include quartz, carbonate, fluorite, and chlorite. **REFERENCES:** Rutskov, 1942, written commun.; Radchenko, 1950, written commun.

P55-26 62 16 146 31	Tigrets-Industria	Sn, Ag, Pb, Zn Sn polymetallic vein	Small.

SUMMARY: Quartz-carbonate-sulfide, quartz-sulfide, and sulfide-quartz veins, and lenticular bodies and zones of veinlets, occur in weakly metamorphosed Upper Permian sedimentary rocks that have been cut by a Late Cretaceous granite porphyry. Ore bodies are 100-200 m long and 0.1-0.8 m thick, and are localized along northeast trending fractures. Upper Cretaceous siliceous lava flows are peripheral to the mineralized area. There are several tin and silver mineral associations in the deposit. A period of deformation separated an early quartz-cassiterite and polysulfide stage of mineralization marked by cassiterite, arsenopyrite, pyrite, chalcopyrite, sphalerite, galena, canfieldite, Fe-freibergite, stannite, and pyrargyrite, from a later selenocanfieldite-quartz stage that produced quartz, pyrite, sphalerite, galena, stannite, selenocanfieldite, and manganocalcite. **REFERENCES:** Lychagin, 1967; Plyashkevich, 1990.

P55-27 62 01 146 45	Tokichan	Au Au quartz vein	Small. Averages 5 to 7 g/t Au.

SUMMARY: Quartz veins and zones of veins and veinlets contain disseminated arsenopyrite, pyrite, galena, sphalerite, scheelite, and native gold. Veins occur in Upper Permian clastic rocks near the Tenka strike-slip fault zone. There are three zones of alteration: (1) an outer carbonate-albite-chlorite zone, (2) a medial sericite-chlorite-quartz zone, and (3) an inner quartz-sericite zone. Deposit occurs along a narrow northwest-trending band that is controlled by an intricate system of longitudinal and reverse faults and mylonite. **REFERENCES:** Gabdrakhmanov, 1969, written commun.; Zhitkov, Zhitkova, and Goryushin, 1991.

P55-28 61 58 146 60	Degdekan	Au Au quartz vein	Small to medium. Averages 7.3 g/t Au. Was active 1946-47.

SUMMARY: Banded and brecciated quartz, carbonate-quartz veins, and zones of quartz veinlets, contain disseminated arsenopyrite, sphalerite, pyrite, chalcopyrite, galena, and gold, with minor tetrahedrite-tennantite, boulangerite, and scheelite. Veins overlap the contacts between propylitized dikes of intermediate and felsic composition and Upper Permian sandstone and shale. Veins also occur in fractured belts and zones of sulfidization in the sedimentary rocks. Dikes generally trend east-west and are conformable with the sedimentary sequence. Deposit is associated with the Tenka strike-slip fault zone. Dikes formed both at the same time and later than the ore bodies. The majority of the ore bodies pre-date dike intrusion. Veins in post-ore dikes of microdiorite and lamprophyre(?) show evidences of thermal metamorphism. Carbonaceous shale beds, 100 to 1400 m in length, are economically important for gold (720-800 fine). **REFERENCES:** Skornyakov, 1953, written commun.; Shlyapnikov, 1956, written commun.

P55-29 61 56 146 03	Kharan	Sn Sn polymetallic vein	Small. High-grade ores.

SUMMARY: Zones of chlorite-sericite-quartz veinlets trend north, northwest and northeast. Veinlets contain crystalline and colloform cassiterite, pyrrhotite, chalcopyrite, galena, sphalerite, marcasite, and arsenopyrite. Tin is confined to country rock along the southern contact of the Early to Late Cretaceous Kharan granitoid pluton; which consists of diorite and quartz diorite intruded by granite porphyry. **REFERENCES:** Lugov, 1986.

P55-30 61 49 146 31	Khenikandja	Sn Sn silicate-sulfide and Sn polymetallic vein	Small.

SUMMARY: Steeply dipping, metasomatic veins, irregular veins and veinlets, and mineralized fracture belts, are associated with metasomatic zones and considerable feldspar. Ore bodies are 1-3 m thick and trend northwest. Tin ores are dominated by albite and cassiterite, with locally abundant adularia, anorthoclase, chlorite, quartz, calcite, tourmaline, and biotite. Metallic minerals, which were mostly deposited after the cassiterite, include galena, sphalerite, pyrite, chalcopyrite, arsenopyrite, magnetite, wolframite, stannite, bismuth, bismuthinite, and bismuth and gold tellurides. Ore bodies are hosted in Upper Cretaceous biotite porphyry, leucocratic granite, and alaskite porphyry. **REFERENCES:** Lugov, Makeev, and Potapova, 1972; Flerov, 1974.

P55-31 61 45 149 33	Vetrenskoe	Au (W) Au quartz vein	Medium. Well explored with encouraging potential. Partly mined out. Typical grades range 17 to 22 g/t Au.

SUMMARY: Quartz, planar and saddle veins, lenses, and reticulate and ptygmatic veinlets, occur in the central portion of a major strike-slip fault, in its secondary fractures, and in hinges of anticlines and synclines near the northwest trending Chai-Urya fault zone. Host rocks consist of Upper Triassic and Lower Jurassic shale with rare siltstone and sandstone. Some interbeds are characterized by a high content of carbon, iron, and titanium. Ore bodies are identified by sampling within the vein zones. Portions of the veins subjected to plastic deformation carry the highest gold content. Veins consist of 85 to 99% quartz, with varying amounts of iron-magnesium carbonate. Ore minerals are primarily arsenopyrite and pyrite; scheelite is also important. Minor minerals include sericite, chlorite, albite, oligoclase, galena, sphalerite, marcasite, pyrrhotite, wolframite, tetradymite, graphite, apatite, and titanium oxides. Native gold (880-890 fine) is present in quartz, and also as intergrowths with arsenopyrite and galena. Small amounts of gold occur in wall rock impregnated with sulfides. **REFERENCES:** Kalinin, 1974, 1975b; Kalinin and Panychev, 1974; Novozhilov and Sher, 1974.

P55-32 61 39 147 41	Natalka	Au Au quartz vein	Large. Encouraging potential. Low-grade ores. Mined since 1945.

SUMMARY: Zones of subparallel and reticulate quartz veinlets can be grouped into two or three systems. They converge locally along strike into podiform and platy veins. Ore minerals cement schistose, brecciated, cataclastic, and graphitized Upper Permian tuffaceous sedimentary rocks. Deposit is associated with the Tenka strike-slip fault. In plan, the ore field has an S-shaped, en echelon fault structure 7 km long, trending northwest, and bifurcates to the south. Deposit forms a steeply dipping "propeller" pattern. Deformed ore-bearing sequence is complicated by synclines and anticlines near the fault zone and abundant pre-ore and post-ore dikes of felsic to intermediate composition. Overall zone of mineralized veinlets is approximately 300 m wide, consists of zones 50-300 m long and 1-15 m thick which comprise economic ore bodies. These bodies converge in a fan-like fashion. Gangue in the veinlets are mainly composed of quartz (90-95%), albite, anorthoclase, carbonate, chlorite, and sericite; with lesser kaolinite, barite, apatite, and graphite. Ore minerals are dominated by fine-grained disseminated arsenopyrite intergrown with pyrite in wall rocks. Subordinate or rare minerals include galena, sphalerite, chalcopyrite, pyrrhotite, löellingite ($FeAs_2$), cobaltite, bournonite, boulangerite, tetrahedrite-tennantite, scheelite, cassiterite, rutile, ilmenite, and stibnite. Fine-grained and microscopic, low-grade gold (about 750 fine) is commonly associated with arsenopyrite and galena in the veins and veinlets. A considerable proportion of the gold is intergrown in arsenopyrite in the wall rock adjacent to the veins. **REFERENCES:** Firsov, 1957a; Shilo, 1960; Voroshin and others, 1989.

P55-33 61 36 146 28	Porozhistoe	Sn Sn polymetallic vein	Small. Ag up to 112 g/t.

SUMMARY: Steeply-dipping mineralized fracture zones and quartz veins in Lower Triassic clastic sedimentary rocks contain cassiterite, pyrite, arsenopyrite, and galena. **REFERENCES:** Lugov, 1986.

P55-34 61 32 147 57	Pavlik	Au Au quartz vein	Medium. Encouraging potential. Low-grade ores.

SUMMARY: Lenticular zones of reticulate quartz veinlets and mineralized zones up to 2 km long and 3-15 m thick occur in Upper Permian sandstone, shale, and tuff. Ore field is an S-shaped, en echelon fault structure associated with the Tenka strike-slip fault zone. Few dikes are present. Veins and veinlets are composed mainly of quartz, with albite, ankerite, sericite, and chlorite. Ore minerals are arsenopyrite, pyrite, sphalerite, galena, chalcopyrite, pyrrhotite, and gold (790-805 fine). Gold is commonly associated with arsenopyrite. **REFERENCES:** Eremenko, 1956, written commun.

P55-35 61 28 148 48	Shkolnoe	Au (Bi, Te, Ag) Granitoid-related Au	Large. Explored and developed preparatory to mining. Averages 26 g/t Au and 48 g/t Ag.

SUMMARY: An en echelon system of quartz veins trending generally east-west. Veins occur in a multiphase granitoid stock about 4 km^2 in size composed mainly of granodiorite and adamellite; that is intruded by dikes of granite-porphyry, rhyolite, pegmatite, aplite, and lamprophyre. Quartz veins are surrounded by zones of beresitic and argillic alteration; skarn- and greisen-like alteration is present locally. Mineralization occurred in two stages separated by intrusion of lamprophyre dikes: (1) gold-polymetallic stage marked by molybdenite, arsenopyrite, löellingite, native bismuth, bismuth tellurides, and native gold; (2) the most economically important stage, marked by arsenopyrite, pyrite, polymetallic sulfides, gold, electrum, küstelite, freibergite, tetrahedrite-tennantite, lead-antimony and silver sulfosalts, argentite, and stibnite. Gold ore bodies extend to great depth, into a large zone of complicated mineralogy, geochemistry, and structure. **REFERENCES:** Orlov and Epifanova, 1988; Voroshin and others, 1990, written commun.; Palymsky and Palymskaya, 1990.

P55-36 61 21 147 56	Tankist	Mo Porphyry Mo	Small to medium.

SUMMARY: Sets of reticulate and subparallel, molybdenite-quartz, molybdenite-feldspar-quartz, and quartz-molybdenite-arsenopyrite veinlets and veins, several millimeters to 30 cm thick, occur in a hypabyssal granite porphyry intrusion and hornfelsed Upper Permian sedimentary rocks. Deposit occurs near the northern contact of the Early Cretaceous Sevastopol granitic body. Disseminated molybdenite also occurs with quartz as magmatic segregations within the pluton. Associated minerals are sericite, chlorite, carbonates, epidote, fluorite, magnetite, hematite, pyrite, chalcopyrite, pyrrhotite, löellingite, sphalerite, galena, and cassiterite. **REFERENCES:** Bubnov, written commn., 1949; Tyukova, 1989.

P55-37 61 25 148 21	Igumen	Au Au quartz vein	Medium. Produced about 11.5 tonnes Au. Grade ranging 1 to 50 g/t Au, and up to several kg/t Ag. Almost completely mined out.

SUMMARY: Steeply-dipping extensive and persistent quartz veins occur in Upper Permian sandstone, shale, and tuff along the Tenka strike-slip fault zone. Veins form a northwest-trending zone about 4 km long and 2.5 km wide, oblique to an anticline axis. Main ore bodies occur in quartz-cordierite-biotite hornfels in the gently-dipping roof of an Early Cretaceous granitic pluton. Southeastern flank of the mineralized zone is truncated by this intrusive. Both the hornfels and quartz veins contain local, post-ore skarn. Gold-bearing quartz veins are dominated by quartz, albite, iron-bearing carbonate, arsenopyrite, pyrrhotite, chalcopyrite, galena, sphalerite, and gold (765-896 fine). Near the intrusion, vein quartz was recrystallized and the native gold becomes coarser and more abundant. Some late-stage bodies have silver values. **REFERENCES:** Firsov, 1958; Bolotova, Nikolaeva and Filippov, 1982; Tyukova, 1989.

P55-38 61 15 149 05	Butugychag	Sn Sn quartz vein	Medium. Almost completely mined out.

SUMMARY: Feldspar-quartz veinlets and veins up to 1.5 m thick, and linear stockwork zones 0.2-5 m or more thick and several hundreds meters long, contain abundant cassiterite. Ore bodies trend northeast and occur in the western dome of Butugychag pluton; a Late Jurassic or Early Cretaceous(?) leucocratic porphyritic granite. Economic tin veins extend for no more than 40-85 m into the hornfels over the granite dome. Dominant minerals are quartz, albite, potassium feldspar, muscovite, cassiterite, fluorite, and ankerite. Topaz, biotite, tourmaline, arsenopyrite, pyrite, and calcite are less common. Sericite, chlorite, sphalerite, galena, wolframite, and molybdenite occur as minor intergrowths with other minerals. Carbonates and sulfides increase with depth. **REFERENCES:** Chaikovsky, 1960; Lugov, Makeev, and Potapova, 1972.

P55-39 61 16 148 37	Rodionov	Au Au quartz vein	Medium. Produced about 4 tonnes Au during 1947-54. Grade ranges 1 to 2000 g/t Au.

SUMMARY: A major gold-bearing quartz vein located on an overthrust structure, which deforms the limb of an anticline composed of Permian tuff and sedimentary rock. Thrust and fold structures are similar in strike. Upper portion of the vein dips gently, but it is steep at depth. Gently-dipping portion has numerous small, steeply dipping veinlets radiating from the hanging wall, which form a "tail" with a vertical extent of 5-8 m. Vein about 550 m along strike and varies from 5 cm to 9 m thick. Hanging wall composed of banded quartz with carbonaceous shale interbeds. Foot wall composed of sedimentary rock breccia cemented by massive quartz. Gangue minerals are feldspars, ankerite, sericite, paragonite, chlorite, and apatite. Ore minerals are pyrite, arsenopyrite, pyrrhotite, galena, sphalerite, chalcopyrite, scheelite, and native gold. Electrum, tetrahedrite-tennantite, and silver sulfosalts are also present. Weak contact metamorphism occurs with formation of diopside, hedenbergite, and actinolite. Deposit is located near the Tenka strike-slip fault zone. **REFERENCES:** Firsov, 1957b; Tyukova, 1989.

P55-40 61 06 14 549	Bogatyr	Sn Sn silicate-sulfide vein	Small.

SUMMARY: Cassiterite-bearing veins and mineralized zones of quartz-chlorite-sulfide composition in Upper Permian marine clastic rocks occur at the contact with a Late Cretaceous granite intrusion. **REFERENCES:** Lugov, 1986.

P55-41 60 58 147 06	Khuren	Sn Sn polymetallic vein	Small.

SUMMARY: Feldspar-quartz, chlorite-quartz, and sulfide veins occur in mineralized fracture zone in contact-metamorphosed Upper Permian shale, siltstone and sandstone. Sulfides also cement the matrix of the fractured zone. Ore occurs in massive and disseminated form, and less commonly in brecciated or banded form. Main ore minerals are: arsenopyrite and pyrite; subordinate minerals are: quartz, chlorite, cassiterite, sphalerite, galena, stannite, native bismuth, and cobaltite. Ore zones strike northwest and northeast for 70 m to 900 m, with the average thickness 0.7-2.8 m. Host rocks are intruded by a small stock of greisenized granodiorite, and numerous dikes of felsic and intermediate composition. **REFERENCES:** Zakandyrin, 1952, written commun.

P55-42 60 44 148 01	Senon, Utro, Serebryanoe	Ag, Au, Sb Epithermal vein and Volcanic-hosted Sb vein	Small. Ranges 0.2 to 10.6 g/t Au and 20 to 900 g/t Ag. Sb content in Utro deposit is 6.7 to 58%.

SUMMARY: Senon deposit consists of sets of subparallel, quartz and feldspar-carbonate-quartz veins with disseminated pyrite, arsenopyrite, argentite, pyrargyrite, stephanite, chalcopyrite, sphalerite, galena, hessite, bismuthinite, and marcasite along a generally east-west zone of propylitization in Upper Cretaceous andesite. Utro deposit consists of disseminated veinlets of stibnite accompanied by pyrite, marcasite, arsenopyrite, and, less common miargyrite, berthierite, dyscrasite, plagionite, sphalerite, cinnabar, native silver, and antimony; in silicified and sericitized ignimbrite. Serebryanoe deposit consists of kaolinite-sericite-quartz altered rock in a hypabyssal dacite body. Altered zone contains east-west trending veins and reticulate systems of veinlets with irregularly disseminated pyrargyrite, miargyrite, polybasite, tetrahedrite-tennantite, arsenopyrite, pyrite, sphalerite, argentite, native silver, and gold. **REFERENCES:** Markova, 1978, written commun.; Zhuravlev and Garifulin, 1979, written commun.; Manafov and others, 1979, written commun.

P55-43	Burgagylkan	Au, Ag	Small to medium. Averages about
60 41		(Bi)	7.4 g/t Au, 800 g/t Ag, and up to
146 39		Epithermal vein	1% Bi.

SUMMARY: Quartz, adularia-quartz, and sulfide-quartz veins and stockwork zones contain disseminated pyrite, sphalerite, galena, chalcopyrite, tetradymite, tetrahedrite, sulfosalts of silver, electrum, tellurides of gold and silver, and stibnite. Gold-silver ore bodies are confined to Upper Cretaceous propylitized andesite and agglomerate of the hypabyssal and vent facies in the margin of a caldera structure. Veins are several hundreds of meters to 2 km long and up to 15 m wide. Massive, brecciated, colloform-banded, framework-platy, and cockade ore structures are typical. Au:Ag ratio ranges from 1:30 to 1:130. **REFERENCES:** Pavlov, 1977, written commun.

P55-44	Sentyabr	Ag, Au	Medium. Ranges 2 to 6273 g/t Ag
60 44		(Co, Bi, Te)	and 1.4 to 787 g/t Au.
149 22		Epithermal vein	

SUMMARY: Quartz stockworks, hydrothermal breccias, and veins; with precious metals, and polymetallic and silver minerals, occur around the periphery of an intrusive dome. Host rocks are Lower Triassic siltstone and shale. Intrusive core of the dome is a Late Cretaceous multiphase stock of gabbro, granite porphyry, and porphyritic granite. Ore bodies are controlled by arcuate faults and the granite porphyry dikes which radiate from the stock. Polymetallic stage of mineralization includes quartz, fluorite, arsenopyrite, löellingite ($FeAs_2$), glaucodot [(Co,Fe)AsS], chalcopyrite, pyrrhotite, pyrite, sphalerite, galena, joseite B, and nagyagite (with low Au and Ag); all of which typically occur in hornfels near the stock. Silver stage of mineralization, characterized by argentite, stromeyerite, tetrahedrite, aguilarite, stephanite, polybasite, pyrargyrite, electrum, and küstelite, is typical of ore zones in low-grade metamorphic rocks further away from the stock. Both types of mineralization occur together in an intermediate zone. **REFERENCES:** Umitbaev, 1986.

P55-45	Oira	Au, Ag	Small. Averages about 37 g/t Au
60 09			and 51 g/t Ag.
149 45		Epithermal vein	

SUMMARY: Sets of adularia-chlorite-quartz veins with disseminated pyrite, argentite, pyrargyrite, miargyrite, electrum, and nagyagite occur in three ore zones up to several hundred meters long and 0.2 to 12 m wide. Zone of ore bodies trends about east-west for 3 to 4 km, and is 1 to 2 km wide. Ore is confined to the margin of a small volcanotectonic structure resulting from a subsidence of the volcanic roof over an Upper Cretaceous granite-granodiorite pluton. Upper Cretaceous andesite and dacite that host the deposit are intensely propylitized to epidote-prehnite-chlorite and chlorite-carbonate facies. Au/Ag ratio is 1:1. Main stage of mineralization was followed by high-temperature contact-metasomatism related to the emplacement of the granitic complex. Metasomatic stage is marked by a garnet-prehnite-wollastonite-epidote assemblage containing galena, sphalerite, and chalcopyrite. **REFERENCES:** Skibina, 1977, written commun., Naiborodin, 1980.

P56-1 63 54 152 33	Opyt	Au, Cu, Pb, Zn, Ag, Au Cu-Ag quartz vein	Small.

SUMMARY: Occurs as veins and zones of massive, disseminated, and brecciated veinlets. Gangue composed of quartz, calcite, dolomite, graphite, and chlorite. Ore minerals include pyrite, chalcopyrite, bornite, galena, sphalerite, cuprite, native copper, chalcocite, arsenopyrite, and electrum. Wall rock is copper-bearing, graphitic, sericite-chlorite-quartz schist of Upper Proterozoic age. Silver-bearing copper-polymetallic veins also occur in Upper Jurassic siltstone and sandstone. Deposit is located at the intersection of a Late Jurassic depression and a block of old metamorphic rocks near a barely eroded granite body. Tin content of ore increases toward the granite. Main ore body is about 2 km long, entire deposit extends northwesterly for about 3 km. **REFERENCES:** Lyaski, 1937, written commun.; Erzin, 1946, written commun.; Ruchkin and Tsykarev, 1984, written commun.

P56-2 63 29 1510043	Datsytovoe	Cu, Ag, Bi Porphyry Cu	Small.

SUMMARY: A stockwork of disseminated quartz-carbonate-sulfide veinlets with silver-copper-bismuth minerals occurs in subvolcanic trachyrhyolite in the middle of a circular volcanic structure. Stockwork extends over an area of about 0.2 km^2. Pyrite is the dominate ore mineral; chalcopyrite, sphalerite, marcasite, galena, silver-lead-bismuth sulfosalts, acanthite, polybasite, and native bismuth are also present. Trachyrhyolite, which hosts the ore bodies, is silicified and sericitized. Skarn is present locally, possibly as xenoliths. **REFERENCES:** Shpikerman and Savva, 1988, written commun.

P56-3 63 27 154 55	Egorlyk	Sn Sn silicate-sulfide vein	Small to medium. Partly mined out.

SUMMARY: Approximately 200 veins form 17 ore fields with varying economic potential, over an area of about 60 km^2. They occur in porphyritic biotite granite and hybrid granodiorite of the Upper Cretaceous Egorlyk pluton. Tin minerals are confined to steeply dipping fractures that trend northwest. Veins are up to several hundreds meters long and average about 1.5 m thick. Ore is composed predominantly of quartz and tourmaline, with cassiterite and muscovite. Cassiterite occurs in masses up to 10 cm in diameter. Variable quantities of pyrite, apatite, rutile, sphene, fluorite, calcite, arsenopyrite, magnetite, hematite, wolframite, scheelite, molybdenite, pyrrhotite, chalcopyrite, galena, sphalerite, native bismuth, and marcasite are present. Wall rocks are tourmalinized and kaolinized, and less commonly chloritized and greisenized. Total vertical extent of the ore bodies is at least 400-500 m; the highest tin content is at the tops and bottoms of this interval. **REFERENCES:** Matveenko, 1957; Erilov, 1970.

P56-4 63 24 150 55	Kunarev	Pb, Zn, Cu, Ag Pb-Zn-Cu-Ag skarn	Large. Average grade about 0.6% Pb, 3.8% Zn, 70 g/t Ag.

SUMMARY: Consists of numerous lead-zinc occurrences of varying morphology. Largest skarn occurrence is in a Middle Jurassic calcareous conglomerate overlain by Middle and Upper Jurassic argillite and siltstone. Mineralized skarn is composed of hedenbergite, garnet (grossular-andradite), epidote, chlorite, quartz, calcite, galena, sphalerite, chalcopyrite, galenobismutite, matildite, stannite, bornite, cobaltite, hematite, and tetrahedrite. Disseminated metasomatic veinlet and brecciated silver ores occur in Devonian carbonate rocks in the outer part of the ore district. These ores are mainly composed of quartz, calcite, pyrite, galena, boulangerite, freibergite, owyheeite, sphalerite, pyrargyrite, acanthite, sulfoantimonides of lead, betekhtinite [$Cu_{10}(Fe,Pb)S_6$], and native silver. Disseminated silver-copper porphyry-type mineralization occurs in rhyolite in the middle of the volcanic structure. This zoning is typical of porphyry copper deposits, but mineralization at Kunarev is dominated by skarn-polymetallic ore bodies. **REFERENCES:** Shpikerman, 1987; Shpikerman and Savva, 1988, written commun.

P56-5 63 20 151 05	Cherninskoe	Fe (Cu, Pb, Zn) Fe (Cu, Pb, Zn) skarn	Small to medium.

SUMMARY: Metasomatic skarn-magnetite bodies 1 to 15 m thick occur in Upper Permian limestone and siltstone along the northern contact of the Late Jurassic Bolshoy Kanyon granite body. Ores are composed of hedenbergite, ilvaite, epidote, garnet, axinite, magnetite, pyrrhotite, and chalcopyrite. Small inclusions of cobaltite and glaucodot are also present. Magnetite skarn is locally overprinted by sulfide minerals such as pyrrhotite, galena, and sphalerite. **REFERENCES:** Ruchkin and others, 1984, written commun.

P56-6 63 15 151 05	Bolshoy Kanyon	Sn Sn skarn	Small to medium.

SUMMARY: Numerous skarn bodies occur at contacts of Permian limestone and aluminous clastic sedimentary rocks with the Late Jurassic Bolshoy Kanyon granite. Tin minerals are associated with the ultrafelsic, subalkalic granite phase of the pluton. Skarns are dominated by a pyroxene-vesuvianite-garnet association; axinite skarns are also present. Skarns are overprinted by ore stage mineralization characterized by quartz, calcite, fluorite, tourmaline, micas, sulfides, and cassiterite. Sheets and podiform ore bodies predominate. Skarn and related mineralization may be as much as 30 m thick near the apex of the granite's roof. Saddle-like occurrences of skarn up to 70 m thick are developed over low points in the roof of the granite. **REFERENCES:** Politov, 1983.

P56-7 63 12 152 13	Lazo	Sn Sn silicate-sulfide vein	Medium. Active in 1940s but now mined out.

SUMMARY: Numerous veins 0.4-0.6 m thick occur in hornfelsed, Middle Jurassic clastic sedimentary rocks at the western contact of the Deryas-Yuryagin granite body. Ore bodies are related to northeast-trending fractures. Veins extend for several hundred meters along strike. Rich ores are banded or irregular in form, often with an oblique or vertical pitch. Veins are dominated by a quartz-tourmaline-pyrrhotite-calcite assemblage. Cassiterite, chlorite, pyrite, arsenopyrite, sphalerite are subordinate. Amount of scheelite increases toward the intrusion. Three major mineral associations are distinguished that correspond to three successive stages of mineralization. First stage is marked by tourmaline, quartz and cassiterite. Second stage is characterized by sulfides of iron, zinc, tin, and other minerals. Third stage is dominated by calcite. Sulfides contain the gold and silver. **REFERENCES:** Vasetsky, 1966.

P56-8 63 17 151 23	Verkhne-Seimchan	Co, Bi Co arsenide vein	Medium. Mined out.

SUMMARY: A set of veins composed mainly of quartz, iron chlorite, and tourmaline in hornfelsed Middle Jurassic siltstone south of the Late Jurassic Bolshoy Kanyon granite pluton. Sparse calcite, fluorite, and adularia occur in the veins. Main ore minerals are: arsenopyrite, pyrite, cobaltite, and bismuthinite. Subordinate ore minerals are: pyrrhotite, chalcopyrite, galena, native bismuth, skutterudite, chloanthite, smaltite, selenides and tellurides of silver, lead, and bismuth; and native gold. Veins are steeply-dipping, 250-1500 m long, 0.1-6 m thick, and are known to a depth of 350 m. Cobalt content decreases at depth, and the quartz-chlorite gangue is replaced by quartz and tourmaline. Ore bodies are controlled by a northwest-trending fault; and are confined to splays from this fault. **REFERENCES:** Ruchkin and others, 1984, written commun.

P56-9 63 17 153 13	Bastion	Sn Sn greisen	Small. High grade portion mined out.

SUMMARY: Lenticular and vein-like bodies of tin-bearing, quartz-tourmaline and quartz-muscovite greisens are several tens of centimeters to 5 m thick and 100-200 m long. They are confined to northeast fractures in Late Cretaceous porphyritic granite and granite porphyry. **REFERENCES:** Aksenova, 1957, written commun.; Avdeev and Sadovsky, 1970, written commun.

P56-10 63 08 154 58	Arylakh	Ag, Au (Sn, Co, Bi) Epithermal vein	Medium. Grade up to 556 g/t Ag and 1 g/t Au.

SUMMARY: Quartz, adularia-quartz, and quartz-sulfide veins, from several hundreds of meters to 1 km long, grade into zones of veinlets. They contain disseminated pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, argentite, pyrargyrite, freibergite, and native silver. Gold-silver minerals are locally associated with tin and cobalt-bismuth minerals. Ore bodies occur in Upper Cretaceous rhyolite and ignimbrite, in a band of subvolcanic rocks about 5-6 km wide that rims a caldera. **REFERENCES:** Grigoriev, 1978.

P56-11 63 05 152 45	Chepak	Au, W, Bi Granitoid-related Au	Small. Ranges 5 to 50 g/t Au, with values as high as 200 g/t Au.

SUMMARY: Steeply dipping, quartz-sulfide veinlets, veins, and associated alteration zones, cut intensely hornfelsed Upper Triassic sandstone and shale overlying a buried granitic pluton. Gold ore bodies are grouped into zones of northeast-trending veins. Host rocks are intruded by dikes of diorite porphyry, lamprophyre, and dolerite; and by small intrusive bodies of Late Jurassic-Early Cretaceous granite porphyry, granodiorite porphyry, dacite, and quartz syenite. Disseminated veinlets are also present in the magmatic rocks and in hornfels. Wall rocks are silicified, chloritized, and sericitized. Veins are composed mainly of quartz (30-40%), sericite, feldspars, chlorite, carbonate, apatite, arsenopyrite, löellingite, scheelite, pyrrhotite, and pyrite. Less common or rare minerals include chalcopyrite, sphalerite, galena, bismuth, bismuthinite, marcasite, wolframite, tetrahedrite-tennantite, magnetite, ilmenite, rutile, sphene, tourmaline, epidote, and fluorite. Arsenopyrite and löellingite make up to 20-40% of the veins. Most gold is finely dispersed in arsenopyrite, löellingite, and pyrrhotite. **REFERENCES:** Skornyakov, 1951, written commun.

P56-12 62 59 151 20	Lyglykhtakh	Mn Sedimentary Mn	Small. Up to 65% MnO.

SUMMARY: Manganese minerals occur in the lower part of an Upper Permian clastic-carbonate sequence 400-750 m thick, which is generally characterized by a high geochemical background for Mn, Ba, Zn, Cu, and Ag. Ore-bearing member is up to 150-200 m thick and composed of variegated crimson, green, and black shale and siliceous shale intercalating with siltstone, tuffaceous sandstone, and organic limestone. Ore bodies are commonly podiform and conformable to bedding. Individual lenses are 0.02 to 1.5 m thick and 0.3 to 6.9 m long. Several ore horizons are present. Ore is generally stratified; but concretionary, oolitic, and spherulitic textures are sometimes present. About two-thirds of the manganese is in rhodochrosite; but pyrolusite, rhodonite, ankerite, and barite are also present. Manganese-bearing units have been metamorphosed near Late Mesozoic granitic intrusions; as a result piedmontite, apatite, and quartz occur there. Pyrolusite, psilomelane, vernadite, and limonite are present in the oxidation zone. Manganese oxide content of primary ore reaches 65%; and supergene ore reaches 57%. **REFERENCES:** Merzlyakov and Shpikerman, 1985.

P56-13 62 51 155 11	Tidit	Ag, Pb, Zn Ag-Pb-Zn vein, Polymetallic vein(?)	Small. Average about 3.4% Pb, 7.6% Zn, and up to 650 g/t Ag. Has been mined. Low-grade reserves remain.

SUMMARY: Altered veins, lenses, and zones of veinlets of quartz-sulfide, chlorite-sericite-quartz, and quartz-rhodochrosite composition, locally highly altered, contain silver-bearing galena, sphalerite, chalcopyrite, pyrite, marcasite, arsenopyrite, pyrargyrite (Ag_3SbS_3), stephanite, freibergite, argentite, polybasite, proustite, famatinite, owyheeite, diaphorite, gudmundite, stannite, cassiterite, native silver, and adularia. Ore bodies are richest along the tectonic contact between a Lower Cretaceous sedimentary sequence and Upper Cretaceous ignimbrites. Mineralized fissures generally strike northeast and dip gently. Mineralized area extends for 1-3.5 km and is 10-20 m wide. **REFERENCES:** Kopytin, 1987, written commun.

P56-14 62 48 155 25	Novy Djagyn	Sn Porphyry Sn	Minor. High grade portion mined out.

SUMMARY: A metasomatized zone up to 130 m wide, marked by a quartz-chlorite-tourmaline alteration, extends for 5 km. It includes sheets, pipe-like bodies, and veined occurrences composed mainly of cassiterite, magnetite, pyrite, hematite, chalcopyrite, arsenopyrite, muscovite, biotite, actinolite, garnet, topaz, dumortierite, and apatite. Native gold, bismuth, stannite, tetradymite, pyrrhotite, pyrophyllite, kaolinite, rutile, and orthite are minor or rare. The tourmaline-cassiterite-chlorite-quartz association is the most productive. Deposit overlies buried granitic intrusion. Lower Cretaceous conglomerate-shale-sandstone sequence that hosts the deposits is intruded by dikes of Late Cretaceous to Paleogene quartz diorite and granodiorite porphyry. Sequence is overlain by Upper Cretaceous volcanic rocks near the deposits. Host rocks are preferentially metasomatized along strike. **REFERENCES:** Bocharnikov, 1968, written commun.; Flerov, 1974.

P56-15 62 48 155 05	Mechta	Ag, Pb, Zn (As, Cu) Ag-Pb-Zn vein , Polymetallic vein(?)	Medium. Average grade about 1% Pb, and 0.74% Zn, with up to 310 g/t Ag and 0.3 g/t Au.

SUMMARY: A set of en echelon, generally north-south, arcuate fracture zones 3.5-4 km wide and 10 km long host quartz-chlorite-sulfide veins and veinlets. Area of mineralization extends south to the Maloken district. Ore bodies form a fan-like structure that branch at the upper levels. They are hosted by Upper Cretaceous, propylitized, and argillized ignimbrites. Explosion breccia and tuff is wide-spread. Main vein minerals are: silver-bearing galena, sphalerite, chalcopyrite, pyrite, arsenopyrite, freibergite, pyrargyrite, stephanite, famatinite, tennantite, argentite, quartz, chlorite, and hydromica. Subordinate minerals are: pyrrhotite, stannite, native gold and silver, feldspar, kaolinite, and carbonate. Ores are dominated by galena-sphalerite and chalcopyrite-freibergite associations. **REFERENCES:** Tkachenko and others, 1976-1979, written commun.; Plyashkevich, 1986; Kopytin, 1987, written commun.

P56-16 62 44 154 60	Maly Ken	Sn, Ag Sn polymetallic vein	Small. Partly Mined out.

SUMMARY: Deposit consists of metasomatic zones, mainly of quartz-chlorite-hydromica-sulfide composition, with fan-like systems of veins, veinlets, and fracture fillings. Ore body is within Upper Cretaceous volcanic rocks (ignimbrite, rhyolite, andesite, and tuff), that trend north-south and northwest, with a thickness of 60-80 m. Ore bodies are composed of quartz, chlorite, cassiterite, pyrite, arsenopyrite, löellingite, pyrrhotite, marcasite, stannite, wolframite, galena, sphalerite, chalcopyrite, tetrahedrite-tennantite, argentite, proustite, and native silver and bismuth. Silver-bearing galena and sphalerite, and tetrahedrite-tennantite and silver sulfosalts, are especially important in the upper levels. **REFERENCES:** Pridatko and others, 1973, written commun.; Lugov and others, 1974a b; Shnaider and others, 1977.

P56-17 62 40 150 07	Goletsov (Golets)	Au Au quartz vein	Small. Average grade 20 g/t Au.

SUMMARY: Numerous steeply-dipping quartz veins and zones of small veinlets occur in folded Lower Jurassic fine-grained sandstone, graywacke, and shale, and less commonly in folded, propylitized, mafic dikes. Veins average 5-20 cm thick, but some reach 3.5 m thick in the noses of folds. Veins extend farther down dip than along strike. Quartz veins contain small amounts of albite, ankerite, mica, chlorite, and rare disseminated arsenopyrite, galena, sphalerite, chalcopyrite, gold, and rutile. Veins are banded; sulfide accumulations are confined to carbonaceous interbeds. Deposit is located on a right-lateral, en echelon segment of the Srednekan-Shturm strike-slip fault zone. **REFERENCES:** Kuznetsov, 1937, written commun.; Trushkov, 1937, written commun.; Skornyakov, 1953, written commun.

P56-18 62 36 155 11	Dukat	Ag, Au Epithermal vein	Large. Discovered in 1967, and currently being mined. Ranges 55 to 1800 g/t Ag and 0.2 to 3.5 g/t Au.

SUMMARY: Silver occurs in quartz-chlorite-sulfide, adularia-quartz, and rhodonite-rhodochrosite-quartz veins and zones of diverse orientation. Hydrothermally altered zones and cryptovolcanic breccia bodies are also present. Ore bodies occur in a sequence of ultrapotassic rhyolites, no older than 93 Ma (K-Ar), in the core of a volcanic dome. Top of an extensive biotite leucogranite pluton (K-Ar age 80±2 Ma) is known at depth of more than 1200 m. Ore zones are up to 1.5 km long and 100 m or more thick. Silver minerals in the ore include intermetallic compounds, simple and complex two-metal sulfides, sulfoantimonides, sulfostannites, and selenides. Acanthite, pyrargyrite, stephanite, native silver, and küstelite predominate. Galena, sphalerite, pyrite, and chalcopyrite are abundant; arsenopyrite, pyrrhotite, magnetite, tetrahedrite, boulangerite, stannite, and other minerals are less common. Mineralization occurred in three stages: (1) quartz-chlorite-sulfide, (2) quartz-adularia, and (3) quartz-rhodochrosite-rhodonite. Ore bodies of the first two stages are bordered by quartz-hydromica alteration. The third stage involved replacement of rhodochrosite by rhodonite, and the formation of skarn with garnet, helvite, epidote, albite, as a result of the intrusion of the granite pluton. Ore stages are dated at 77 Ma by K-Ar methods. Cassiterite ore bodies are related to late tourmalinization. **REFERENCES:** Brostovskay and others, 1974; Savva and Raevskaya, 1974; Kalinin, 1975a, 1986; Raevskaya, Kalinin, and Natalenko, 1977; Sidorov, 1978; Natalenko and others, 1980; Sakharova and Bryzgalov, 1981; Sidorov and Rozenblum, 1989; Shergina and others, 1990.

P56-19 623726N 1554805	Podgornoe	Au, Co, Bi, Te, (As) Au-Co arsenide vein	Small. Ranges 2.5 to 139 g/t Au and 0.2 up to 2.6% Co.

SUMMARY: Conformable and cross-cutting podiform bodies and veins are associated with sulfidization, silicification, tourmalinization, and chloritization. Ores are composed of quartz, tourmaline, chlorite, biotite, and Co-löellingite; with subordinate arsenopyrite, native bismuth, bismuthinite, gold, calaverite, tetradymite, molybdenite, pyrite, chalcopyrite, sphalerite, galena, tennantite, chalcocite, fluorite, and aragonite. District is located in hornfelsed Lower Cretaceous sandstone and siltstone at the contact of the Late Cretaceous Omsukchan leucocratic biotite granite and hybrid granodiorite. **REFERENCES**: Osipov, and Sidorov, 1973; Savva, 1980, written commun.

P56-20 62 33 155 34	Khataren-Industrial	Sn Sn silicate-sulfide vein	Small. Almost completely worked out at average grade of 1% Sn.

SUMMARY: Several tens of banded veins, predominantly of quartz-tourmaline-cassiterite composition, occur in medium-grained biotite granite of the Late Cretaceous Omsukchan pluton. Veins are nearly vertical and trend northeast. Veins are thin, but are several hundreds of meters to 1 km or more in length. Mineralization occurred in five stages: (1) quartz-tourmaline alteration; (2) quartz-tourmaline-cassiterite, with apatite, magnetite, hematite, muscovite, siderophyllite, albite, epidote, allanite, and gadolinite (REE); (3) quartz-chlorite-cassiterite, with hematite, magnetite, xenotime, arsenopyrite, and fluorite; (4) a local sulfide stage, with pyrite, marcasite, pyrrhotite, chalcopyrite, and molybdenite; and (5) fluorite, with calcite, adularia, kaolinite minerals, and quartz. Cassiterite is commonly present as isometric and prismatic crystals of dipyramidal habit. **REFERENCES:** Lugov, Makeev, and Potapova, 1972; Lugov, 1986.

P56-21 62 31 151 04	Utinka	Au Au quartz vein	Medium. Discovered in 1929. Partly mined out. Ranges 0.1 to 3923 g/t Au; ore shoots range 5 to 25 g/t Au.

SUMMARY: A Late Jurassic suite of ore-bearing dikes that extend for about 35 km cuts a Middle Jurassic sedimentary sequence at an acute angle to bedding. Sedimentary rocks are isoclinally folded into west-northwest trending structures. Main ore body extends 12 km and occurs in a steeply dipping dike, 0.4 to 1.3 m thick, of hydrothermally altered andesite porphyry. Dike intensely crushed and tectonized. Gold-bearing quartz veins form complicated, often diagonally cross-cutting, systems within the dike. Some quartz veins also cut the dikes obliquely, and continue out into the surrounding sedimentary rocks. Arsenopyrite, pyrite, and pyrrhotite make up several per cent of the veins; gold, galena, sphalerite, chalcopyrite, jamesonite, Bi-boulangerite, tetrahedrite, scheelite, marcasite, and stibnite also occur. Gold distribution is quite irregular; individual ore shoots are 5 to 30 m in strike and several hundreds of meters in width. **REFERENCES:** Yakushev, 1950, written commun.; Skornyakov, 1953, written commun.

P56-22 62 23 150 05	Nadezhda	Au Au quartz vein	Small. Ranges 10.2 to 660 g/t Au.

SUMMARY: Deposit is located near the Debin strike-slip fault zone. District occurs in an anticlinal fold with Lower to Middle Jurassic (Toarcian and Aalenian) siltstone and shale exposed in the core, and Middle Jurassic (Bajocian-Bathonian) siltstone and sandstone in the limbs. Short, lenticular quartz veins, reticulate veinlets, and silicified dikes of quartz-albite porphyry occur within elongate fracture zones up to 15 m wide. Quartz veins and veinlets contain arsenopyrite, pyrite, galena, gold, and stibnite. **REFERENCES:** Amelchenko, 1964, written commun.; Zenkov and others, 1966, written commun.

P56-23 62 21 155 49	Galimoe	Sn, Ag Sn silicate-sulfide vein	Small. Most of reserves mined out.

SUMMARY: Tin occurs in conformable and cross-cutting ore bodies. Conformable, gently-dipping ore bodies are formed by replacement of Lower Cretaceous argillite and conglomerate at the contact with Early Cretaceous diorite porphyry and felsite sills. Ore is banded or massive quartz-tourmaline altered rocks with veinlets and disseminations of cassiterite, chlorite, pyrite, marcasite, arsenopyrite, wolframite stannite, chalcopyrite, sphalerite, and galena. Silver occurs native and with sulfides, tetrahedrite-tennantite, and sulfosalts. Paired mineralized layers occur at the roof and floor of the sills, connected by transverse, cross-cutting veins of similar composition; which contain the main bulk of metal. Ore bodies persist along dip. **REFERENCES:** Chaikovsky, 1960; Lugov, 1986.

P56-24 62 15 155 26	Nevskoe	Sn, W, Se Porphyry Sn	Small to medium. Most of reserves mined out.

SUMMARY: District extends north-northwest along a belt of intensely fractured Lower Cretaceous clastic sedimentary rocks. Belt is 180 to 350 m wide and separates granite of the Upper Cretaceous Nevsky pluton from extrusive late Cretaceous rhyolite to the west. Granite contact is tectonic in character. Rocks along the belt are replaced by quartz, tourmaline, pyrophyllite, kaolinite, and locally, by dumortierite and topaz. Ore bodies coincide with the most altered rocks; they are pipe-like, and strike for hundreds of meters. Ores are fine-grained, complexly intergrown, and are composed mainly of pyrophyllite, topaz, quartz, muscovite, and cassiterite. Tourmaline, chlorite, wolframite, arsenopyrite, chalcopyrite, galena, sphalerite, pyrite, pyrrhotite, marcasite, tetrahedrite-tennantite, stannite, rutile, and scheelite are wide-spread; semseyite, platynite, guanajuatite, laitakarite, silver, zunyite, apatite, fluorite and other minerals are rare. Sn content decreases with depth, as do topaz and pyrophyllite; but quartz increases. **REFERENCES:** Lugov, Makeev, and Potapova, 1972; Lugov, 1986.

P56-25 62 22 152 01	Krokhalinoe	Sb, Au Sb-Au vein (simple Sb)	Small. Ranges 0.5 to 33% Sb (average grade of 11.4% Sb), and 0.5 up to 93 g/t Au (average grade of 3.9 g/t Au).

SUMMARY: A set of beresitized porphyry dikes with gold-antimony minerals occurs in Lower Jurassic flysch. Main ore-bearing dike can be traced for 3.5 km; it is usually about 0.7 to 1.5 m thick but some reach 15 m thick. Dike is cut by ladder veins and veinlets composed of albite, carbonate, and quartz with lenses of massive stibnite up to 2.5 m long and 1.5 m thick. Stibnite is also disseminated and in veinlets in the dike. Stibnite is associated with fine, disseminated gold, pyrite, arsenopyrite, chalcopyrite, and bournonite. **REFERENCES:** Panychev, and Fedotov, 1973, written commun.

P56-26 62 20 152 22	Srednekan	Au Au quartz vein	Medium. Low-grade ores. Sulfide concentrates from pilot mill contained up to 1736 g/t Au and 213 g/t Ag.

SUMMARY: A suite of Late Jurassic diorite porphyry and granite porphyry dikes is cut by transverse and oblique sets of steeply-dipping to sometimes gently-dipping quartz veinlets. Dikes are broken into boudins, and are intensely fractured, altered, and tectonized. The necks between boudins are intensely sulfidized. Ore bodies are composed of quartz, albite, calcite, chlorite, sericite, siderite, arsenopyrite, pyrite, pyrrhotite, sphalerite, galena, chalcopyrite, gold, magnetite, and rutile. Gold is present in discrete masses, in dendrites, and in veinlets; masses of gold up to 3 g have been found. Deposit is located along the Srenekan-Shturm strike-slip fault zone. Suite of gold-bearing dikes obliquely cut the Lower and Middle Jurassic clastic sedimentary rock sequence, which has been deformed in steep east-west and northwest folds. **REFERENCES:** Skornyakov, 1953, written commun.

P56-27 62 18 152 39	Kuzmichan	Hg Clastic sediment-hosted Hg or hot-spring Hg?	Small.

SUMMARY: Upper Triassic sandstone and shale are intruded by porphyritic biotite granite and related dikes of the deposit. The sedimentary and intrusive rocks are cut by northwest-, east-west-, and northeast-trending faults. Disseminated veinlets of cinnabar occur in deformed and fractured zones which trend northwest; the zones are 4-5 m thick and about 70-80 m long. Cinnabar also occurs as stockworks in fractured wall rocks. Gangue minerals are quartz, carbonate, and chalcedony. Ore minerals are cinnabar, metacinnabarite, pyrite, and marcasite. **REFERENCES:** Babkin, 1969.

P56-28 62 17 151 58	Kinzhal	Sn (As, Zn) Sn silicate-sulfide vein	Small. Sulfide-tin concentrates contain up to 14.3 g/t gold and 112.4 g/t silver.

SUMMARY: Approximately sixty ore bodies include typical fracture-filling veins, altered veins, and mineralized breccias. They occur in hornfels and spotted cordierite-mica schist at the contact of the late Cretaceous Verkhne-Orotukan granite. Veins trend northeast with dips of 30° to 80°. They are several hundreds of meters to 1 km long, average 0.1-0.3 m thick, and locally reach 4 m thick. Tourmalitization is prominent in deformed belts and adjacent rocks. Quartz and tourmaline are the main gangue minerals. Main ore minerals are crystalline and colloform cassiterite, arsenopyrite, pyrite, sphalerite, and marcasite. Calcite, chlorite, sericite, apatite, fluorite, rutile, sphene, pyrrhotite, chalcopyrite, galena, and stannite are less common. **REFERENCES:** Matveenko, 1959.

P56-29 62 16 151 44	Kamenistoe	Au Au quartz vein	Small. Ranges 0.1 to 190 g/t Au.

SUMMARY: Quartz veins are confined to mineralized and fractured belts in sedimentary rocks. Fractured belts average 300 m long and are 0.2-3.5 m thick. Quartz veins are 20 to 25 m long and 0.6-1 m thick. Most productive quartz vein is 140 m long and varies in thickness from 0.3 to 3.6 m. It contains disseminated arsenopyrite, pyrite, and gold. Two ore bodies have been defined. **REFERENCES:** Skornyakov, 1953, written commun.

P56-30 62 10 150 37	Yugler	Au Au quartz vein	Small. Ore body partly mined out in 1940-50's. Produced about 1.1 tonnes Au from ore containing 12.2 g/t Au (about 90,160 tonnes of ore).

SUMMARY: Deposit is associated with an en echelon, granite porphyry dike that intrudes Upper Triassic volcaniclastic rocks and Lower and Middle Jurassic shale and siltstone. Quartz veins with intergrown carbonates and disseminated pyrite, arsenopyrite, galena, boulangerite, and gold are confined to a one or both contacts of the dike. Veins cut the dike at an acute angle and extend some distance from it. Veins are 100-250 m long and usually are about 0.1 to 1 m thick, but may reach 3.8 m thick. Deposit is located near the Debin-Umar strike-slip fault. **REFERENCES:** Novoselov, 1964, written commun.

P56-31 62 06 151 52	Laryukov	Au (As) Au quartz vein	Small. Ranges trace to 371 g/t Au

SUMMARY: A set of mineralized fracture zones with quartz veins, one of which is economic. Vein is 160 m long, up to 1.4 m thick, and is known to a depth of 40 m. Gold is concentrated in the footwall with arsenopyrite and pyrite. Ore bodies are controlled by bedding dislocations related to reverse and thrust faults. Host Lower and Middle Triassic clastic rocks have been subject to linear and branching folding that trends northeast and east-west. **REFERENCES:** Skornyakov, 1953, written commun.

P56-32 62 07 152 08	Vetvisty	Ag, Au Epithermal vein	Small.

SUMMARY: A set of silver-bearing zones with numerous veins and veinlets extends up to 2.2 km; they average 2-2.8 m thick. These occur in quartz-sericite-chlorite altered rocks developed from hornfelsed Middle Triassic shale. Main ore mineral is argentite; arsenopyrite, pyrite, and anglesite are common; and chalcopyrite, stephanite, proustite, and electrum are present. Au:Ag ratio ranges from 1:1000 to 1:5000. Mineralization occurs over the southeastern portion of the Late Cretaceous Verkhne-Orotukan granite pluton; within a circular structure about 5 km in diameter. Hypabyssal bodies and dikes of Late Cretaceous granite porphyry occur along arcuate faults bounding the south side of the structure. Bodies of Late Cretaceous and Paleogene rhyolite occur along a north-south fracture cutting the structure. Ore bodies are controlled by northwest faults and are associated with the rhyolite dikes. **REFERENCES:** Rozenblyum, 1991, oral commun.

P56-33 62 04 155 14	Okhotnichie	Sn (W, Bi, Co) Sn silicate-sulfide vein	Small. Partly mined out. Up to 59 g/t Ag and 0.4 g/t Au.

SUMMARY: Cassiterite-quartz-chlorite veins contain small amounts of tourmaline, sericite, carbonates, and sulfides (arsenopyrite, pyrite, chalcopyrite, galena, and sphalerite). Most veins are in weakly hornfelsed, Upper Triassic sandstone, siltstone, and shale; but some are in Albian-Cenomanian andesite and tuff; especially the upper portions of the veins. Subordinate minerals are wolframite, scheelite, bismuthinite, native bismuth, tetradymite, cobaltite, safflorite, tetrahedrite-tennantite, stannite, xenotime, and orthite. Veins are structurally complex. Ore bodies occur around the periphery of a circular volcanotectonic structure, and show no relationship to the intrusive rocks. Veins generally occur in north-south fractures and their northwest splays are associated with the Omsukchan fault zone. **REFERENCES:** Lugov, 1986.

P56-34	Trood	Sn, Pb Zn, Ag	Small to medium. Ranges 0.1 to
62 04			46% Sn, 50 to 4000 g/t Ag, and up
155 42		Sn polymetallic vein	to 1.6 g/t Au, 1.9% Pb, and 1.5% Zn.

SUMMARY: Cassiterite-quartz-sulfide, sulfide-quartz, and quartz-tourmaline veins and mineralized zones extend for hundreds of meters. They are confined to steeply-dipping northwest-trending fractures along a deep fault. Host rocks are mainly Upper Cretaceous andesite flows, tuff, and tuffaceous flows; underlain by Upper Triassic clastic deposits. Granite and diorite are less significant. Area consists of a volcanic dome broken by a complex fracture pattern. Volcàniclastic rocks are interbedded with Late Cretaceous hypabyssal intrusive bodies. Sequence is intruded and metamorphosed by tin-bearing granite of the Omsukchan complex. Ore bodies are composed of pyrite, marcasite, quartz, cassiterite, arsenopyrite, hydromicas, galena, sphalerite, chlorite, siderite, chalcopyrite, calcite, tetrahedrite-tennantite, stannite, tourmaline, anatase, fluorite, pyrrhotite, brookite, and apatite. Deposits are characterized by high content of silver, indium, and cadmium. **REFERENCES:** Lugov and others, 1974a b; Pridatko and Ananyin, 1980.

P56-35	Zatessnoe	Au	Small. High-grade ore.
61 52			
152 35		Au quartz vein	

SUMMARY: A set of quartz veins in a northeast-trending fractured belt. Veins are up to 700 m long and dip to the south at 40°-70°. Veins cut a gently-folded Triassic sedimentary sequence. Veins are usually no more than 20-30 cm thick and are composed of quartz, calcite, arsenopyrite, and gold. Individual gold grains may reach 8 mm in size. Gold values are high, but erratically distributed. **REFERENCES:** Gutt, 1949, written commun.; Baranov, 1960, written commun.

P56-36	Ircha	Sn, Ag	Medium. Considerable potential.
61 51		(Cu)	
155 39		Porphyry Sn	

SUMMARY: This stockwork-like deposit trends northwest in Upper Cretaceous andesite which is underlain by Jurassic tuff and sedimentary rocks. Ore zone extends for many hundreds of meters and varies in thickness from tens to hundreds of meters. Ore body is near the contact of a heterogeneous Late Cretaceous pluton composed of gabbro, diorite, and rhyolite. Jurassic rocks are weakly hornfelsed; the Upper Cretaceous andesite is propylitized. Ore bodies are en echelon systems of podiform veins, veinlets, and oblique-to-vertical pipe-like bodies. Gangue is mainly quartz, with intergrown tourmaline, chlorite, sericite, adularia, calcite, and fluorite. Ore minerals are cassiterite, arsenopyrite, chalcopyrite, pyrite, pyrrhotite; and less common wolframite, scheelite, molybdenite, bismuthinite, bismuth, stannite, teallite, marcasite, galena, sphalerite, sternbergite, freibergite, pyrargyrite, acanthite, and native silver. Cassiterite deposition was preceded by fracturing of the earlier quartz-tourmaline and quartz-chlorite altered rocks. **REFERENCES:** Ananyin, Pridatko, and Terentiev, 1980; Kuleshov, Kopytin, and Pristavko, 1984; Lugov, 1986; Plyashkevich, 1986.

P56-37	Hetchen-Khaya	Au, Mo, Bi	Small.
61 42			
151 32		Granitoid-related Au	

SUMMARY: Zones of en echelon quartz and quartz-tourmaline-sulfide veins, trend northeast in the apical portion of a Cretaceous multiphase intrusion composed of gabbro, diorite, granodiorite, porphyritic granite, and aplite. Pluton is somewhat elongated to the north, and extends over an area of about 6 by 4.5 km. Ore bodies are 100-150 m long and 1.5-2 m thick. Veins are associated with zones of greisenization. Ore minerals are arsenopyrite (which comprises up to 30% of the vein), löellingite, pyrite, molybdenite, tetradymite, bismuthinite, and gold. Fluorite occurs in the veins; and silver, tin, and tungsten are detected by chemical analyses. **REFERENCES:** Aksenova, 1990.

P56-38 61 43 153 19	Ossolonyn	Sn Sn greisen	Small.

SUMMARY: Greisenized granite porphyry bodies, with zoned quartz-topaz greisen and sericitic alteration, host quartz-topaz-fluorite and quartz-fluorite-sericite veinlets containing cassiterite, arsenopyrite, pyrite, and small amounts of tourmaline, chlorite, apatite, and rutile. Ores contain notable tungsten and bismuth. Seven ore bodies trend northwest in hornfelsed Triassic sandstone and shale near the Upper Cretaceous Sredne-Buyund granite. **REFERENCES:** Matveenko, 1959.

P56-39 61 45 150 44	Bokhapcha	W W vein and greisen	Medium. Ranges 0.15 to 4.27% WO_3, with minor Au, Sn, Bi.

SUMMARY: A linear stockwork composed of variably oriented quartz, carbonate-quartz, and feldspar-quartz veins and veinlets; quartz-muscovite, quartz-topaz, quartz-tourmaline greisens; and greisenized aplites that contain wolframite and some scheelite. Stockwork extends over an area of about 1600 m by 250 m. Wolframite occurs as thick tabular crystals and masses up to 30 cm in size. Minor or rare ore minerals include arsenopyrite, pyrite, molybdenite, cubanite, bismuthinite, and cassiterite. Ore-bearing stockwork is elongated to the northeast and occurs in hornfelsed Upper Triassic sandstone and shale at a steeply dipping contact with the northwest portion of the Lower Cretaceous Bokhapcha granite. **REFERENCES:** Chicherin, 1970, 1978, written commun.; Kolesnichenkok Pristavko, and Sobolev, 1985.

P56-40 61 41 150 34	Ekspeditsionnoe	Au Au quartz vein	Small. Ranges trace to tens of g/t Au.

SUMMARY: Quartz veins, veinlets, and mineralized fracture zones trend east-west and northeast in Upper Triassic shale, siltstone, and sandstone. Ore bodies generally extend east-west over an area about 1.8 km long and 200-300 m wide. In addition to quartz, the veins contain calcite, arsenopyrite, pyrite, and gold. Veins and mineralized zones are up to 160 m long and 1.5 thick. Ore bodies cut porphyritic dikes, which themselves intrude folds at an acute angle. **REFERENCES:** Baranov, 1949, written commun.

P56-41 61 28 150 52	Maltan Stock	Au, Bi, Te (Mo) Granitoid-related Au	Small. Au and Ag contents variable. Samples with up to 242 g/t Au, minor Bi, W, and Co.

SUMMARY: Deposit is associated with en echelon fracture zones in Cretaceous biotite gabbro, quartz diorite, granodiorite porphyry, and porphyritic granite; that intrude Middle and Upper Triassic sedimentary rocks. En echelon structures are 2.5 to 3 km long. Ore bodies are controlled by northeast fractures that are transverse to the fractures that control the intrusions. Mineralization consists of quartz, quartz-carbonate, and sulfide-quartz veins; tens to hundreds meters long and 10-20 cm thick. Ore minerals are arsenopyrite, löellingite, molybdenite, galena, sphalerite, pyrrhotite, pentlandite, scheelite, boulangerite, native bismuth, bismuthinite, bismuth sulfotellurides, silver tellurides, and native gold (450-1000 fine). **REFERENCES:** Kamenikhin and Shtokolova, 1986, written commun.; Malinovsky, 1970, written commun.; Osipov and Savva, 1975, written commun.; Voroshin and others, 1990, written commun.

P56-42 61 20 151 36	Dneprov	Sn (W, Mo, Bi, Au, Ag) Sn silicate-sulfide vein and Sn greisen	Medium.

SUMMARY: Tourmaline-quartz, fluorite-tourmaline, and sulfide-tourmaline veins; most of which trend approximately north-south, but some trend east-west. Veins occur with quartz-tourmaline, tourmaline-topaz, and muscovite-topaz-quartz tin-bearing greisens. Veins average about 70 m long, with a maximum length of 600 m, and they are 0.5-3 m thick. Main gangue minerals are quartz, tourmaline, topaz, fluorite, muscovite, chlorite, calcite, and albite. Main ore minerals are arsenopyrite, löellingite, cassiterite, ferberite, marmatite, chalcopyrite, pyrite, pyrrhotite, and magnetite. Minor minerals are beryl, zircon, xenotime, monazite, yttrium-bearing fluorite, apatite, siderite, stannite, galena, marcasite, jamesonite, tetrahedrite, tennantite, bismuthite, molybdenite, native bismuth, gold, silver, and colloform cassiterite. Ore bodies occur in 12 separate areas along contacts of subalkalic porphyry granite, granite porphyry, and microgranite of the Upper Cretaceous Dneprov pluton; both within and adjacent to the plutons. Main part of the tin reserves is located in granite along its margin, in a northeasterly trending band. Some mineralization occurs in hornfelsed Triassic tuff and sedimentary rocks. Freibergite and sulfides increase with depth. **REFERENCES:** Lugov and others, 1974a, b.

P56-43 61 06 151 47	Kheta	Sn, Zn, Pb, Cu, Bi, Ag Sn polymetallic vein	Small. Moderate Sn content. Ag values up to 80 g/t or more.

SUMMARY: Three pipe-like, steeply dipping, explosion breccia bodies in a volcanic neck cover about 1400 m^2. Breccia bodies occur in sericitized, kaolinized, chloritized, and silicified Upper Cretaceous rhyolite and associated tuff. Volcanic rocks are intruded by trachyrhyolite and basalt dikes. Disseminated veinlets, stockworks, and some massive cassiterite-sulfide and sulfide-stannite ores, occur within intensely fractured and hydrothermally altered pipe-like bodies, separated by weakly mineralized rock. Ore is composed of quartz, iron chlorite, siderite, fluorite, sphalerite, cassiterite, pyrite, stannite, galena, and chalcopyrite; with subordinate sericite, kaolinite, alunite, pyrrhotite, arsenopyrite, marcasite, native bismuth, native lead, tetrahedrite-tennantite, pyrargyrite, polybasite, argyrodite, canfieldite, famatinite, and argentite. Mineralization consisted of metasomatism superimposed on repeated igneous events. **REFERENCES:** Chaikovsky, 1960; Lugov, Makeev, and Potapova, 1972; Lygov and others, 1974a, b.

P56-44 61 00 152 09	Suvorov	Sn Rhyolite-hosted Sn	Small.

SUMMARY: Colloform cassiterite nodules (wood tin) are present in intensely silicified and kaolinized, fluidal rhyolite, agglomeratic vitric tuff flows, and tuff- and lava-breccia. The volcanic rocks are Upper Cretaceous in age and associated with vent facies volcanism. Cassiterite is associated with fine-grained quartz, hematite, chlorite, kaolinite, pyrite, and arsenopyrite. Ore is characterized by high iron and indium. **REFERENCES:** Lugov and others, 1974a, b; Flerov, 1974.

P56-45 60 58 151 10	Zerkalnoe	Au, Ag, Bi, Te Epithermal vein	Small. Ranges 0.4 to 39 g/t Au and 18 to 349 g/t Ag.

SUMMARY: Zones of disseminated veinlets occur in a granite porphyry dike 400 m long and 60 m thick that intrudes a Late Cretaceous diorite pluton. Deposit consists of quartz and quartz-carbonate veinlets containing silver sulfosalts, tetradymite, petzite, hessite, electrum, arsenopyrite, galena, and sphalerite. **REFERENCES:** Ponomarev and Ivanyuk, 1988.

P56-46 60 58 150 53	Agat	Au, Ag (Pb, Zn, Cu) Epithermal vein	Medium. Considerable potential. Average contents 6.5 to 11.8 g/t Au and 65 to 174 g/t Ag. Bonanza ores contain up to 30 kg/t Au.

SUMMARY: Several tens of quartz, carbonate-quartz, and sulfide-quartz veins occur in sheets of propylitized Cretaceous andesite. Veins are generally simple in form; they are controlled by fissures trending northwest to north-south. Ore bodies are usually tens to hundreds of meters long, but sometimes up to 2 km in length; they average 0.2-1 m thick but some reach 50 m. Hydromicatization, chloritization, and silicification are typically associated with the veins, but less eroded veins are accompanied by weak adularization. Symmetrical crustification-banding and complex deformation structures are characteristic of the veins. Main gangue minerals are quartz and carbonates, including calcite, dolomite, siderite, manganese-rich siderite, rhodochrosite, and kutnahorite. Barite, chalcedony, and opal occur near the periphery of the deposit. Main ore minerals are: galena, sphalerite, chalcopyrite, marcasite, and pyrite. Arsenopyrite, pyrrhotite, tetrahedrite-tennantite, tellurides, sulfosalts of silver and other minerals are present locally. Gold occurs in the form of electrum (550-500 fine). Average sulfide content of veins is 5-10%, but locally ranges to 20-30%. A gold-sphalerite-galena-quartz assemblage is the most productive, and is present in most veins. This assemblage also contains chalcopyrite, tetrahedrite-tennantite, tellurides of gold and silver, pyrargyrite, stephanite, and argentite. The Au:Ag ratio varies from 5:1 to 1:100, and averages about 1:2-1:5. **REFERENCES:** Naborodin, 1971, 1977, written commun.

P56-47 60 49 153 32 190	Khakandya	Mo Porphyry Mo	Small. Ranges 0.1 to 6.7% Mo, 589 g/t Ag, and 6.8 g/t Au.

SUMMARY: Deposit consists of quartz veins containing molybdenite, arsenopyrite, sphalerite, and galena, and vein-like bodies of quartz-muscovite greisens cut by molybdenite veinlets. More than 20 ore bodies are known; they are about 120-180 m long and occur in greisenized Late Cretaceous granodiorite and subalkalic granite. Molybdenum is associated with polymetallic veins containing galena, sphalerite, chalcopyrite, and pyrite; and up to 589 g/t silver and 6.8 g/t gold. **REFERENCES:** Kobylyansky, 1970, written commun.

P56-48 60 46 150 16	Svetloe	Sn Sn polymetallic vein	Small.

SUMMARY: Deposit consists of a set of steeply dipping, quartz-chlorite veins, up to 1 to 2 m thick, that cut hornfelsed Permian sandstone, shale, and tuffaceous shale. Veins contain fine-grained pyrite, chalcopyrite, and pyrrhotite. Deposit occurs in the marginal portion of a domal structure related to the intrusion of a Late Cretaceous leucogranite. **REFERENCES:** Umitbaev, 1986.

P56-49 60 44 153 28	Nyavlenga	Au, Ag Epithermal vein	Medium. Considerable potential. Ranges 6.4 to 14.5 g/t Au and 241.5 to 431 g/t Ag.

SUMMARY: Altered chlorite-quartz, adularia-chlorite-quartz, and quartz veins and veinlets occur in the middle of a volcanotectonic depression; at the intersection of north-south, northeast and east-west faults. Approximately 20 ore bodies, each about 10-20 m thick, occur in three zones. Two of the zones are in Lower Cretaceous propylitized andesite; and the third one is in an altered quartz-sericite-pyrophyllite rock developed from rhyolite fragmental flows. Ore textures are colloform to indistinctly banded, massive, and brecciated. Ore minerals are pyrite, sphalerite, galena, chalcopyrite, arsenopyrite, pyrrhotite, bornite, jamesonite, wittichenite, native silver, küstelite, freibergite, acanthite, stephanite, polybasite, stromeyerite, canfieldite, molybdenite, and hematite. A gold-silver-chlorite-quartz phase of mineralization is locally superimposed on a later garnet-epidote-quartz association with hematite and magnetite. Native silver in pyrite is common, and becomes coarser grained with increased thermal metamorphism. Molybdenum and polymetallic mineralization are associated with the later granitic rocks. Mineralization age is Lower Cretaceous (Aptian-Albian). **REFERENCES:** Bocharnikov, 1977, written commun.;

Bocharnikov and Ichetovkin, 1980; Savva, 1981, written commun.; Demin, 1990.

P56-50 60 46 150 38	Skarnovoe	Zn, Pb, Ag Pb-Zn-Ag skarn	Small.

SUMMARY: Podiform sulfide-polymetallic ore bodies extend for several tens or hundreds of meters and are several meters thick. They are controlled by weak fractures in a Upper Triassic (Norian) limestone that has been altered to skarn. Amount of skarn decreases away from a granite pluton. Pyrrhotite skarn bodies contain varying amounts of magnetite, wollastonite, tremolite, epidote, zoisite, garnet, and carbonate. Main ore minerals are sphalerite, accompanied by galena. Silver is mainly in the galena. Skarn also contains gold and rare earth elements. **REFERENCES:** Umitbaev, 1986.

P56-51 60 36 150 20	Kandychan	Sn, Ag Sn polymetallic vein	Small. Partly mined out.

SUMMARY: Groups of veins and veinlets occur in a generally north-south band more than 2 km long and 500 to 600 m wide, in Upper Cretaceous subvolcanic and flow rocks of moderately felsic to felsic composition. Volcanic rocks are propylitized, silicified, and argillized. Ore bodies consist of quartz-chlorite-cassiterite-sulfide veins with various carbonates (calcite, siderite, dolomite), sericite, hydromica, kaolinite, dickite, pyrophyllite, fluorite, and tourmaline. Sulfide minerals include stannite, pyrargyrite, hessite, and argentite; as well as pyrite, chalcopyrite, arsenopyrite, löellingite, marcasite, pyrrhotite, sphalerite, galena, bornite, and covellite. Deposits are characterized by high silver, bismuth, cobalt, and gold. Sulfide veins with colloform cassiterite give way at depth to low-sulfide chlorite-quartz veins with crystalline cassiterite. **REFERENCES:** Firsov, 1972; Lugov and others, 1974a, b; Savva, 1980, written commun.

P56-52 60 37 151 27	Kolkhida	Ag, Au, Sn Epithermal vein	Small.

SUMMARY: Quartz-carbonate vein with adularia, chlorite, manganocalcite, kaolinite, pyrite, chalcopyrite, tetrahedrite-tennantite, polybasite, native silver, küstelite, argentite, stephanite, galena, sphalerite, marcasite, and cassiterite. Vein cuts hydrothermally altered Upper Cretaceous brecciated flows and tuff of rhyolite-dacite composition, near the contact with a granite porphyry dike. Au:Ag ratio is about 1:1000. Vein occurs at the southern end of a small volcanotectonic structure. **REFERENCES:** Umitbaev, 1986.

P56-53 60 31 149 60	Verkhne-Seimkan	Co, Bi Co-Bi arsenide vein	Small.

SUMMARY: Sets of quartz, quartz-chlorite, and quartz-tourmaline veins in hornfelsed Jurassic sedimentary rocks near the contact of the Late Cretaceous Seimkan multiphase granitic pluton. Main ore minerals are cobaltite and cobalt-bearing arsenopyrite. Subordinate minerals are chalcopyrite, galena, sphalerite, pyrite, marcasite, pyrrhotite, boulangerite, löellingite, glaucodot, bismuthinite, native bismuth, and molybdenite. **REFERENCES:** Demin, 1945, written commun.; Umitbaev, 1986.

P56-54 60 26 150 41	Utessnoe	Ag, Au, Hg Epithermal vein	Small. Typical ore contains up to 5.8 g/t Au and 680 g/t Ag.

SUMMARY: A set of discontinuous adularia-quartz veins and veinlets, with associated alteration zones, occur in a subvolcanic body of Late Cretaceous fluidal rhyolite and associated breccia. Subvolcanic intrusion is controlled by a northeast fault of the Arman volcanic collapse structure. Veins are grouped in three zones, which tend to converge at the root of a lopolith-like body. Dominant ore minerals are: pyrargyrite and stephanite; freibergite, polybasite, miargyrite, native silver, electrum, pyrite, and sulfides of copper, lead, and zinc are minor or rare. Au:Ag ratio is 1:100 or less. There is a distinct vertical metasomatic zoning. Gold-silver ore bodies occur in a quartz-adularia-hydromica zone about 300 m thick; beneath it is a zone of andesite marked by low-temperature propylitization; above the ore zone there is a sharp change to quartz-kaolinite and quartz-kaolinite-alunite alternation, with quartz containing disseminated stibnite and cinnabar. Deposit is barely eroded and was deposited near the surface; as indicated by the wide occurrence of ultrafelsic metasomatism and the preservation of a layer of subaerial ignimbrite. **REFERENCES:** Eremin, 1974.

P56-55	Karamken	Au, Ag	Major. Discovered in 1964. Now being mined.
60 14			
150 60		Epithermal vein	

SUMMARY: Deposit consists of numerous adularia-quartz and adularia-carbonate-quartz veins more than 200 m long and more than 0.2 m thick. They are controlled by arcuate and linear faults which define and crosscut a caldera filled with Upper Cretaceous dacite, andesite-basalt, and rhyolite. Main deposit, which contains about 80-90% of the reserves, is confined to few major veins that are spatially related to a hypabyssal body cut by circular faults and composed of andesite, andesitic dacite, volcanic breccia of andesite-dacite composition, and rhyolite. Most productive veins are associated with an altered zone comprised of adularia-hydromica and quartz; and explosion and hydrothermal breccia bodies. A zone of kaolinite, alunite, and quartz alteration occurs in higher parts of the ore deposit. Ore minerals are pyrite, sphalerite, chalcopyrite, canfieldite, freibergite, tennantite, naumannite (Ag_2Se), polybasite, electrum, küstelite, native silver, and other less common sulfides, selenides, sulfostannates, and sulfosalts of silver. Au:Ag ratio is 1:3 to 1:4 in the richest portions of Glavnaya vein. Veins form in clusters, which converge at depth. Gold-canfieldite-freibergite-chalcopyrite and gold-pyrite-sphalerite zones are the most productive; at depth they are succeeded by a galena-canfieldite zone with tin-silver minerals. **REFERENCES:** Krasilnikov and others, 1971; Nekrasova, 1972; Goldfrid, Demin, and Krasilnikov, 1974; Nekrasova and Demin, 1977; Sidorov, 1978.

P57-1	Grisha	Au, Ag	Small.
63 48			
159 28		Epithermal vein	

SUMMARY: Rare, thin veins and zones of quartz veinlets extend for several tens or hundreds of meters; and are up to several meters thick. Disseminated native gold, galena, sphalerite, chalcopyrite, and high molybdenum values are present. Au:Ag ratio is 1:2 to 1:3. Ore bodies are confined to a zone just inside the northern contact of the Early Paleozoic Anmandykan pluton. The pluton is composed of alkalic syenite and nordmarkite, and lies along a northeast trending fault zone. Early Paleozoic and Late Mesozoic stages of mineralization have been identified; the latter involves the remobilization of the earlier. **REFERENCES:** Korobeinikov, oral commun., 1991.

P57-2	Sedoi	Ag, Co	Small. Veins contain up to 8 g/t Au and 196 g/t Ag.
63 49			
158 25		Ag-Co arsenide vein and Fe-Pb-Cu-Ag-Au skarn	

SUMMARY: Polysulfide-carbonate veins occur in conformable and cross-cutting bodies of garnet-epidote-sulfide and pyrrhotite-garnet skarn hosted in Ordovician limestone and dolomite. Some limestone layers have been replaced by hematite. Wall rocks are intruded by Late Devonian biotite granite and subsequently by hypabyssal rhyolite emplaced along the granite-limestone contact, locally forming sheets. Skarn stage of mineralization is marked by tellurides of silver, lead, and bismuth; with rare inclusions of native gold. Fracture veins related to volcanogenic mineralization are composed of calcite, manganocalcite, galena, sphalerite, and fine-grained intergrowths of proustite, stephanite, pyrargyrite, sternbergite, argentopyrite, and silver-bearing löellingite, glaucodot, and arsenopyrite. Karst development is widespread, often associated with areas notable for crustification banding that contains native silver. **REFERENCES:** Savva and Vedernikov, 1989.

P57-3 63 44 160 01	Kubaka	Au, Ag Epithermal vein	Medium. Average about 17 g/t Au and 15.7 g/t Ag.

SUMMARY: Veins and zones of veinlets of adularia-quartz and adularia-chalcedony-hydromica-quartz composition with admixtures of fluorite, barite, and carbonate, occur in an elongate tectonic block that trends northwest, transverse to the main structural elements of the area. Most intensely mineralized veins trend about east-west and west-northwest. Deposit occurs in a stratified volcaniclastic sequence of Middle to Upper Devonian ignimbrites, pumiceous rhyolite to dacite, trachyandesite and rhyolite-dacite sills, and tephra and agglomerate tuff of various compositions. Deposits die out in the overlying, Lower Carboniferous carbonaceous shale and siltstone. Dikes of Cretaceous rhyolite and alkalic basalt extend through and beyond the mineralized tectonic block. Basalt dikes cross the mineralized veins and are themselves cut by later, gold-poor quartz-carbonate veins and veinlets. Host rocks are intensely silicified, adularized, and sericitized; with the development of much hydromica. Initial stage of mineralization is marked by a gold-chalcedony association with colloidal gold (+electrum and küstelite). Later adularia-quartz stage involve coarser, recrystallized native gold and scattered, disseminated pyrite, arsenopyrite, galena, freibergite, acanthite, aguilarite, naumannite, argentopyrite and sulfides of gold and silver in fine-grained aggregates. Native gold predominates markedly over sulfide-bound gold. Au:Ag ratio is 1:1 to 1:2. **REFERENCES:** Yarantseva and Boldyrev, 1988; Savva and Vortsepnev, 1990; Stepanov and others, 1991.

P57-4 63 33 159 38	Yolochka	Au, Ag Epithermal vein	Small.

SUMMARY: Zone of veinlets and veins of quartz and carbonate-quartz composition that visually appear unmineralized, are accompanied by haloes of altered aplite-like rock. Ore bodies are up to 16 m thick, but the gold values are erratic. Au:Ag ratio is 1:1 to 1:3. Deposit occurs in Devonian volcanic rocks that form a volcanic dome in the Omolon massif. Archean schist underlies the volcanic rocks in the western part of the district. A large, linear body of Devonian diorite porphyry occurs along an east-west fault. Hypabyssal porphyritic dacite and dacitic brecciated flows are exposed in the middle of the dome. Deposit is related to the hypabyssal dacite. **REFERENCES:** Rozenblyum, 1991, oral commun.

P57-5 63 29 158 50	Vechernee	Mo, Cu Porphyry Mo-Cu	Large. Averages 0.2% Mo, 0.2% Cu, 0.1 to 0.6 g/t Au, 2 to 10 g/t Ag.

SUMMARY: Molybdenite-chalcopyrite quartz stockwork zone of altered pyritized, and silicified rocks with illite, occurs in mid-Paleozoic subalkalic granite that forms the core of an intrusive dome in Archean and Upper Proterozoic rocks. Richest ore bodies are confined to zones along the contacts of the granite; both within and adjacent to the pluton. Minor tungsten. **REFERENCES:** Rozenblyum, 1991, oral commun.

P57-6 63 29 158 32	Skarn	Fe (W, Au, Ag) Fe (±Au, Cu, W, Sn) skarn	Large. Estimated 120 million tonnes containing 40% Fe, 2.96% MnO, 0.16% TiO2, and minor Au and Ag.

SUMMARY: Garnet, garnet-pyroxene, and pyroxene-clinohumite skarns contain numerous steeply-dipping, magnetite ore bodies about 300-800 m by 10-100 m in size. Massive ores are common and the ore bodies are controlled by faults. Skarn and associated deposits form a zone up to 150 m wide and about 2.2 km long around a Lower Paleozoic quartz monzonite intrusion. Skarns are succeeded by tremolite-wollastonite marble farther from the intrusion. District is mainly composed of a Riphean carbonate terrain that includes Archean migmatite with small jaspilite bodies. Magnetite skarns characteristically contain tungsten in scheelite, and gold and silver values. **REFERENCES:** Fadeev, 1975.

P57-7 63 24 157 04	Khetagchan	Au, W, Bi Granitoid-related Au	Small. Up to 20 g/t Au and up to 50-60 g/t Ag.

SUMMARY: Zones of sulfide-quartz and sulfide-chlorite-quartz veins and veinlets up to 150 m long and 10-15 m thick occur along the contacts of an Upper Cretaceous granodiorite body; both within and adjacent to the intrusion. Ore minerals are galena, sphalerite, chalcopyrite, wolframite, pyrite, arsenopyrite, bismuthinite, native bismuth, gold, electrum, tetrahedrite-tennantite, silver sulfosalts, and argentite. **REFERENCES:** Sidorov, 1990, oral commun.

P57-8 63 23 161 42	Kegali	Au, Ag Epithermal vein	Medium. Considerable potential.

SUMMARY: Thick and extensive quartz, adularia-quartz, and carbonate-adularia-quartz veins and zones of veinlets in an area 2 km or more long contain disseminated pyrite, chalcopyrite, argentite, polybasite, stromeyerite, galena, sphalerite, native gold, and native silver. Veins occur in a large Lower to Upper Cretaceous, hypabyssal dacite body and in volcanic flows of intermediate to basic composition. Veins are accompanied by the haloes of illite-quartz alteration. Orientation of the ore bodies is related to sets of arcuate faults between an extrusive dome and an area of local volcanic subsidence. Au/Ag ratio is 1:3 to 1:10. **REFERENCES:** Peskov, 1975, written commun.

P57-9 63 21 158 22	Verkhny-Omolon	Fe Omolon-type Iron Formation	Large. Estimated to contain 960 million tonnes of 33 to 51% Fe (average grade 40.5% Fe) and up to 0.3 g/t Au.

SUMMARY: Sheet-like and podiform bodies of banded iron formation occur in Archean migmatite, amphibole and biotite-amphibole plagiogneiss, amphibolite, and mafic schist. Banded iron ore is composed of magnetite (45-65%), and quartz (35-55%) intergrown, with apatite and actinolite. Sulfur is absent. Ores are variously medium to coarse grained, massive, or banded. Main deposit extends for 3.5 km and averages 250 m thick in the thickest, central portion. It locally includes alternating, nearly conformable ore bodies and mineralized horizons of the country rock. Formation of the banded iron ore is a complicated metamorphic-metasomatic process related to granitization of the crust. **REFERENCES:** Gelman, Titov, and Fadeev, 1974; Fadeev, 1975.

P57-10 63 07 159 19	Verkhny-Koargychan	Au, Ag, Pb, Zn Au-Ag-Polymetallic vein	Small. Samples contain up to 84.9 g/t Au, 538 g/t Ag, 15.8% Pb, 19% Zn, and 0.7% Cu.

SUMMARY: Quartz-sulfide and quartz-carbonate-sulfide veins and sulfidized fractured zones contain massive galena, sphalerite, and pyrite, with gold and silver values. Host rock is Upper Permian limestone, and less commonly, siltstone. Ore zones strike predominantly about north-south and extend for several tens or sometimes several hundred of meters. **REFERENCES:** Vasetsky and Dorogoy, 1978, written commun.

P57-11 62 60 160 03	Druchak	Ag, Au (Pb, Zn) Epithermal vein	Small. Samples contain 0.1 to 5.8 g/t Au, 112 to 3613 g/t Ag, and up to 1% Pb, Zn, Mo.

SUMMARY: Steeply-dipping quartz, adularia-quartz, carbonate-quartz, and sulfide-carbonate veins 20 to 350 m long are transitional along strike into zones of sulfide-carbonate-quartz veinlets. Ore bodies occur in Upper Cretaceous extrusive rocks and strike northwest and north-northeast. Ore minerals are argentite, pyrargyrite, polybasite, pyrostilpnite, owyheeite, electrum, galena, sphalerite, chalcopyrite, tetrahedrite-tennantite, and arsenopyrite. **REFERENCES:** Lyaschenko and others, 1990, written commun.

P57-12 62 41 159 55	Irbychan	Au, Ag Epithermal vein	Small. Up to 12 g/t Au and 220 g/t Ag.

SUMMARY: Gently dipping veins, lenses, and zones of veins formed in three stages: (1) an adularia-quartz stage with gold and silver values, marked by pyrite, argentite, pyrargyrite, sternbergite, and gold, (Au:Ag = 1:10); (2) a quartz stage carrying high silver values marked by pyrite, argentite, and native silver (Au/Ag = 1:300-1:500), and (3) a carbonate-quartz silver-polymetallic stage with pyrite, galena, sphalerite, and chalcopyrite. Main ore bodies occur in a hypabyssal rhyolite body along approximately east-west-trending faults. Ore bodies are several hundreds meters long. Deposit is in the margin of a circular structure dominated by Upper Cretaceous ignimbrite and subject to resurgent doming. Underlying rocks are Devonian volcanic rocks, and carbonates and clastic rocks of Permian, Triassic and Upper Jurassic age. **REFERENCES:** Zhivotnev and Litovchenko, 1977.

P57-13 62 35 157 16	Orlinoe	Mo (W) Porphyry Mo	Small. Mo averages 0.01 to 0.03% but ranges up to 8.5%.

SUMMARY: Steeply-dipping stockwork extending for tens of meters. It is composed of thin quartz veins and veinlets with disseminated and masses of molybdenite. Subordinate minerals are pyrite, chalcopyrite, wolframite, powellite, muscovite, fluorite, calcite, chlorite, and garnet. Molybdenum mineralization occurs in hornfelsed Upper Triassic sedimentary rocks and the Late Cretaceous granite that intrudes them. **REFERENCES:** Okhotkin, 1957, written commun.

P57-14 62 32 159 45	Evenskoe	Au, Ag (Te, Bi) Epithermal vein	Medium. Considerable potential. Au ranges 5.4 to 9.7 g/t, Ag 142 to 259 g/t.

SUMMARY: Complicated veins, altered zones with veinlets, and linear explosion-hydrothermal breccias. They occur in ignimbrite and andesite flows; and in sheets, fissured bodies, and extrusive domes of Late Cretaceous rhyolite, trachyrhyolite, rhyodacite, and dacite. Hydrothermal alteration ranges from low- and middle-temperature propylitization to highly-altered quartz-adularia-illite metasomatite. Mineralized zones are several hundred meters to 4 km long, and 5-10 m thick. Several mineral associations are recognized: (1) a gold-sulfide polymetallic association with gold and silver tellurides in epidote-quartz and quartz veins; (2) a gold-argentite association with selenides and locally stibnite in adularia-carbonate-quartz and quartz veins; (3) a gold-sulfide-sulfoantimonide association with selenides and pyrite in veins of the same composition as the previous association; and (4) a gold-sulfide-sulfoantimonide association in quartz and barite-quartz veins. Main ore minerals are gold, electrum, küstelite, native silver, argentite, polybasite-pearceite, proustite, pyrargyrite, stromeyerite, tetrahedrite-tennantite, naumannite, aguilarite, and hessite; native bismuth, iron, zinc, and copper; several polymetallic minerals are also known. Au:Ag ratio is generally about 1:20-1:30. More than ten independent ore zones occur in a circular hypabyssal complex along the northwest fault that bounds the Turomcha volcanic structure, which extends for 50 km and is approximately 7 km wide. **REFERENCES:** Kostyrko, Plyashkevich, and Boldyrev, 1974; Kostyrko, 1977; Kostyrko and Romanenko, 1978, 1980; Sidorov, 1978.

P57-15 62 26 157 35	Olyndja	Ag, Au Epithermal vein	Small. Ranges up to 4 g/t Au and 3 to 1079 g/t Ag.

SUMMARY: Sets of closely spaced, approximately north-south, quartz, quartz-carbonate, and adularia-quartz veins and veinlets occur over a zone about 1 km long in silicified, kaolinized, and sulfidized Upper Cretaceous volcanic rocks. Main ore minerals are silver sulfosalts, argentite, xanthoconite, and native silver. Pyrite, chalcopyrite, and galena are minor. Zone occurs at the south side of a volcanotectonic depression formed at the intersection of northwest and nearly east-west faults. **REFERENCES:** Kuzyukov, 1977, written commun.

P57-16 62 19 159 58	Aldigych	Au, Ag Epithermal vein	Small. Up to 14.5 g/t Au and 98 g/t Ag.

SUMMARY: Stockwork zones 200 to 300 m long, include short en echelon and subparallel, quartz and barite-quartz veins and veinlets containing electrum, galena, sphalerite, chalcopyrite, silver-bearing tetrahedrite, sulfosalts of silver, and stibnite. Upper Cretaceous porphyritic ignimbrite wall rock is locally altered to quartz-kaolinite and siliceous metasomatite. Some veins are confined to propylitized andesite and hypabyssal gabbro-diorite porphyry. **REFERENCES:** Kostyrko, Plyashkevich and, Boldyrev, 1974.

P57-17 62 14 159 11	Nevenrekan	Au, Ag Epithermal vein	Small. Ore ranges 0.5 to 23 g/t Au and 22 to 746 g/t Ag.

SUMMARY: Steeply-dipping quartz, adularia-quartz, carbonate-quartz, and sulfide-quartz veins and zones of veinlets up to several hundreds of meters long occur in weakly altered Upper Cretaceous ignimbrite, felsite, rhyolite, and subordinate andesite. Ore minerals are argentite, pyrargyrite, native gold, native silver, pyrite, arsenopyrite, chalcopyrite, coarse-grained disseminated galena, sphalerite, magnetite, and supergene copper minerals. Minor gangue minerals include chlorite, tourmaline, kaolinite, and amphibole. Deposits are localized at the intersection of a deep, northwest to approximately north-south-trending fault, and a system of northeast to nearly east-west fractures. **REFERENCES:** Politov, 1981, written commun.

P57-18 61 40 161 20	Tikas	Mo Porphyry Mo	Small. Veinlets and sulfidized rocks contain 1-5 g/t silver.

SUMMARY: Irregularly disseminated molybdenite, pyrite, arsenopyrite, and galena occur in quartz and feldspar-quartz veins and veinlets in silicified, sericitized, and sulfidized sedimentary rocks near the contact of an Early Cretaceous granodiorite which is cut by thin aplite dikes. Disseminated sulfide minerals also occur in the granodiorite. Weakly hornfelsed Middle Jurassic sandstone and shale host the pluton and are also cut by sheets of gabbro and granite porphyry. Veinlets and sulfidized rocks contain 1-5 g/t silver. **REFERENCES:** Ivanov, Leonenko, and Livshits, 1966, written commun.

P57-19 61 20 156 17	Spiridonych, Teply	Au, Ag Epithermal vein	Medium Samples contain from 0.7 to 16.9 g/t Au, 348.3 to 1630 g/t Au, and >1% Pb, Zn, Cu, Mn.

SUMMARY: Bands of closely-spaced subparallel, mineralized fracture zones with veins and veinlets of quartz, epidote-chlorite-quartz, quartz-chlorite-sulfide, quartz-pyrolusite-rhodonite, and quartz-carbonate composition. Ore minerals are argentite, stromeyerite, native silver, electrum, pyrargyrite, galena, sphalerite, chalcopyrite, and bornite. Host rocks are Upper Cretaceous ignimbrite and andesite. Ore occurs in the centers of volcanic depressions and is spatially related to stocks and dikes of diorite, granodiorite, granite, andesite-bassalt and andesite. Northwest-striking veins predominate. Altered wall rock containing quartz, adularia, and illite reflects widespread mid- and low-temperature propylitization. **REFERENCES:** Kopytin, 1987, written commun.; Konstantinov, 1989.

P58-1 63 53 165 47	Sergeev	Au, Ag Epithermal vein	Small to medium. Moderate Au values.

SUMMARY: Quartz and adularia-quartz veins and veinlets, altered rocks, and mineralized fracture zones cover an area of approximately 15 km^2 on the tops and limbs of an intrusive dome composed of Upper Cretaceous andesite-basalt and basalt flows that have been intruded by a central laccolith-like body composed of granodiorite and quartz monzonite porphyry cut by numerous dikes and stocks of intermediate to felsic composition. En echelon, linear and arcuate ore bodies are controlled by the intersection of a major northeast fault, a set of radial and concentric fractures, and the contacts of the hypabyssal plutons. Domal structure coincides with an aureole of intense epidote-chlorite propylitization, local areas of actinolite-epidote propylitization, and illite-quartz alteration near the veins. Mineral associations consist of: (1) an early, high-temperature garnet-epidote-quartz association with hematite; (2) a productive adularia-quartz association with pyrargyrite, acanthite, electrum, native silver, canfieldite, galena, sphalerite, chalcopyrite, bornite, pyrite, and magnetite; and (3) a later pyrite-quartz and prehnite-zeolite-carbonate association. Deposits are characterized by increase in sulfides as mineralization progressed, and by the presence of tellurides. **REFERENCES:** Vasilenko, Rozhkov, and Shepitsyn, 1977.

P58-2	Tsirkovy	Au, Ag, Cu, W, Bi	Small.
63 33			
165 07		Granitoid-related Au	

SUMMARY: Gold-silver-polymetallic veins are associated with Late Cretaceous intrusions of granodiorite porphyry, syenite-diorite, and diorite. Deposit has affinities with copper-molybdenum porphyry deposits. **REFERENCES:** Vasilenko, 1973, written commun.

P58-3	Talov	Cr	Small.
61 49			
165 48		Podiform Cr	

SUMMARY: Podiform and disseminated chromite occurs in serpentinite veins in serpentinized peridotite. Large boulders and pebbles of massive chromite are scattered in residual and alluvial deposits derived from the peridotite. **REFERENCES:** Mikhailov, 1961.

P58-4	Khrustal	Sn, Ag	Small.
61 42			
166 45		Sn polymetallic vein	

SUMMARY: Quartz-chlorite and less common quartz-tourmaline-chlorite breccias in clastic sedimentary rocks, as well as zones of veinlets, carry considerable tin. Ore bodies are up to 700 m long. Disseminated cassiterite and massive cassiterite veinlets occur in breccia cemented by quartz and chlorite, or by quartz and limonite, or as rims around clasts of the breccia. Sulfide minerals include galena, pyrite, chalcopyrite, and pyrrhotite; most of which have been oxidized and removed. Tin-bearing zones occur in Upper Cretaceous argillite and sandstone northeast and south of a Paleogene granodiorite porphyry stock. Deposits form a zone about 500 m wide trending northwest. **REFERENCES:** Lugov and others 1974a, b.

P58-5	Tikhorechen	Cr	Small. Ranges 34% to 52% Cr_2O_3.
61 37		(PGE, Ni)	
164 50		Podiform Cr	

SUMMARY: A band of rock debris in a serpentinite melange zone contains massive and finely disseminated chromite. Melange is 1.5-2 km wide and about 7 km long. Peridotite outcrops occur in residual deposits and contain chromite masses and lenses up to 5 m wide and 25-30 m long. Platinum and nickel are present. **REFERENCES:** Pokhialainen, 1965, written commun.; Gryaznov, 1970.

P58-6	Unnei	Sn, Ag, Au	Small.
61 31			
166 07		Sn polymetallic vein	

SUMMARY: Quartz-chlorite and quartz-sulfide veins trend about north-south and northwest. They occur in zones of silicification, chloritization, and kaolinization in intricately deformed Upper Cretaceous sandstone, siltstone, and argillite. Veins contain disseminated cassiterite, stannite, pyrite, arsenopyrite, sphalerite, stibnite, proustite, pyrargyrite, and small amounts of gold. Sedimentary rocks are intruded by Paleogene granite porphyry stocks and dikes. **REFERENCES:** Rozhkov, 1969.

P58-7 61 19 164 49	Ametistovoe	Au, Ag Epithermal vein	Medium to large. Considerable potential and prospecting.

SUMMARY: District is centered on a magmatic structure about 5-6 km deep. Volcanic rocks in the area include flows of Late Paleogene andesite, andesite-basalt, andesite-dacite, and dacite, and abundant extrusive-vent and hypabyssal rocks of similar composition. Deposits are controlled by a combination of northwest and nearly north-south faults, radial and concentric fractures, and the extrusive and hypabyssal bodies. Two types of ore bodies are distinguished: (1) ore pipes with small subparallel veins and veinlets, and (2) steeply dipping veins. Ore bodies are hundreds of meters long and from several meters thick (veins) to several tens of meters thick (zones). Veins include quartz, kaolinite-quartz, and sulfide-quartz types. Main ore minerals are gold, argentite, and küstelite. Subordinate minerals are stephanite, stibiopearceite, aguilarite, pyrargyrite, miargyrite, freibergite, naumannite, and native silver. Pyrite, galena, sphalerite, and chalcopyrite are widespread, making up to 20-30% of some veins. Gangue minerals are quartz, kaolinite, adularia, and chlorite. Au:Ag ratio averages 1:3. Richest ore bodies are confined to altered rocks with kaolinite, illite, and quartz superimposed on widespread epidote-chlorite-carbonate propylitization. **REFERENCES:** Khvorostov, 1983.

P58-8 61 21 165 07	Sprut	Ag, Au Epithermal vein	Small.

SUMMARY: Veins and zones of veinlets are confined to a system of subparallel fractures trending northwest. Veins are of kaolinite-adularia-quartz composition and contain proustite, pyrargyrite, electrum, native silver, polybasite, freibergite, and mercury-bearing tetrahedrite. Au:Ag ratio is 1:500. Host rocks are Paleogene andesite-dacite and dacite porphyry related to extrusive vents and volcanic domes. **REFERENCES:** Khvorostov and others, 1982, written commun.

P58-9 61 16 165 21	Ivolga	Ag, Sn (As, Sb) Epithermal vein	Small.

SUMMARY: Quartz veins and sets of parallel veinlets generally trend north-south. They contain arsenopyrite, pyrite, marcasite, proustite, pyrargyrite, miargyrite, famatinite, argentite, stannite, and stibnite in fracture zones, zones of silicification, pyritization, and kaolinization of Paleogene felsic extrusive rocks and Upper Cretaceous marine clastic rocks. Au:Ag ratio is 1:1000 or less. Deposits are associated with a small granite porphyry stock which forms an elongate band trending north-northeast. **REFERENCES:** Rozhkov, 1969; Khvorostov and others, 1982, written commun.

P58-10 61 05 165 17	Ainavetkin	Sn, Ag (Pb, Zn, Cu, Au, W, In) Sn polymetallic vein	Medium.

SUMMARY: Quartz-chlorite and quartz-chlorite-sulfide veins, veinlets, veined breccias, and altered zones occur together in crosscutting and parallel systems that generally trend northwest and east-west. Ore minerals are cassiterite, magnetite, pyrrhotite, chalcopyrite, galena, sphalerite, arsenopyrite, wolframite, scheelite, pyrite, stannite, canfieldite, pyrargyrite, gold, and native copper. Fine-grained, disseminated cassiterite is abundant. Local concentrations of the noble metals and indium are characteristic of the ores. Deposits occur in hornfelsed and propylitized, Upper Cretaceous sandstone and shale. A buried granite intrusion may underlie the mineral deposit. Strata hosting the deposits are intruded by dike-like and spindle-shaped bodies of Paleogene granite, granite porphyry, and rhyolite. **REFERENCES:** Lugov, Rozhkov, and Ivanov, 1974b; Lugov, 1986.

P58-11 Reznikov Sn, Ag, Au Small to medium.
60 50
164 39 Sn polymetallic vein

SUMMARY: Tin-bearing quartz, and chlorite-quartz veins and mineralized fracture zones extend for hundreds of meters and contain cassiterite, stannite, and sulfides of iron, copper, zinc, silver, and lead. Paleogene felsic dikes and intrusions along fractures trend northwest, forming a ladder system that trends northeast. Tin-bearing bodies often occur along the contacts of diorite porphyry and granite porphyry dikes with Upper Cretaceous clastic sedimentary rocks. Ore bodies are similar to the Ainavetkin ore district in composition and structure. **REFERENCES:** Lugov and others, 1974a, b.

P58-12 Olyutor Hg, Sb, As Large. Estimated to contain 700 tonnes Hg at average grades of 0.7 to 2.5% Hg, and ranging up to 0.4% Sb and 4 g/t Au.
60 35
167 49 Clastic sediment-hosted Hg or hot-spring Hg?

SUMMARY: Deposits occur in steeply-dipping fracture zones, which radiate from a large, northeast trending fault. Host volcaniclastic rocks are of Paleogene and Neogene age and are deformed into small linear folds. Ore bodies strike for tens of meters to 600 m. Veins have numerous apophyses in the form of typical mineralized breccias, which often grade into zones of veinlets. Most productive deposits are confined to tuff. Quartz and kaolinite, and less commonly dolomite, are the main gangue minerals. Main ore mineral is cinnabar accompanied by stibnite and sometimes realgar, cementing quartz and quartz-kaolinite breccia fragments. Wall rock alteration includes weak silicification, kaolinization, and carbonatization. **REFERENCES:** Babkin, 1975.

P59-1 Orlovka Au, Zn, Cu, Hg Small.
64 00
168 34 Epithermal vein

SUMMARY: Linear zones of quartz and quartz-carbonate veins and veinlets up to 1 m thick and 100-150 m long contain native gold, pyrite, magnetite, pyrrhotite, sphalerite, chalcopyrite, arsenopyrite, and cinnabar. Zones occur in areas of altered quartz-sericite and propylitic rock. Deposits occur in the middle of a volcanic dome consisting of Cenozoic andesite and andesite-basalt. High gold values are associated with geochemical aureoles of silver, copper, and molybdenum. **REFERENCES:** Rozenblyum, 1991, oral commun.

P59-2 Berezovaya Sn Small.
64 00
173 52 Sn polymetallic vein

SUMMARY: Quartz-tourmaline-chlorite veins and lenticular breccias with fine-grained and colloform cassiterite, occur in extensive altered zones of sulfidized tourmaline-chlorite-quartz altered rock. Main ore bodies are related to northeast-trending fractures. Host rocks are intensely deformed Cretaceous volcaniclastic and clastic sedimentary rocks that are overlain by Cenozoic extrusive rocks of intermediate to felsic composition. Sedimentary and volcanic rocks are intruded by stocks and dikes of granite porphyry and diabase, and hypabyssal bodies of Paleogene dacite and rhyolite. **REFERENCES:** Lugov and others, 1974a, b.

P59-3 Agranai Hg Small.
63 53 (As, Sb)
173 10 Volcanic-hosted Hg

SUMMARY: Sheets and lenticular zones with disseminated veinlets containing cinnabar occur in Late Paleogene rhyolite and dacite. Main minerals are quartz, kaolinite, and cinnabar. Minor minerals are opal, pyrite, stibnite, realgar, and metacinnabar. **REFERENCES:** Rozenblyum, Zincevich, and Nevretdinov, 1975.

P59-4 Vaegi Au Small.
63 33
171 09 Au quartz vein

SUMMARY: Thin quartz and carbonate-quartz veins and veinlets contain disseminated gold, hematite, pyrite, and chalcopyrite; with spare arsenopyrite. Mineral deposits occur in Paleozoic and supposed Proterozoic intermediate metavolcanic rocks. Placer mining in area. Gold-cinnabar intergrowths are found in nearby heavy mineral placers which have been mined. **REFERENCES:** Zakharov and Vasilenko, 1977, written commun.

P59-5 Pervenets Hg, As, Sb Small.
63 28
173 51 Silica-carbonate Hg

SUMMARY: Scattered cinnabar occurs as disseminations, veinlets, and masses in a northwest trending block of fractured, silicified, and kaolinized, sandstone, siltstone, and conglomerate of Lower Cretaceous (Aptian-Albian) age. Masses and veinlets of realgar occur with the cinnabar and separately. Orpiment, metacinnabar, guadalcazarite, and stibnite are present. **REFERENCES:** Kim, 1978.

P59-6 Kuibiveen Mo, Cu, Au Small to medium.
62 43
170 06 Porphyry Cu-Mo

SUMMARY: Quartz-tourmaline breccias, altered rocks, veins, and zones of linear and stockwork quartz-sulfide veinlets, are present in a nearly east-west zone about 25 km long and about 4 km wide. Deposits are associated with a Neogene complex of small intrusions and dikes of intermediate and felsic composition. Deposits occur along a fault that thrusts Upper Cretaceous siliceous sedimentary rocks over Oligocene-Miocene sandstone and conglomerate. Mineralization consists of disseminated molybdenite, arsenopyrite, chalcopyrite, galena, and native gold, in zones from tens of meters up to hundreds of meters thick. **REFERENCES:** Zakharov and Vasilenko, 1977, written commun.; Rozenblyum, oral commun., 1991.

P59-7 Lalankytap Mo, Cu Small to medium.
62 09
173 11 Porphyry Cu-Mo

SUMMARY: An oval stockwork about 1.2 by 0.6 km in area contains randomly oriented quartz veinlets which contain irregularly disseminated pyrite, molybdenite, and chalcopyrite; with minor pyrrhotite, sphalerite, galena, magnetite, martite, rutile, anatase, and sphene. Ore minerals occur both in the veinlets and disseminated between them. Copper and molybdenum minerals are related to a zone of quartz-biotite (with sericite and pyrite) alteration in both a Paleogene quartz diorite and monzodiorite pluton and in Late Cretaceous flysch which both host the deposit. Pluton is bounded by a nearly east-west zone of pyritized altered rocks more than 11 km long and 1 to 4 km wide. Small amounts of gold occur in Quaternary, goethite-cemented, alluvial conglomerate near the deposit. Deposit is controlled by a nearly-east-west suture at the juncture of two major structural boundaries. **REFERENCES:** Brazhnik and Kolyasnikov, 1989; Brazhnik and Morozov, 1989.

P59-8 Krassnaya Gorka Hg Small. Average grade 0.1% Hg, but
61 54 ranges up to 1.4% Hg.
168 48 Clastic sediment-hosted Hg or hot-spring Hg?

SUMMARY: Saddle-shaped mercury deposits are confined to beds of Upper Cretaceous sandstone where cross-cutting fracture zones intersect the cores of gentle anticlinal folds. Cinnabar is disseminated in quartz-dickite-dolomite vein material. In addition to cinnabar, marcasite, pyrite and native arsenic are present. **REFERENCES:** Babkin, 1969.

P59-9 61 40 168 15	Neptun	Hg, Sb, As Clastic sediment-hosted Hg or hot-spring Hg?	Small. Estimated to contain about 330 tonnes Hg in ore with 0.6% Hg.

SUMMARY: Conformable, mineralized, northwest-trending fracture zones occur in Upper Cretaceous sandstone, siltstone, and shale. Cinnabar is associated with stibnite, and minor amounts of pyrite, marcasite, realgar, galena, sphalerite, and chalcopyrite. Ore minerals are scattered in quartz-dickite-dolomite material that cements breccia; or occur in sets of thin branching veinlets associated with quartz and carbonate. **REFERENCES:** Babkin, 1969; Tarasenko and Titov, 1970.

P59-10 61 37 171 39	Snezhnoe	Cr, PGE Zoned mafic-ultramafic Cr-PGE	Small.

SUMMARY: Natural alloys of iron and platinum occur in chromite bodies within dunite of a zoned ultramafic complex that intrudes gabbro, clinopyroxenite, wehrlite, and dunite that in turn intruded Upper Cretaceous siliceous volcanic rocks. **REFERENCES:** Kutyev and others, 1988a; Kutyev and others, 1988b.

P59-11 61 34 168 01	Lyapganai	Hg, Sb Clastic sediment-hosted Hg or hot-spring Hg?	Medium. Estimated to contain 1400 tonnes Hg in ore with 0.17 to 1.95% Hg.

SUMMARY: Mineralized fracture zone in Upper Cretaceous sandstone and mudstone is cemented by quartz and dolomite with subordinate kaolinite and calcite. Cinnabar is disseminated in the vein material or coats breccia clasts as thin rims. Stibnite and pyrite are minor. Ores are disseminated to massive, brecciated, in veinlets, and in banded disseminations. Ore bodies vary in size from 0.1 to 4.2 m in width by 110 m to 420 m in length. The most promising ore bodies occur in faults trending northeast parallel to fold axes. Deposit has a peculiar high germanium content. This deposit is similar to many other Hg deposits in the Koryak upland. **REFERENCES:** Tarasenko and Titov, 1970; Babkin, 1975.

P59-12 61 24 172 20	Itchayvayam	Mn Volcanogenic Mn	Medium. Ranges 11 to 47.4% Mn.

SUMMARY: Mn mineralization is confined to the Albian-Campanian basalt-siliceous Vatyn Formation. Massive, patchy, and brecciated manganese ores form concordant, lens-like bodies 1 to 30 m long and 0.3 to 10 m thick in siliceous rocks. Main ore mineral is braunite, but pyrolusite is present locally. Manganese also occurs in veins of metamorphic origin 2 to 10 m long. **REFERENCES:** Egiazarov and others, 1965.

P60-1 63 27 175 44	Chirynai	Cr, PGE Podiform Cr	Medium.

SUMMARY: Thirty chromite ore occurrences are known in the Chirynai alpine-type ultramafic body. Ore bodies occur in chains 100 to 150 m long which consist of thin lenses (up to 20-40 cm thick), masses, and schlieren of nearly massive to massive chromite. Banded zones of disseminated chromite 5 to 7 m thick and more than 50 m long are known. Chromite occurs in dunite, commonly at the contact zone between dunite and intergrown pyroxenite, dunite, and harzburgite. Accessory platinum-group minerals occur as Os, Ir, and Ru sulfides; and also as hexagonal solid solutions of ruthenium, osmium and iridium with iron, copper, and nickel. Most common PGE mineral is an iron-ruthenium solid solution. Ultramafic rocks occur in alpine-type setting. **REFERENCES:** Silkin, 1983; Dmitrenko and Mochalov, 1986; Dmitrenko and others, 1987.

P60-2 63 29 174 14	Tamvatney	Hg, W, As Silica-carbonate Hg	Large. Reserves estimated at 30,000 tonnes Hg in ore averaging 0.81% Hg.

SUMMARY: Cinnabar, tungstenite, wolframite, and sulfides of iron and arsenic occur in mylonitized, carbonatized, silicified, and argillized serpentinite, serpentinized peridotite, conglomerate, and coarse-grained sandstone, and argillite. Deposits are confined to the northern tectonic contact of the Tamvatney lherzolite ophiolite body that overlays a clastic rock sequence of Lower Cretaceous (Aptian-Albian) and Oligocene-Miocene ages. Ultramafic rocks are intruded by bodies of Early Cretaceous gabbronorite, Late Cretaceous plagiogranite, and Neogene andesite-basalt. Age of the deposits is assumed to be Lower Pleistocene. Main ore minerals are cinnabar, tungstenite, wolframite, huebnerite, scheelite, marcasite and pyrite. Minor minerals include metacinnabar, stibnite, realgar, orpiment, arsenopyrite, sphalerite, chalcopyrite, millerite, bravoite, chalcocite, pyrrhotite, and hematite. Relic ilmenite, chromite, magnetite, niccolite, and pentlandite are present in the serpentinite and silica-carbonate metasomatite. Gangue minerals in the veins are mainly quartz, chalcedony, magnesite, dolomite, kaolinite, dickite associated with peculiar hard and liquid bitumens, and native sulfur. Middle portion of the ore-bearing zone is made up of stockworks, masses of ore minerals, veins, and a dense network of sulfide veinlets. Zone extends for about 20 km with an average thickness of about 20-30 m. **REFERENCES:** Rozenblum and others, 1973; Babkin, 1975; Voevodin and others 1979, 1980.

P60-3 63 25 176 52	Nutekin	Au, Hg Au quartz vein	Small.

SUMMARY: Steeply-dipping quartz and quartz-carbonate veins which grade into zones of silicified and sulfidized veinlets along strike. Deposits trend northwest and are up to 500 m long. Gold-bearing veins occur in Early Mesozoic, and less frequently Early Cretaceous, clastic sedimentary rock. Highest gold contents are in veins within Paleogene dolerite dikes. Gold is associated with rare disseminated pyrite and arsenopyrite, and is marked by high mercury content. Deposits are restricted to the axial portion of a horst-anticlinorium structure. **REFERENCES:** Vasilenko, 1977, written commun.

P60-4 63 16 175 24	Krassnaya Gora	Cr, PGE Podiform Cr	Small to medium.

SUMMARY: Two horizons with numerous chromite bodies occur within the Krassnaya Gora alpine-type ultramafic body. Upper horizon is near the contact of dunite and an overlying intergrown pyroxenite-dunite-harzburgite assemblage; the chromite occurs in dunite bands. Podiform and schlieren occurrences of nearly massive to massive chromite extend for 35-70 m with a thickness of up to several meters. Several large podiform bodies at the base of dunite layers contain massive and concentrated chromite for 60-100 m along strike and are more than 1 m thick. A zone of disseminated chromite 22 m thick is also located there. Platinum-group metals associated with chromite occur as solid solution in the sulfides with Os, Ir, and Ru in hexagonal sites, and Ir, Os, Pt, Ru, and Rh in cubic sites. Some secondary, rare, platinum, rhodium, and palladium arsenites and sulfoarsenides are also present. **REFERENCES:** Silkin, 1983, written commun., Dmitrenko and Mochalov, 1986; Dmitrenko and others, 1987.

P60-5 63 16 176 39	Ugryumoe	Cu, Zn, Pb, Au Probable Cyprus Cu-Zn-Ag massive sulfide	Small.

SUMMARY: Massive sulfide ores, containing high concentrations of copper, zinc, lead, and gold, occur along a silicified zone up to 3 km long. Ore bodies occur in a Mesozoic sequence of intricately interbedded basalt, plagiorhyolite, various tuffs, and siliceous tuffaceous siltstone. Intrusive rocks include granite, plagiogranite, and gabbro. **REFERENCES:** Oparin and Sushentsov, 1988.

Q01-1 67 52 179 24	Chaantal	Sn, W (As) Sn quartz vein and Sn greisen	Small to medium.

SUMMARY: Sets of branching, erratic quartz veins, veinlets, and zones of greisenized rock occur within and near the West Iultin biotite granite pluton. Ore bodies trend easterly and are several tens to hundreds of meters long. Ore minerals are arsenopyrite, wolframite and cassiterite; chalcopyrite, scheelite, molybdenite, and beryl are less common. Arsenopyrite and wolframite are commonly confined to the middle portions of the quartz veins; cassiterite is confined to greisenized selvages. **REFERENCES:** Slavtsov, 1951, written commun.; Tarakanov, 1958, written commun.

Q01-2 67 51 178 44	Iultin	Sn, W Sn-W polymetallic vein	Large. Discovered in 1937, mined since 1959.

SUMMARY: The deposit occurs as quartz veins, mineralized stockwork zones, and disseminated veinlets in greisen. Deposit occurs along the contact of the mid-Cretaceous Iultin granite (K-Ar age of 90-110 Ma), and is hosted by Lower and Upper Triassic sandstone and shale that has been successively subjected to contact metamorphism and metasomatism. Mineralized quartz veins with northeast, northwest, and generally east-west; north-south-trending veins are most productive. Veins are both steeply-dipping and gently-dipping. Some ore bodies wedge out vertically. Ore bodies occur both as tungsten ore over the top of a leucogranite pluton which is about 300 m below the surface; and as tin ore in the marginal zone of the leucogranite. Approximately 65 minerals are known, the most common are quartz (95%), muscovite, fluorite, albite, cassiterite, wolframite, arsenopyrite, and löellingite. Topaz, pyrite, pyrrhotite, bismuthinite, stannite, chalcopyrite, sphalerite, galena, molybdenite, scheelite, hematite, and native silver and bismuth, are less common. Cassiterite is commonly associated with wolframite, arsenopyrite, and muscovite. Cassiterite occurs as short, columnar crystals up to 10 cm across. Large (up to 4-9 cm) and gigantic (up to 0.5 m) wolframite crystals and crystal intergrowths are present. The vertical extent of economic tin-tungsten ore bodies exceeds 900 m. **REFERENCES:** Zilbermints, 1966; Lugov, Makeev, and Potapova, 1972; Lugov, 1986.

Q01-3 67 47 178 47	Lenotap	Au Au quartz vein	Small. Ranges 0.6 to 98 g/t Au, 0.7 to 18.9 g/t Ag, and up to 1.53% WO_3.

SUMMARY: Zones of cross-cutting and conformable quartz veins, veinlets, and silicified breccia occur in Upper Permian and Lower to Middle Triassic sandstone and shale at the contacts of Triassic gabbro-diabase sills. Ore bodies vary in length from 30 to 220 m and in thickness from 0.5 to 2 m; but locally are up to 28 m thick. Gold is associated with arsenopyrite, pyrite, galena, sphalerite, and tetrahedrite-tennanite. Quartz veins have been metamorphosed by the Iultin tin-bearing granite. **REFERENCES:** Panychev, 1977, written commun.

Q01-4 67 40 178 06	Tumannoe	Au, As, Sb Disseminated Au-sulfide	Medium. Ranges 1.4 to 76.1 g/t Au, 0.4 to 15.6 g/t Ag, up to 1% Sb.

SUMMARY: Auriferous, fractured belts and folded zones trend about northwest and east-west in an Upper Triassic sandstone-siltsone-shale sequence. Mineralized zones are marked by a clay-mica matrix with fine disseminated sulfides; cut by thin quartz veinlets. Linear mineralized zones are often associated spatially with quartz-stibnite veins. The ore structure is associated with an intricate dome-like uplift developed where a fault intersects a syncline. Early-stage veins and veinlets with rare-earth metal minerals occur within a central granodiorite porphyry stock and the surrounding hornfels. **REFERENCES:** Vasilenko and Eremin, 1977, written commun.

Q01-5 67 34 178 04	Ekug	Sn, W (As, Cu) Porphyry Sn or Sn greisen	Medium. Sn ore contains 0.2 g/t Au and up to 32.7 g/t Ag. No data on reserves.

SUMMARY: Stocks and dikes of late Cretaceous quartz porphyry are altered to tin-bearing quartz-topaz greisen in association with abundant fluorite and sericite. Subordinate mineralization consists of fractured zones and cassiterite-quartz stockworks in Upper Triassic sandstone and shale. Highly altered quartz-topaz rocks with abundant disseminated fluorite, arsenopyrite, and lesser cassiterite and wolframite, also occur in hornfelsed sedimentary rocks near the central porphyry stock; especially near radial fractures. Cassiterite is finely disseminated in greisen; larger crystals are present in quartz-sulfide veinlets. Cassiterite is typically associated with arsenopyrite, pyrite, and chalcopyrite; and less commonly with galena, sphalerite, and stannite. By-product Au and Ag occur in sulfides. **REFERENCES:** Greshilov and Kozlov, 1969; Lugov, Makeev, and Potapova, 1972; Lugov, 1986.

Q01-6 67 12 179 09	Garnetnoe	Mo Porphyry Mo	Small.

SUMMARY: Quartz veins with feldspar, muscovite, tourmaline, and chlorite up to 130 m long and up to 0.6 m thick are confined to a Cretaceous granite body. Molybdenite is present as disseminations and masses up to 3-5 cm in size. Minor chalcopyrite, arsenopyrite, pyrite, pyrrhotite, and wolframite. **REFERENCES:** Rokhlin, 1961, written commun.

Q01-7 66 25 179 22	Matachingai	Hg Silica-carbonate Hg	Small.

SUMMARY: Small lenses, masses, and irregular occurrences of cinnabar occur in thin monominerallic or quartz- and carbonate-bearing veinlets in serpentinite, silica-carbonate metasomatites, and less commonly in propylitized extrusive volcanic rocks. Mineralized area is in a mass of serpentinized peridotite in tectonic contact with Upper Cretaceous brecciated basalt and andesite tuff. Sheet-like bodies of ore-bearing silica-carbonate rocks are mostly steeply dipping, locally gently inclined, and are fault bounded. They form chain-like strings tens to hundreds of meters long. The altered rocks are mainly carbonate varieties and are broken by northeast-trending faults. The cinnabar ore shoots occur at these altered-zone/fault intersections. Cinnabar is mainly associated with magnesite, dolomite, and quartz; talc, chlorite, kaolinite, pyrite, chalcopyrite, arsenopyrite, marcasite and millerite are less common. **REFERENCES:** Babkin, 1975; Kim, 1978; Kopytin, 1978.

Q01-8 66 24 178 55	Eruttin	Sn Sn silicate-sulfide vein	Small to medium.

SUMMARY: Deposit consists of a dense network of thin, quartz and quartz-tourmaline veinlets which contain fine-grained cassiterite and sulfides. The deposit occurs in a zone of intense silicification, sericitization, tourmalinization, sulfidization, and locally kaolinization, up to 2.5 km long; which is controlled by northeast fractures. High-grade tin-bearing zones are several tens to hundreds of meters long. Deposit occurs above a Late Cretaceous granitic pluton in a Lower Cretaceous andesite-dacite sequence intruded by numerous stocks and dikes of granodiorite porphyry, granite, andesite-basalt, and dolerite of Early Cretaceous to Paleogene age. **REFERENCES:** Zilbermints and Kolesnichenko, 1973; Lugov and others, 1974a, b.

Q01-9	Elmaun	Sn	Small to medium.
66 19			
1794538		Sn silicate-sulfide vein	

SUMMARY: Tourmaline, chlorite, and arsenopyrite-quartz veins and veinlets with cassiterite, occur in zones of chlorite and sericite-quartz alteration. Mineralized area occurs in the periphery of a caldera-like structure composed of Lower and Upper Cretaceous volcanic rocks of intermediate and felsic composition, which are intruded by Cretaceous and Paleogene hypabyssal rocks. A deeply buried intrusion is suspected. Sulfide-polymetallic bodies containing sphalerite, galena, chalcopyrite, and other minerals are prevalent in the upper portions of the deposit. **REFERENCES:** Lugov and others, 1974a, b.

Q01-10	Pepenveem	Au, Ag	Medium. Ranges 0.2 to 112.3 g/t Au
65 52		(Cu, Pb, Zn)	and 20 to 5430 g/t Ag.
175 37		Epithermal vein	

SUMMARY: Adularia-quartz and adularia-carbonate-quartz veins and veinlets occur in an altered zone up to 1 km long. Most veins are hosted in an Upper Cretaceous rhyolite-ignimbrite sequence near the periphery of a large volcanic subsidence structure. Ore bodies are controlled by widespread northwest and northeast fracturing and are associated with widespread hydrothermal alteration of Paleogene volcanic layers. The alteration includes regional propylitization and local silicification, adularization, sericitization, and kaolinization. Ore mineral associations are: (1) pyrite-arsenopyrite (Au:Ag 30:1 to 1:25); (2) chalcopyrite-galena-sphalerite with tetrahedrite-tennantite, gold, and silver (Au:Ag 1:30 to 1:50); (3) gold-pyrargyrite with argentite, polybasite, stromeyerite, and native silver (Au:Ag 1:1.5 to 1:3000); and (4) hematite. The chalcopyrite-galena-sphalerite and gold-pyrargyrite associations are the most wide-spread. **REFERENCES:** Berman and Naiborodin, 1967; Sidorov, 1978.

Q01-11	Dioritovoe	Sn	Medium.
65 40		(Ag, Cu, Pb, Bi)	
174 06		Sn polymetallic vein	

SUMMARY: Tin ore bodies are confined to zones of fractured and hydrothermally altered Lower Triassic shale, sandstone, and siltstone. Ore zones vary in thickness from several meters to 150-200 m, and extends 100 m to 2.5 km along strike. The central zone consists of banded bodies up to 2-3 m thick with abundant quartz-sulfide and sulfide veinlets which contain cassiterite as cryptocrystalline aggregates, wolframite, pyrite, arsenopyrite, galena, tetrahedrite-tennantite, chalcopyrite, and sphalerite. The outer zone, a band 4-5 m wide, consists of quartz-sericite-chlorite altered rocks and a dense network of cassiterite-bearing quartz-sericite-chlorite, quartz-sulfide, and sulfide veinlets; with pyrite, arsenopyrite, chalcopyrite, and cubanite. Silver and bismuth values are high. Magmatic rocks occur within 0.5-2 km; including Early Cretaceous gabbro and gabbro-diorite dikes, hypabyssal bodies of diorite porphyry and granodiorite, Late Cretaceous rhyolite and diorite porphyry dikes, and Paleogene gabbroic dikes. Tin is assumed to be related to Late Cretaceous volcanism. **REFERENCES:** Nedomolkin, 1974; Lugov and others, 1974a, b.

Q01-12	Enpylkhkan	Pb, Zn, Cu, Ag	Small. Contains up to 140 g/t silver.
65 20			
174 16		Pb-Zn skarn	

SUMMARY: Disseminated, massive, and banded galena-sphalerite-chalcopyrite ore bodies occur in skarn in Paleozoic limestone above a Late Cretaceous granite porphyry. Banded pyroxene skarn is at least 40 m thick and extends for 350-400 m to the northeast. **REFERENCES:** Spirov, 1954, written commun.

Q02-1	Serdtse-Kamen	Pb, Zn, Cu, Sn, Ag	Small.
66 50			
171 44		Pb-Zn skarn	

SUMMARY: A set of quartz-sulfide and quartz-carbonate-sulfide veins occurs in skarn developed in Paleozoic limestone at the contact of a satellite of a Cretaceous granitic pluton. Ore is composed of pyrrhotite (25-35%), sphalerite (15-25%), galena (5-15%), and chalcopyrite (5-10%); with subordinate arsenopyrite, pyrite, cassiterite, stannite, scheelite, proustite, pyrargyrite, and gold. **REFERENCES:** Chaikovsky, 1960.

Q02-2 66 22 172 03	Barin	Ag, Zn Ag polymetallic vein and replacement	Medium. Contains 754 to 2148 g/t Ag.

SUMMARY: Ore zone at contact between a Late Cretaceous granite-porphry dike and mid-Paleozoic limestone. Dike trends northeast; it is about 8-10 m thick and 1 km long. Limestone is cemented by quartz with disseminated sphalerite and small amounts of copper minerals over an area 10-12 m long and 2-3 m wide. **REFERENCES:** Kryukov, 1974, written commun.

Q02-3 66 15 172 04	Melyul	Pb, Zn, Ag, (Cu) Pb-Zn-(Cu)-Ag skarn	Small. Ag up to 165 g/t.

SUMMARY: Polymetallic occurrence composed of pyrite, galena, sphalerite, and chalcopyrite in epidote-garnet and vesuvianite-pyroxene-garnet skarn at the contact between an Early Cretaceous granitic body and Proterozoic(?) marbles. **REFERENCES:** Kryukov, 1974, written commun.

Q02-4 66 09 173 17	Erulen	Sn Sn silicate-sulfide vein	Small to medium.

SUMMARY: Quartz-tourmaline and sulfide-quartz-tourmaline veins and veinlets 2 to 20 cm thick with disseminated cassiterite and masses of sulfides, are found in the middle of a zone of tourmaline alteration replacing brecciated granitic rocks. Also contains muscovite, fluorite, calcite, scheelite, arsenopyrite, pyrite, chalcopyrite, galena, and sphalerite. Zone of mineralization is about 3.5 km long and up to 500 m wide. Deposit occurs at the margin of a Late Cretaceous tourmaline two-mica granite pluton that intrudes Permian to Triassic clastic sedimentary rocks and Triassic gabbro. **REFERENCES:** Nedomolkin, 1974.

Q02-5 64 57N 172 29	Reechen	Fe, Pb, Zn, Sn Fe-Pb-Zn-Sn skarn	Small.

SUMMARY: Garnet-magnetite-epidote-vesuvianite skarn bodies are developed for 250-400 m at the contact between Middle Devonian limestone and phyllite, and Early Cretaceous granite. Skarn contains lenses and bands up to 2 m thick of pyrite, arsenopyrite, galena, and sphalerite. Sulfide bodies carry high tin concentrations. **REFERENCES:** Nedomolkin, 1974.

Q02-6 64 36 172 45	Chechekuyum	Pb, Zn, Cu, Ni Pb-Zn skarn	Small.

SUMMARY: Gently dipping deposit, about 18 m thick and 30 m along strike, composed of pyrrhotite, sphalerite, galena, chalcopyrite, magnetite, pyrite, niccolite, marcasite, calcite, garnet, diopside, and quartz. Ore bodies confined to a fracture zone in skarn developed in Middle Devonian limestone, that is overlain by Upper Cretaceous felsic extrusive rocks and cut by granite porphyry and spessartite dikes. Massive and disseminated pyrrhotite ore occurs in the hanging wall. Massive galena, and less common sphalerite-galena ore, are present in the middle part of the ore body. Sparse massive sphalerite ore is prominent in the hanging wall. Skarn has sparsely disseminated ore minerals. Tin, cadmium, cobalt, bismuth, and silver are detected with chemical analyses. **REFERENCES:**

Zhukov and others, 1953, written commun.

Q55-1 65 15 148 05	Agyndja	Cu Basaltic Cu or sediment-hosted Cu?	Large. Average grade about 1% Cu.

SUMMARY: Disseminated and vein-like ore bodies, and less common breccia ores, occur in red, amygdaloidal trachybasalt and sandstone of Middle to Upper Ordovician age. Ore minerals are bornite, chalcocite, chalcopyrite, covellite, and locally native copper. Copper mineralization in trachybasalt is confined to amygdules and synvolcanic fissures in the upper portion of lava flows. Ore minerals occur both as cement and as clasts in sandstone. The bottom of stratified ore bodies is commonly composed of mineralized trachybasalt overlain by copper-bearing sandstone. The deposit extends over about 100 km^2. Individual ore horizons are 1 to 30 m thick and trend northwest. Ore-bearing sequence is broken by faults of diverse orientation, including numerous thrust faults which repeat the mineralized horizons. **REFERENCES:** Shpikerman and others, 1988.

Q55-2 64 59 144 02	Mitrei	Au Au quartz vein	Small.

SUMMARY: Thin quartz veins and veinlets cut dikes of rhyolite-dacite composition, of Late Jurassic and Early Cretaceous age; now altered to beresite. Mineral associations are: arsenopyrite-pyrite-quartz; albite-muscovite with chalcopyrite and sphalerite; gold-tetrahedrite-buornonite; gold-jamesonite-zinkenite; and post-ore, quartz-carbonate-chlorite. **REFERENCES:** Rozhkov and others, 1971.

Q55-3 64 34 149 25	Vesnovka	Cu, Pb, Zn, Ge Kipushi Cu-Pb-Zn	Small.

SUMMARY: Vein and disseminated ore occurs in Middle Ordovician limestone, shale, and siltstone. Ore bodies trend east-west and occur as metasomatic replacements conformable to bedding. Dimensions and morphology of ore bodies are not well defined. Ore minerals include sphalerite, galena, chalcopyrite, and renierite(?). The calcareous siltstone which hosts the ore bodies is silicified and cut by calcite veins. **REFERENCES:** Shpikerman, 1989, oral commun.

Q55-4 64 11 146 20	Tunguss	Au, Sb Au quartz and Sb vein	Small.

SUMMARY: Quartz veins occur near the contact of an Upper Jurassic to Early Cretaceous granite porphyry dike. Mineral associations are: arsenopyrite-pyrite-quartz; albite-muscovite with chalcopyrite and sphalerite; tetrahedrite-bournonite; lead sulfo-antimonides with gold; and quartz-stibnite with berthierite and zinkenite; which formed during the last stage of mineralization. **REFERENCES:** Rozhkov and others, 1971.

Q55-5 64 14 148 25	Omulev	W Austrian Alps W	Small. Average grade up to 1% WO_3.

SUMMARY: Deposit consists of veins in Middle Ordovician black carbonaceous, calcareous siltstone. The main ore mineral is scheelite. Pyrite, antimonial realgar, orpiment, galena, and chalcopyrite are locally present. Ore minerals are restricted to a conformable, thin layer that is intricately folded along with adjacent rocks; all of which were subjected to greenschist-facies metamorphism. Outcrops of the ore-bearing sequence are confined to a core of a large, open, northwest-trending anticline. No magmatic rocks occur nearby. Mineralized area covers about 100 km^2. **REFERENCES:** Shpikerman and others, 1986.

Q55-6 64 02 144 50	Khangalass	Au Au quartz vein	Small.

SUMMARY: Conformable and cross-cutting quartz lenses with albite, ankerite, muscovite, disseminated pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, marcasite, and gold occur in Lower and Middle Triassic sandstone and shale that has been folded into an open anticline. **REFERENCES:** Rozhkov and others, 1971.

Q55-7 64 01 147 43	Darpir	Sn (Zn) Sn silicate-sulfide vein	Medium. Average about 0.5% Sn.

SUMMARY: A set of quartz-chlorite, quartz-tourmaline, and, less common quartz veins and lenses, occur in hornfelsed, Lower and Middle Jurassic clastic sedimentary rocks. Ore bodies are about 2.0-2.5 km from the contact of the Darpir granite pluton. More than 20 veins are known, most of which trend northeast and about east-west, with dips of 50-85°. Veins are up to 200 m long and 0.4 to 2.7 m thick. Ore minerals are cassiterite, sphalerite, pyrite, arsenopyrite, and locally galena, and titanomagnetite; all of which occur as disseminations and sulfide segregations in veinlets. Zinc and tin are the most important commodities. Wall rocks are commonly tourmalinized. **REFERENCES:** Klochkov and others, 1979, written commun.

Q56-1 66 51 153 54	Slezovka	Pb, Zn Mississippi Valley Pb-Zn	Small.

SUMMARY: Vein, disseminated, and breccia ores occur in Middle Devonian clastic sedimentary rocks and carbonates; in association with a mineralized dolomite sequence in a synclinal fold. Deposit is made up of 5 mineralized beds, each 3-5 m thick, separated by barren interbeds 3-10 m thick. Ore minerals include galena, sphalerite, pyrite, and barite. Ore bodies are cut by quartz and calcite veinlets. **REFERENCES:** Artemov and others, 1976, written commun.

Q56-2 66 36 154 19	Gornoe	Pb, Zn Mississippi Valley Pb-Zn	Small.

SUMMARY: Vein, disseminated, and breccia ores occur in clastic and carbonate rocks from a Middle Devonian continental shelf environment. Mineralization is near a tectonic contact with Upper Proterozoic sedimentary rocks. Host rocks are fossiliferous dolomite. Ore minerals include abundant galena, sphalerite, chalcopyrite, hematite, pyrite, limonite, magnetite, malachite, azurite, cerussite, wulfenite, barite, and calcite. Brachiopods are replaced with galena locally, but more often, the galena forms replacement bodies in dolomite or cement in breccia ore. **REFERENCES:** Nikolaev, 1972, written commun.

Q56-3 65 43 152 12	Pobeda	Fe Ironstone	Medium.

SUMMARY: Stratiform hematite occurs in Upper Proterozoic dolomitic marble in a zone of imbricated thrust faults. Gabbro and gabbro-amphibolite bodies with hematite occur along the thrust fault planes. Mineralization includes massive, brecciated, and stockwork ores. Massive ores contain up to 70% iron. Brecciated ores are composed of clasts of hematized dolomite and gabbro-amphibolite cemented by hematite. Stockwork ore forms separate halo-shaped bodies around the massive and brecciated ores. Ores also contain calcite, quartz, barite, chlorite, pyrite, chalcopyrite, galena, and malachite. Ore-bearing horizon extends for 18 km, but the best defined stratiform deposit is 150 to 600 m long and 2 to 20 m thick. Mineralized dolomite is underlain by hematitic sandstone with up to 34% iron. **REFERENCES:** Kats, 1979, written commun.; Kravchenko and others, 1979, written commun.

Q56-4	Kopach	Au	Small.
65 21			
152 57		Au quartz vein	

SUMMARY: Disseminated and vein occurs in metarhyolite and biotite-amphibole-chlorite-quartz schist of Upper Proterozoic age. Wall-rock alteration includes silicification, epidotization, and sulfidization. Ore minerals are pyrite, magnetite, hematite, goethite, and native gold. Ore bodies contain 10 to 20% quartz. Ore veins are localized along the contacts of metarhyolite bodies; both within them and in adjacent rocks. Veins vary in thickness from 8 cm to 2 m and are often associated with boudinage structures. Ore is confined to selvages of veins. Basalt dikes cut the metarhyolite bodies. **REFERENCES:** Semenov and others, 1974, written commun.

Q56-5	Glukhariny	Au	Small.
64 58			
153 04		Au quartz vein	

SUMMARY: Gold in quartz-chlorite-epidote schist, quartzite, and metarhyolite of Upper Proterozoic age; and in quartz-cemented breccias in these rocks. Wall rocks are metamorphosed to upper greenschist facies. Ore minerals are native gold, pyrite, magnetite, and hematite. Ore minerals occur in three east-west trending zones up to 1200-4000 m long and 400 to 900 m wide. **REFERENCES:** Lutskin, 1964, written commun.; Semenov, 1974, written commun.

Q56-6	Oroek	Cu	Small.
64 54			
152 48		Sediment-hosted Cu	

SUMMARY: Stratiform copper deposits in an Upper Proterozoic volcaniclastic sequence 150-180 m thick. Sequence is dominated by quartzite, chlorite and graphite-chlorite shale, and phyllite. Thin conformable beds of basalt and tuffaceous rocks are present. Copper occurs as chalcocite, bornite, and chalcopyrite in the metamorphosed sandstone, siltstone, and shale. Ore-bearing sequence contains many quartz boudins with chalcopyrite, bornite, and hematite. Later cross-cutting quartz veins also contain minor malachite, chalcocite, azurite, chrysocolla, bornite, and native copper. Mineralized rocks are deformed and form an overturned, isoclinal fold whose limbs dip southeast at 40°-90°. **REFERENCES:** Volkodav and Korobitsyn, 1979, written commun.

Q56-7	Rogovik	Ag, Au	Medium. Contains 0.5 to 34 g/t Au
64 18			and 2.7 to to 747 g/t Ag.
153 58		Epithermal vein	

SUMMARY: Area is composed of Triassic sedimentary rocks, and is characterized by a complicated block structure and widespread explosive (cryptovolcanic) breccias; forming a series of graben-like depressions and cross structures. The breccias and sedimentary rocks are locally intensely altered, and contain veins and veinlets of banded quartz with adularia, argentite, and pyrargyrite, which have silver and gold values. **REFERENCES:** Umitbaev, 1986.

Q57-1	Dalny	Cu, Mo, Au	Small.
67 31			
160 49		Porphyry Cu-Mo and polymetallic vein	

SUMMARY: Stockwork made up of a network of quartz, carbonate-quartz, and quartz-sulfide veinlets 0.3-5 mm thick that contain fine-grained disseminated pyrite, pyrrhotite, chalcopyrite, and magnetite, and lesser galena, sphalerite, arsenopyrite, and molybdenite. Ore bodies occur in an Early Cretaceous intrusive complex, including syenite-diorite porphyry and quartz syenite porphyry, which intrudes Upper Triassic shale. Wall rocks adjacent to the plutonic rocks are altered to quartz and potassium feldspar, and quartz-biotite and quartz-sericite-chlorite metasomatites. Occurrences of gold and several other metals are widespread near the periphery of the plutonic complex. **REFERENCES:** Gorodinsky, Gulevich, and Titov, 1978.

Q57-2 67 17 159 22	Innakh	Pb, Zn, Cu, Mo, Au Polymetallic vein and Porphyry Cu-Mo	Small.

SUMMARY: Quartz and quartz-carbonate veins several tens of meters long contain masses and disseminations of pyrite, chalcopyrite, magnetite, galena, sphalerite, arsenopyrite, löellingite, tetrahedrite, and native bismuth. Gold is associated with pyrite and other sulfides, magnetite, and tetrahedrite ores. Veins occur in hornfelsed siltstone about 1.5-2 km from a late Cretaceous gabbro-monzonite-syenite pluton; especially near diorite and monzodiorite dikes. Pluton itself is characterized by small stockwork zones of gold-molybdenite-pyrite-chalcopyrite deposits. Ore bodies are associated with two tectonic zones; one trends northwest, and the other about north-south. **REFERENCES:** Gorodinsky and others 1974; Goryachev and Polovinkin, 1979.

Q57-3 60 74 161 13	Klen	Au, Ag Epithermal vein	Medium. Grade ranges from traces up to 380.5 g/t Au and up to 1067.9 g/t Ag.

SUMMARY: Steeply-dipping carbonate-quartz veins trending northwest are several hundreds of meters to 1300 m long. The veins contain disseminated pyrite, chalcopyrite, arsenopyrite, gold, argentite, and freibergite; in propylitized, silicified, and sericitized Cretaceous volcanic rocks. Au/Ag ratio in the ores is about 1:3. **REFERENCES:** Gorodinsky and others, 1974; Shilo and others, 1975.

Q57-4 66 43 157 21	Berezovskoe	Pb, Zn, Cu, Ag Polymetallic vein	Small. Average 4.07% Pb, 6.89% Zn, 0.03% Cu, 250.3 g/t Ag.

SUMMARY: Silver-bearing concordant quartz-sulfide veins occur in Paleozoic carbonate and volcaniclastic rocks. **REFERENCES:** Gorodinsky and others, 1974.

Q57-5 65 18 156 57	Zet	Au, Ag Epithermal vein	Small.

SUMMARY: Mineralized quartz and chalcedony-quartz veins, veinlets, and breccias are transitional into quartz-carbonate-hydromica and adularia-chlorite-quartz metamorphic rocks. The vein contacts are not well defined. Disseminated and masses of pyrite, hematite, and galena are present; sphalerite, chalcopyrite, molybdenite, arsenopyrite, and pyrargyrite are less abundant. Gangue minerals include amethyst, kaolinite, and fluorite. Gold is finely dispersed in the ore; the Au/Ag ratio is 1:5. Deposit occurs in Middle to Upper Devonian dacite tuff. Gold-silver ore bodies occur within a zone that is generally about 200-250 m wide, but may be as much as 500-700 m wide if low-grade off-shoots are included. District extends northeast for 3-4 km. **REFERENCES:** Kovalchuk and others, 1969, written commun.; Shamin and others, 1983, written commun.

Q57-6 65 17 159 32	Medgora	Mo, Cu Mo-Cu skarn	Medium. Grades of 0.1 to 0.64% Mo, 0.94 to 2.94% Cu, and 0.4 g/t Au.

SUMMARY: Disseminated veinlets containing molybdenum and copper mineralization are associated with the Early Cretaceous Medgora granite-granodiorite intrusion. Metallic minerals are: pyrite, chalcopyrite, molybdenite, pyrrhotite, magnetite, hematite, and sphalerite. Skarn bodies associated with the intrusion are composed of garnet, pyroxene, actinolite, scapolite, calcite, quartz, chlorite, epidote, and green mica. Individual ore zones extend for 30-160 m. Copper content of the ore varies from hundredths of a percent to over 2%. **REFERENCES:** Gorodinsky, Gulevich, and Titov, 1978.

Q57-7 64 57 156 26	Olcha	Au, Ag (Hg, Cu, Mo) Epithermal vein	Medium. Grade ranges 0.5 to 273 g/t Au and 26.3 to 4978 g/t Ag.

SUMMARY: Ore bodies consist of steeply dipping quartz, carbonate-quartz, and adularia-quartz veins and stockwork zones, which are from several tens of meters to 1300 m long. They are hosted in Middle to Late Devonian volcanic rocks of the Kedon series. Veins occur along fractures, mainly within extrusive andesite breccia of the volcanic vent facies, and more rarely, in hypabyssal dacite-porphyry bodies and felsic extrusive rocks. Ore minerals include gold (500-700 fine), chalcopyrite, argentite, polybasite, galena, sphalerite, pyrite, hematite, manganese oxides, stromeyerite, tetrahedrite, native silver, and tellurides. Gangue minerals are quartz and adularia, with lesser calcite, dolomite, rhodochrosite, and barite. Gold and silver is associated with mercury, copper, molybdenum, lead, zinc, manganese, and arsenic. Ore minerals are accompanied by propylitic and quartz-sericite alteration. Gold-silver ore bodies are controlled by arcuate faults around a volcano-tectonic depression over a basement composed of Archean metamorphic rocks and Early Paleozoic(?) carbonate and clastic sedimentary rocks. The adularia-quartz veins have a K-Ar age of 268 Ma and a Rb-Sr age of 251 Ma.
REFERENCES: Zagruzina and Pokazaniev, 1975; Pokazaniev, 1976a, b.

Q57-8 64 52 158 39	Obyknovennoe	Au, Ag Epithermal vein	Estimated about 5 tonnes Au ore averaging 29.6 g/t Au and 68 g/t Ag.

SUMMARY: Northwest trending zones of adularia-quartz veins and veinlets in extrusive bodies of intensely silicified and sericitized, fluidal rhyolites of the Kedon series. Dominant ore minerals are galena, sphalerite, pyrite, bornite, electrum, and silver sulfosalts. The Au/Ag ratio is 1:2 or 1:3. Ore zones extend for 400 m, and are up to 120 m thick. **REFERENCES:** Burenkova, 1989, written commun.

Q57-9 64 22 160 22	Bebekan	Mo, Cu Porphyry Cu-Mo	Small to medium. Average about 0.5% Mo, 0.7% Cu with minor Pb, Zn, W, Au, and Ag.

SUMMARY: Stockwork of sulfide-quartz veinlets with disseminated molybdenite, chalcopyrite, pyrite, sphalerite, pyrrhotite, arsenopyrite, bornite, and covellite. Deposit occurs in an Early Cretaceous stock of porphyritic granodiorite. Ore body is confined to silicified and sericitized rocks marked by biotite, quartz, and orthoclase. Ore body is about 1.5 km by 400-500 m in size and coincides with the intrusion. A pyrite aureole extends about 1 km from the intrusion area and coincides with a zone of propylitization of the Upper Jurassic volcanic-sedimentary country rocks. **REFERENCES:** Alekseenko, Korobeinikov, and Sidorov, 1990.

Q57-10 64 16 160 02	Tumannaya	Au, Ag Epithermal vein (Au-Ag association)	Small. Up to 16.7 g/t Au and 50 g/t Ag.

SUMMARY: Quartz veins and veinlets occur in an area several hundreds of meters long and up to 20 m wide in Middle Upper Devonian volcanic rocks of the Kedon series. Veins contain disseminated pyrite, sphalerite, chalcopyrite, arsenopyrite, gold, electrum, and silver sulfosalts. **REFERENCES:** Biryukov, 1988, written commun.

Q58-1 67 49 167 28	Svetlin	Au Au quartz vein	Small. Average 5.0 to 30 g/t Au.

SUMMARY: Deposit consists of lenticular and lenticular quartz veins tens to hundreds of meters long, and linear stockworks with disseminated arsenopyrite, pyrite, galena, sphalerite, and chalcopyrite; minor boulangerite, stibnite, and ubiquitous gold. Veins occur in altered Lower to Middle Triassic carbonaceous shale, siltstone, and sandstone; in hornfels; and in Triassic gabbro-diabase sills. About 200 en echelon veins are known along zones up to 10 km long. Gold ore bodies are confined to a fracture zone between two Early Cretaceous granitic bodies which occur at the intersections of major east-west and northwest structures. **REFERENCES:** Shavkunov and Panychev, written commun., 1977.

Q58-2 67 45 165 27	Elombal, Yakor	Au, As, Sb Sb-Au vein?	Small.

SUMMARY: Numerous, generally north-south zones of fracturing, silicification, and ankeritization, contain veins and veinlets of calcedony-like quartz with gold, arsenopyrite, stibnite, native arsenic, realgar, orpiment, pyrite, and chalcopyrite. Ore bodies are confined to hypabyssal intrusions of mid-Cretaceous (K-Ar age of 97 Ma) syenite to diorite porphyry that intrude a weakly deformed Upper Triassic sandstone-shale sequence. Mineralization is controlled by a major northwest trending fault. **REFERENCES:** Aksenova, 1990.

Q58-3 67 14 163 44	Asket	Cu, Mo, Au Porphyry Cu-Mo and Polymetallic vein	Small. Average about 0.5% Cu, 0.05% Mo, and 0.2 g/t Au.

SUMMARY: Deposit consists of a stockworks of quartz-sulfide and chlorite-sulfide veinlets with disseminated pyrite and chalcopyrite, and subordinate molybdenite, magnetite, native gold, marcasite, ilmenite, sphalerite, pyrrhotite, and arsenopyrite. Ore body confined to zones of fissuring and brecciation at the contact of an Early Cretaceous diorite body that intrudes volcanic and sedimentary rocks. Copper-porphyry mineralization is associated with propylitic alteration of the host rocks. Numerous quartz and quartz-carbonate veins with gold-silver-polymetallic ore minerals are associated with the porphyry Cu-Mo body. **REFERENCES:** Gorodinsky and others, 1974; Gulevich, 1987, written commun.

Q58-4 67 13 166 16	Kulpolney	Hg (Cu, Zn, Pb, Au, Ag) Volcanic-hosted Hg	Small.

SUMMARY: Quartz, quartz-dickite, and quartz-carbonate veins, as well as breccias and altered rocks contain disseminated veinlets that include polymetallic tetrahedrite-tennantite ore bodies in spilite, gabbro-diabase, and tuffaceous and volcaniclastic rocks of Upper Jurassic age. Ore bodies are confined to the southern end of a volcanic depression related to Early Cretaceous hypabyssal intrusions and necks of intermediate to mafic composition. Ore bodies are controlled by east-west structures and a radial fracture zone. Main ore and vein minerals are Hg-tetrahedrite, tetrahedrite, quartz, dickite, and nacrite, with subordinate amounts of galena, sphalerite, chalcopyrite, pyrite, chalcocite, calcedony, chlorite, illite, ankerite, and calcite. **REFERENCES:** Kopytin, 1978.

Q58-5 66 36 164 30	Peschanka	Cu, Mo, Au Porphyry Cu-Mo	Large. Contains 0.3 to 1.2% Cu, 0.05% Mo, and up to 2.0 g/t Au and 6.0 g/t Ag.

SUMMARY: Deposit is confined to the eastern portion of the Late Jurassic Egdegkych multiphase pluton; composed of monzodiorite and quartz monzodiorite intruded by planar bodies of quartz monzonite and granodiorite porphyry. Sulfide veinlets and disseminations, with copper and molybdenum minerals, are pervasive throughout the entire elongated monzonite-granodiorite porphyry body, and extend into the wall rock. Main ore minerals are pyrite, chalcopyrite, bornite, tetrahedrite-tennantite, and molybdenite. Magnetite, hematite, sphalerite, galena, chalcocite, native gold, gold tellurides, enargite, arsenopyrite, pyrrhotite, and marcasite occur in minor amounts or are rare. Gangue minerals are quartz, carbonate, and anhydrite. Four mineral associations are distinguished: (1) molybdenite, which is associated with the quartz-sericite subzone of phyllic alteration; (2) pyrite and chalcopyrite, associated with quartz-sericite-chlorite alteration; (3) chalcopyrite, bornite, and tetrahedrite coincident with quartz-sericite and biotite alteration; and (4) polysulfide mineralization which occurs with all alteration types. Mineralization was preceded by wide-spread pyritization in the peripheral propylitic zone. Trace elements include Ag, Pb, Bi, Co, Ni, Zn, Pd, Pt, and Te. **REFERENCES:** Gorodinsky and others, 1978; Volchkov and others, 1982; Migachev and others, 1984; Gulevich, 1987, written commun.

Q58-6 66 30 164 24E	Vesennee	Au, Ag Epithermal vein	Medium. Grade ranges 0.1 to 48 g/t Au and up to 300 g/t Ag.

SUMMARY: Carbonate-quartz veins, altered veinlets, and mineralized breccias occur in structurally complex forms. Veins are controlled by northeast and approximately east-west fractures which cut northwest-trending zones of copper-porphyry bodies. Individual ore bodies extend for 150-500 m. Main gangue minerals are quartz, calcite, and rhodochrosite with subordinate adularia, dolomite, celestite, and gypsum. Ore minerals include sphalerite, galena, pyrite, chalcopyrite, tetrahedrite, tennantite, bournonite, and electrum, with minor silver sulfides and sulfosalts, stannite, and matildite. Au:Ag ratio varies from 1:5 to 1:30. Ores commonly contain trace Cu, Mo, As, Bi, Sb, Co, Ni, Mn, Cr, Cd, In, and Te. Ore bodies occur mainly in propylitized trachyandesites of an Upper Jurassic volcaniclastic sequence that is intruded by hypabyssal bodies and dikes of gabbroid rocks, syenite, granodiorite porphyry, and andesite-dacite, of Late Jurassic to Late Cretaceous ages. **REFERENCES:** Gorodinsky and others, 1974; Shilo and others, 1975; Shapovalov, 1976; Sidorov, 1978; Gulevich, 1987, written commun.

Q58-7 66 28 166 48	Uralskoe	Hg, Sb, Au, Ag Volcanic-hosted Hg	Small.

SUMMARY: Mercury deposits are present along two northeast-trending belts associated with hypabyssal bodies of Early to Late Cretaceous granite porphyry and quartz porphyry. Deposits are hosted by sandstone and siltstone in a Lower Cretaceous volcaniclastic molasse. Individual ore zones are typically 100 m long by 20-30 wide. Ore minerals are cinnabar, metacinnabar, pyrite, arsenopyrite, chalcopyrite, hematite, silver sulfosalts, and native gold. Gangue minerals include quartz, calcedony, kaolinite, hydromica, calcite, and chlorite. Cinnabar is mainly confined to silicified and sericitized rocks as fine disseminations, powdery coatings, and thin veinlets. High concentrations of lead, zinc, antimony, molybdenum, tin, tungsten, and bismuth are characteristic of the ores. Cinnabar ore bodies are localized at the intersections of structures that trend approximately north-south and east-west. **REFERENCES:** Babkin, 1975.

Q58-8 66 29 164 49	Teleneut	Cr, Ni Podiform Cr	Small. Up to 70% chromite.

SUMMARY: Deposit occurs in serpentinite at the south end of the Aluchin alpine-type ultramafic body. Irregularly-shaped chromite deposit extends about 1.5 km toward the north with a width of about 700 m. Chromite ores are disseminated, banded, lenticular, and sometimes massive; with a chromite content up to 70%. Disseminated pentlandite, millerite, bravoite, violarite, pyrrhotite, and chalcopyrite occur in both chromite rich and chromite poor zones, in serpentinite, and in listwänite. **REFERENCES:** Aksenova, Dovgal, and Sterligova, 1970.

Q58-9 65 47 165 06	Rzhavy	Cu, Mo, Au Porphyry Cu-Mo	Small.

SUMMARY: Stockwork and disseminated veinlets of pyrite, chalcopyrite, molybdenite, magnetite, pyrrhotite, and native gold are hosted by Cretaceous diorite, granodiorite, and diorite and granodiorite porphyry. Central portions of the stockworks are locally dominated by molybdenite. Peripheral zones are marked by chalcopyrite; sometimes with intergrowths of galena, sphalerite, and tetrahedrite-tennantite, especially in andesite lavas. **REFERENCES:** Gulevich, 1987, written commun.

Q58-10 64 42 166 50	Irgunei	Au, Ag (Cu, Pb, Zn) Epithermal vein	Medium. Ore contains 0.2 to 68 g/t Au and 11.2 to 146 g/t Ag.

SUMMARY: Deposits consist of adularia-quartz and adularia-carbonate-quartz veins containing electrum, silver sulfosalts and selenides, galena, sphalerite, chalcopyrite, and, more rarely, molybdenite, arsenopyrite, cinnabar, and realgar. These veins are located over a complex intrusive dome at the intersection of a northeast trending fault, the Anadyr suture, and a northwest trending fault. A large hypabyssal andesite body occurs in the center of the dome and is surrounded with smaller stocks and dikes of diorite, granodiorite porphyry, andesite-dacite, and rhyolite. Periphery of the zone is composed of sheets of Lower and Upper Cretaceous felsic and basic volcanic rocks. Veins are commonly hosted in highly altered quartz-adularia-hydromica rocks near the hypabyssal body, and are associated with radial fissuring and fault zones. **REFERENCES:** Vasilenko, 1973, written commun.

Q59-1 68 00 170 36	Omrelkai	Hg, Sb Volcanic-hosted Hg	Small.

SUMMARY: Ore district is composed of seven areas spaced about 1 km apart, which occur in a graben-like, east-west trending structure in late Mesozoic volcanic rocks. Ore bodies occur in steeply-dipping mineralized fracture zones in tuff of intermediate and moderately felsic composition. Deposits are spatially related to hypabyssal bodies of diorite porphyry, andesite, and basalt that form the feeders for extrusive sheets. Rocks were intensely propylitized and locally silicified, followed by pervasive superimposed pyritization. Cinnabar occurs in separate veinlets and masses but more commonly, as irregularly disseminations in the host rock, and in quartz and calcite veinlets. Cinnabar is commonly associated with pyrite, and, more rarely, stibnite. **REFERENCES:** Babkin, 1975; Kopytin, 1978.

Q59-2 67 02 171 58	Enmyvaam	Au, Ag Epithermal vein	Small.

SUMMARY: Zones of gold-silver veins occur in Upper Cretaceous dacite of the Snezhnin caldera. Zones are typically 1-2 km long and 100-200 m wide. **REFERENCES:** Chubarov, 1978, written commun.

Q59-3 66 14 167 56	Maly Peledon	Au, Ag Epithermal vein	Small. Contains 0.5-13 g/t Au, and from 5 to 1850 g/t Ag.

SUMMARY: Quartz and fluorite-quartz veins with brecciated and cockade structures occur in zones of silicified and argillized, Albian and Cenomanian andesite and rhyolite. Individual veins are tens and hundreds of meters long. Ore occurrences are confined to the southern portion of a paleocaldera. Disseminated pyrite, hematite, and streaks of manganese oxides are visible in the area. Arsenic, copper, lead, and zinc are detected in chemical analyses. **REFERENCES:** Zotov, 1970, written commun.; Zotov and others, 1973, written commun.

Q59-4 66 15 169 34	Gornostai	Au, Ag Epithermal vein	Small. Ranges 0.5 to 11.1 g/t Au, 100-1028 g/t Ag.

SUMMARY: A fracture zone approximately 7 km long and 1.5-2 km wide crosses the core of a northwest-trending volcanic structure composed of lower Cretaceous andesite flows cut by necks and dikes of rhyolite and diorite porphyry. Silicified and propylitized volcanic rocks host more 100 veins and sets of stockworks. Vein types are: quartz, sulfide-quartz, sparse adularia-quartz, and epidote-chlorite-quartz. Veins average about 150-200 m long and 0.1-1.2 m thick. Veins are typically marked by brecciated, drusy, or cockade structures; but some are massive. Disseminated sulfides and sulfide veinlets make up 5 to 90% of the veins. Ore minerals are chalcopyrite, pyrite, galena, sphalerite, magnetite, and aikinite. **REFERENCES:** Timofeev and others, 1967, written commun.; Zotov and others, 1973, written commun.

Q59-5 66 11 171 26	Chineyveem	Au, Ag Epithermal vein	Small.

SUMMARY: Quartz veins with disseminated galena, chalcopyrite, pyrite, tetrahedrite-tennantite, and silver sulfosalts are confined to linear zones of sulfidized and tourmalinized, hydromica-quartz altered rocks; trending nearly east-west and northeast. Gold-silver veins occur in the middle of a collapsed volcanic structure subjected to resurgent doming. Veins and highly altered rocks occur along a major fault, where it intersects the contact of a diorite-granodiorite body that intrudes Albian to Cenomanian rhyolite-dacite volcanic rocks. Veins and alteration occur in both the intrusive body and country rocks. **REFERENCES:** Kotlyar, 1986.

Q59-6 65 50 170 08	Berezogor	Au, Ag, Pb (Cu, Zn) Epithermal vein	Small.

SUMMARY: Quartz veins, and mineralized fractured and brecciation belts 200-1000 m long, occur in propylitized andesites of Upper Cretaceous age. Ore bodies trend predominantly northwest. Typical gangue minerals are: quartz, sericite, carbonate, chlorite, and adularia. Ore minerals are: galena, chalcopyrite, sphalerite, pyrite, tetrahedrite-tennantite, gold, silver sulfosalts, molybdenite, marcasite, and hematite. Au:Ag ratio is about 1:30. **REFERENCES:** Zakharov, 1977, written commun.

Q59-7 65 27 173 04	Ust-Belaya	Cr, PGE Podiform Cr	Medium. Chromite ranges to 10-30%.

SUMMARY: Zones of closely spaced, banded chromite (10-30% chromite) occur as lenses, schlieren, and vein-like bodies of disseminated and massive chromite. Chromite occurs in layers up to 1300 m long and 400 m wide in dunite of the Ust-Belaya alpine-type ultramafic body. The chromite occurrences extend northward for 13 km along a belt more than 2 km wide. **REFERENCES:** Silkin, 1983.

Q59-8 65 17 169 00	Serovskoe	Au, Ag Epithermal vein	Small.

SUMMARY: Carbonate-quartz, and barite-carbonate-quartz veins containing galena, sphalerite, pyrite, chalcopyrite, pyrargyrite, and electrum occur in Late Cretaceous syenite-diorite, quartz diorite, granodiorite, and granite; which are intruded by hypabyssal intrusions of intermediate and basic composition. Au:Ag ratio is about 1:100. Veins are localized where the the Anadyr fault is cut by northward-trending fractures. **REFERENCES:** Vasilenko, 1974; Zakharov, 1977, written commun.

Q59-9 64 48 168 36	Travka	Mo Porphyry Mo	Small.

SUMMARY: Disseminated molybdenite and pyrite occur in altered, silicified, Lower Cretaceous extrusive volcanic rocks that are related to a granodiorite-granite plutonic complex. **REFERENCES:** Nevretdinov, 1966, written commun.

Q59-10 64 04 173 18	Parkhonai	Sn Sn polymetallic vein and Sn silicate-sulfide vein	Small.

SUMMARY: Numerous sericite-quartz and tourmaline-chlorite-sulfide veins, veinlets, and mineralized zones contain cassiterite, arsenopyrite, pyrrhotite, pyrite, chalcopyrite, sphalerite, galena, tetrahedrite, various silver minerals, stibnite, and considerable mercury in a Late Cretaceous flysch sequence composed of interbedded sandstone, siltstone, and argillite. Individual ore bodies extend for several hundreds of meters. Clastic rocks are intruded by small bodies and dikes of late Paleogene granite porphyry. Ore bodies are located over the periphery and middle of a volcanic dome that is controlled by a deep, concealed, northwest-trending fault. **REFERENCES:** Rozenblyum, Zincevich, and Nevretdinov, 1975; Lugov, 1986.

Q59-11 64 05 172 60	Lamut	Hg (As, Sb) Volcanic-hosted Hg	Small.

SUMMARY: Lenticular occurrences and masses of quartz, opal, chalcedony, dolomite, dickite, and cinnabar occur in intensely silicified, kaolinized, carbonatized, and chloritized late Paleogene rhyolite, and, less commonly, in basalt and tuffite; along northeast-trending fracture zones. Subordinate ore minerals are metacinnabar, realgar, stibnite, and pyrite. **REFERENCES:** Babkin, Drabkin, and Kim, 1967; Rozenblyum, Zincevich, and Nevretdinov, 1975.

Q60-1 67 59 178 05	Telekai	Sn Sn silicate-sulfide vein and Sn greisen	Medium.

SUMMARY: Quartz-cassiterite, quartz-cassiterite-tourmaline, and cassiterite-chlorite veins, and tin-bearing aplites and greisens, are present in the marginal zone of the Late Cretaceous Telekai granitic pluton. Ore zone extends north-west along the Chukchi fold structure. Quartz, tourmaline, muscovite, sericite, chlorite, albite, potassium feldspar, and fluorite are the main gangue minerals. Cassiterite is the main ore mineral; occurring as masses and in cross-cutting veinlets. Molybdenite, scheelite, löellingite, arsenopyrite, bismuthinite, and magnetite are present locally in some veins and zones of the ore bodies. Chalcopyrite, pyrrhotite, stannite, galena, sphalerite, wolframite, garnet, beryl, rutile, sphene, xenotime, and monazite are present in minor amounts. Mineralization began with albitization and ended with the development of low-sulfide quartz veins. **REFERENCES:** Voevodin, 1969.

Q60-2 67 55 178 51	Vodorazdelnoye	Sn (Cu, Ni, Ag, PGE) Sn silicate-sulfide vein	Small. High grade ores.

SUMMARY: Two types of ores are distinguished: (1) cassiterite-quartz-tourmaline veins in and adjacent to the Early Cretaceous Telekaigranite pluton; (2) disseminated veinlets of tin-nickel-copper mineralization with gold and accessory platinum, palladium and rhodium hosted in sericitized, silicified and tourmalinized injection migmatites which form a subhorizontal sheet-like body between the granite and overlying sedimentary rocks. The first ore body type also includes: chlorite, dolomite, and calcite; with minor pyrite, arsenopyrite, pyrrhotite, sphalerite, galena, stannite, scheelite, molybdenite, bismuthinite, and other minerals. The second type of ore bodies consist mainly of chalcopyrite and less abundant pyrrhotite and cassiterite; associated with the nickel minerals niccolite, gersdorfite, corynite, and hauchecornite. Deposit is probably related to two separate magmatic sources at different depths. **REFERENCES:** Tsvetkov, and Pospelova, 1986; Tsvetkov, 1990.

Q60-3	Mymlerennet	Sn	Small.
67 47		(W, Bi)	
179 46		Sn silicate-sulfide vein	

SUMMARY: Deposit consists of elongate stockworks of closely spaced, subparallel quartz veinlets with chlorite and sericite. Ore minerals are: arsenopyrite, pyrrhotite, cassiterite, and pyrite; with lesser sphalerite, chalcopyrite, cobaltite, and tetrahedrite-tennantite. Tungsten minerals are present locally, in the association: wolframite, scheelite, bismuthinite, native bismuth, topaz, fluorite, muscovite, and albite. Host rocks are variably hornfelsed, Lower and Upper Triassic clastic rocks which are intruded by the dikes of lamprophyre, granodiorite porphyry, and diorite porphyry. Mineralized area occurs in a zone made up of thrusts and steeply dipping faults that trend northeast and northwest. The stockworks are oriented northeast. **REFERENCES:** Borodkin, and Pristavko, 1989.

Q60-4	Gora Krassnaya	Mo, Cu, Au	Small.
66 35			
1753031		Porphyry Cu-Mo	

SUMMARY: Zones of disseminated sulfide veinlets and auriferous quartz-carbonate and quartz-epidote-chlorite veins contain pyrite, pyrrhotite, chalcopyrite, and molybdenite in Upper Cretaceous extrusive volcanic and granitic rocks. **REFERENCES:** Zakharov and Vasilenko, 1977, written commun.

Q60-5	Valunistoe	Au, Ag	Medium. Ranges 1.4 to 787 g/t Au
66 28		(Pb, Zn, Cu)	and 2 to 6273 g/t Ag.
177 38		Epithermal vein	

SUMMARY: More than one hundred adularia-quartz, adularia-carbonate-quartz, and fluorite-quartz veins are located in zones up to 1.5 km long and 400 m wide. Ore minerals consist mainly of finely disseminated electrum, argentite, aguilarite, stromeyerite, native silver, galena, sphalerite, and chalcopyrite. A gold-argentite association is predominant in veins of the upper portions of the deposit. At depth, gold-argentite is succeeded by a gold-chalcopyrite and gold-galena-sphalerite associations. Ore bodies are confined to Upper Cretaceous volcanic rocks within a volcanic dome structure that occurs at the intersection of northwest and northeast trending faults. Wall rocks are dominated by andesite-dacite and dacite with quartz-adularia-hydromica and propylitic alteration. Quartz veins are lenticular to podiform, commonly occur en echelon, and locally pass into a stockwork of veinlets associated with hydrothermal and subvolcanic breccia. **REFERENCES:** Berman and Trenina, 1968; Berman, 1969; Sidorov, 1978.

Q60-6	Shakh, Zhilny	Au, Ag	Small.
66 22			
177 11		Epithermal vein	

SUMMARY: Silicified and sulfidized, auriferous zones, and quartz-polymetallic and low-sulfide adularia-quartz veins several hundreds of meters long. Deposit occurs in Upper Cretaceous propylitized, felsic volcanic rocks and underlying Paleozoic talc-chlorite-sericite, quartz-chlorite-sericite, and epidote-chlorite schists, and marble. Ore minerals are pyrite, chalcopyrite, galena, sphalerite, electrum, and argentite. Mineralized zones are controlled by a large, north-south trending fault. **REFERENCES:** Zakharov, 1977, written commun.

Q60-7 65 25 174 08	Skalistaya	Cu (Ag) Basaltic Cu	Small. Cu about 1-2%.

SUMMARY: A network of prehnite-pumpellyite-carbonate veinlets 2-20 cm thick contains disseminated copper. Veinlets consist largely (80-90%) of prehnite and low-iron pumpellyite; secondary minerals include laumontite, calcite, dolomite, chlorite, quartz, epidote, and adularia. Native copper intergrowths 0.5-8 mm in diameter are present in prehnite and pumpellyite masses and in wall rocks. Copper content of the ore is about 1-2%. Native copper contains up to 100 g/t silver. Ore bodies occur in amygdaloidal basalt and associated tuff in a Upper Jurassic to Lower Cretaceous volcaniclastic sequence that extends over an area of about 1.0 by 0.6 km. Similar occurrences of native copper are known along a belt up to 18 km long. **REFERENCES:** Shkursky and Matveenko, 1973.

R01-1 68 11 178 55	Tenkergin	W, Sn Sn quartz vein	Small.

SUMMARY: Steeply dipping, branching quartz veins that contain wolframite, scheelite, and subordinate cassiterite cut hornfelsed Lower to Middle Triassic sandstone and shale. Quartz veins also contain sericite, clay minerals, tourmaline, and beryl. Minor ore minerals include chalcopyrite, arsenopyrite, and sphalerite. **REFERENCES:** Lugov, 1986.

R01-2 68 04 178 19	Svetloe	Sn, W Sn-quartz vein	Medium. Has been mined from 1979 to present.

SUMMARY: Deposit consists of en echelon sets of quartz veins and veinlets grouped in two zones that diverge to the southeast. Each ore zone hosts several tens of veins, which are 0.2-1.5 m thick and several hundreds of meters long; and about one hundred smaller veins. Ores are dominated by tin with abundant sulfides, over a buried stock of greisenized granite. Veins are hosted in metamorphosed Triassic sandstone and shale cut by granite porphyry and aplite dikes of the Cretaceous Iultin complex. Successive mineral associations are: (1) topaz-fluorite-muscovite stage (greisen); (2) cassiterite-wolframite-quartz stage with topaz, löellingite, and fluorite (this stage has been the most productive); (3) arsenopyrite-quartz stage with cassiterite and native bismuth, (4) stannite-chalcopyrite stage with small amounts of bismuthinite, sphalerite, galena, pyrrhotite, and bornite; (5) scheelite-fluorite-albite stage with chlorite, pyrite, marcasite, and cassiterite; and (6) fluorite-calcite stage with kaolinite. Complex cassiterite-wolframite mineralization predominates in the upper portion of the deposit; and tungsten ores are dominant at depth. **REFERENCES:** Lugov, 1986; Kuleshov, Pristavko, and Plyashkevich, 1988.

R58-1 69 41 163 11	Ichatkin	Sn (W, Zn, Pb, Sb) Sn silicate-sulfide vein	Small. Low-grade ores.

SUMMARY: Metasomatic quartz-tourmaline veins up to 100 m long and 4-5 m thick, and morphologically complex zones up to 40 m wide, contain arsenopyrite, chalcopyrite, sphalerite, pyrrhotite, galena, scheelite, stibnite, magnetite, and cassiterite. Tin mineralization (cassiterite) is not easily recognized in hand specimen. Deposit occurs within the Early Cretaceous Ichatkin granitic body. Alteration includes kaolinization, tourmalinization, and lesser silicification, sulfidization, and greisenization. Quartz-tourmaline veins often grade into quartz-sulfide veins along strike. Deposit has not been explored below a depth of 50 m. **REFERENCES:** Zivert, 1951, written commun.; Korolev, 1953, written commun.

R58-2 69 19 164 03	Kanelyveen	Au (As) Granitoid-related Au	Prospective medium-size deposit. Grades range 4.3 to 19.5 g/t Au.

SUMMARY: Quartz and sulfide-quartz veins, stockworks, and mineralized brecciated zones contain gold, pyrite, arsenopyrite, chalcopyrite, and stibnite. Veins, stockworks, and mineralized zones occur in hornfelsed Triassic shales and sandstones in contact with Early Cretaceous diorite intrusions. Gold is commonly disseminated in arsenopyrite. Quartz-sulfide veins with tourmaline, tetradymite, chalcopyrite, molybdenite, proustite (Ag_3AsS_3) and pyrargyrite are less common. Individual veins vary in thickness and strike. Most extend for no more than 60 or 70 m, but some are up to 200 m long. **REFERENCES:** Sadovsky, 1970, written commun.

R58-3 68 23 167 48	Yassnoe	Hg Clastic sediment-hosted Hg or hot-spring Hg?	Small. Up to 3% Hg.

SUMMARY: Cinnabar occurs in bands and lenses 0.2-0.8 m thick in zones of brecciated, silicified, and kaolinized rocks along a northeast-striking fault. Deposit occurs in sedimentary rocks that include Upper Triassic siltstone and shale and Lower Cretaceous sandstone; which are intruded by Early Cretaceous diorite, lamprophyre, and rhyolite stocks and dikes. **REFERENCES:** Babkin, 1969.

R58-4 68 15 165 56	Ozernoe	Au Au quartz vein	Small. Grades from 19.2 to 48.1 g/t Au.

SUMMARY: Steeply-dipping, northwest-trending quartz veins, 0.5-1.5 m thick and from 50 m to 230 m long, contain disseminated gold, arsenopyrite, and galena. Sulfide content of veins is less than 1-2%. Gold (814 fine), occurs as separate inclusions up to 4 mm in size and as intergrowths in sulfides. Gold content is rather high. Wallrock alteration includes silicification, carbonatization, and the development of epidote, zoisite, and albite. Mineral deposits occur in an Upper Triassic sedimentary sequence intruded by granite bodies and diorite porphyry dikes. **REFERENCES:** Kopytov and Vyalov, 1961, written commun.

R58-5 68 11 166 09	Karalveem	Au (W) Au quartz vein	Medium. Prospected and developed preparatory to mining.

SUMMARY: Numerous longitudinal, transverse, and diagonal, steeply-dipping ladder quartz veins up to several meters thick occur in Triassic gabbro-diabase sills, especially near their contacts with Triassic sandstone and shale. The sedimentary rocks and sills are strongly contorted into narrow, steep, northwest-trending folds. Gold ore bodies are controlled by strike-slip faults associated with the folding. Host rocks exhibit greenschist facies metamorphism. Silica-carbonate alteration and sulfidization occur adjacent to ore zones. Veins are 95-97% quartz with segregations of arsenopyrite and lenses of scheelite, albite, ankerite, and muscovite. Calcite, dolomite, potassium mica, galena, native gold (780-812 fine), topaz, aquamarine, sphalerite, pyrite, and pyrrhotite are widespread. Gold is mainly associated with bluish-gray quartz veinlets in a matrix of coarse-grain quartz and arsenopyrite, in the upper horizons of the deposit. Near the surface, quartz veins often host druse-like intergrowths of large, well-crystallized quartz and isometric gold crystals. Coarse-grained masses of gold, and less common dendritic gold, up to 1 cm in size are characteristic of the deposit. At depth, the gold occurs mainly as fine, dispersed masses in arsenopyrite. **REFERENCES:** Olshevsky, 1974, 1976, 1984; Davidenko, 1975, 1980; Skalatsky and Yakovlev, 1983.

R59-1 69 49 171 52	Kekur	Sn (Bi, As, Cu) Sn silicate-sulfide vein	Small. Grades from 0.3 to 2.0% Sn.

SUMMARY: Steeply dipping, quartz-tourmaline and quartz-topaz veins contain chlorite, muscovite, fluorite, cassiterite, pyrite, marcasite, arsenopyrite, chalcopyrite, galena, and bismuthinite. Veins vary in thickness and are related to domes of the Severny biotite granite. **REFERENCES:** Peltsman, 1988, written commun.

R59-2 69 39 170 12	Valkumei	Sn Sn silicate-sulfide vein	Large. Discovered in 1935, mined from 1941 to present.

SUMMARY: Simple and complex veins, mineralized zones, and less common linear stockworks, occur mainly within the marginal zone of the Late Cretaceous Pevek granite-adamellite-grandiorite pluton, and to a lesser degree in the Cretaceous sandstone and shale which host the pluton. Mineralization occurs in a north-northwest trending zone alone the contact of the pluton. Ore bodies commonly consist of a conjugate system with major north-south veins and feathered veinlets, and a zone of veins with approximately east-west and northwest trends. Seventy minerals are known from the deposits but the majority of the veins are composed dominantly of tourmaline, with quartz, chlorite, albite, arsenopyrite, cassiterite, pyrrhotite, chalcopyrite, stannite, sphalerite, stibnite, fluorite, and various carbonates. Ore bodies are vertically extensive. The cassiterite-quartz-tourmaline veins are replaced by sulfide veins at depth. **REFERENCES:** Lugov, Makeev, and Potapova, 1972; Lugov, 1986.

R59-3 69 33 171 57	Pyrkakai	Sn, W (Au, Ag, Zn, Cu, Pb, Bi, In, Cd) Porphyry Sn	Large. Prospected and developed preparatory to mining.

SUMMARY: Deposit is a linear stockwork composed of subparallel, steeply dipping sulfide-quartz veinlets. Three ore zones occur in Upper and Middle Triassic shale and subordinate sandstone. The major ore structures are north-striking fissure zones. Magmatic sequence associated with the veins includes numerous Upper to Lower Cretaceous dikes of quartz syenite, granodiorite and monzonite porphyry, diorite porphyry, and lamprophyre. Tin-bearing stockworks occur along the periphery of a deep-level granitic intrusion (the lower zone of mineralization), and above its apical portion (the upper zone). Mineralized zone is bounded by a steeply dipping contact of the pluton that extends for about 30 km along strike. Deposit has a vertical range of at least 300 m. More than 60 primary and supergene minerals are known. Quartz, muscovite, pyrrhotite, arsenopyrite, pyrite, fluorite, cassiterite, wolframite, sphalerite, and sometimes topaz and albite, are the most common minerals. In altered rocks, quartz, tourmaline, sericite, and chlorite are common. The veinlets contain 6 to 9% sulfides. The gold occurs mainly in arsenopyrite; silver is mainly associated with galena, sphalerite, and pyrite; zinc, copper, lead, indium, cadmium and bismuth also are present. Latest-formed mineralization is similar to epithermal gold-silver deposits associated with volcanic rocks. **REFERENCES:** Tsvetkov and Epifanov, 1978; Epifanov and Tsvetkov, 1980; Tsvetkov, 1984, 1990.

R59-4 69 14 172 56	Sredne-Ichuveem	Au (W) Au quartz vein	Small at ordinary grades, perhaps medium if all ore considered. No reserves data. Samples contain from 0.2 to 400 g/t Au.

SUMMARY: Deposit consists of sulfide-quartz, carbonate-quartz, and quartz veins, and vein-stockwork zones that generally trend north-south, but less commonly east-west. Veins are confined to a dome of a small anticline composed of Upper Triassic shale, siltstone, and sandstone. Mineralization is controlled by an east-west-trending broken zone marked by rhyolite dikes. Gold-bearing veins are confined to shale. About 60 veins and zones of ore bodies are known in an area of approximately 6 km^2. Individual veins are 20 to 100 m long with varying thickness and orientation. Zones with veins and veinlets are up to hundreds of meters long and up to 15 m thick. Sulfides make up 6-10% of the veins and consist mainly of pyrite, arsenopyrite, galena, sphalerite, and chalcopyrite; with minor but wide-spread wolframite and scheelite. Gold (850-950 fine) is disseminated as masses 2 mm up to 1.5 cm in size, and commonly associated with galena. Gold content of the veins is uneven with local high-grade concentrations. **REFERENCES:** Poznyak, 1959, written commun.; Sidorov, 1966; Sosunov, 1977, written commun.

R59-5 69 01 172 09	Palyan	Hg Clastic sediment-hosted Hg or hot-spring Hg?	Estimated 10,117 t Hg in ore containing 0.53% Hg.

SUMMARY: Stockworks and podiform mercury occurrences are in upper Cretaceous sandstone and shale overlying a deeply eroded, volcanic dome; now exposed as a block of volcaniclastic rock with an intrusive core. Mercury mineralization occurred in several stages and deposits formed at the intersections of major north-south and east-west faults. Localization of the ore bodies is greatly influenced by extensive layering in the volcanic rocks, and zones of tectonic disruption and explosive brecciation. More than 30 minerals are characteristic of the veinlets and disseminated ore bodies, including: quartz, dickite, dolomite, siderite, calcite, cinnabar, marcasite, pyrite, galena, sphalerite, native arsenic, realgar, and nickel minerals. Wall-rock alteration has not been identified. **REFERENCES:** Syromyatnikov, 1972; Babkin, 1975; Syromyatnikov, Dubinin, 1978.

R59-6 69 02 173 44	Maiskoe	Au, As, Sb, Ag Au sulfide disseminated	Large. Prospected and developed preparatory to mining.

SUMMARY: Deposit is associated with linear shear zones that generally trend north-south, have variable strike and dip, and that are marked by distinctive cleavage, fissuring, contortion, and boudinage. Mineralization consists of veinlets and disseminated zones of gold-bearing pyrite and arsenopyrite. Ore zones are confined to the more plastic rocks such as siltstone, and silty shale, and shale in a Middle(?)- and Upper-Triassic flysch sequence. Folding and zones of plastic flowage are discordant to a plicated structure within a horst-like block, which occurs in a large domal uplift. Sedimentary rocks are intruded by dikes of quartz-feldspar porphyry, granite, granosyenite porphyry, Early Cretaceous lamprophyre (kersantite and minette), Late Cretaceous rhyolite, as well as by vein-like bodies of intrusive breccia of Okhotsk-Chukota volcanic-plutonic belt. Magmatic rocks are beresitized and kaolinized. Carbonaceous rocks are metamorphosed to phyllite. There is also weak sericitization, carbonatization, graphitization, and irregular silicification. Ore consists mainly of disseminated high-grade gold in acicular arsenopyrite and arsenic-rich pyrite. A later quartz-stibnite (with native arsenic) stage of mineralization is also widespread within the ore zones. Beyond the ore zones, veins occur mainly in sandstone dikes and consist of molybdenite-quartz and rare metal-polysulfide-quartz ore bodies accompanied by cassiterite, scheelite, wolframite, bismuth minerals, tetrahedrite-tennantite, and lead and silver sulfosalts. Gold mineralization is vertically and areally extensive. **REFERENCES:** Sidorov and others, 1978; Gavrilov, Novozhilov, and Sidorov, 1986; Olshevsky and Mezentseva, 1986; Sidorov, 1966, 1987.

R59-7 68 59 172 57	Gora Sypuchaya	Au (Sb, As) Au quartz vein and Au-sulfide disseminated	Medium. Average ores are low and moderate grade. Grades range 1 to 12,356 g/t Au.

SUMMARY: Mineralized fractured zones, and zones of contortion and brecciation, contain axial quartz veins in deflections and limbs of small synclines and flexures. Ore bodies are confined to parallel, slight dislocations, which are mainly conformable to the Upper Triassic laminated sandstone hosting the deposit. Veins and zones of veinlets contain gold, pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, tetrahedrite, and lead sulfosalts. Stibnite is associated with disseminated gold-sulfide mineralization which contains gold-bearing pyrite and fine, acicular arsenopyrite in fractured and folded zones. **REFERENCES:** Sidorov, 1966; Fadeev and others, 1986; Volkov, 1990.

R59-8 68 54 168 00	Kyttamlai	Hg, Sb Clastic sediment-hosted Hg or hot-spring Hg?	Small.

SUMMARY: Mineralized zones in brecciated sandstone and sandy shale are confined to faults trending approximately east-west and northwest, which splay off a major northeast trending fault. Deposit occurs in Early Cretaceous clastic sedimentary rocks deformed into northwest-trending folds. Mercury-bearing zone, which is 200 km long and 20-30 m wide, trends northwest. Few magmatic rocks occur in the area. Mercury-bearing zones form parallel chains of ore bodies, several tens of meters apart, up to 50-100 m long and 0.4-0.5 m thick. Cinnabar and stibnite is present in quartz-carbonate, quartz, and carbonate-kaolinite vein material that cements the matrix. Disseminated ores are the most wide-spread; disseminated veinlets and cockade ore are less common. **REFERENCES:** Babkin, 1975.

R59-9 68 53 173 48	Promezhutochnoe	Au, Ag (Sb) Epithermal vein	Small. Grade ranges from traces to 887 g/t Au and up to 10,357 g/t Ag.

SUMMARY: Ore bodies consist of: (1) quartz breccia veins with disseminated arsenopyrite, pyrite, marcasite, and silver sulfosalts; (2) quartz veins with segregations of stibnite, silver sulfosalts, and gold; (3) auriferous quartz veins with chalcopyrite, galena, sphalerite; and (4) auriferous stibnite-quartz veins. Individual ore bodies are several hundred meters long and up to 10 m thick. Veins are characterized by brecciated structures with banded quartz coating sedimentary rock clasts. Host rock is shale interbedded with fine-grained sandstone, and occurs on the limb of a broad syncline that is cut by a set of east-west trending, Late Cretaceous trachyandesite and andesite dikes, which are cut by the veins. **REFERENCES:** Sidorov, 1966, 1978.

R59-10 68 34 168 34	Draznyaschy, Upryamy	Au (As, Pb, Zn) Au quartz vein and Epithermal vein	Small. Grade ranges from 15.4 to 164 g/t Au and to 10 g/t Ag.

SUMMARY: Discontinuous, ankerite-quartz veins, less than 100 m long, and vein-like breccia bodies cemented by quartz, form an en echelon mineralized zone that extends for about 500 m. Ore bodies occur adjacent to a sedimentary basin of Upper Jurassic and Lower Cretaceous volcaniclastic and clastic sedimentary rocks. Ore bodies are controlled by linear zones of fissuring and deformation that trend both northwest and northeast. Majority of the veins are confined to domed anticlines. Two productive mineral assemblages are distinguished: (1) a deeper assemblage with microcrystalline quartz, ankerite, sericite, pyrite, arsenopyrite, sphalerite, galena, bournonite, tetrahedrite-tennantite, and gold; and (2) an upper assemblage marked by finely crystalline crustified quartz, pyrite, stibnite, and gold. In quartz-cemented breccias, silver dominates over gold. **REFERENCES:** Zhukov and Pole, 1974.

R59-11 68 20 168 34	Elveney	Au, As Au sulfide disseminated	Prospective medium-size deposit with low-grade ores.

SUMMARY: Linear mineralized shear zones in Upper Triassic sandstone contain fine grained, disseminated gold-arsenopyrite mineralization. Tungsten veins and stockworks are also present in the vicinity of the deposit. **REFERENCES:** Rozenblum and Fadeev, 1990.

R59-12 68 02 169 09	Pelvuntykoinen	Au, Bi, Te Granitoid-related Au	Small.

SUMMARY: Quartz veins containing disseminated pyrite, arsenopyrite, native bismuth, tetradymite, and gold occur in Upper Triassic sedimentary rocks and Lower Cretaceous extrusive volcanic rocks, adjacent to a granitic pluton. **REFERENCES:** Naiborodin, 1966.

R60-1 69 33 176 02	Dvoinoi	Au Au quartz vein	No data.

SUMMARY: Quartz, carbonate-quartz, and sulfide-quartz veins occur along silicified and sulfidized breccia zones. Veins contain gold, pyrite, chalcopyrite, galena, sphalerite, cassiterite, ilmenite, and magnetite over an area about 30 km by 20 km. Veins generally strike east-west. Most of the ore bodies occur in Devonian sandstone and shale adjacent to the Early Cretaceous Velitekenai granitic pluton. Veins and mineralized fracture zones are confined to structures radiating out from major faults which trend northwest. Gold-bearing mineralized zones are 100 to 150 m wide and up 1 km long. Sulfide content of the veins is less than 1-2% (sulfide poor). **REFERENCES:** Piankov, 1981, written commun.

R60-2 69 21 178 19	Ryveem	Au Au quartz vein	Small occurrences. Minor prospecting.

SUMMARY: Deposit consists of low-sulfide quartz-carbonate veins with disseminated pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, and fine-grained gold in metamorphosed mid-Paleozoic clastic sedimentary and carbonate rocks. Ore bodies are 200-500 m long and range greatly in thickness. Mineralized area is about 1700 km^2, but the extent of mineralization is poorly known. **REFERENCES:** Pole, 1977, written commun.

R60-3 69 08 174 05	Kukenei	Sn, Ag (Cu, Pb) Sn polymetallic vein	Large. Considerable prospecting.

SUMMARY: Tin ore bodies are associated with a Cretaceous epizonal granitic pluton exposed in the middle of an intrusive dome. Host rock is mainly Upper Triassic sandstone with minor shale, intruded by granite porphyry and lamprophyre dikes. Wall rocks are intensely sericitized, tourmalinized, chloritized, and pyritized. Tin occurs mainly in veins, mineralized fractures, and northwest-trending broken zones. Both cassiterite-quartz and cassiterite-sulfide mineral assemblages are present. A cassiterite-sulfide association makes up to 70-90% of the richest ore bodies and includes arsenopyrite, fine acicular cassiterite, pyrite, marcasite, sphalerite, chalcopyrite, stannite, galena, gold, and sulfosalts of lead and silver. Silver occurs as argentite, and also as native metal and as inclusions in most of the sulfides. Near the intrusion, tin-silver mineralization changes to predominantly tin mineralization. Tin ore zones coincide with disseminated gold-sulfide minerals. Last stage of mineralization is marked by a stibnite-quartz assemblage. **REFERENCES:** Sidorov, 1966; Volkov and Dobrotin, 1990; Goncharov and others, 1990.

R60-4 68 58 174 03	Sopka Rudnaya	Au, Ag (Sb, As) Epithermal vein	Small. Grade ranges 8 to 17 g/t Au and 26 to 510 g/t Ag.

SUMMARY: Disseminated veinlets of adularia-hydromica-quartz composition contain kaolinite, dolomite and fine-grained, disseminated electrum, miargyrite, pyrargyrite, galena, sphalerite, chalcopyrite and argentite. Chalcedony-quartz veins contain disseminated and intergrowths and aggregates of arsenopyrite, marcasite, stibnite, and rare gold. Laminated and rhythmically-banded vein structures are typical. Ore-bearing area is composed of Lower and Upper Cretaceous felsic volcanic rocks that overlie Upper Triassic sandstone and shale. Volcanic rocks are broken by a set of northwest, and approximately east-west and north-south trending faults which are intruded by Late Cretaceous andesite-basalt hypabyssal plutons. A vertical alteration pattern is reflected in a zone of argillization and kaolinite with lenses of stibnite, that is over-printed by gold-bearing, quartz-adularia-hydromica zones and ore-bearing zones of low-temperature propylitization. **REFERENCES:** Sidorov, 1966.

R60-5 68 49 174 49	Lunnoe	Sn, W (As, Zn) Sn silicate-sulfide vein	Medium.

SUMMARY: Tin-bearing stockworks, mineralized zones, and veins occur in Middle and Upper Triassic, tourmalinized, silicified, sulfidized, sericitized, and chloritized sandstone and siltstone that overlie a buried granitic intrusion. Individual ore bodies, which are several hundred meters long, occur along fissures of diverse attitude. Ore bodies are composed of quartz, albite, tourmaline, chlorite, sericite, muscovite, fluorite, pyrite, arsenopyrite, cassiterite, stannite, galena, sphalerite, chalcopyrite, pyrrhotite, wolframite, and other minerals. Cassiterite-quartz ore bodies are the most important economically, but small amounts of wolframite, chlorite, muscovite, and tourmaline occur widely. **REFERENCES:** Lugov, 1986.

R60-6	Kuekvun	Au, Bi, Te, Sn, W	Small.
68 46			
178 53		Granitoid-related Au	

SUMMARY: Scattered quartz veins, 0.2 to 2.5 m thick and 100 to 800 m long, occur in Triassic gabbro and diabase which intrude carboniferous schist and Triassic shale; adjacent to an intermediate granitic intrusion. Veins contain tourmaline, sericite, albite, carbonates, arsenopyrite, pyrite, pyrrhotite, chalcopyrite, galena, sphalerite, tetrahedrite, cassiterite, scheelite, native bismuth, and tellurides of bismuth, gold, and silver. **REFERENCES:** Gorodinsky, Gulevich, and Naiborodin, 1977, written commun.

R60-7	Shurykan	Mo, Cu	Small.
68 44			
174 23		Porphyry Cu-Mo	

SUMMARY: Group of ore deposits that consist of stockworks of northeast-trending quartz, quartz-tourmaline, quartz-chlorite, and quartz-fluorite-calcite veinlets, with disseminated molybdenite, chalcopyrite, and pyrite. Ore bodies occur in hydrothermally altered diorite, granodiorite porphyry, and dacite of the Shurykan hypabyssal intrusion; which is cut by north-east trending mineralized fractures. Fine-grained disseminated sulfides are also widespread in the quartz-sericite rocks adjacent to the pluton. **REFERENCES:** Zhuravlev, 1981, written commun.

R60-8	Plamennoe	Hg, Sb	Medium. Produced 442 tonnes Hg
68 21			from high grade ore.
177 12		Volcanic-hosted Hg	

SUMMARY: Conformable lenses and pods with cinnabar occur in brecciated, silicified, and sericitized rhyolite which forms a number of extrusive domes along faults. Main ore body is a sheet-like deposit about 40 m wide that extends northwest for about 180 m. Rhyolitic ignimbrite forms the hanging wall and is commonly altered to a quartz-rich rock that obscures the deposits. Ores are massive or in disseminated veinlets in areas of intense alteration. Strong mineralization extends to a depth of at least 30 m, and some mercury ore bodies extend to 100 m in depth. Cinnabar is associated with quartz, chalcedony, stibnite, pyrite, and marcasite. Stibnite dominates locally. Lower Cretaceous volcanic rocks form a dome about 4 by 5 km in size which is intruded by a Late Cretaceous diorite stock and comagmatic hypabyssal bodies and dikes of basalt, andesite, and diorite porphyry. Ore zone about 4 km by 0.5-1 km, and is bounded by a system of steeply dipping faults trending northwest and east-west. **REFERENCES:** Kopytin, 1972; Babkin, 1975.

R60-9	Mramornoe	Sn, Ag	Medium.
68 06		(As, Cu, Pb, Zn)	
176 30		Sn polymetallic vein	

SUMMARY: Deposit consists of mineralized zones and stockworks with quartz, chlorite, sericite, tourmaline, and sulfides; and quartz-chlorite veins with disseminated, crystalline, and colloform cassiterite and stannite. Sulfide minerals include pyrite, marcasite, pyrrhotite, sphalerite, galena, chalcopyrite, and sparse arsenopyrite and chalcocite. Silver-sulfide and tetrahedrite-tennantite is wide-spread. Stibnite and cinnabar are present locally. Cassiterite and stannite occur with wolframite, bismuthinite, bismuth, and molybdenite in the rich ores. Ore occurrences are associated with a dome approximately 18 km in diameter composed mainly of Albian and Cenomanian ignimbrites and tuffs. Zones of veins and veinlets are controlled by northeast trending faults, closely associated with Late Cretaceous granite porphyry dikes and stocks. Ore bodies are up to 800 m long.

REFERENCES: Rozenblyum, 1991, oral commun.

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TABLE 4. SIGNIFICANT PLACER DISTRICTS OF THE RUSSIAN NORTHEAST

By
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Site No. Latitude Longitude	Deposit Name Region	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
P55-01 62 50 147 52	Susuman-Chai-Yuryuyen Central Kolyma	Au Placer Au	1-20 g/m^3

SUMMARY: The largest concentration of placer gold deposits in the Central Kolyma District. More than 400 individual placer deposits have been exploited. Deposits are Lower to Upper Pleistocene and most are buried only to shallow depths (up to 15 m). Terrace and buried or ancestral placers occur in neotectonic hollows at depths of up to 300 m. Placers of ancestral streams occur in interstream areas. Gold fineness ranges from 800 to 900. Major portion of the placer deposits are now worked out. Lode sources of the placer mineralization are quartz veins, mineralized dikes, and zones of low-sulfide gold-quartz formation.

Site No. Latitude Longitude	Deposit Name Region	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
P55-01 62 50 147 52	Chai-Yuruyue Central Kolyma	Au Placer Au	1-20 g/m^3

SUMMARY: Placer deposits occur in a fifth-order stream drainage system. The thickness of gold-bearing stratum is 1.2 m. Coarse gold is common; more than 60% of the gold being 4 mm or larger. The largest nuggets exceed 1 kg in weight. Gold is intergrown with quartz. Gold fineness averages 869. Original lode sources for the gold are quartz-vein zones and dikes of intermediate composition which contain 1.6 to 12 g/m^3 gold.

Site No. Latitude Longitude	Deposit Name Region	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
P55-01 62 50 147 52	Berelekh Central Kolyma	Au Placer Au	1-15 g/m^3

SUMMARY: Placer deposits occur in seventh-order stream drainage system. Auriferous deposits are 4-5 m thick. Some coarse gold is recovered. Gold fineness averages 867. Gold distribution is extremely irregular, with deposits concentrated in pods. Terrace deposits within eighth-order stream drainages and placers ancestral to and diagonal to modern stream courses also occur.

Site No. Latitude Longitude	Deposit Name Region	Significant Metals (Minor Metals) Deposit Type	Grade and Tonnage
P55-01 61 24 148 41	Tenka Ust-Omchug	Au Placer Au	1-10 g/m^3

SUMMARY: More than 100 placer deposits occur in a north-west-trending zone confined to the central part of Ayan-Yuryakh anticlinorium. The most concentrated areas of placer development are found in Upper Pleistocene to Holocene age deposits of third- to fifth-order streams. Most placer deposits are relatively shallow in valley alluvium. Auriferous terrace alluvium is only poorly preserved, and contains subordinate gold values. Alluvial placers are also present. Gold fineness exhibits a wide range from 510 to 900, but averages 800 to 850. Most placer deposits have been commercially exhausted. Lode sources are quartz-carbonate low-sulfide veins, mineralized zones, and dikes, and contain up to 20 g/t gold.

P55-01 61 24 148 41	Omchak Ust-Omchug	Au Placer Au	No grade/tonnage data

SUMMARY: Placer deposits occur in a fifth-order stream drainage and reach maximum widths of 510 m and thicknesses of 2 to 3.3 m. Gold is generally fine-grained (0.6-0.9 mm); fineness ranges from 740 to 811. Original sources of the gold are sheeted low-sulfide quartz vein systems in the Natalka, Pavlin, and other lode gold deposits which contain 3 to 7 g/t gold.

P55-02 61 53 149 39	Sanga-Talon	Au Placer Au	No grade/tonnage data

SUMMARY: Placer deposits occur in a northwest-trending zone that crosses the Kolyma River Valley. More than 96 placer deposits have been delineated in first-to-ninth order stream drainages. The main gold concentrations occur in third-to-sixth order stream systems, with gold about equally divided between terrace and modern valley deposits. Most placers in higher order stream valleys are found in terrace alluvium. Placer deposits range in age from Lower Pleistocene to Holocene, but those of Upper Pleistocene are predominate. These gold-bearing stratum range in thickness from 1.2 to 1.4 m, most are buried by 3 to 70 m of overburden, and have gold fineness ranging from 750 to 900. Gold is mostly coarse and intergrown in low-sulfide quartz-arsenopyrite veins. Gold content in veins is 12 to 15 g/t. The connection of placer deposits to original lode sources is vividly expressed in Vetren Region, where placer deposits occur near and are derived from lode sources in the valley.

P55-02 61 53 149 39	Elgenya	Au Placer Au	3 to 12 g/m^3

SUMMARY: Placer deposits occur in terrace alluvium along a sixth-order steam drainage system. Auriferous alluvium occurs in four distinct levels within the terrace deposits; at depths of 5, 25, 50, and 80 m. The two youngest terrace deposits are of Middle Pleistocene age. Placer deposits locally reach widths exceeding 200 m, and gold-bearing pay zones range from 0.8 to 1 m thick. Auriferous deposits are commonly concentrated in small pod-like zones. Coarse gold is common and gold fineness ranges from 837 to 863. Buried placers up to 40 m thick occur under slope and glacial deposits.

P56-01 62 23 150 50	Debin-Srednikan East Kolyma	Au Placer Au	No grade/tonnage data

SUMMARY: Area contains more than 270 individual placer deposits. Most deposits are in Upper Pleistocene placers up to 8 m thick, with less common Middle and Lower Pleistocene deposits. Buried placers occur in Seimchan-Buyundin and Taskan hollows. Gold is of various sizes, and several nuggets of more than 4 kg have been recovered. The bulk of the gold consists of small flakes and grains with fineness of 710 to 975. Original lode sources are quartz veins containing up to 300 g/t gold and shear zones and dikes with up to 14 g/t gold.

P56-01 62 23 150 50	At-Yuryakh East Kolyma	Au Placer Au	5 g/m^3

SUMMARY: Placers occur in terrace alluvium within a fifth-order drainage system. Pay channels increase in width and gold grade increases in the mouths of tributary streams, where placer deposits are up to 900 m wide. Thickness of gold-bearing stratum ranges from 0.4 to 3.8 m. Gold consists mainly of well-rounded, laminated, fine grains; with fineness ranging from 916 to 980. Major impurities are admixtures of silver and zinc. Cassiterite, scheelite, and ilmenite occur in placer concentrates.

P56-01 Orotukan East Kolyma Au, Sn No grade/tonnage data
62 23
150 50 Placer Au

SUMMARY: Placers occur in terrace alluvium within a sixth-order drainage system. The most persistent placers occur in 10-m thick terrace alluvium; where gold-bearing stratum reach 1.4 m in thickness. Cassiterite and scheelite occur in noneconomic concentrations in the placer deposits.

P57-01 Taigonoss Au 1-6 g/m^3
62 07
161 14 Placer Au

SUMMARY: Gold placer deposits in second-to-fourth order valleys occur in the northern and central parts of Tiagonoss Peninsula. At least 12 placer deposits are known; the largest include those on the Avekov, Pylgin, and Kolymak Rivers. Placer deposit types include alluvial, flood plain, and rare terrace alluvial and spit placers, with a width up to 100 m, are known in the Avekov River valley. The age of most of the placer deposits is Holocene, and rarely Pleistocene. The Prima placer deposit which occurs at depths of 45 m, is believed to be Early Quaternary in age. Most placers are shallow (0.4-2.6 m down), and gold is complexly distributed throughout the alluvium. Several placer deposits are in the process of formation. Gold grains are small (0.5-0.8 mm), laminated, and mainly well-rounded in shape. Gold-bearing quartz veins and mineralized zones in metamorphosed rocks of the Avekov block, and Mesozoic sedimentary-volcanogenic formation, are the principal lode sources. The mineralized lodes reach a maximum of 8 g/t gold.

Q01-01 Penyelkhin Au No grade/tonnage data
67 28
177 20 Placer Au

SUMMARY: As many as 10 placer deposits occur in valleys in a mountainous area near the Vankarem lowland. The principal placer deposit is Penyelkhin, which formed during Miocene to Pleistocene time during multiple erosional events. Gold-bearing stratum is confined to thalweg channel and 10 m thick terrace alluvium that are now buried under up to 30 m of glacial drift. The Penyekhin deposit extends for 4 km in length and reaches 300 m in width. Auriferous gravels are up to 3 m thick; rarely more. Gold placers are concentrated in pods. Gold grains are small and average 0.5 mm in diameter. Octahedral gold crystals have been found. Gold fineness ranges from 880 to 900. Low-sulfide gold-bearing veins and silicified shear zones are the lode sources.

Q56-01 Stolbov Shamanikha Au No grade/tonnage data
65 04
152 57 Placer Au

SUMMARY: Fifteen placer gold deposits overlie Proterozoic metamorphic complexes. Unlike placers in tectonically active zones such as those near Ucts-Omchug and the Central Kolyma areas, the placer deposits of the Shamanikho-Stolbov district occur in a deeply eroded, mature region with a passive recent tectonic history. Principal placers range in age from Neogene to Lower Quaternary. These, including the Stolbovaya and Glukhariny deposits, occur in river valleys at depths of 15-70 m and have widths of up to 300 m. Late Pliocene to Holocene placers are less important. Gold grains are moderately rounded and have undergone secondary attenuation in the form of coatings of hydroxides of iron up to 2.2 mm thick. Younger placers occur both in stream valley and terrace alluvium, where average gold grain size is about 1.3 mm. Neotectonic block subsidence took place in some valleys, where auriferous deposits up to 8 m thick were formed. Gold fineness ranges from 820 to 960. Low-sulfide stockwork zones and rare quartz veins with gold contents of up to 20 g/t are thought to be the original lode sources of the placer deposits.

Q56-01 Glukhariny Shamanikha Au 3-15 g/m^3
65 04
152 57 Placer Au

SUMMARY: Placer deposits of the Glukhariny district formed in a complex alluvial environment. The deposits consist of valley-thalweg deposits of Lower to Upper Pleistocene age, and karst placers of Pre-Quaternary age; both of which have been buried in the Glukhariny alluvial basin. The karsts of the latter type formed in Proterozoic limestone. Placer deposits are characterized by extremely irregular, but rich accumulations of gold. Thickness and width of auriferous gravels reach 8 m and 220 m respectively. Gold grains are of moderate size (3-4 mm), poorly rounded, and contain coatings of hydroxides of iron. Maximum concentration of gold occurs where shaly deposits fill karst holes and depressions. Younger portions of placer deposits within "old" thalwegs where unconsolidated river gravel ranges from 20 to 70 m thick and is up to 220 m wide. Gold grains range in size from 0.25 mm to 2.2 mm; gold fineness from 830 to 960.

Q57-01 Khetachan Au 3-15 g/m^3
67 39
160 39 Placer Au

SUMMARY: At least 12 placer deposits in the Khetachan District occur discontinuously within a region transitional between the mountainous area of Kuryin Ridge and the Anyui lowland. The most important placers include the Dalniy, Topolevka, and Ruslan deposits. The placers are buried under a thick section (up to 40 m) of Upper Pleistocene rock debris and silty deposits of the Yedom Formation. Placers are in banded alluvial deposits and are confined to alluvium on or near bedrock. Weathering into the sedimentary and granitoid bedrock is up to 3 m thick. Auriferous zones range in thickness from 1 to 3.5 m. There are also placers of alluvial-talus origin, associated with weathering crusts; but gold reserves are not significant. The age of the majority of placers is pre-Upper Pleistocene, probably Lower Pleistocene. Gold grains are small (averaging 0.97-1.53 mm); and in some placers gold grains average less than 0.5 mm in diameter. Gold fineness is 860. Mineralized quartz-sulfide zones, spatially associated with Cretaceous gabbro-syenite intrusions, are considered to be the lode sources of the placer deposits. Most mineralized lode zones contain up to 7 g/t gold, but bonanza contents are also known. These mineralized zones are thought to be part of a porphyry copper system.

Q57-02 Innakh Kuyra Au No grade/tonnage data
67 16
159 35 Placer Au

SUMMARY: About 20 placer deposits occur in third-order stream drainages that are radially positioned around a massif composed of Cretaceous syenite and diorite. Placer formation has been influenced by high-angle and vertical fault movement. The Valley of Springs deposits which occur in tributaries of the Omolon River are buried by 30 to 50 m thick slope deposits. The placer deposits range in age from Upper Pleistocene to Holocene. Gold fineness ranges from 800 to 860; rarely higher. Gold grains are typically small. The original lode sources of the gold are sulphidized crushed zones and sparse quartz-sulfide veins and stockwork zones associates with the Cretaceous syenite-diorite.

Q57-02 Uzhasny Kuyra Au, Cu 2-8 g/m^3 Au
67 16
159 35 Placer Au

SUMMARY: Placer alluvium occurs in third-order stream valleys about 7 km long. Placer deposits are found in banded gravels to depths of 5-20 m. Auriferous pay zones average 1.6 m thick. Gold grains in lower gravels average 0.73 mm in size, upper gravels contain gold grains that average 1.3 mm in size.

Q57-03 65 26 157 24	Visualnin	Au, Ag Placer Au, Ag	1-15 g/m^3

SUMMARY: More than 20 placer deposits occur in the Omolon massif, and include the Rassokha, Burgachan, and Bulun deposits. All deposits are confined to second- to third-order stream valleys. The placer deposits range in age from Upper Pleistocene to Holocene. Morphologically they consist of shallow alluvial gravel that ranges from 3 to 8 m thick. Auriferous zones are 0.6 to 2.2 m thick and include gold found within altered bedrock. Gold grains are small to very small in size, averaging 0.97 mm. Gold fineness exhibits a wide range from 525 to 924. Small native silver nuggets occur in some of the placer deposits. The original lode sources are zones of silicification and sulphidization in brecciated rocks, low-sulfide gold-bearing quartz and quartz-carbonate veins, and gold-silver lodes. Gold content reaches a maximum of 15 g/t in the known lode deposits.

Q58-01 67 45 167 51	Aliskerov (Main District)	Au Placer Au	0.5-11 g/m^3

SUMMARY: The geological composition of the Aliskerov District is analogous to placers at Keperveem (11b), but with a smaller number of placer deposits (about 25) and lower gold concentrations. The largest placers are confined to fourth-order stream valleys. Placers are shallow and averaging 8.2 m. Gold fineness ranges from 812 to 845. Gold grains are small and laminated. Nuggets are very rare. The deposit is zoned with regard to gold fineness and grain size. Quartz veins containing up to 3 to 25 g/t gold, and mineralized shear zones with 1.5 g/t gold, are the original lode sources.

Q58-01 67 45 167 51	Egilkytveem Aliskerov	Au Placer Au	0.87 g/m^3

SUMMARY: Placer deposit is confined to a fourth-order stream valley and can be traced for more than 8 km. In upper parts of the valley the deposit sharply narrows, with maximum widths of 20 m and depths of 5-6 m. Gold fineness ranges from 812 to 820. Placer deposits have been exhausted using hydraulic mining methods.

Q58-02 66 58 166 44	Stadukhin	Au Placer Au	2-10 g/m^3

SUMMARY: Gold-bearing placer deposits occupy a large area. Commerical exploitation has focussed in the Yarakvaam District where at least 12 placer deposits have been worked. Alluvial placers of Holocene age are dominant. Alluvial terraces of Late Pleistocene sediment buried 25-30 m deep also occur. Gold-bearing stream channels in hanging tributaries have been exposed in valley walls by erosion by large trunk glaciers. The largest placer deposit is located in the flood plain of the Karalveem River, and on two sets of alluvial terraces at the 25 m and 10-15 m levels. Placer deposits in the Khrabtovy River drainage are confined to an extinct ancestral drainage system, and are concentrated on granitoid bedrock. Gold fineness ranges from 822 to 907; gold grain size from 0.7 to 2.2 mm. Low-sulfide quartz veins and silicified zones up to 1 m thick and containing up to 20 g/t are the original lode sources.

Q58-03 66 13 164 36	Bayim Bayimski	Au, Ag, Cu, Pt Placer Au	1-12 g/m^3 Au

SUMMARY: At least 40 placer gold deposits occur discontinuously in a north-northwest trending belt 150 km long. Placers are of the valley alluvial type and are found in first-to-third order stream drainages. Gold-bearing alluvial terraces and alluvial talus 10-25 m above the valley deposits are Upper Pleistocene in age and are poorly preserved. Most of the deposits are thought to be of Holocene age. Gold grains are generally small. Gold fineness ranges from 673 to 934, averaging 824. Ferruginous coatings on grains are common. Zones of gold- and silver-bearing sulfide mineralization associated with a copper porphyry stockwork are believed to be the original lode source of the placers. The gold content of the mineralized lode zones is between 0.26 and 20 g/t. The main parts of the placer deposits have been commercially exhausted.

Q58-03 66 13 164 36	Krivoy Bayimski	Au, Ag, Cu Placer Au	No grade/tonnage data

SUMMARY: The Krivoy placer deposit is confined to talus and alluvium in a small, steep stream with an asymmetrical profile. The deposit is one of the largest placers in the Bayimski Region. Gold-bearing talus deposits occur as far upstream as the river head; but deposits near the river mouth contain the most concentrated resources and are the most extensively developed with placers up to 150 m wide. Greenish-yellow gold with fineness values averaging 720 prevails. Gold- and silver-bearing quartz-carbonate veins and zones of sulfide mineralization are the principal lode sources.

Q59-01 67 58 170 41	Omrelkai	Sn Placer Sn	600-1700 g/m^3 cassiterite

SUMMARY: The seven tin-bearing placer deposits occur in this district are located in a transitional zone between the Chukotka upland and the Chaun plain, in an area of low-mountain relief. The placer deposits occur in first- to fourth-order stream valleys (examples: Oleniy, Ptichiy) and sixth-order stream valleys (example: Lenyuveem). Pay zones of Upper Pleistocene to Holocene placers are up to 2 km in length and are generally simple single-layered deposits. Deeply-buried (40 m and more deep) placers of Lower- to Upper-Pleistocene age are between 2 and 5.5 m thick and contain 600 to 1700 g/m^3 cassiterite. These deep placers occur in gravel deposits. Small eluvial-talus placers associated with stockwork zones of the Ptichiy lode deposits are also present. Lode mineralization consisting of cassiterite and quartz is the principal lode source.

Q59-02 67 58 170 06	Chaanay	Au Placer Au	5-6 g/m^3 Au

SUMMARY: The Chaanay district is located within the Chaun lowland; an old, ancestral river drainage system not expressed in modern drainage patterns. The main gold-bearing placer deposits are part of the buried Oligocene-Miocene age Chaanay River valley, and are among the oldest placer systems known in the Russian Northeast. Placer concentrations are multiply stacked, alluvial in origin, and extend for a length of 11 km. Two buried alluvial terraces at the 15-20 m and 30-40 m levels relative to the thalweg have been identified. Gold-bearing placers occur below sea level, average 30-40 m in thickness, and are buried under unconsolidated deposits ranging from 50 to 120 m thick. Separate pay channels from 30-200 m wide, localized bonanza pay zones, and variable gravel thickness ranging from 0.6 to 6.4 m are typical. Gold grain size ranges from 0.4 to 1.6 mm; fineness ranges from 900 to 960. Gold grains are coated in iron hydroxides. Meavy minerals include cinnabar and cassiterite. Placer deposits are partly exhausted. Lode sources have not been identified.

Q59-03 65 02 172 30	Otrozhen (main deposit)	Au Placer Au	No grade/tonnage data

SUMMARY: More than 18 placer deposits formed from Late Tertiary to Holocene time; and are characterized by complex geomorphology. Gold occurs in crevices up to 1.7 m into bedrock. The main part of this drainage system was formed in Late Tertiary time, and Quaternary valleys have partly inherited the ancestral Tertiary channels. All placers are alluvium types, and the majority of them are in near-surface concentrations. Thickness of gold-bearing stratum ranges from 0.4 to 5.2 m. Gold is of small grain size (up to 3 mm). Gold fineness ranges from 830 to 975. Nuggets weighing up to 4 kg have been found. Cinnabar and uncommon platinum are observed in the placers. The majority of the placer deposits have been exhausted. Lode sources of gold are quartz veins and mineralized zones with low gold content.

Q59-03 65 02 172 30	Otrozhnaya	Au Placer Au	No grade/tonnage data

SUMMARY: The Otrozhnaya placer deposit is one of the largest in the Otrozhen District. Its lower part occurs within the Udachnen hollow, deposited on Late Tertiary sediments. Its formation took place mainly from Middle Pleistocene to Holocene time. Placers reach 300 m wide and range from 0.8 to 2.2 m thick. Productive stratum is confined to the lower part of alluvial deposits. The average size of gold particles is 4.3 mm. Gold is distributed in elongate streaks. Placer gold content is highly variable from trace amounts to 20 g/m^3.

Q60-01 64 58 178 48	Zolotogorsk	Au Placer Au	5-7 g/m^3 Au

SUMMARY: Placer gold has been known in Zolotoy Ridge since 1906. This is a small gold-bearing district, containing 8 placer deposits which formed from Early Pleistocene to Holocene time. These deposits are of the valley-alluvial type and occur mainly on bedrock composed of igneous rocks. Placer paystreaks reach a maximum length of 160 m. The placer deposits are buried to depths of 20 m. Thickness of gold-bearing stratum ranges from 0.6 to 1.5 m; rarely to 2.7 m. Gold particle size ranges from 0.9 to 2.1 mm. Gold fineness is 837. The Pravaya Kolbi placer deposit of Early Pleistocene age is buried to depths of 32 m. Gold fineness ranges from 850 to 860. Small gold placer deposits are known along the shoreline of Anadyr Bay in modern marine sediments. Quartz veins, mineralized zones and gold-bearing dikes are the lode sources.

R01-01 68 02 178 55	Iultin	Sn, W, (Au) Placer Sn, W	200-650 g/m^3 cassiterite

SUMMARY: More than 27 placer deposits are concentrated near the Iultin tin-tungsten lode deposit, in an area of moderate releif. Glaciation has modified the topography. Placer deposits are of several morphological types: alluvial, valley-fill, deeply-buried, and complex, (Iultinskaya, Granitny, Lenotan). Wolframite, and rarely gold, are present in commercial concentrations. Placer deposits are concentrated in second- to fourth-order streams and formed from Early Pleistocene to Holocene time. Upper Pleistocene to Holocene talus-alluvial placers are poorly developed. Placers are characterized by variable thickness of stratum. Thickness of metal-bearing gravels ranges from 1.5 to 10 m. Tin-tungsten lode deposits at Iultin, Svetloye, Solnechnoye, and Severnoye, as well as other cassiterite-tungsten-quartz deposits are the original source of the placer deposits.

R01-02 69 14 1782445E	Ryveem (Proper)	Au, Ti, Agate Placer Au	No grade/tonnage data

SUMMARY: More than 15 placer deposits of the Ryveem District (proper) are confined to the valleys of first- to fifth-order streams and the near-shore coastal plain of the Chukotsk Sea. Most deposits are alluvial, but one is of strandline-marine origin. The age of most placers is Lower to Middle Pleistocene, with minor deposits of Upper Pleistocene to Holocene age. Most placers are buried by overburden ranging in depth from 8 to 50 m. Coastal placers are the thickest, ranging up to 5 to 8 m thick. Grain size of gold averages 2 mm in diameter. Gold grains are commonly coated with greigite (Fe_3S_4) and iron hydroxides. Gold fineness ranges from 700 to 866. Principal admixtures in gold bullion include silver, copper, and iron. Ilmenite, scheelite, and other minerals are also found in the placers. Low-sulfide gold-bearing quartz veins and silicified shear zones with gold contents reaching 15 g/t are the original lode sources for the placer deposits. The lodes occur in Paleozoic terrigenous deposits.

R01-02 69 14 178 25	Ryveem (Lower River and Coastal Plain)	Au, Agate, Ti Placer Au	1-25 g/m^3 Au

SUMMARY: Complex placer deposits of alluvial and coastal marine origin occur in the lower part of Ryveem River valley and Valkarai lowlands. Both types of deposit are believed to be Pliocene to Pleistocene in age. Exceptionally wide valley placers range from 4 to 7 km in width. Rich bonanza-grade placers occur in zones of extensive weathering and increasing thickness of paystreaks. Multiple pay zones are common. Auriferous deposits are in the lower parts of the river, which are usually less than 1 m thick. Gold concentrations are localized in pods. Gold grains are poorly rounded and average 2 mm in size. Gold fineness ranges from 814 to 866. Strandline placers are subparallel to the coastal plain and consist of several parallel pay streaks. Gold concentrations occur along the contacts of consolidated and unconsolidated deposits. Iron oxide coats gold particles. Exploration is currently in progress.

R01-03 68 43 1781904E	Kuvet	Au Placer Au	4-8 g/m^3

SUMMARY: More than 12 placer deposits occur in the Kuvet District, which is situated in the Kuvet River basin and at the head of the Kuekvunya River. The most important placers are those of Kuvet River and its tributaries. The placer deposits are of buried, valley, and alluvial types; and are of Upper Pleistocene age. Sediment overburden ranges from 20 to 100 m thick. Gold-bearing stratum ranges from 0.4 to 2.2 m thick, and up to 200 m wide. Gold occurs in individual, narrow paystreaks. The largest placers are concentrated in the Kuvet River valley. Distribution of gold is irregular, with some gold-bearing zones up to one km long. Bonanza concentrations occur locally. Gold is mainly well-rounded, ranging in size from 0.75 to 3.5 mm. Small nuggets have been recovered. Gold fineness ranges from 865 to 895. Placers are partly exhausted. Quartz and quartz-carbonate low-sulfide veins and zones of silicification and brecciation are the lode sources. Lode deposits contain 4 to 12 g/t gold.

R58-01 68 07 165 60	Keperveem Bilibino	Au, W, Sb Placer Au	No grade/tonnage data

SUMMARY: At least 50 placer deposits occur in the Keperveem District; largely confined to Upper Pleistocene to Holocene fourth-order stream valleys. Adjacent auriferous terrace alluvium has subordinate gold values. Auriferous zones 0.8 to 3.3 m thick are buried by 14 m of overburden. Multiple gold-bearing layers in placers is characteristic. Glacio-fluvial placers are known in the Enmyveem River basin, where glacial activity is well expressed. Placers, buried under Upper Pleistocene glacial deposits, occur at a depth of more than 90 m. Gold fineness is 800 to 950. Fineness decreases at the flanks of the district. Gold-bearing quartz veins in Triassic gabbro-diabase and sedimentary rocks, and rare low-sulfide mineralized zones, contain 3-40 g/m^3 gold and are the original lode source of the placers.

R58-01 68 07 166 00	Karalveem Bilibino	Au, W Placer Au	3-15 g/m^3

SUMMARY: The Karalveem District contains a continuous placer deposit 10 km long in the valley of the Karalveem River, extending downstream from the mouth of the Byezymanny River. The placers occur in a fourth-order drainage system. The auriferous sandy-pebble deposits are of Upper Pleistocene to Holocene age. Bedrock surface underneath the placer deposits is relatively even, and composed of sandstone, shale, and diabase. Multiple pay layers are characteristic of these placers, with auriferous zones reaching thicknesses of 5 m where layers join. Gold is commonly coarse (averaging 2-6 mm) and nuggets weighing more than 1 kilogram have been found.

Average gold grains range in size from 2 to 6 mm. The placer deposit reaches a maximum width of 300 m. Gold concentration increases in some places where the valley narrows. Gold fineness ranges 886 to 916 and averages 900. Heavy minerals include galena, ilmenite, and scheelite. Bedrock source for the placer gold is the Cretaceous age Karalveem quartz vein lode which contains up to 40 g/t gold.

R59-01 69 52 171 35	Northern	Sn Placer Sn	200-600 g/m^3 cassiterite

SUMMARY: The more than 55 placer deposits of the Northern District are located in the northern part of the Chaun Mesozoic fold belt; a region of moderate relief. Most placers are near-surface alluvial deposits in first- to third-order stream valleys, forming single-stratum concentrations of Upper Pleistocene to Holocene age. Multiple pay layers are rare. The cassiterite placers extend for a length of 11 km, average 0.6 to 1.2 m thick, and contain 200-600 g/m^3 cassiterite, with locally up to 1500 g/m^3 cassiterite. Eluvial-talus placer deposits are found near the Terrace and Olovyanny lode tin deposits. Placers are mainly monomineralic, but small admixtures of gold, wolframite, and scheelite do occur. Most placer deposits in the Northern District are now exhausted. Cassiterite-silicate stockworks, streaky zones, mineralized dikes, and rare veins are the main lode sources. Cassiterite grains are small (1-2 mm, rarely 5-8 mm). The content of tin in lode deposits ranges from 0.5 to 1.0%.

R59-02 69 29 171 58	Pyrkakay	Sn, (Au, W) Placer Sn (Au, W)	200-800 g/m^3 cassiterite

SUMMARY: The Pyrkakay District is located in the central part of the Chukotka Mesozoic fold belt in an area of moderate relief. More than 23 placer deposits are closely associated with the original lode sources, and are located in second- to fifth-order stream drainages. Placer formation took place from Miocene to Holocene. The pre-Quaternary placers formed in places with extensive chemically-weathered crusts up to 10 m thick. Late Pleistocene to Holocene placers occur as alluvial, valley-fill, and eluvial-talus accumulations. Valley-fill placers extend for 5 km in length and contain gravel ranging in thickness from 2 to 3.6 m. Placers contain both single and multiple pay layers. The cassiterite content in placers is 200 to 800 g/m^3; wolframite, gold, topaz, garnet, and sulfides are also present. The content of gold and tungsten is not high, but they are recovered as by-products. Lode sources are quartz-sulfide-gold veins, stockwork zones, and shear zones containing cassiterite and sulfides. Cassiterite found in lode deposits exhibits small grain size (0.1 mm) with a few large crystals reaching 1-2 cm in diameter.

R59-03 69 08 172 53	Ichuveem	Au, Sn, W Placer Au, Sn	No grade/tonnage data

SUMMARY: At least 30 placer deposits are concentrated in valley bottoms of second- to sixth-order streams, mainly in Holocene age material. Placers of Upper Pleistocene age occur in the terrace alluvium at 10-12 m elevations, and rarely higher. Thickness of metal-bearing stratum ranges from 1.4 to 2.0 m, width of terrace alluvial placers reaches 700 m. Most gold grains average less than 2 mm in size; however, there are common occurrences of nuggets up to 2 kg. Gold fineness ranges from 850 to 900, the major admixture is silver. Placer deposits of Promyezhutochny River differ from others in the district and are characterized by small grain size and low gold fineness. Placer deposits in Mlelyuveem River contain up to 400 g/m^3 tin, locally more. Low-sulfide gold-bearing quartz veins and rarely mineralized shear zones and dikes of intermediate composition are the main lode sources of metals.

R59-03 69 08 172 53	Ichuveem—M. Ichuveem	Au Placer Au	2-15 g/m^3 Au

SUMMARY: Placer deposits occupy valley bottoms of fourth- to sixth-order streams, and uncommonly terrace alluvium at the 7-8 m levels. Thickness of gold-bearing stratum ranges from 1.2 to 3.2 m, rarely up to 5 m. Overburden thickness ranges from 25 to 70 m. Gold particles have a broad range of shapes, including scales and plates. Gold grain size ranges from 0.2 to 8 mm. Gold fineness averages 882. Placers are mainly exhausted.

R59-04 68 32 168 38	Rauchan Baraneecha	Au Placer Au	No grade/tonnage data

SUMMARY: More than 20 placer gold deposits occur in second- to fifth-order stream drainages and are mainly of Late Pleistocene age. The average thickness of gold-bearing strata is 1.4 m. Gold grains are generally very small, but nuggets weighing several hundred grams have been recovered. Gold is poorly to moderately rounded, and fineness ranges from 874 to 896; rarely up to 917. Auriferous quartz-carbonate veins and mineralized sulfide-bearing shear zones are the original lode sources. These lodes contain up to 5 or 6 g/t gold, rarely more.

R59-04 68 32 168 38	Gremuchaya Baraneecha	Au Placer Au	3-7 g/m^3

SUMMARY: The main placer deposit is more than 12 km long, lying in an old thalweg at depths between 8 and 25 m. Auriferous zones range from 2.7 to 5 m thick. Gold grain size ranges from 0.8 to 1.5 mm, with average fineness of 917. Placer deposits are mainly worked out. Quartz-chlorite and quartz-carbonate veins containing sulfides and up to 0.5 to 20 g/t gold are the original lode sources.

R60-01 68 49 175 00	Pegtymel	Sn (Au) Placer Sn	270-1000 g/m^3 cassiterite

SUMMARY: The twelve placer deposits of the Pegtymel District are located at the boundary between Chukotka Mesozoic sedimentary rocks and the Okhotsk-Chukotka volcanogenic belt. Placer deposits occur in first- to fourth-order streams as buried alluvial thalwegs, with several auriferous layers. Pay zones in placer deposits reach a length of 7 m, and occur at depths of 3 to 40 m. Minor amounts of gold occur in the placers, along with cassiterite. The Lunnoye tin lode is the principal bedrock source for the placer deposits. Associated cassiterite-quartz vein lode deposits. Cassiterite crystals range in size from 1 to 2 mm.

Index to to significant placer districts of the Russian Northeast

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