NATIONAL URANIUM RESOURCE EVALUATION

AERIAL RADIOMETRIC AND MAGNETIC SURVEY

NATIONAL TOPOGRAPHIC MAP

PERRYTON

TEXAS, OKLAHOMA

FINAL REPORT

MAY 1980

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PREPARED FOR U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

UNDER CONTRACT NO. DE-AC13-76 GJO 1664

AND BENDIX FIELD ENGINEERING CORPORATION SUBCONTRACT NO. 80-418-S

AERIAL RADIOMETRIC AND MAGNETIC SURVEY

PERRYTON NATIONAL TOPOGRAPHIC MAP

TEXAS/OKLAHOMA/KANSAS

WEST TEXAS PROJECT

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

UNDER BENDIX FIELD ENGINEERING SUBCONTRACT NO. 80-418-S
BY
GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

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ABSTRACT

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Perryton National Topographic Map NJ14-10 is presented in this report. The airborne data gathered is reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

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<u>INTRODUCTION</u>

SECTION I.

INTRODUCTION

A. SURVEY AREA

Geodata International, Inc., Dallas, Texas, conducted an airborne gamma ray and total magnetic field survey for the Perryton National Topographic Map Sheet as outlined in Figure I.1. This survey was performed from a fixed-wing aircraft, using a computer-controlled, large-volume radiation detector system to detect the gamma radiation flux emanating from the surface materials. Each map line was flown in an east-west direction with line lengths of 111.0 miles; each tie line was flown in a north-south direction with line lengths of 69.0 miles. Map lines and tie lines are located as shown in Figure II.1.

Sections I through IV of this report present information and results associated with this specific survey. Section V gives the data acquisition and the processing procedures which are generally applicable to any survey flown with the equipment described.

B. SUMMARY of MAP LOCATION, GEOLOGY and PHYSIOGRAPHY

The Perryton map sheet area (Figure I.2) is located in the northern portion of the Texas panhandle, in the Oklahoma panhandle, and in the extreme southern edge of Kansas at latitudes 36°00' to 37°00' north, longitudes 100°00' to 102°00' west. The map area is predominantly included in the High Plains section of the Great Plains physiographic province. To a much lesser extent, the map sheet region occupies a portion of the Osage Plains section of the Central Lowlands province. In general, the map region is made up of relatively smooth plains and river valleys made by entrenched streams.

The Perryton map sheet area includes two major structural features that controlled sedimentation from Pennsylvanian to Late Cretaceous time. They are the assymetrical Andarko syncline and Amarillo-Wichita anticline. Subsequent complete burial of the features in the Cenozoic is responsible for the extremely limited exposures of older rock.

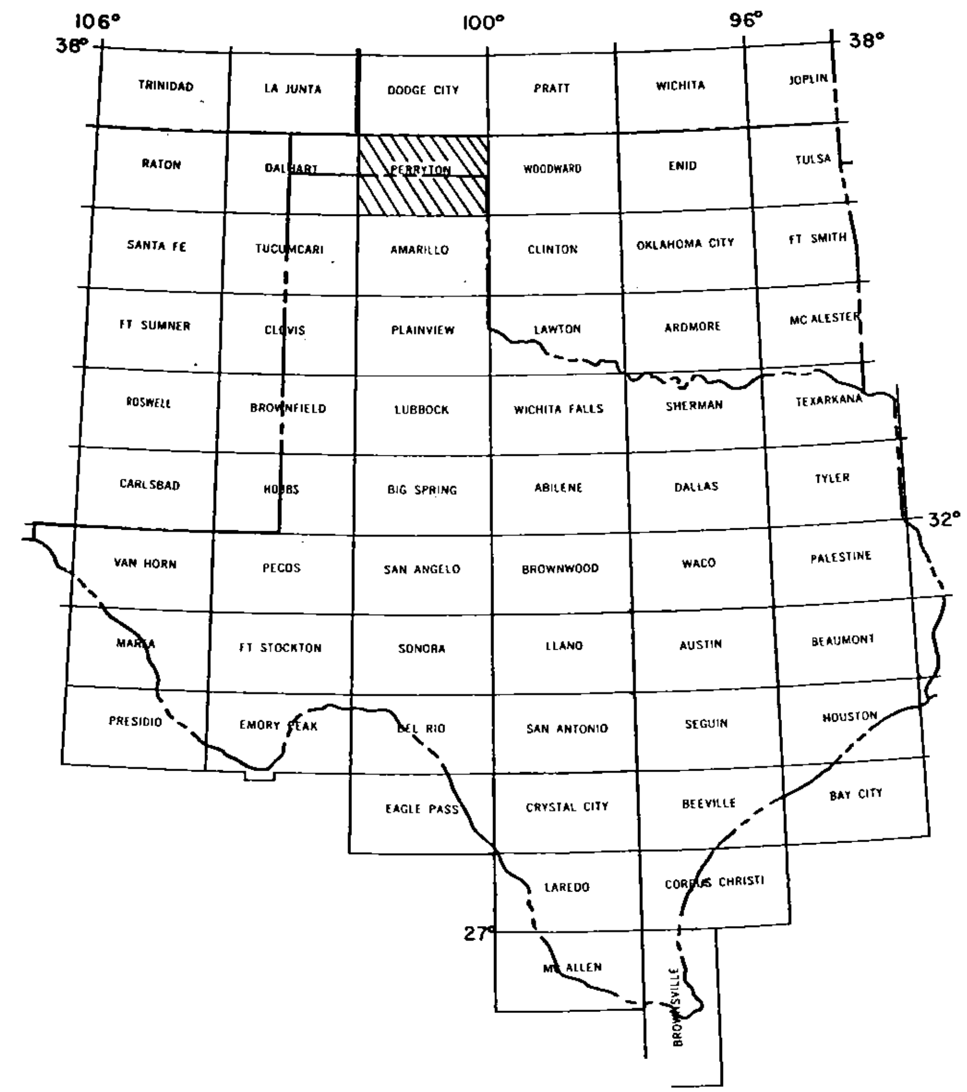
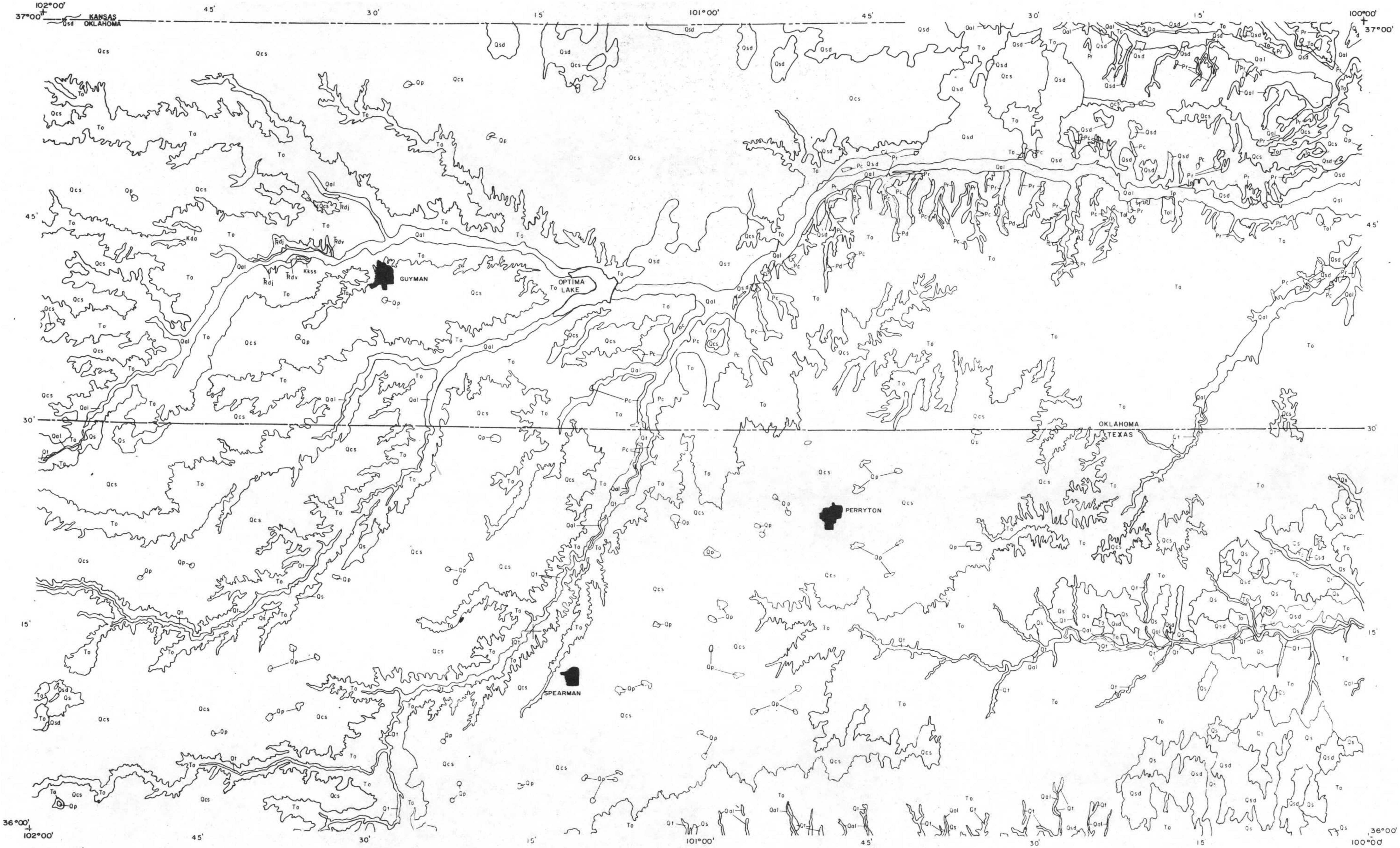


Figure I.1 Survey Index Map



GEODATA INTERNATIONAL, INC.
7035 JOHN W. CARPENTER FRWY DALLAS, TEXAS 75247

NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

GEOLOGY BASE

REF. NTMS, NJ 14-10

PREPARED FOR
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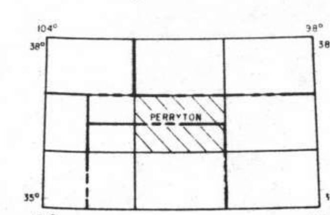


Figure I.2 Geologic Base Map

SECTION II

FLIGHT OPERATIONS

SECTION II.

FLIGHT OPERATIONS

A. SURVEY TIME SUMMARY

The Perryton map sheet was flown between May 4 and 9, 1980. A detailed list of dates flown and lines flown on those dates, as well as average altitude and speed for those dates, appears in Appendix I.A.

B. LINE COORDINATE LOCATION

Doppler navigation system data have been used to locate the positions of the flight lines. These lines are positioned and verified by point locations, determined by visual sighting by the navigator or photographic recovery, and corresponding record numbers displayed by the on-board computer. The data are then plotted as solid lines with ticks every ten records, circles every fifty records, and record numbers every one hundred records. Record numbers and circles also appear at the end of each line. The points used for location reference (at least every 10 miles) are marked with an "X". The flight base is then photographed with the geologic base map to produce the composite map in Figure II.1.

C. TEST LINES

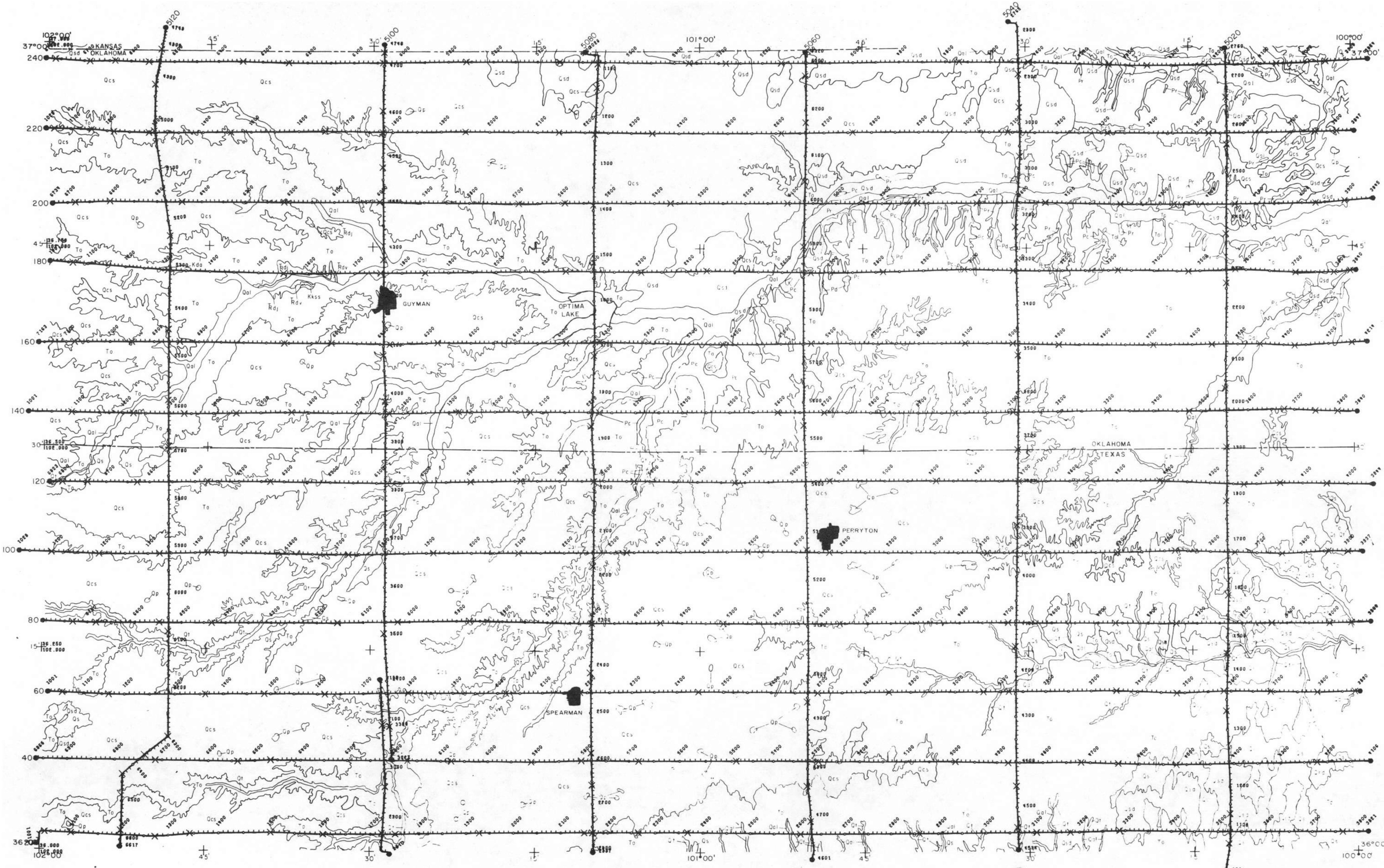
When conditions allow, two five-mile test lines are flown, one at the beginning of the day and one at the end of the day, over the same base. The data are used to check the repeatability of the system's measurements, and are presented in Appendix I.B.

D. MAGNETIC DIURNAL CORRECTION - BASE STATION

A base station magnetometer is set up in the area to acquire data pertaining to the diurnal changes in the magnetic field. These data are analyzed to evaluate a diurnal correction to the magnetic data obtained by the aircraft. A list of these corrections appears in Appendix I.C.

E. ALTITUDE AND GROUND SPEED SUMMARY

The average altitude and ground speed for each line is determined. A list by date appears in Appendix I.A, and is discussed in Section II.A. A list by flight line is given in Appendix I.E.



GEODATA INTERNATIONAL, INC.

NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

FLIGHT BASE

REF. NTMS, NJ 14-10

PREPARED FOR U.S. DEPARTMENT OF ENERGY

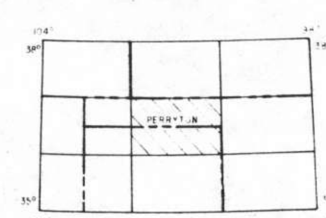


Figure II.1 NTMS Showing Flight Line Location

SECTION III

GEOLOGY OF THE SURVEYED AREA

SECTION III.

GEOLOGY of the SURVEYED AREA

A. LOCATION and GENERAL PHYSIOGRAPHY

The aerial radiometric and magnetic survey was conducted over portions of southern Kansas and the pandhandles of Oklahoma and northern Texas. The Perryton National Topographic Map Sheet area (N.T.M.S., 1954) is bounded by latitudes 36°00' to 37°00' north and longitudes 100°00' to 102°00' west. The map includes all or portions of the following counties: Morton, Seward, and Stevens counties in Kansas; Beaver and Texas counties in Oklahoma; Hansford, Hemphill, Hutchinson, Lipscomb, Moore, Ochiltree and Sherman counties in Texas.

The greater portion of the Perryton map sheet occupies the High Plains section of the Great Plains physiographic province. As such, it is typified by broad, intervalley remnants of smooth, fluviatile plains. The extreme southeastern corner of the map area is included in the Osage Plains section of the Central Lowlands province. This region is described as old, scarped plains which bevel gently inclined strata. The main streams in the Osage Plains section are rejuvenated, as is the North Canadian River in the map area.

The North Canadian (or Beaver) River, Cimarron River, Wolf Creek and their tributaries drain the map sheet area.

B. GEOLOGY

The structural and depositional history of the Perryton map sheet area (Figure I.2) is reported by Sellards et.al. (1932), Roth (1955) and Pierce et.al. (1964), and these data are summarized in the following.

Precambrian Era

Based on well-cutting information, most of the Precambrian rocks buried in the Perryton map area are volcanic in origin. To a much smaller extent, granite was emplaced during the Precambrian in the southeastern region of the map (Roth, 1955).

Paleozoic Era

During the Late Cambrian, an intracontinental geosyncline was formed which extended from southern Oklahoma through northern Texas. The trough began depositing sediments in the map sheet area from sources to the northeast, west and south. These positive areas included the old Llanoria landmass of southern Texas.

The geosynclinal region subsequently became emergent in the Middle Devonian. Extensive erosion of the Early Paleozoic sediments exposed rocks as old as Precambrian in the location of the ancestral Amarillo-Wichita uplift.

By Mississippian time, the region had again become submergent and the sea encroached over the map sheet area from the southeast. Marine carbonates were deposited in the basin. Late Mississippian to Early Pennsylvanian upwarping was responsible for emergence and subsequent erosion in some areas; deposition, however, continued to occur in the deeper areas of the geosyncline.

Wichita orogenic pulsing during the Early Pennsylvanian Period resulted in block-faulting and uplift of the ancestral Amarillo Arch into a mountain chain. The region was then delimited into the Andarko Basin to the northeast of the uplift and the Palo Duro basin southwestward. Minor fluctuations in sea level followed, creating offlap-onlap conditions for deposition.

The oldest outcropping rocks in the map area are Permian in age, and they apparently are exposed due to rejuvenation and subsequent downcutting of the major rivers. By the end of the Permian Period, the basin areas were generally completely filled, and the seas became landlocked. Evaporites, along with clastic deposits, were produced by these restricted seas.

Mesozoic Era

During the Triassic and Jurassic periods, non-uniform, terrestrial deposition prevailed in the map area. The sea transgressed over the land again in the Cretaceous, but by Late Cretaceous to Early Tertiary time, the Laramide orogeny had caused tilting toward the east and emergence of the region. Significant erosion of the marine Cretaceous rocks ensued.

Cenozoic Era

Following the orogenic movements of the Laramide, the region has remained relatively undisturbed with only minor warpings (Eddleman, 1961). Terrestrial deposits of gravels, sand, and alluvium have prevailed to the present, and have buried the structural elements of the area.

C. DESCRIPTION of GEOLOGIC MAP UNITS

The following brief descriptions of the outcropping units in the Perryton map area are given, based on data reported by Sellards et.al. (1932), Pierce et.al. (1964), and the University of Texas Bureau of Economic Geology (1970). Thicknesses are recorded where known.

Cenozoic Era

Qal: Alluvium

This unit consists of floodplain deposits. It includes some low terrace deposits in Oklahoma, and gravel, sand, silt and clay along present-day streams. Thickness ranges from 10 to 100 feet.

Qs;Qsd: Windblown Sand

The unit Qs is characterized by sand and silt in sheets that are locally modified by surface wash. United Qsd represents localized dunes and dune ridges. Thicknesses of up to 100 feet or more are reported for these units.

Qt: Fluviatile Terrace Deposits

In Oklahoma, only the low terrace deposits are mapped. The deposits consist of sand and silt. The sand is fine- to coarse-grained quartz that is cross-bedded to massive, lenticular, and reddish-brown-, pink- and grey-colored. The silt is sandy and lenticular. The thickness of the unit ranges from 10 to 50 feet.

In Texas, the deposits are comprised of gravel, sand, and silt. The gravel constituent is sandy, and it is composed of pebbles and cobbles of quartz, quartzite and caliche. The sand and silt components are similar to those described for the Oklahoma terrace deposits.

Qp: Playa Deposits

Clay and silt that are sandy, grey in color, and found in shallow depressions. The deposits weather to a light-grey color.

Qcs: Windblown Cover Sand

This unit is comprised of quartz sand that is fine- to medium-grained, silty, calcareous, massive, and contains caliche nodules. It is pink to greyish-red-, reddish-brown- and olive-grey-colored, and contains a localized, distinct soil profile. The unit is 25 feet thick, and feathers out locally.

Tertiary

To: Ogallala Formation

Sand, silt, clay, gravel, and caliche. The sand is fine- to coarse-grained quartz that is silty in part. It contains localized caliche nodules, and is locally cemented by calcite and by silica; the sand is locally cross-bedded. It is various shades of grey, brown and red. The silt and clay are minor constituents in the Ogallala. They contain caliche nodules and are sandy in places, massive, and white, grey, olive-green, brown, red, and maroon in color. The gravel is not ubiquitous. It is composed of pebbles and cobbles of quartz, quartzite, minor chert, igneous rocks, metamorphic rock, limestone, and clay balls in the lower portion. The caliche is limited in presence, sandy, pisolitic, and white, grey and pink in color. It comprises one or more beds up to 10 feet thick in the upper part, and forms ledges and caprock locally. The maximum thickness of the unit is 400 feet.

Mesozoic Era

Cretaceous

Kda: Dakota Group

This unit represents an unnamed, lower sandstone member of the Dakota Group. It consists of sandstone, pink quartzite and conglomerate, and is collapsed into underlying formations. The sandstone that is fine- to coarse-grained, cross-bedded, and brownish-yellow to pink in color. The conglomerate is composed of jasper and feldspar. Reworked siltstone pebbles of possible Triassic age and some fossil bone are present. From 5 to 25 feet thick.

Triassic

TRdj: Trujullo Formation

Conglomerate, sandstone, shale and siltstone. The conglomerate is sandy and is composed of pebbles of sandstone, dolomite, and some fossil bone. It is cross-bedded and yellowish-grey to grey and reddish-brown in color. The sandstone is fine- to coarse-grained, micaceous and grey, reddish-brown, orange-brown, and dark red in color. It grades laterally into shale and siltstone. Thickness 25 to 75 feet, truncated.

TRdv: Tecovas Formation

This unit consists of siltstone, shale, and sandstone. The siltstone and shale are laminated, well-indurated, and orange-brown to reddish-brown in color. The sandstone is micaceous, lenticular, fine- to coarse-grained, and greenish-grey-colored. Some of the shale is micaceous and yellow. The unit is 220 feet thick in the subsurface west of Guymon, and it thins eastward.

Paleozoic Era

Permian

Pd: Doxey Shale

Siltstone, shale, and sandstone. The siltstone and shale are well-indurated, laminated, and reddish-brown to mottled, light yellowish-brown. There is some sandstone near the base of the unit; it is fine-grained, and orange-brown in color. Approximately 120 feet thick, the unit is truncated.

Pc: Cloud Chief Formation

The unit is comprised of shale, sandstone, gypsum, and dolomite. The shale, plus some sandstone, is found near the central portion of the unit. It is reddish-brown to orange-brown in color. Interbedded, thin dolomite and/or gypsum beds are present; pink to white in color. Thickness ranges from 125 to 160 feet, thinning eastward.

Pr: Rush Springs Sandstone

Sandstone and shale. The sandstone is fine-grained, and orange-brown in color. There is some shale, reddish-brown in color. Thickness ranges from 150 to 200 feet.

D. RADIOACTIVE MINERAL PROSPECTS in the SURVEYED AREA

Pierce et.al. (1964) record uranium and radium concentrations and their association with petroleum and asphaltite in the Panhandle Gas Field of Texas and Oklahoma. The highest radon content in gas wells in the surveyed area is reported approximately from latitude 35°00' and longitude 102°00', southwest of the Perryton map sheet area, in Moore County, Texas. The uranium has apparently remobilized and concentrated in the asphaltite residues of the Pennsylvanian and Permian caprocks in the Panhandle Gas Field.

Butler and Schnabel (1956) report uranium occurrences from: 1) Cimarron and Texas counties in Oklahoma, near the Texas border and northwest of the Perryton map sheet area, and 2) in Hartley County, Texas, southwest of the map area. Both occurrences are in asphaltite. There are no reported radioactive mineral deposits directly within the map sheet area, however.

SECTION IV

RESULTS OF DATA ANALYSIS

SECTION IV.

RESULTS OF DATA ANALYSIS

A. DESCRIPTION OF STACKED DATA PROFILES

1. Multivariable Radiometric Stacked Data Profiles

These profiles are presented at a horizontal scale of 1:500,000. The vertical scales are:

Altitude: 100 feet/div.; aircraft altitude above the surface

TL(^{208}Tℓ)*	1.5 ppm/div;	7.15 c/s = 1 ppm/eTh
BI(^{214}Bi)*	.50 ppm/div;	13.52 c/s = 1 ppm/eU
K (^{40}K)*	.25%/div;	98.06 c/s = 1%K
BiAir	5.0 c/s/div.	50 seconds averaged

Residual Magnetic Field 20 gammas/div. (See Sec.V.B.1)

GC (Count from 400 keV to 3.0 MeV) 400 c/s/div.

Bi/TL	.075 /div.
Bi/K	.30 /div.
TL/K	.75 /div.

Geology Strip: An approximate six-mile width of the geology map, containing each line, is displayed above the profiles.

* 7-second average weighted 1:2:3:4:3:2:1 is used and plotted at center.

2. Residual Magnetic Field Profiles

Altitude:	100 feet/div.
Temperature:	1^{o}C/div.
Pressure:	3mm of Hg/div.
Base Magnetic Field:	10 gammas/div.
Residual Magnetic Field:	10 gammas/div.

Geology Strip: An approximate six-mile width of the geology map, containing each line, is displayed above the profiles.

All profiles appear in Section IV.H.

B. SINGLE AND AVERAGE RECORD LISTINGS

Single and average record listings are provided on microfiche. Samples of each type are presented in Appendix III.

C. STATISTICAL PRESENTATION OF DATA BY GEOLOGIC TYPE

Tables IV.(1-6) contain the average value of each variable as a function of line number and geologic type. The tables are in order eTh, eU, K, eU/eTh, eU/K, eTh/K.

D. FREQUENCY DISTRIBUTON OF DATA FOR EACH GEOLOGIC TYPE

Table IV.7 contains the mean, standard deviation, and number of events for each geologic type encountered over the entire map sheet. Histograms for these data aopear in Section IV.H.2.

E. DATA INTERPRETATION

1. Analysis of Geologic Histograms

The radioactivity data is shown in histogram form with parts per million or percent plotted against number of events (Appendix I). The histograms for ^{208}Tℓ and ^{40}K were examined for conformity to a Gaussian curve. It is generally assumed that a geologic map unit, which encompasses a fairly homogeneous lithology, would have a unimodal distribution. Where map units vary significantly from a unimodal distribution, a further subdivision into more homogeneous lithologic types may be recommended. Table IV.8 shows the map units, which vary from a unimodal model, and for which separation of two or more distributions is feasible. Only units with excess of 200 events are considered.

2. Discussion of Anomalies

Introduction

The ^{208}Tℓ, ^{214}Bi, and ^{214}Bi/^{208}Tℓ (ratio) data were examined for anomalous values. An anomaly is defined by a minimum of two adjacent, two-standard deviation values, or a single, three-standard deviation value. The anomalies were listed by flight line in Table IV.9; by qeologic map unit in Table IV.10; Table IV.10 is statistically summarized in Table IV.11. Only positive anomalies were examined for ^{208}Tℓ and ^{214}Bi, but both positive and negative values were studied for the ratio anomaly.

Table IV.1 Geologic Unit Average Value as a Function of Map Line for eTh (PPM Times 10)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	48	31	33	53		95	51						
ML 40:		37	31	70		94	71						
ML 60:		57		61	62	85	59						
ML 80:		54	33	58	93	92	62						
ML 100:	55	45		53		95	69						
ML 120:	45			60	91	92	68					59	
ML 140:	62					86	71					70	
ML 160:	54					86	71					60	
ML 180:	50		45			72	67	69	70	63		68	78
ML 200:	46		35			75	58					58	58
ML 220:	52		48			75	64						
ML 240:	40		42			67	50						67
ML 5020:	44	45	32	45		80	63						46
TL 5040:	35		32	48		75	68				91	41	
TL 5060:	38		47	39		83	67					67	
TL 5080:	62		38	45		80	59						
TL 5100:				71		65	66						
TL 5101:	44			46		83	54						
TL 5120:	48	50		60		79	63	63					

Table IV.2 Geologic Unit Average Value as a Function of Map Line for eU (PPM Times 10)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	12	7	8	13		26	14						
ML 40:		7	6	17		22	18						
ML 60:		14		17	13	21	15						
ML 80:		12	7	12	23	21	16						
ML 100:	20	10		13		22	18						
ML 120:	16			13	22	22	17					14	
ML 140:	14					21	18					18	
ML 160:	14					19	17					17	
ML 180:	12		9			16	16	14	13	12		19	17
ML 200:	11		8			17	14					15	15
ML 220:	11		11			17	15						
ML 240:	9		8			15	11						15
ML 5020:	10	12	7	11		19	15						9
TL 5040:	9		10	12		19	17				20	12	
TL 5060:	11		10	7		20	18					18	
TL 5080:	16		7	36		20	20						
TL 5100:				18		14	15						
TL 5101:	11			13		19	14						
TL 5120:	19	12		15		21	17	15					

Table IV.3 Geologic Unit Average Value as a Function of Map Line for K (PC Times 100)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	167	106	104	158		163	144						
ML 40:		116	111	142		163	135						
ML 60:		197		146	97	157	152						
ML 80:		205	193	176	159	167	155						
ML 100:	162	210		177		164	158						
ML 120:	163			173	165	164	154					181	
ML 140:	178					165	170					195	
ML 160:	179					164	168					174	
ML 180:	174		170			158	178	188	167	171		176	187
ML 200:	170		185			157	168					186	175
ML 220:	184		148			151	159						
ML 240:	163		130			139	167						176
ML 5020:	197	179	136	172		167	178						211
TL 5040:	173		179	136		155	156				184	183	
TL 5060:	162		157	188		154	148					173	
TL 5080:	171		118	141		152	145						
TL 5100:				146		129	136						
TL 5101:	179			118		159	148						
TL 5120:	183	156		148		160	154	201					

Table IV.4 Geologic Unit Average Value as a Function of Map Line for eU/eTh (Times 100)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	26	25	24	26		27	30						
ML 40:		21	20	25		23	26						
ML 60:		25		28	20	25	26						
ML 80:		23	21	21	24	23	26						
ML 100:	36	22		26		23	27						
ML 120:	35			22	24	24	25					23	
ML 140:	23					25	25					26	
ML 160:	26					22	24					29	
ML 180:	24		22			22	24	21	19	19		27	21
ML 200:	24		22			23	23					26	26
ML 220:	22		23			23	23						
ML 240:	25		21			23	22						23
ML 5020:	24	28	25	25		23	24						21
TL 5040:	28		34	29		26	26				22	30	
TL 5060:	30		21	18		24	28					26	
TL 5080:	28		19	79		25	35						
TL 5100:				25		22	24						
TL 5101:	25			30		24	26						
TL 5120:	40	24		24		27	28	24					

Table IV.5 Geologic Unit Average Value as a Function of Map Line for eU/K (Times 1000)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	815	711	764	877		1623	1070						
ML 40:		689	576	1260		1345	1367						
ML 60:		739		1188	1374	1359	1062						
ML 80:		637	376	767	1452	1324	1086						
ML 100:	1237	507		823		1358	1239						
ML 120:	1600			797	1351	1373	1145					784	
ML 140:	823					1314	1076					932	
ML 160:	798					1165	1063					1033	
ML 180:	711		587			1027	933	802	804	710		1123	922
ML 200:	665		458			1125	851					835	869
ML 220:	624		780			1144	972						
ML 240:	613		696			1097	704						889
ML 5020:	542	754	623	661		1160	883						475
TL 5040:	581		598	912		1259	1173				1128	688	
TL 5060:	727		722	382		1294	1281					1052	
TL 5080:	1001		641	2847		1329	1480						
TL 5100:				1253		1148	1157						
TL 5101:	643			1181		1239	993						
TL 5120:	1190	802		1010		1365	1183	770					

Table IV.6 Geologic Unit Average Value as a Function of Map Line for eTh/K (Times 1000)

UNIT:	QAL	QS	QSD	QT	QP	QCS	TO	KDA	TRDJ	TRDV	PD	PC	PR
LINE													
ML 20:	2976	2899	3135	3480		5854	3635						
ML 40:		3188	2823	4961		5729	5223						
ML 60:		2923		4181	6855	5436	3981						
ML 80:		2707	1698	3393	5883	5565	4173						
ML 100:	3415	2267		3080		5781	4537						
ML 120:	2797			3496	5555	5636	4488					3276	
ML 140:	3519					5207	4272					3612	
ML 160:	3031					5251	4331					3478	
ML 180:	2966		2737			4551	3802	3742	4205	3690		3929	4215
ML 200:	2741		1925			4784	3529					3164	3303
ML 220:	2882		3299			4962	4128						
ML 240:	2488		3269			4720	3085						3815
ML 5020:	2244	2610	2573	2645		4805	3615						2214
TL 5040:	2037		1820	3518		4875	4427				4971	2288	
TL 5060:	2389		3161	2121		5344	4566					3927	
TL 5080:	3610		3254	3252		5194	4209						
TL 5100:				4891		5101	4814						
TL 5101:	2496			3955		5174	3824						
TL 5120:	2654	3261		4107		4958	4182	3134					

eTh		eU		K		eU/eTh		eU/K		eTh/K		MAX. NO. EVENTS	GEOL. UNIT
σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$		
1.3094	4.8	0.4345	1.2	0.1801	1.8	0.0821	0.2593	0.2628	0.7071	0.7495	2.7680	1378.0	QAL
1.3620	4.6	0.4475	1.1	0.4693	1.7	0.0790	0.2424	0.2763	0.6604	0.8186	2.7581	1223.0	QS
1.0513	3.9	0.3281	0.9	0.3743	1.4	0.0813	0.2260	0.2572	0.6377	0.8458	2.8342	2278.0	QSD
1.4041	5.6	0.8411	1.5	0.2358	1.6	0.1930	0.2747	0.7033	1.0012	1.0268	3.6488	400.0	QT
1.7633	8.2	0.6233	2.0	0.3828	1.4	0.0450	0.2323	0.2289	1.3948	1.1451	6.1114	65.0	QP
1.8784	8.4	0.5794	2.0	0.1763	1.6	0.0573	0.2438	0.3439	1.2835	0.9215	5.2896	19650.0	QCS
1.7212	6.5	0.5415	1.7	0.2769	1.6	0.0855	0.2628	0.4276	1.0715	1.1508	4.1128	17731.0	TO
0.8187	6.9	0.2659	1.5	0.1759	1.9	0.0416	0.2200	0.1776	0.7989	0.6983	3.6673	89.0	KDA
0.6701	7.0	0.3092	1.3	0.1727	1.7	0.0375	0.1924	0.1568	0.8043	0.4719	4.2053	79.0	TRDJ
0.6940	6.3	0.2969	1.2	0.0731	1.7	0.0444	0.1923	0.1865	0.7106	0.4234	3.6909	35.0	TRDV
0.3741	9.2	0.1574	2.1	0.0537	1.8	0.0130	0.2267	0.0502	1.1283	0.1451	4.9717	12.0	PD
1.2397	6.4	0.5035	1.7	0.1544	1.8	0.0717	0.2756	0.3219	0.9738	0.7510	3.5308	401.0	PC
1.7098	6.4	0.4720	1.5	0.1604	1.8	0.0637	0.2460	0.2737	0.8663	0.9349	3.5679	178.0	PR

Table IV.7 Mean ($\bar{X}$) and Standard Deviation (σ) for Each Geologic Type.

TABLE IV.8 Geologic Units with Apparent Significant Variations from Unimodal Distributions, Based on the Analysis of the eTh Histograms*

Geologic Unit	No. Events	^{208}Tl Recommended Split (equivalent ppm)
Qal	1378	none
Qs	1223	none
Qsd	2276	none
Qt	400	none
Qcs	19649	none
To	17731	none
Pc	401	none

*Recommended Splits on the Histograms are Given Only Where Such Splits Appear to be Obvious.

TABLE IV.9 SUMMARY OF ANOMALIES
PERRYTON

	208	TL	214	BI	214 / 208	BI/ TL
ML20			QCS	1181- 1226	QCS	1191- 1226
				1256- 1261		1256- 1261
				1431- 1456		1276- 1281
						1441- 1456
					TO	2236
						2331- 2336
						2406
						2501- 2511
						2521- 2546
						2671- 2676
						2756- 2761
						2767- 2772
						2797- 2802
						2917- 2932
						2957- 2962
					QSD	3652- 3657
ML40						
ML60			QCS	1006- 1011	QCS	2026
					TO	2796
						2976
						2986
						3006
						3016-3026
						3041-3046
ML80	QS	4594- 4599	QS	4289		
ML100	TO	1608- 1613	QS	1788- 1808	TO	2253- 2268
	QS	1788- 1808	TO	2253- 2268		2290-2308
					QS	(3698- 3713)
ML120	TO	4574- 4584			TO	5699- 5704
ML140	TO	3071- 3076	TO	3251- 3256	TO	1706- 1711
		3170-3181			QCS	1726- 1731
	QAL	3486- 3496			QAL	(1200-1210)
	QCS	3161-3166				
ML160	TO	4699- 4709	10	5059- 5064	PC	5714- 5724
		5239- 5244		5194- 5199	TO	(5789- 5794)
		5384- 5389			QCS	(5799- 5809)
		5449- 5454			TO	(5814- 5819)
					QCS	(6614- 6624)
						(6634- 6639)
ML180	TO	1086- 1096	QCS	1006- 1011	QSD	2566- 2571

(...) DENOTES NEGATIVE ANOMALY

(TABLE IV.9 CONT'D)

	208	TL	214	BI	214 / 208	BI/ TL
ML180	TO	1181- 1186				
ML200					QSD	4250- 4255
					QCS	5365- 5370
						5380
						(6250)
						6260- 6265
ML220	QSD	2971-2978	QSD	2968- 2983	QCS	1048- 1053
		3023- 3028		3208		(1753- 1758)
	QCS	2963-2967				(2083- 2088)
ML240	QSD	5574- 5579			QCS	(4634- 4639)
	QCS	6115-6120				5299- 5304
		6295-6310				(5844- 5849)
		6320-6325				(5909)
						6724
					QSD	(4931-4941)
TL5020					QS	1076
					QSD	1166- 1171
TL5040						
					QCS	2915- 2920
					QSD	3130
					TO	4280- 4290
TL5060			TO	5721- 5726	TO	4711- 4726
				5806- 5811		4620-4625
TL5080	QCS	1758- 1763	TO	2073- 2088		
				2103- 2108	QCS	2038
				2148- 2153	TO	2073- 2088
			QT	2158- 2163		2103- 2108
			QAL	2168		2148- 2153
					QT	2158- 2163
					QAL	2168
					TO	2198- 2203
						2233
						2243
TL5100	TO	2890- 2895			QCS	4449-4451
TL5101					QCS	4447- 4452
TL5120			TO	5463- 5478	TO	5473- 5478
				5483		5483
				5498- 5508		5498- 5508

(...) DENOTES NEGATIVE ANOMALY

(TABLE IV.9 CONT'D)

	208	TL	214	BI	214 / 208	BI/ TL
TL5120			QCS	6428- 6433	TO	5543
			TO	6473- 6483	QCS	6358- 6368
			QCS	6583- 6613		6378- 6388
						6398- 6413
						6428- 6433
						6593- 6613

(...) DENOTES NEGATIVE ANOMALY

TABLE IV.10 **Radioactivity Anomalies per Geologic Map Unit**

Geologic Unit	$^{208}T\ell$	^{214}Bi	$^{214}Bi/^{208}T\ell$
Quaternary			
Qal	1	1	(1)
Qs	2	2	1 (1)
Qsd	3	2	5 (1)
Qt	0	1	1
Qcs	6	7	21 (9)
Tertiary			
To	11	12	34 (2)
Permian			
Pc	0	0	1

(...) denotes negative anomaly

TABLE IV.11 Statistical Summary of Radioactivity Anomalies per Geologic Period(s)

Geologic Unit	$^{208}T\ell$	^{214}Bi	$^{214}Bi/^{208}T\ell$
Quaternary			
No. of Units w/Anomalies	4	5	5
No. of Anomalies	12	13	29 (12)
Tertiary			
No. of Units w/Anomalies	1	1	1
No. of Anomalies	11	12	34 (2)
Permian			
No. of Units w/Anomalies	0	0	1
No. of Anomalies	0	0	1
Total Sample			
No. of Units w/Anomalies	5	6	7
No. of Anomalies	23	25	64 (14)

(...) denotes negative anomaly

Quaternary Geologic Units: Qal,Qs,Qsd,Qt,Qcs

$^{208}T\ell$ Anomalies

Fifty-two percent of the $^{208}T\ell$ anomalies in the Perryton map sheet area were recorded over the Quaternary units, with the exception of the unit Qt. The Quaternary-aged exposures comprise roughly 50% of the map sheet area. The thorium ion is relatively insoluble in most surface waters, and is rarely concentrated through chemical precipitation. Placer deposits generally require a nearby source of rocks rich in dispersed thorium in order to be formed. For these reasons, the Quaternary $^{208}T\ell$ anomalies are presumably not economically significant.

^{214}Bi and $^{214}Bi/^{208}T\ell$ Anomalies

Fifty-two percent of the ^{214}Bi anomalies, and forty-five and eighty-six percent, respectively, of the positive and negative ratio anomalies are reported from the Quaternary units. There are seven loci of geographically coincident ^{214}Bi and $^{214}Bi/^{208}T\ell$ anomalies in these units: ML20, stations 1191-1226, 1256-1261 and 1441-1456 (Qcs); TL5080, stations 2158-2163 (Qt) and 2168 (Qal); and TL5120, stations 6428-6433 and 6593-6613 (Qcs).

Where these anomalous types are not coincident, they may be representative of intraformational changes within the heterogeneous units (see Table IV.8).

Tertiary Geologic Unit: To

$^{208}T\ell$ Anomalies

Forty-eight percent of the $^{208}T\ell$ anomalies are present in the unit To, which is exposed over approximately 48% of the map sheet area. These anomalies may represent potentially significant concentrations, although none have been reported from the unit.

^{214}Bi and $^{214}Bi/^{208}T\ell$ Anomalies

Forty-eight percent of the ^{214}Bi anomalies and fifty-three percent of the positive ratio anomalies are recorded in the unit To. Fourteen percent of the negative anomalies are present in To outcrops. There are seven points of coincidence between these two anomalous types in the unit To: ML100, stations 2253-2268; TL5080, stations 2073-2088, 2103-2108, and 2148-2153; and TL5120, stations 5473-5478, 5483, and 5498-5508.

The ^{214}Bi and positive ratio anomalies may be indicative of potentially significant, epigenetic concentrations of uranyl ions in the Ogallala Formation.

Permian Geologic Unit: Pc

$^{214}Bi/^{208}Tl$ Anomaly

Approximately two percent of the positive ratio anomalies are recorded from the unit Pc. It is not considered to be economically significant.

Relationship between Known Radioactive Mineral Deposits and Radioactivity Anomalies

There are no known radioactive mineral deposits directly within the Perryton map sheet area.

Relationship between Radioactivity Anomalies and Cultural Features

The cultural features in the Perryton map sheet area which could affect radiometric data include: the towns of Perryton, Spearman, Hooker, Guymon, Beaver, Texhoma, and Gruver, the Optima Lake with its man-made dam, and the North Canadian River, plus various smaller creeks.

There are several ^{214}Bi and $^{214}Bi/^{208}Tl$ anomalies associated with Palo Duro Creek on ML100 and TL5080. Since the creek is intermittently dry (N.T.M.S., 1954), these anomalies are probably derived from the rock exposures connected with it.

One $^{214}Bi/^{208}Tl$ "anomaly", ML60, stations 2160-2180, lies directly within the city limits of the town of Spearman. The town is presumed to have a causal relationship with this discrepancy in the data.

Trends

^{208}Tl Anomalies

There is no generalized pattern of distribution apparent for the ^{208}Tl anomalies in the Perryton map sheet area, perhaps due to the relatively low number of anomalous occurrences of ^{208}Tl.

^{214}Bi Anomalies

There is a relatively large cluster of ^{214}Bi anomalies in the extreme southwestern corner of the map area and in the general vicinity of the western axis of the buried Amarillo-Wichita Uplift. With the exception of another smaller cluster near the Palo Duro Creek, the ^{214}Bi anomalies are scattered throughout the map sheet area.

$^{214}Bi/^{208}Tl$ Anomalies

The ratio anomaly distribution generally mirrors that of the ^{214}Bi anomaly pattern, with the addition of: 1) a clustering of ratio anomalies in the extreme southcentral portion of the map sheet area, and 2) a loosely scattered aggregate of ratio anomalies which trend from the northcentral to the northwestern corner of the map area.

3. Summary and Recommendations

Approximately one-half of all the ^{208}Tl, ^{214}Bi, and $^{214}Bi/^{208}Tl$ anomalies in the Perryton map sheet area (Figure I.2) are recorded from the Tertiary unit To and almost the same percentage is found in the Quaternary-aged units. Together, exposures of these units comprise roughly 98% of the total map sheet area.

Due perhaps in part to the limited surface exposures of Permian-aged rock in the survey area, only one anomalous occurrence is reported. Since the uranium occurrences in the region (Section III.D) are sedimentologic and epigenetic in character, the younger units with organic-material reductants may contain signficant deposits of uranium.

F. NATIONAL GAMMA RAY MAP SERIES (NGRMS)

The geologic base has been photographically screened to allow emphasis of the flight line locations and of the information regarding data analysis. These maps are used as the base for presenting statistical information on the six variables:

* ^{208}Tl
* ^{214}Bi
* ^{40}K
* $^{214}Bi/^{208}Tl$ Ratio
* $^{214}Bi/^{40}K$ Ratio
* $^{208}Tl/^{40}K$ Ratio

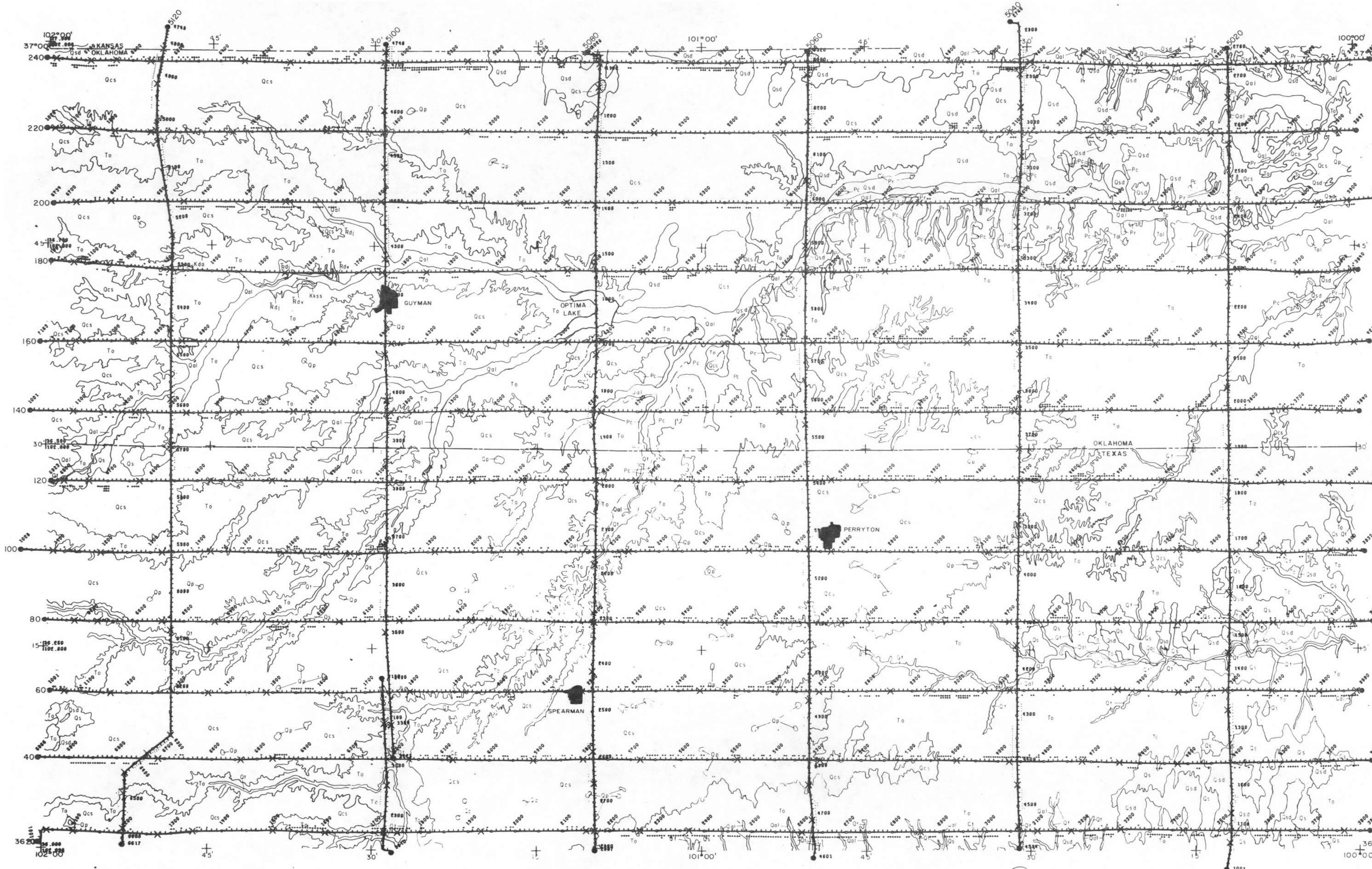
The six NGRMS sheets are presented in Figures IV. (1-6) of this report at a scale of 1:500,000 and as separate sheets at a scale of 1:250,000.

The statistical information is summarized on these maps through the utilization of one, two or three dots above or below the flight line at every fifth data point. One dot above the line indicates that the variable value at that point is between 1σ and 2σ greater

than the mean value for that geologic type where σ values are determined for each geologic type based on all flight line data from the area, as is discussed further in Section V.B.4. Two dots indicate values between 2σ and 3σ, and three dots show values greater than 3σ. Dots below the line indicate the variable values which are less than the mean value by 1, 2 or 3σ in the same manner.

G. LINE PRINTER CONTOURS

Printer contours have been generated at a 1:500,000 scale for seven variables (eTh, eU, K, eU/eTh, eU/K, eTh/K, and RMag, respectively). They appear in Appendix IV. Note that every alternate contour interval is composed of blanks to help delineate contour boundaries. Dots are used where the denominator value for a ratio is approaching zero, and to denote non-data areas.



GEODATA INTERNATIONAL, INC.
7035 JOHN W. CARPENTER FRWY. DALLAS, TEXAS 75247

NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

Tl - STANDARD DEVIATIONS

REF. NTMS, NJ 14-10

PREPARED FOR
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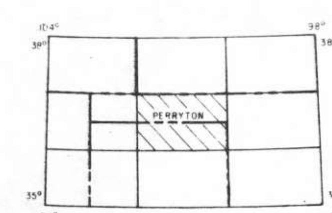
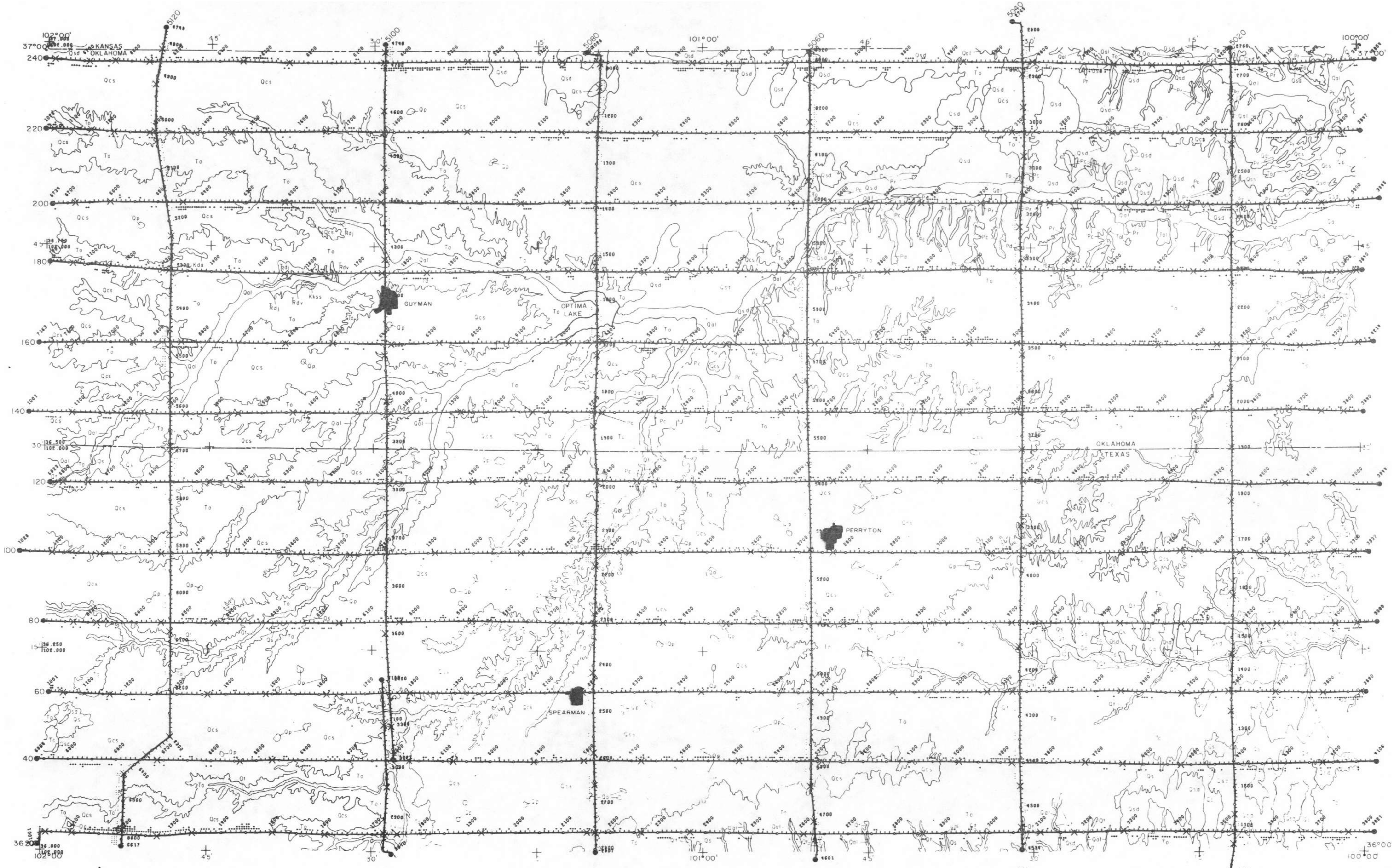


Figure IV.1 National Gamma Ray Map Series



GEODATA INTERNATIONAL, INC.

NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

Bi: STANDARD DEVIATIONS

REF NTMS NJ 14-10

PREPARED FOR U.S. DEPARTMENT OF ENERGY

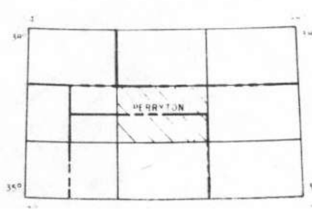
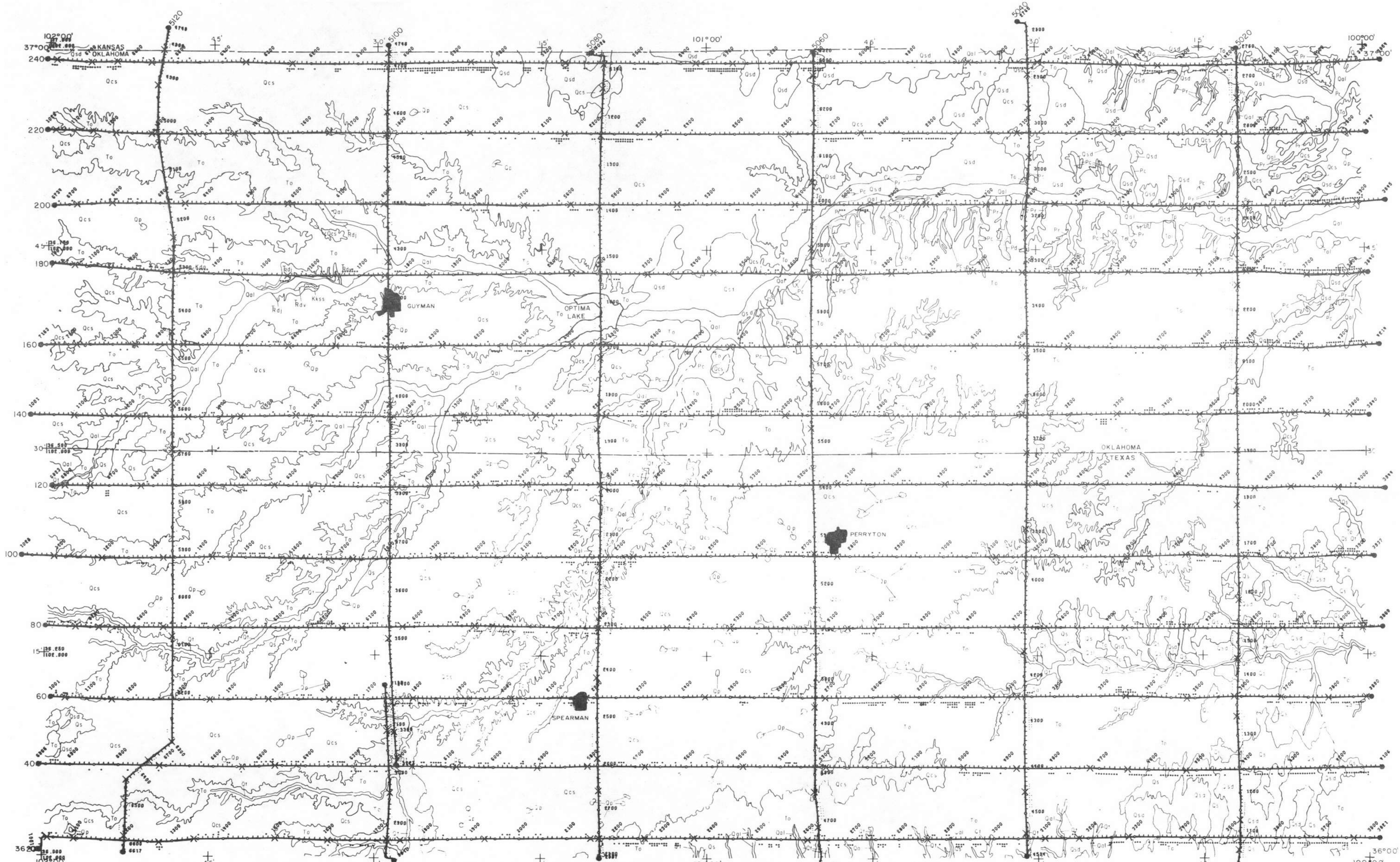


Figure IV.2 National Gamma Ray Map Series



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NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

K=STANDARD DEVIATIONS

REF NTMS, NJ 14-10

PREPARED FOR
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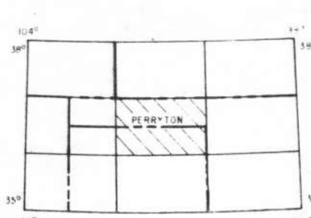
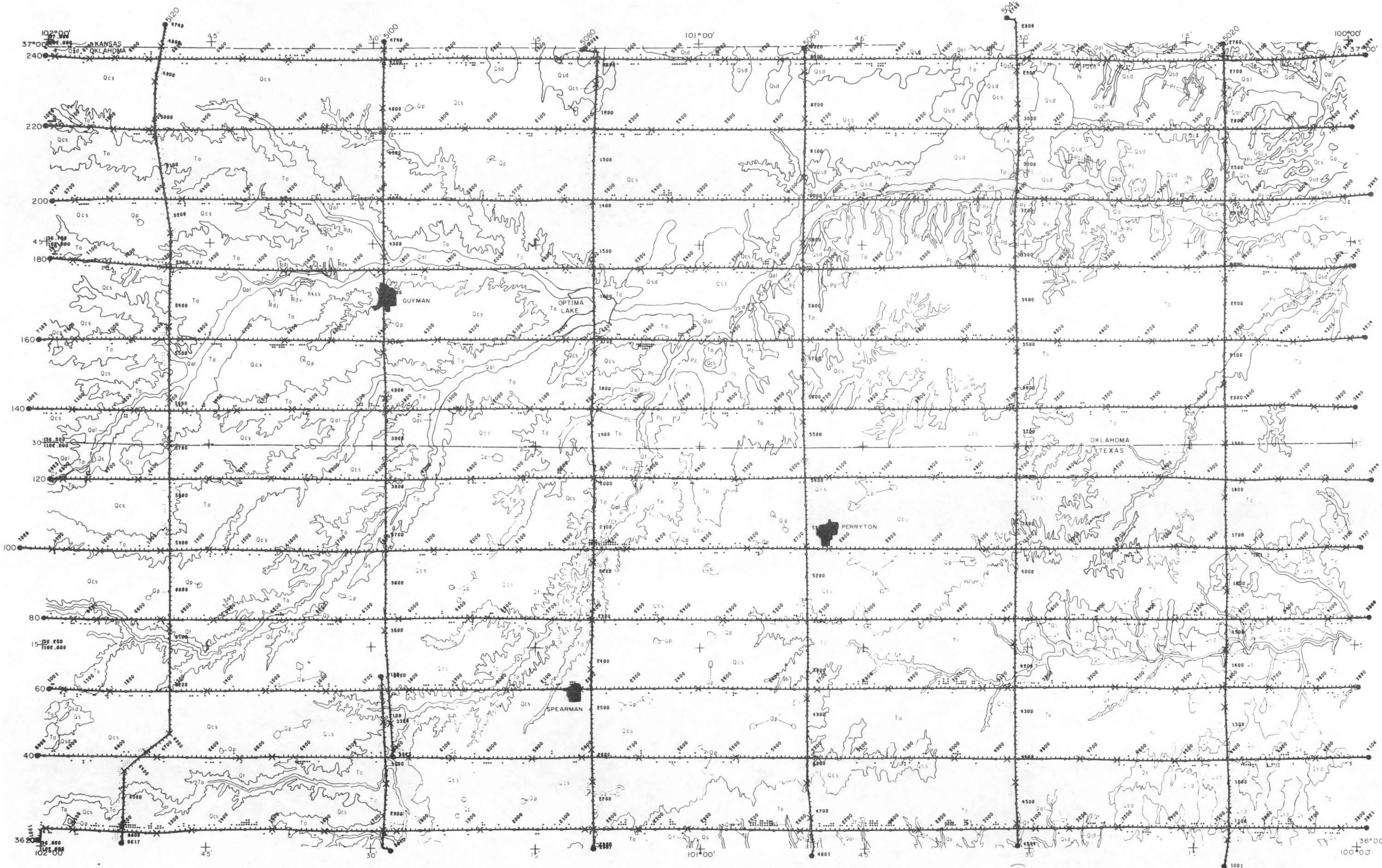


Figure IV.3 National Gamma Ray Map Series



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Perryton, Texas; Oklahoma; Kansas

^{214}Bi/^{208}Tl - STANDARD DEVIATIONS

REF. NTMS, NJ 14-10

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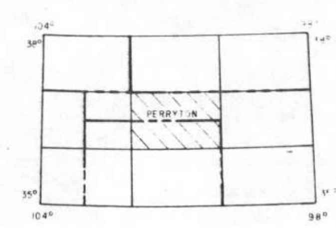
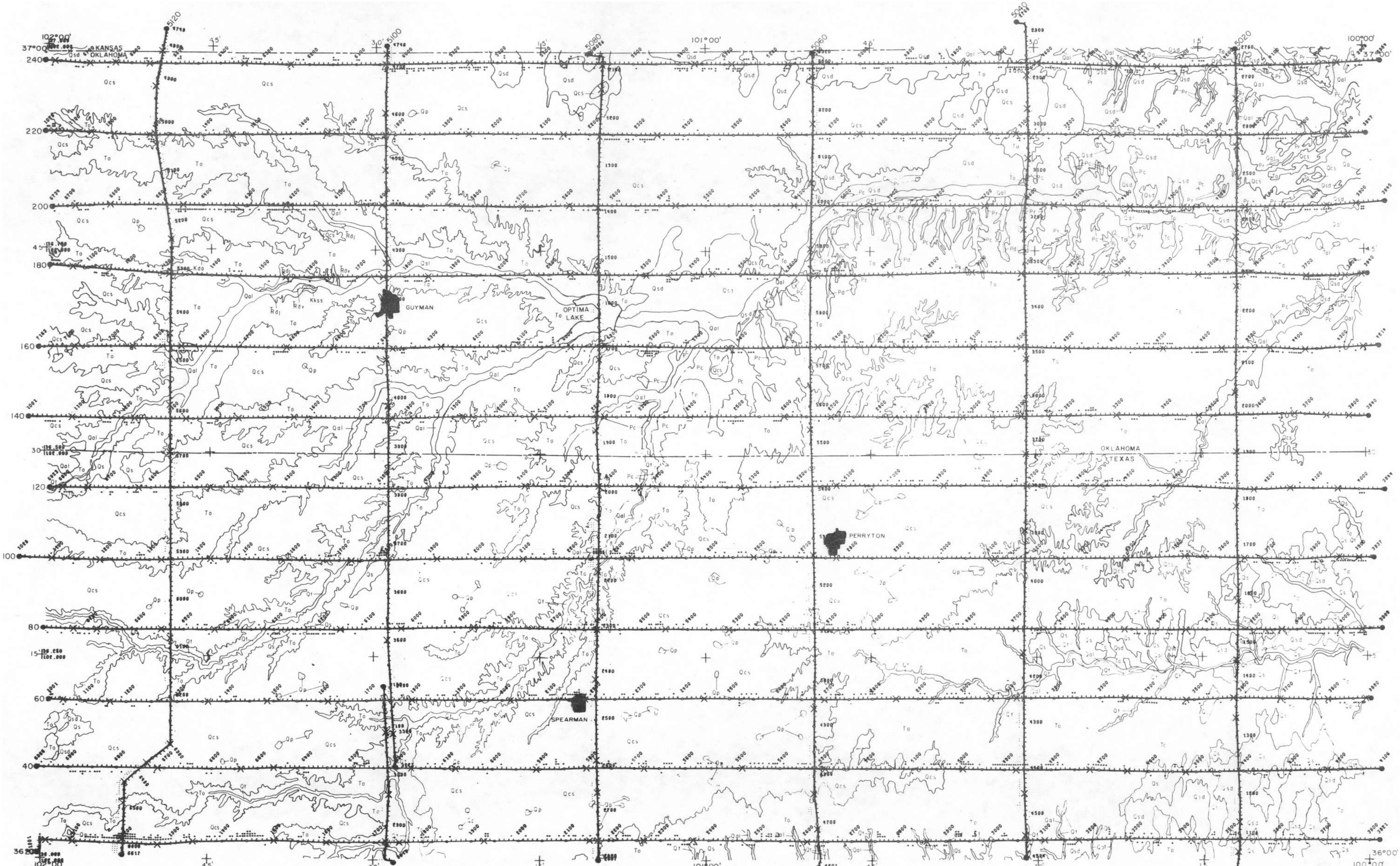


Figure IV.4 National Gamma Ray Map Series



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$^{214}Bi/^{40}K$ STANDARD DEVIATIONS

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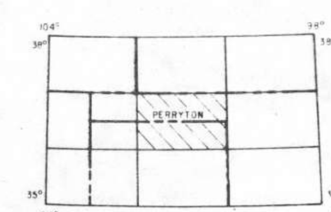
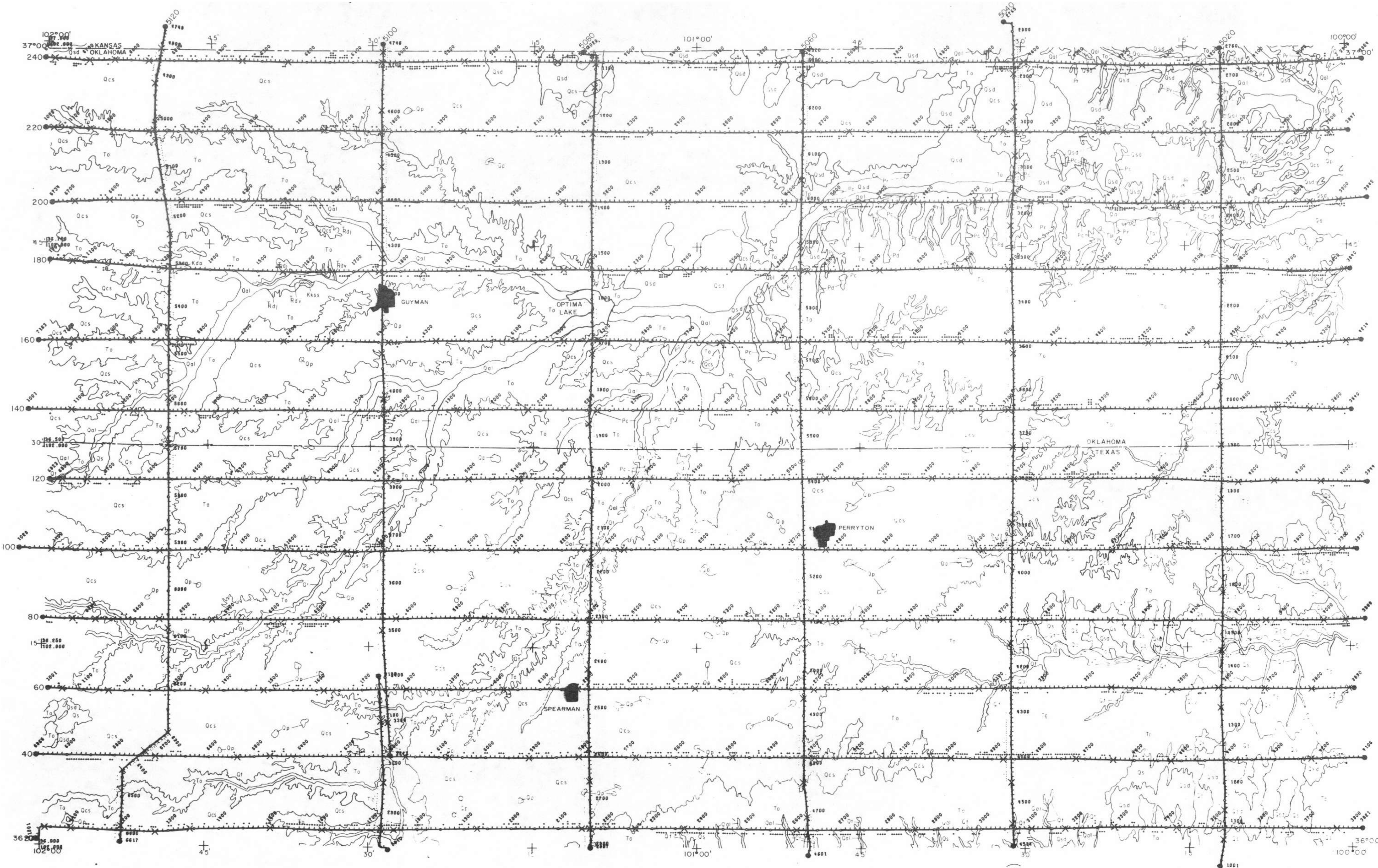


Figure IV.5 National Gamma Ray Map Series



GEODATA INTERNATIONAL, INC.

NATIONAL GAMMA RAY MAP SERIES

Perryton, Texas; Oklahoma; Kansas

228Tl/40K STANDARD DEVIATIONS

REF. NTMS, NJ 14-10

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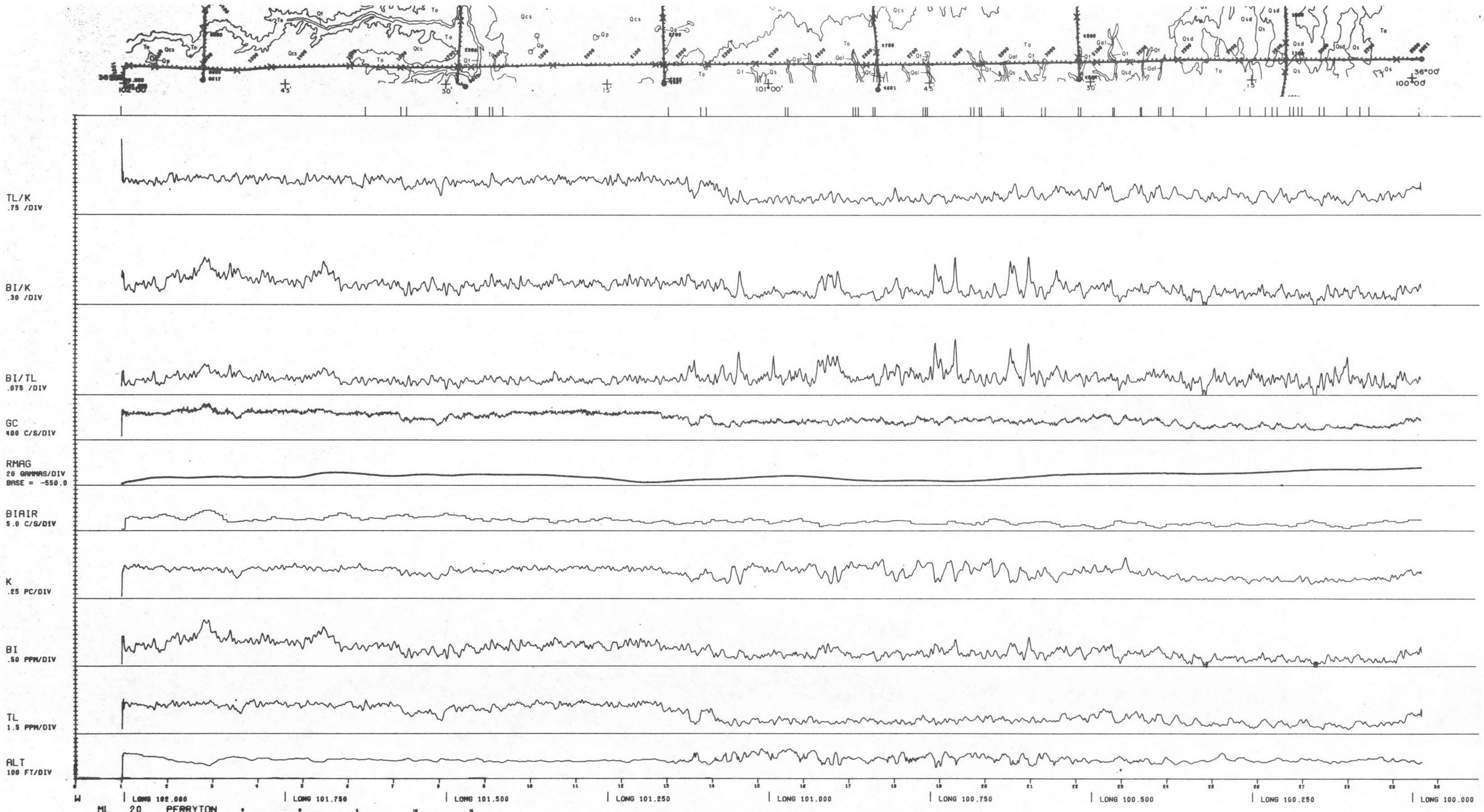
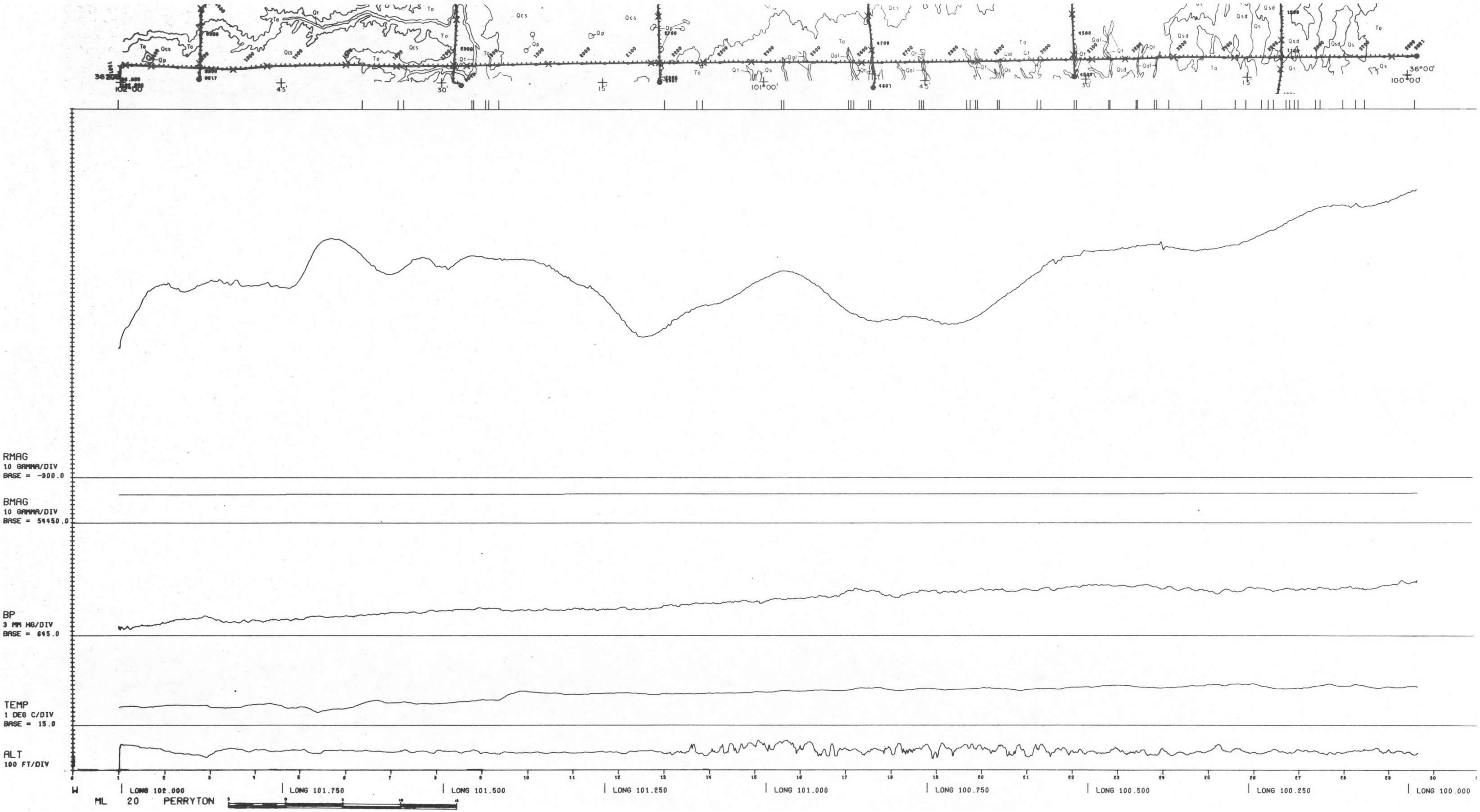
Figure IV.6 National Gamma Ray Map Series

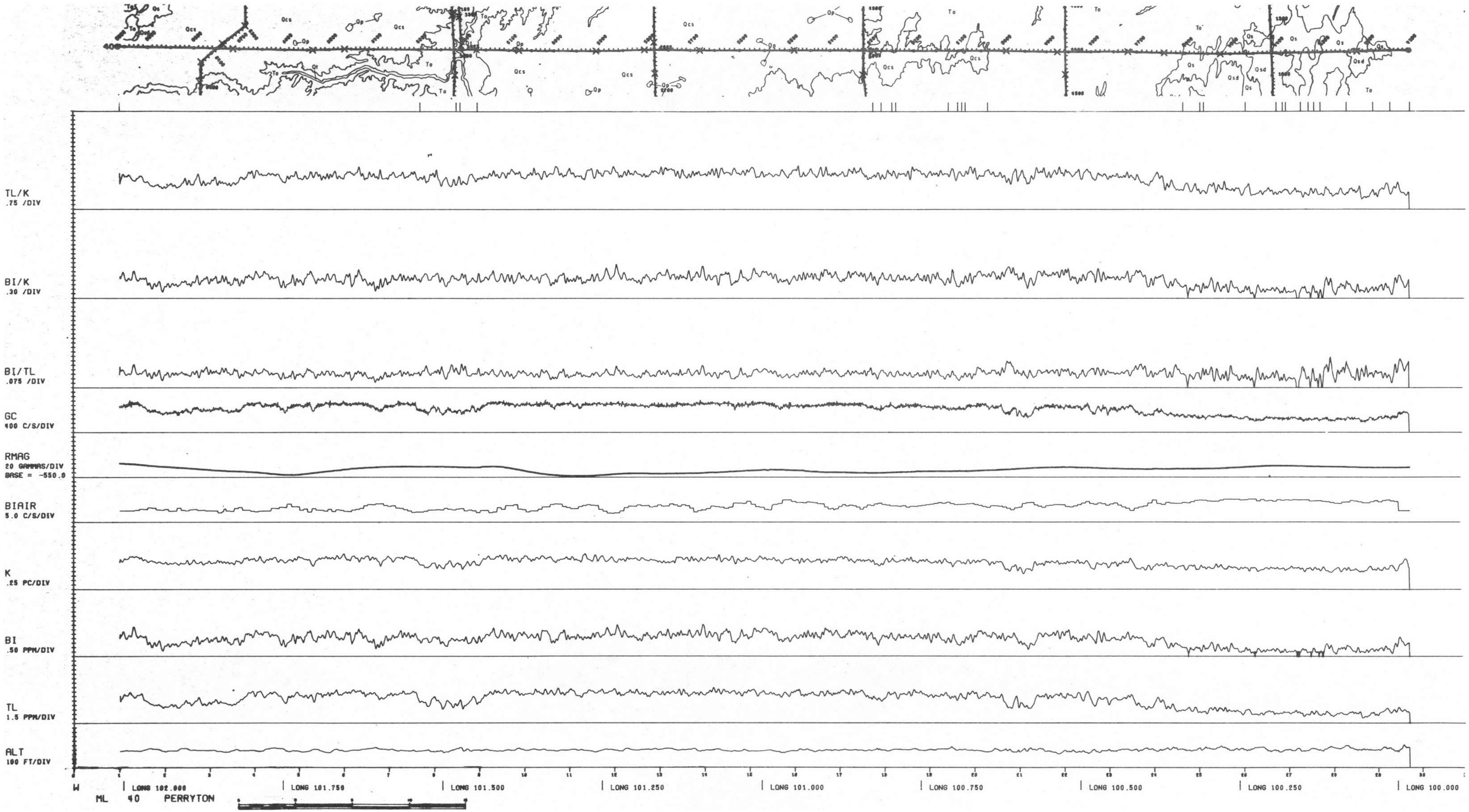
H. STACKED DATA PROFILES AND GEOLOGIC HISTOGRAMS

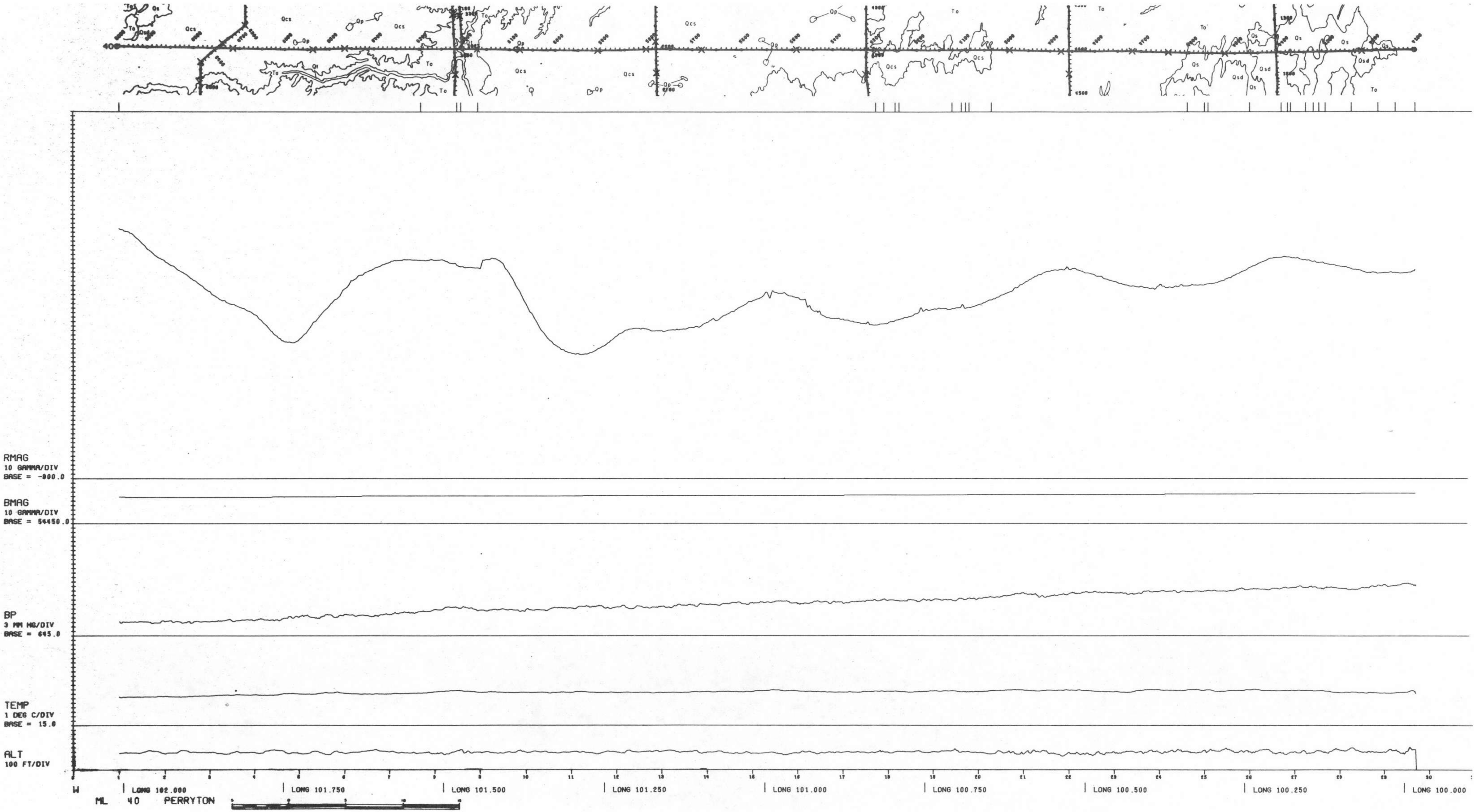


36°00'
102°00'
45'
30'
15'
101°00'
45'
30'
15'
36°00'
100°00'
TL/K
.75 /DIV
BI/K
.30 /DIV
BI/TL
.075 /DIV
GC
400 C/S/DIV
RMAG
20 GAMMAS/DIV
BASE = -550.0
BIAIR
5.0 C/S/DIV
K
.25 PC/DIV
BI
.50 PPM/DIV
TL
1.5 PPM/DIV
ALT
100 FT/DIV
W
LONG 102.000
LONG 101.750
LONG 101.500
LONG 101.250
LONG 101.000
LONG 100.750
LONG 100.500
LONG 100.250
LONG 100.000
ML 20 PERRYTON

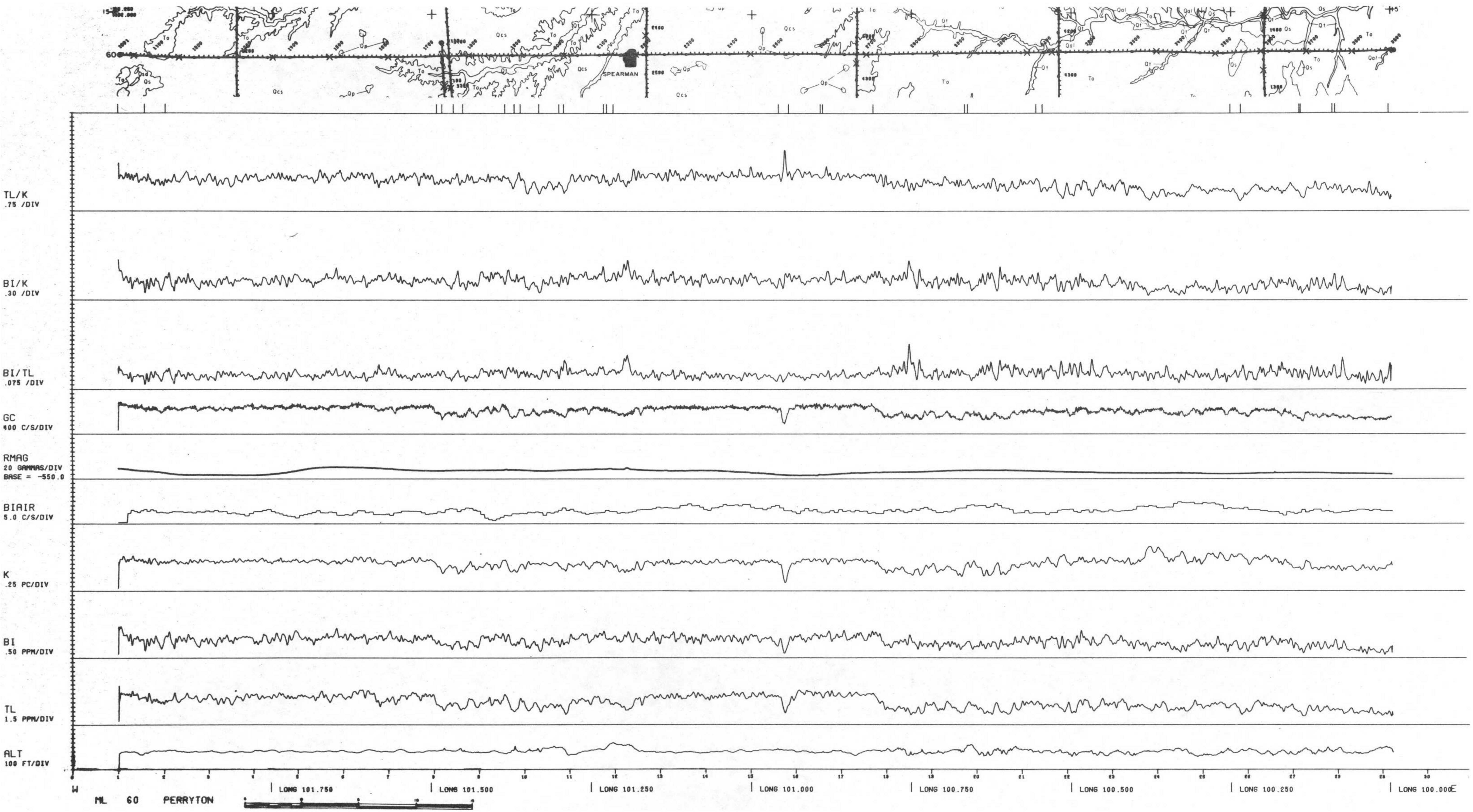


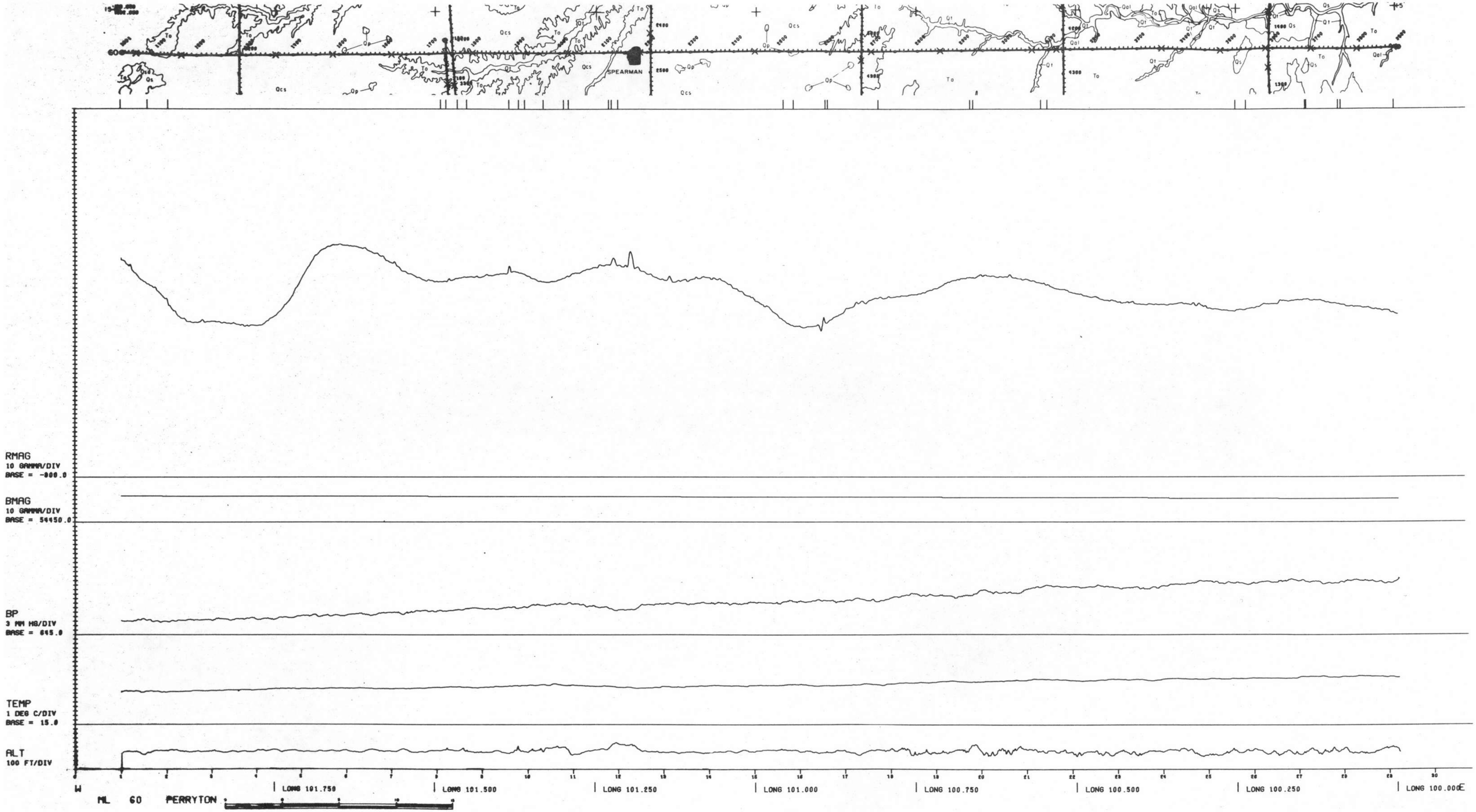
36°00'
102°00'
45'
30'
15'
101°00'
45'
30'
15'
36°00'
100°00'
RMAG
10 GAMMA/DIV
BASE = -300.0
BMAG
10 GAMMA/DIV
BASE = 54450.0
BP
3 MM HG/DIV
BASE = 645.0
TEMP
1 DEG C/DIV
BASE = 15.0
ALT
100 FT/DIV
W
LONG 102.000
LONG 101.750
LONG 101.500
LONG 101.250
LONG 101.000
LONG 100.750
LONG 100.500
LONG 100.250
LONG 100.000
ML 20 PERRYTON


TL/K
.75 /DIV
BI/K
.30 /DIV
BI/TL
.075 /DIV
GC
400 C/S/DIV
RMAG
20 GAMMAS/DIV
BASE = -550.0
BIAIR
5.0 C/S/DIV
K
.25 PC/DIV
BI
.50 PPM/DIV
TL
1.5 PPM/DIV
ALT
100 FT/DIV
W
LONG 102.000
LONG 101.750
LONG 101.500
LONG 101.250
LONG 101.000
LONG 100.750
LONG 100.500
LONG 100.250
LONG 100.000
ML 40 PERRYTON



RMAG
10 GAMMA/DIV
BASE = -900.0
BMAG
10 GAMMA/DIV
BASE = 54450.0
BP
3 MM HG/DIV
BASE = 645.0
TEMP
1 DEG C/DIV
BASE = 15.0
ALT
100 FT/DIV
W
LONG 102.000
LONG 101.750
LONG 101.500
LONG 101.250
LONG 101.000
LONG 100.750
LONG 100.500
LONG 100.250
LONG 100.000
ML 40 PERRYTON


SPEARMAN
TL/K
.75 /DIV
BI/K
.30 /DIV
BI/TL
.075 /DIV
GC
400 C/S/DIV
RMAG
20 GAMMAS/DIV
BASE = -550.0
BIAIR
5.0 C/S/DIV
K
.25 PC/DIV
BI
.50 PPM/DIV
TL
1.5 PPM/DIV
ALT
100 FT/DIV
W
LONG 101.750
LONG 101.500
LONG 101.250
LONG 101.000
LONG 100.750
LONG 100.500
LONG 100.250
LONG 100.000
E
ML 60 PERRYTON



SPEARMAN
RMAG
10 GAMMA/DIV
BASE = -800.0
BMAG
10 GAMMA/DIV
BASE = 54450.0
BP
3 MM HG/DIV
BASE = 645.0
TEMP
1 DEG C/DIV
BASE = 15.0
ALT
100 FT/DIV
W
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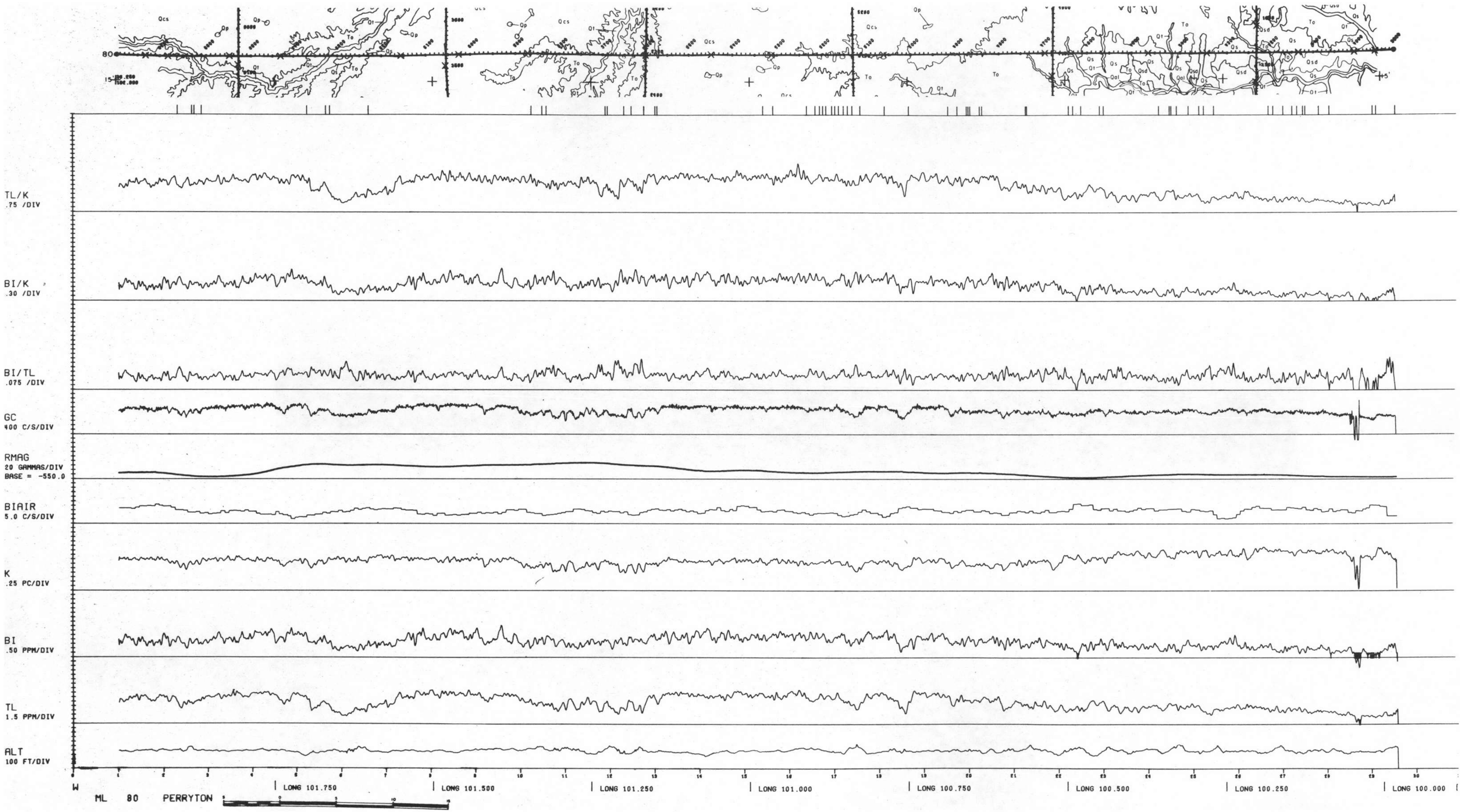
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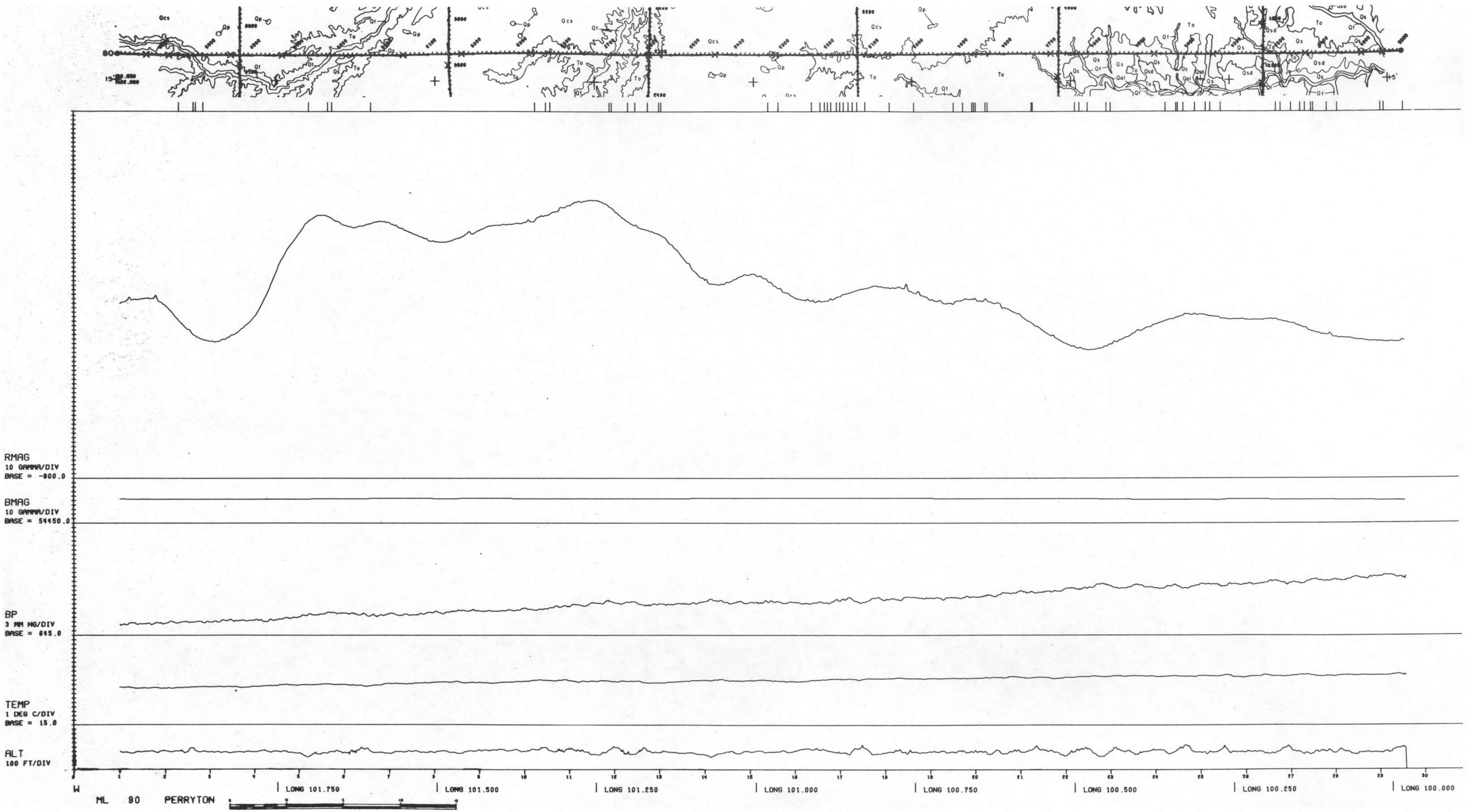
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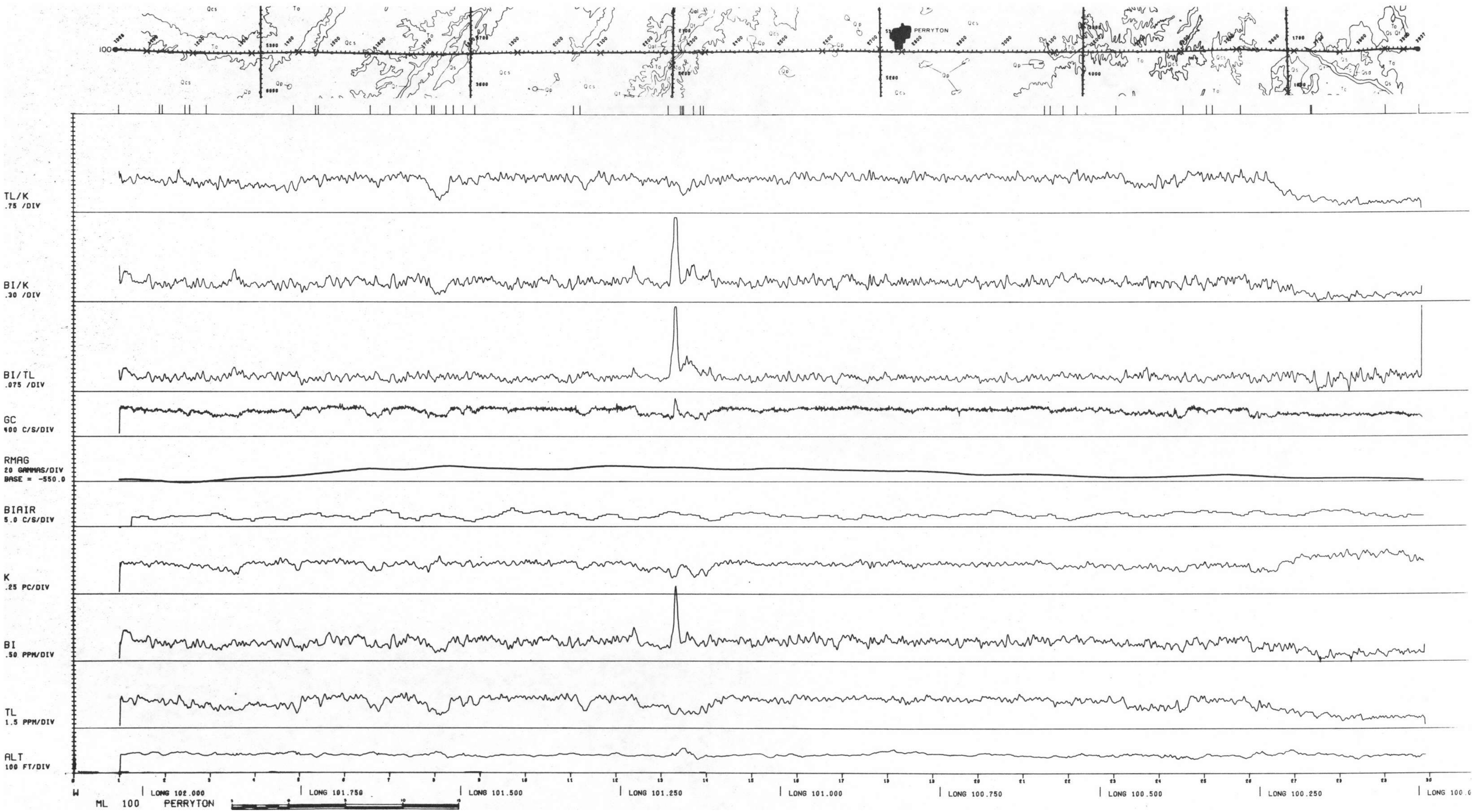
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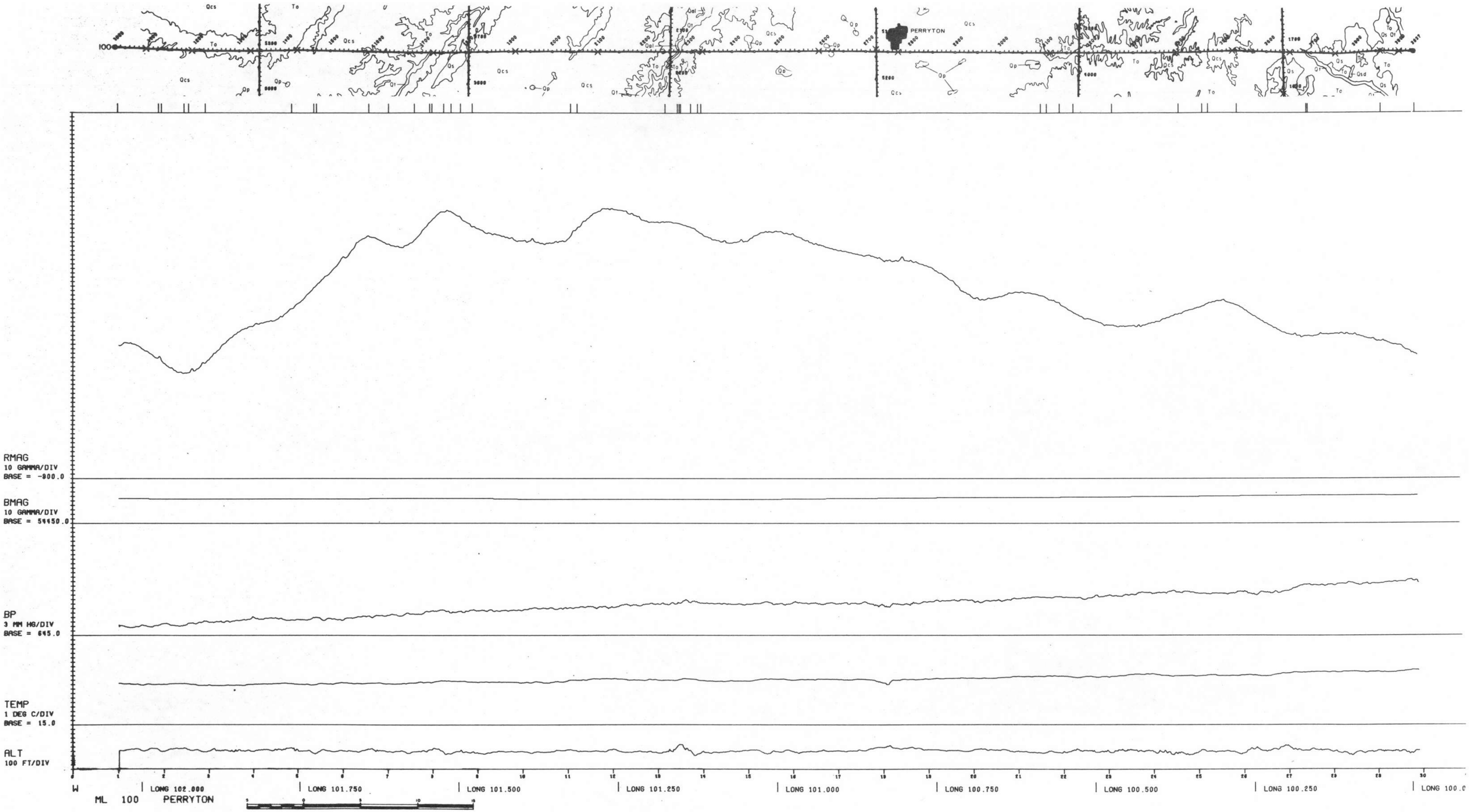
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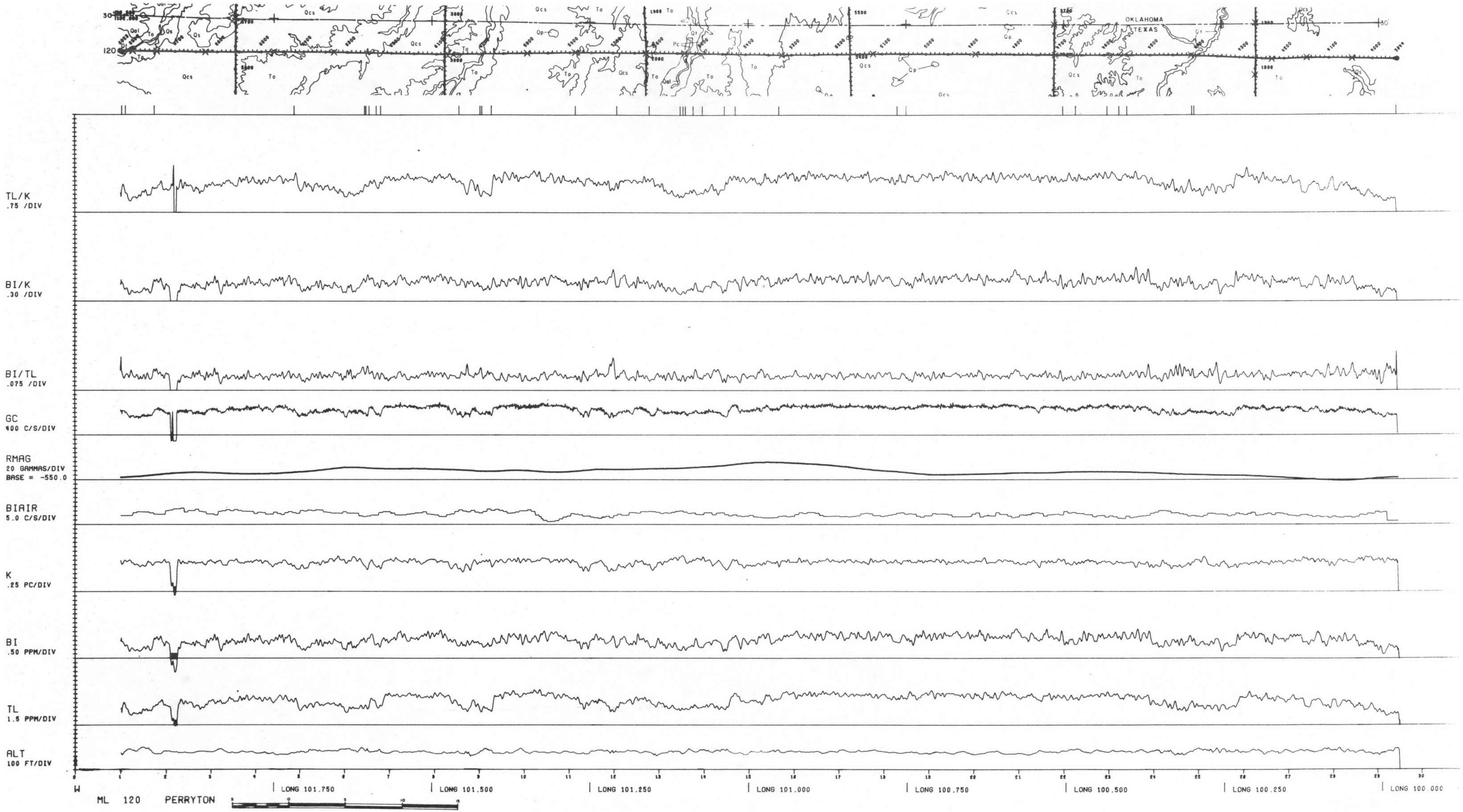

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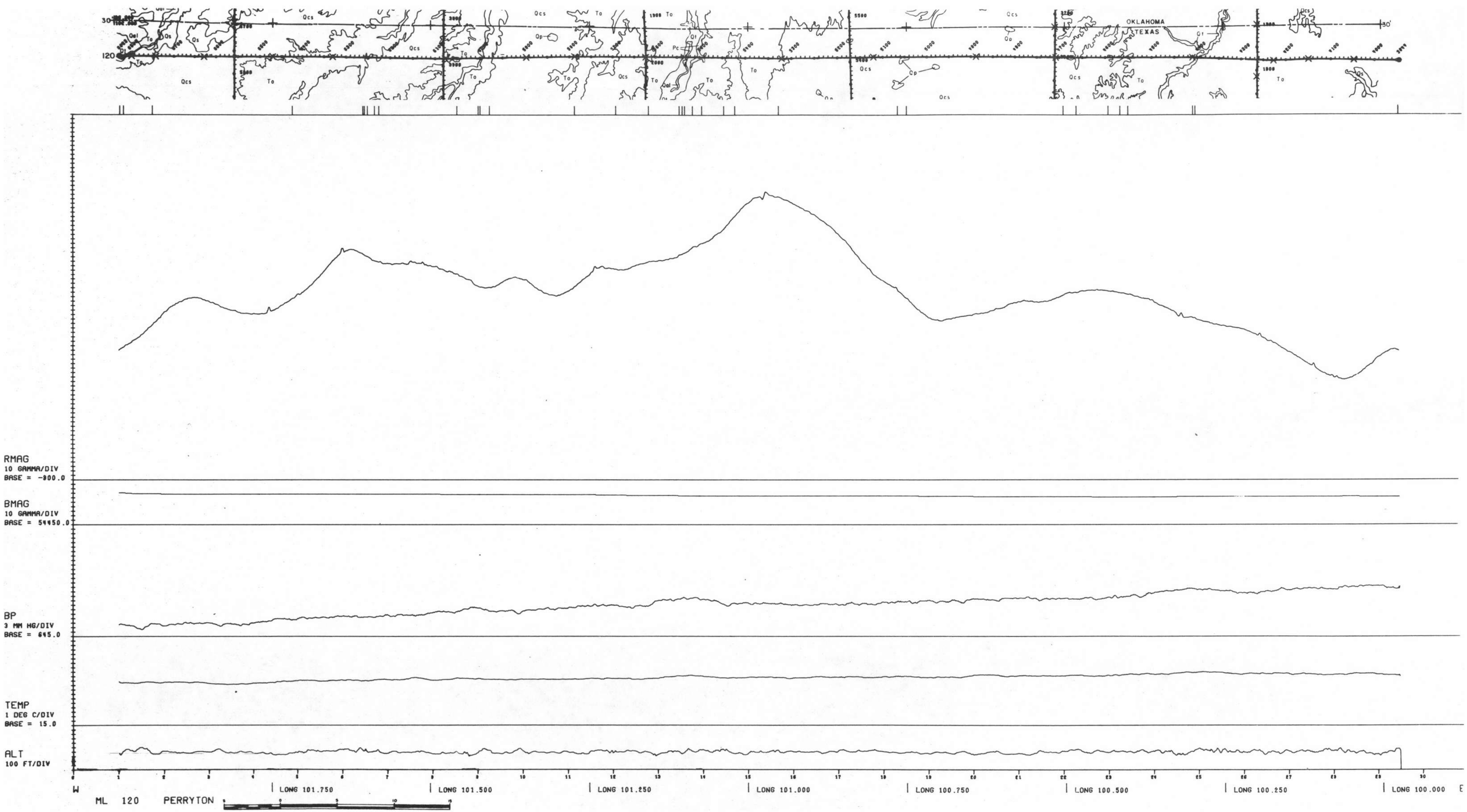
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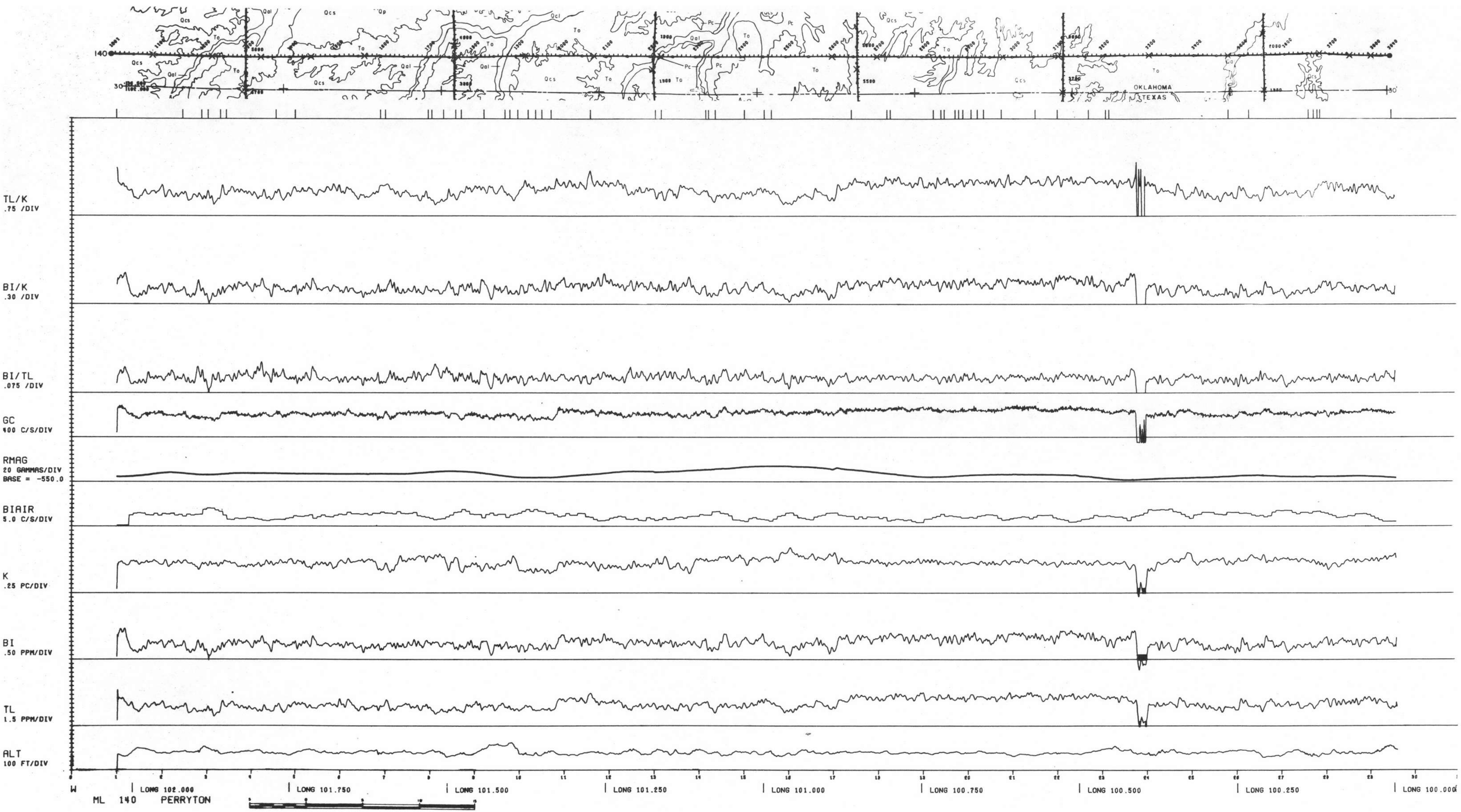

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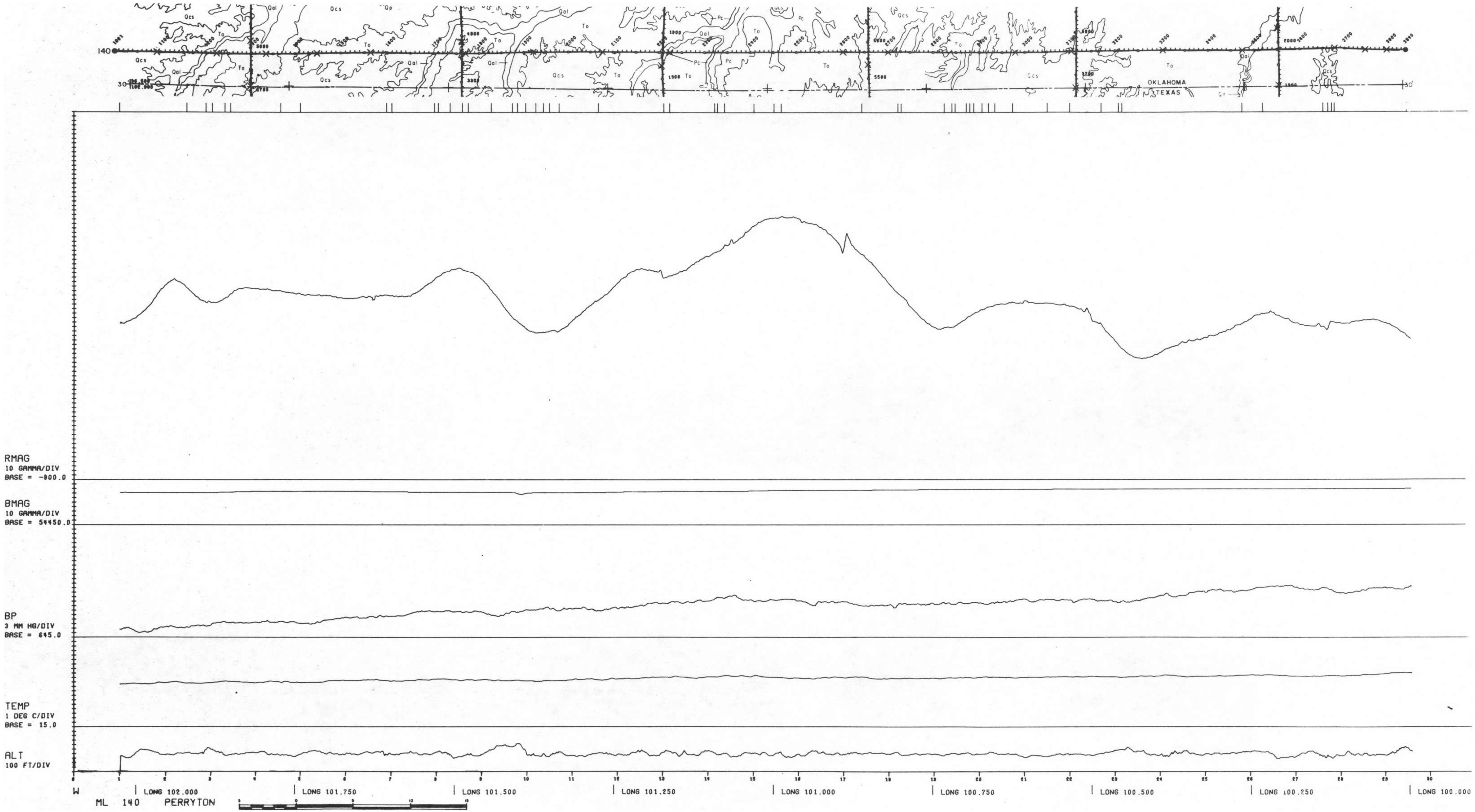

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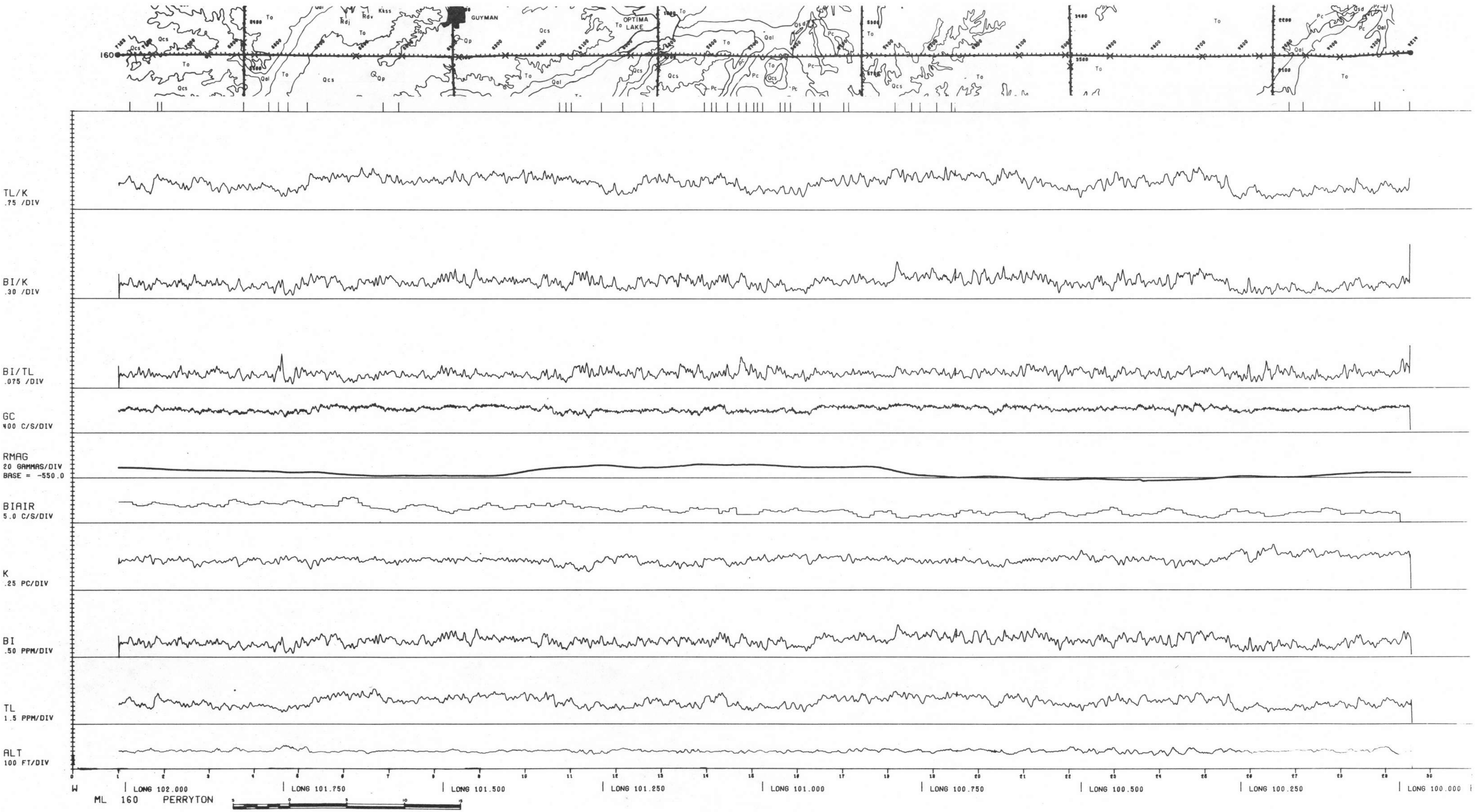
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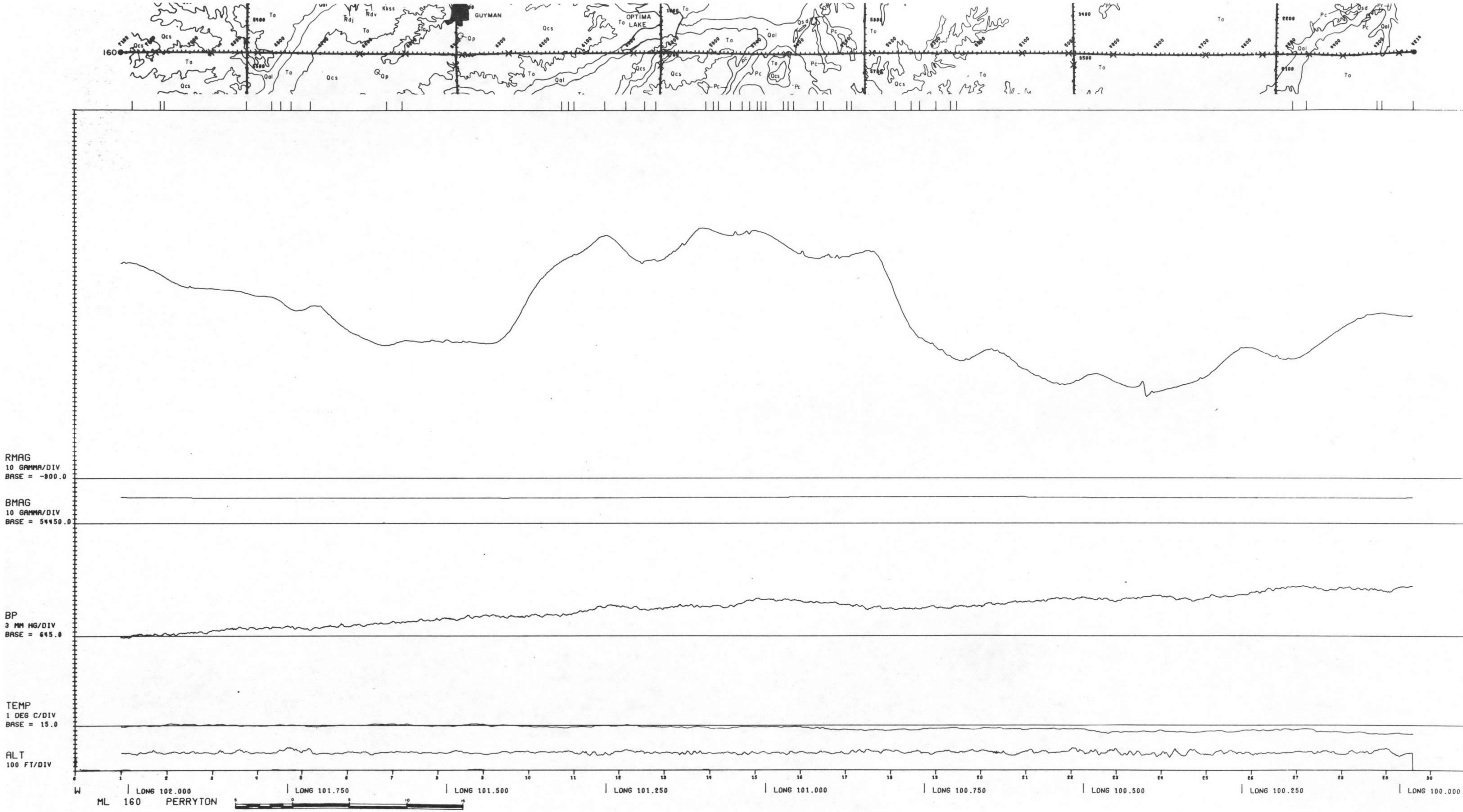

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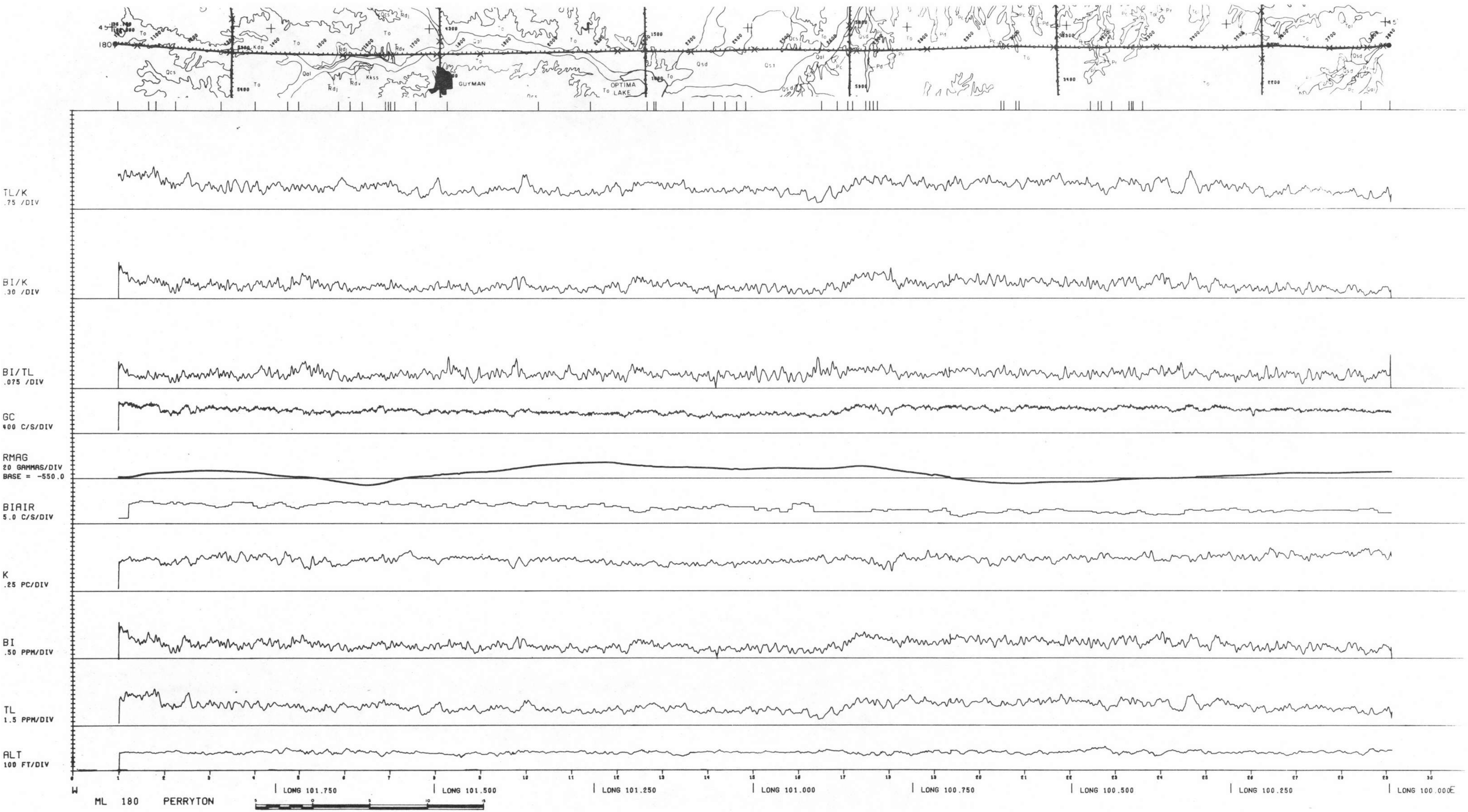
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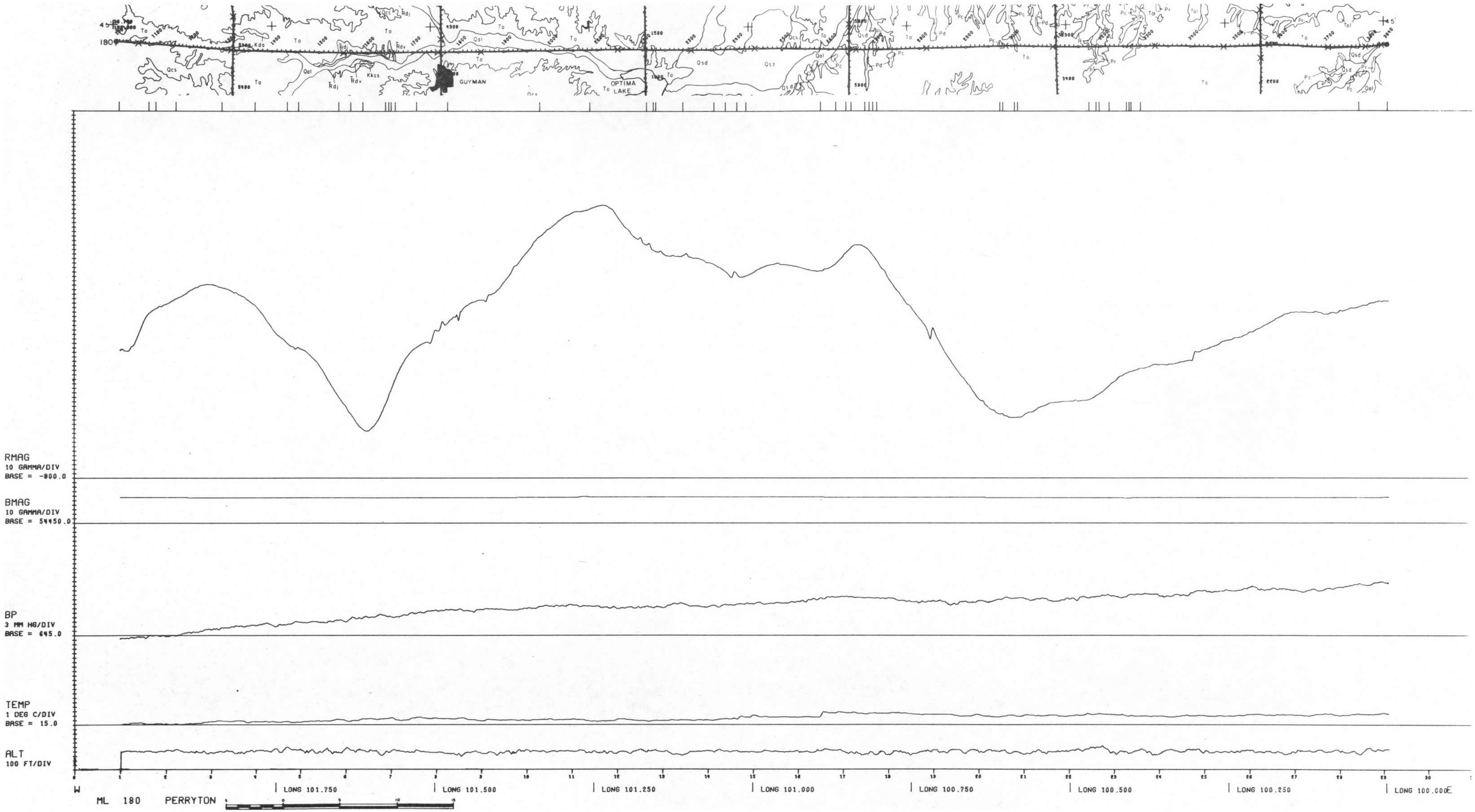
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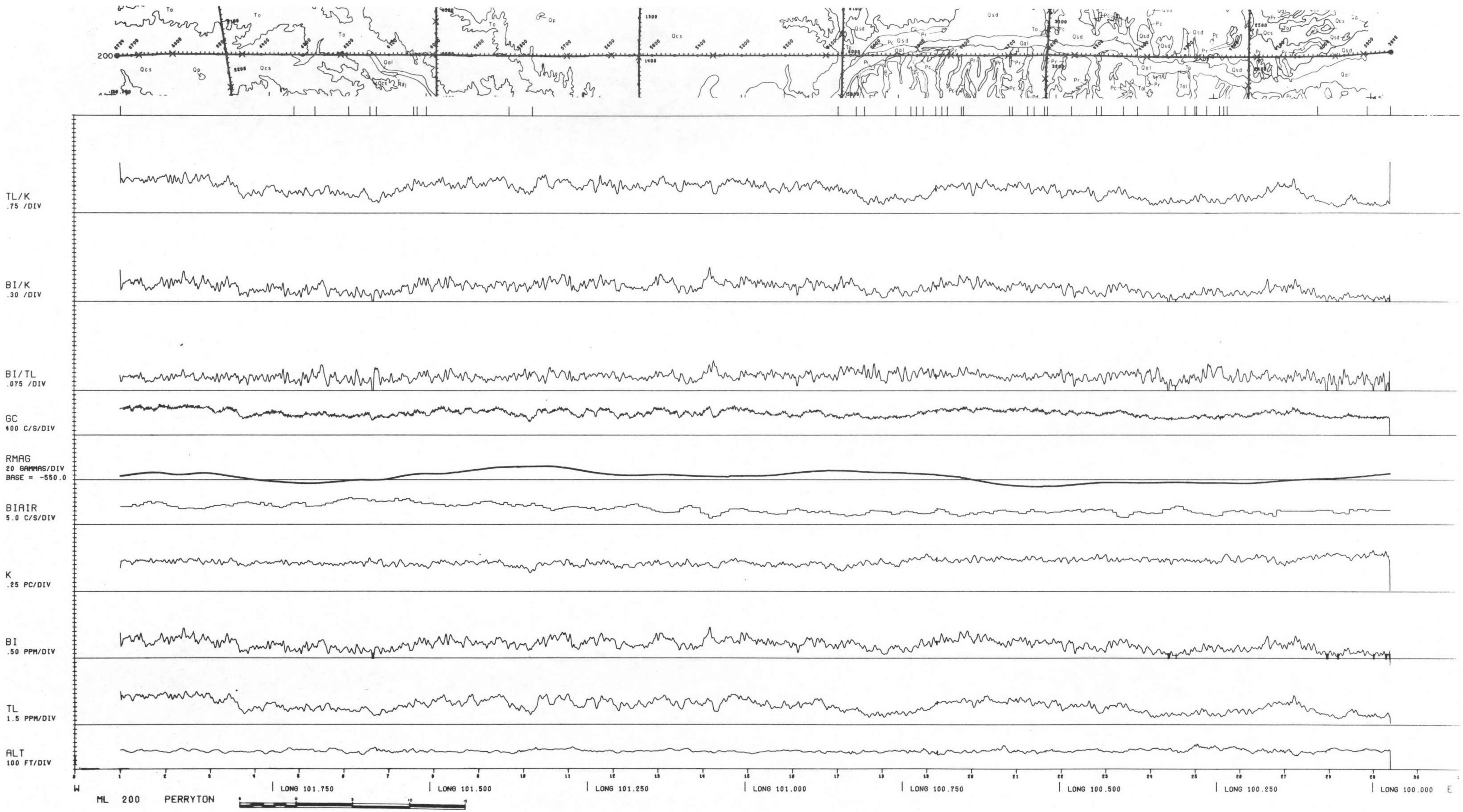
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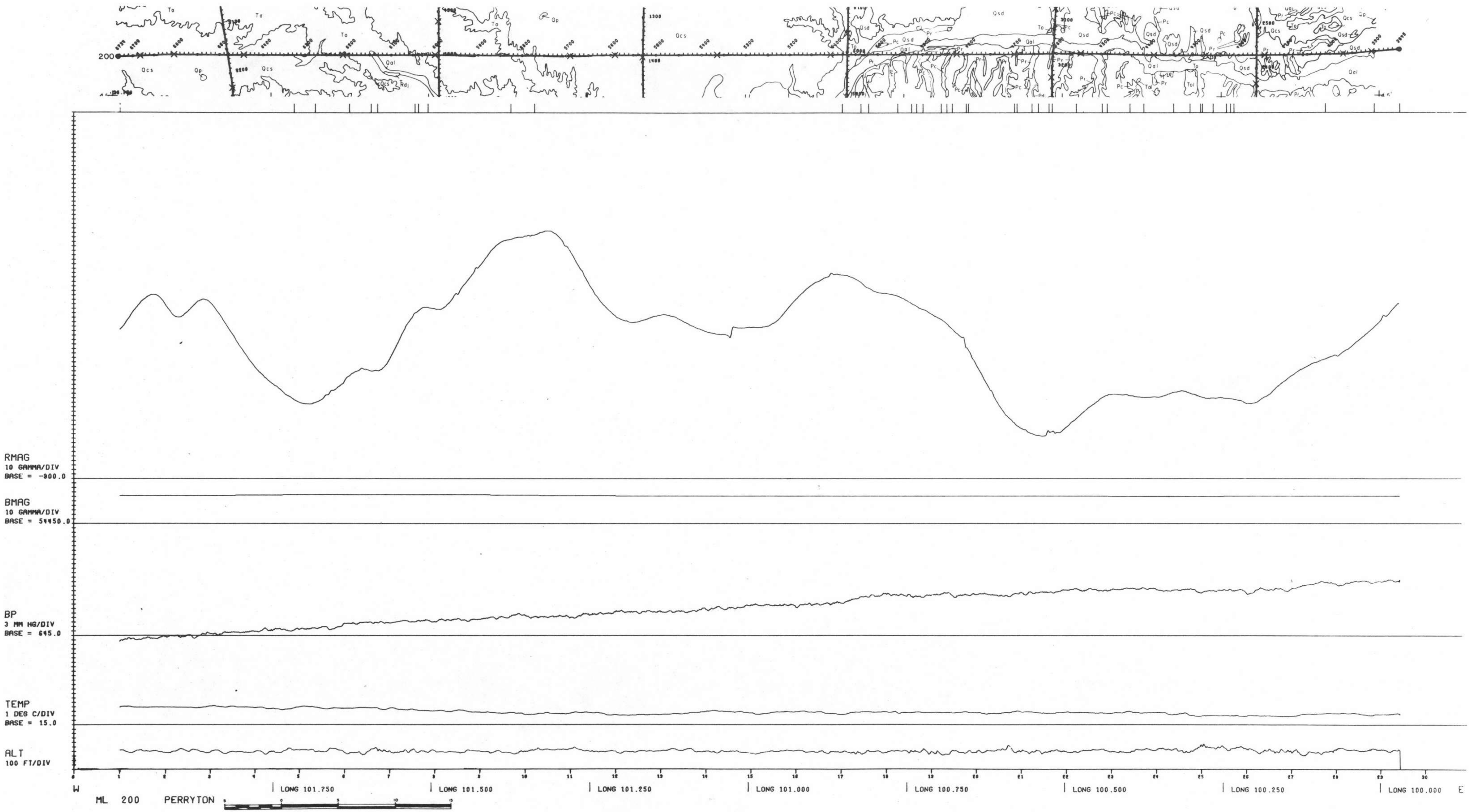

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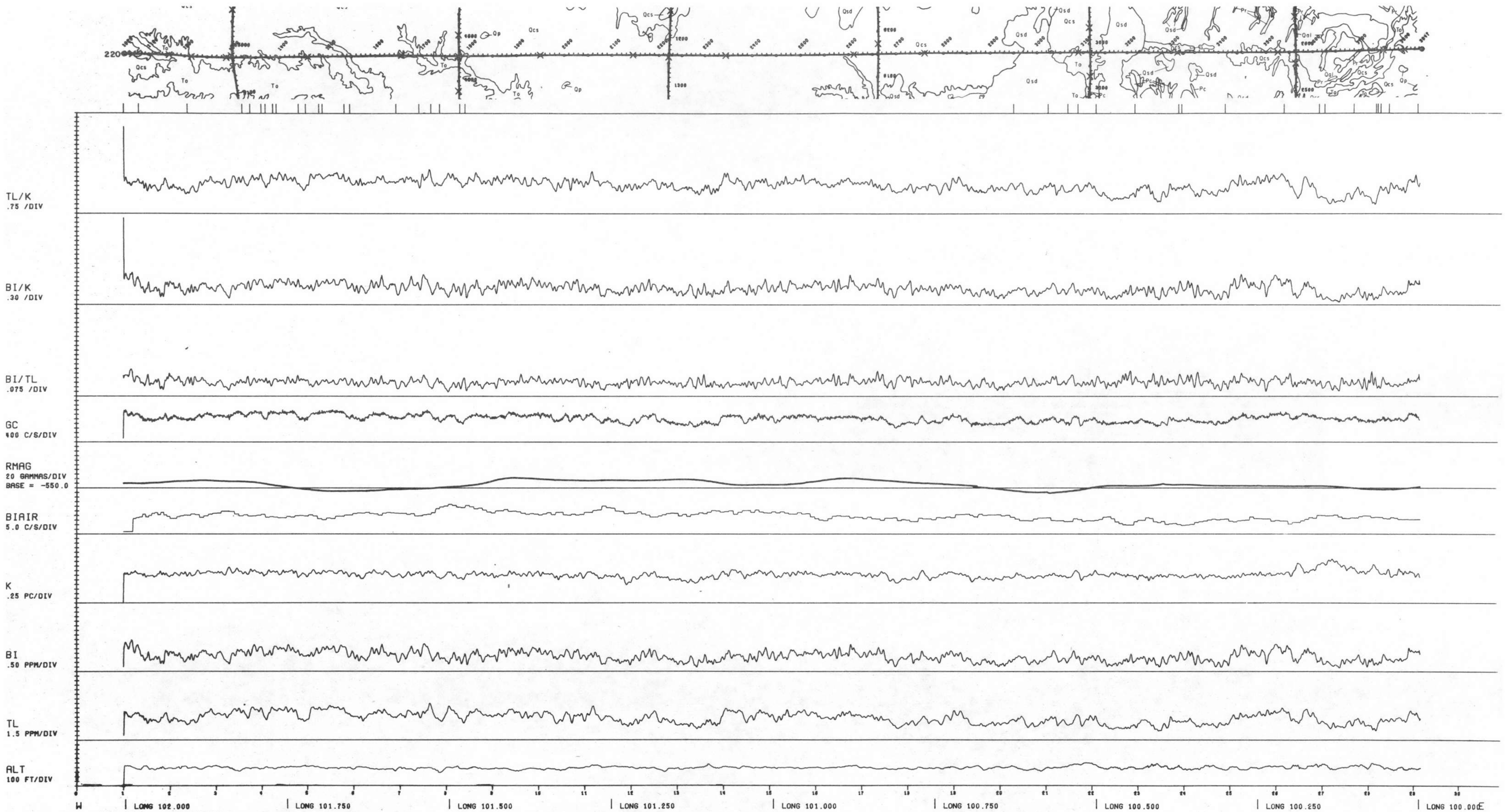

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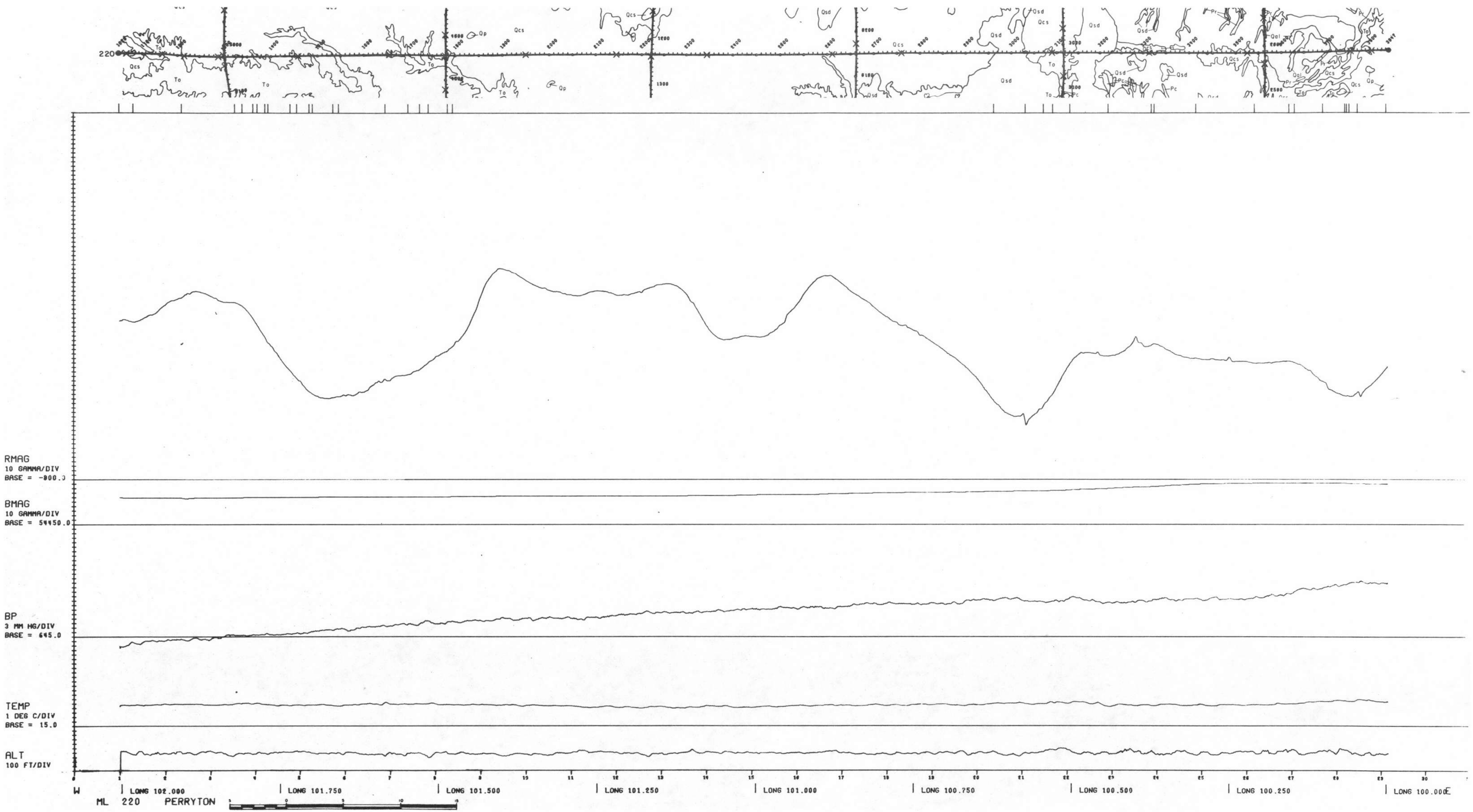
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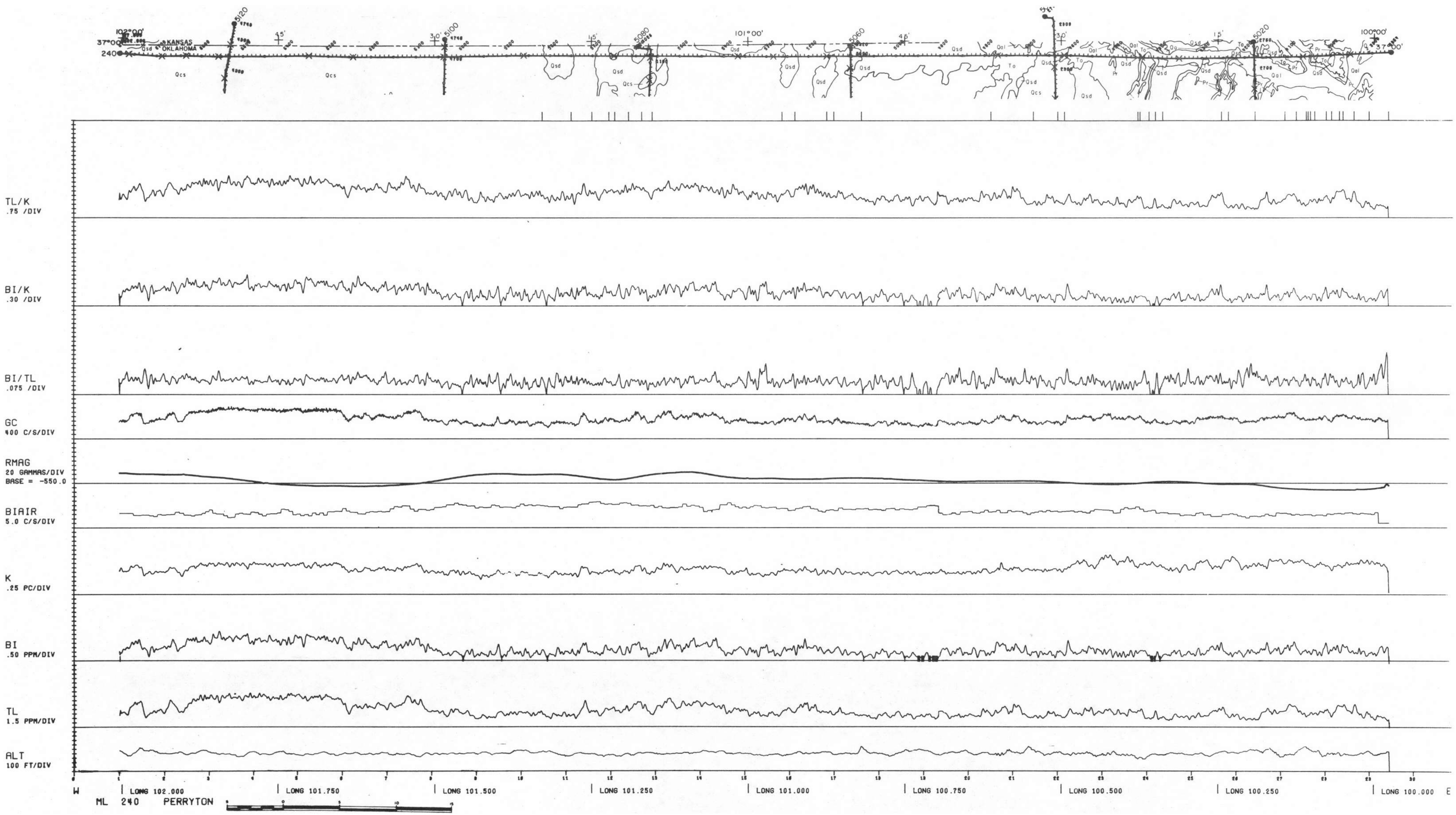

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37°00'
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OKLAHOMA
240
5120
5100
5080
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37°00'
15'
30'
45'
Qcs
Qsd
Qal
To
Pr
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BI/K
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RMAG
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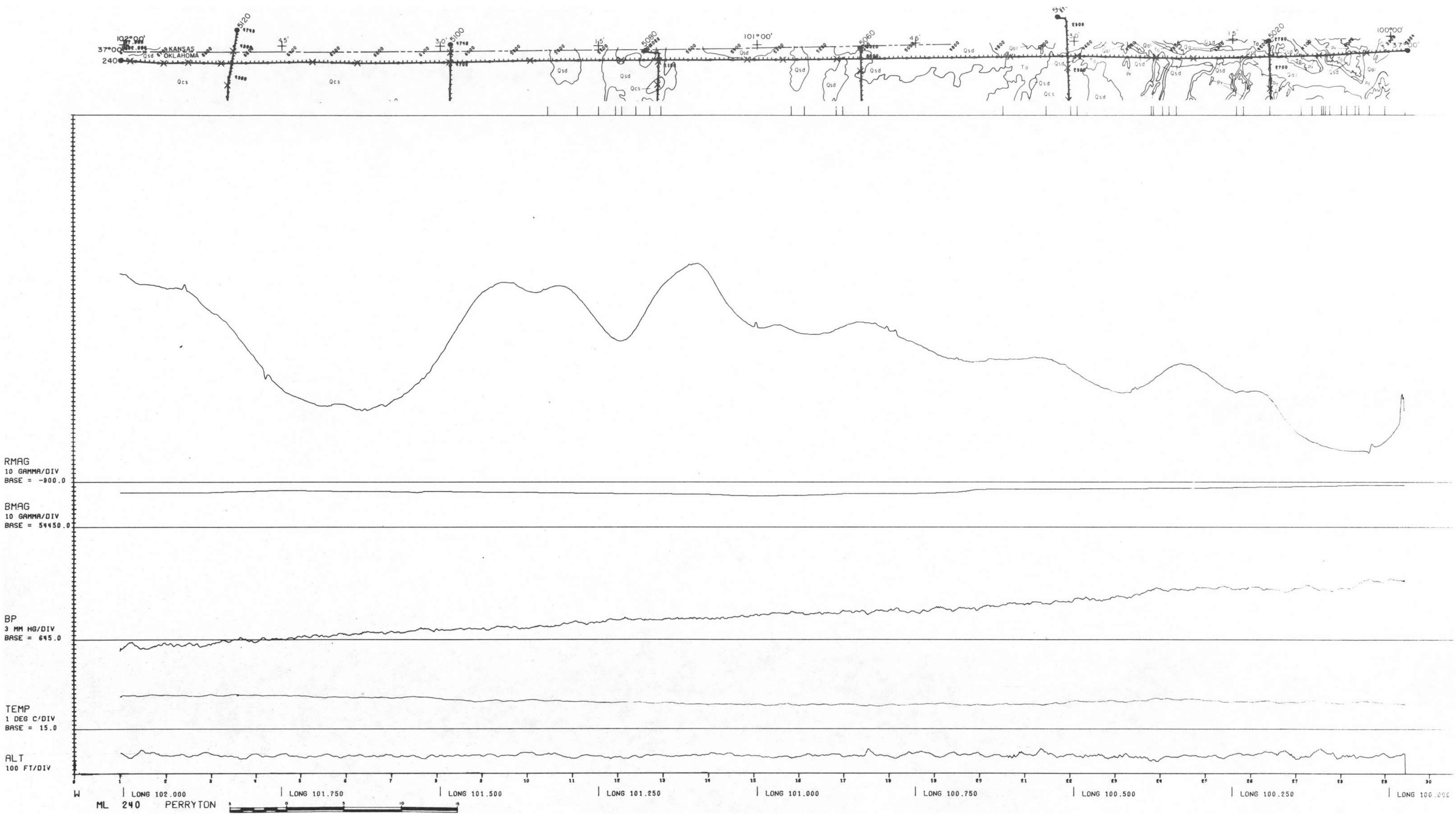
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KANSAS
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45'
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5060
45'
30'
5040
15'
5020
100°00'
37°00'
To
Qal
Pr
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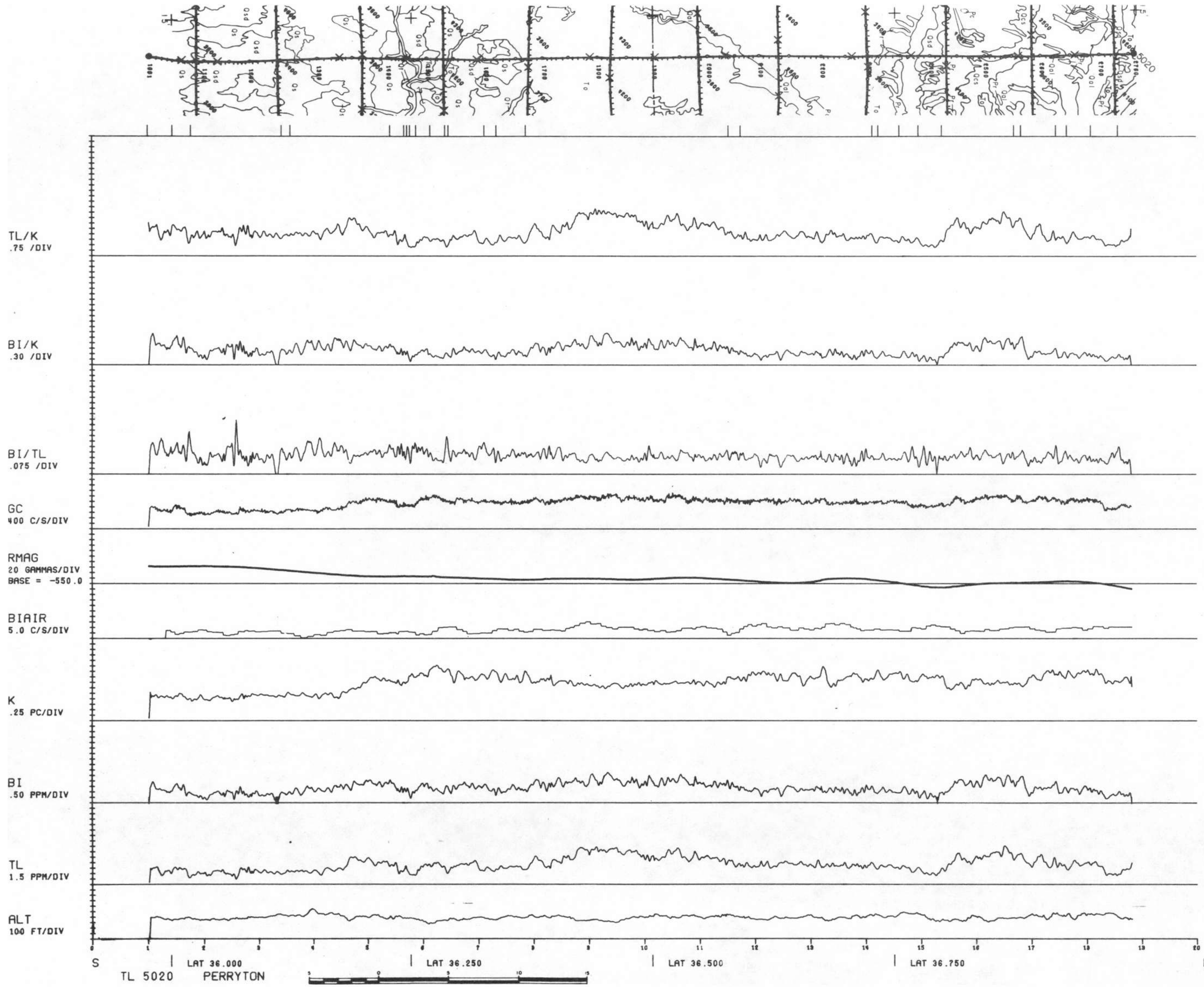
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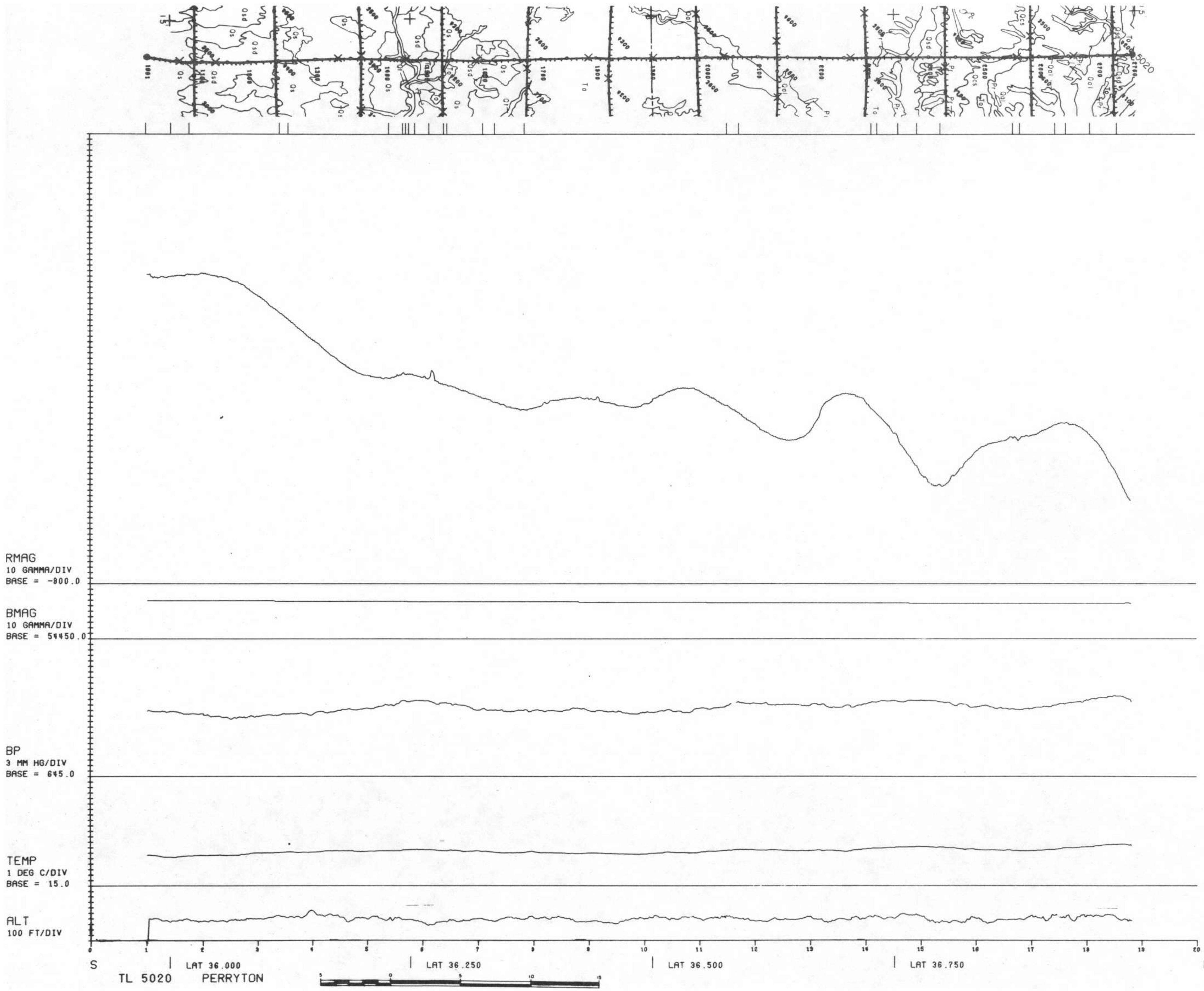

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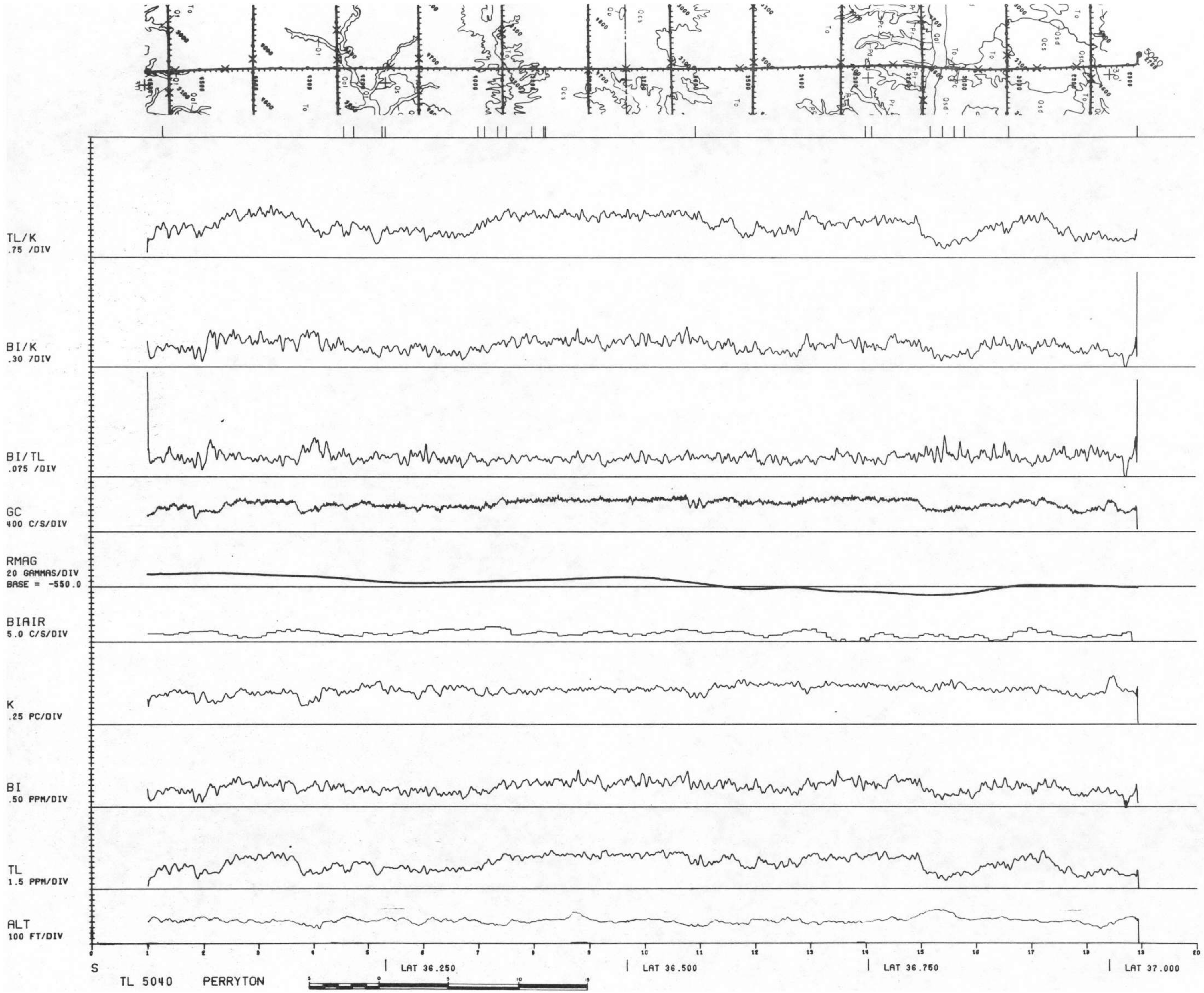
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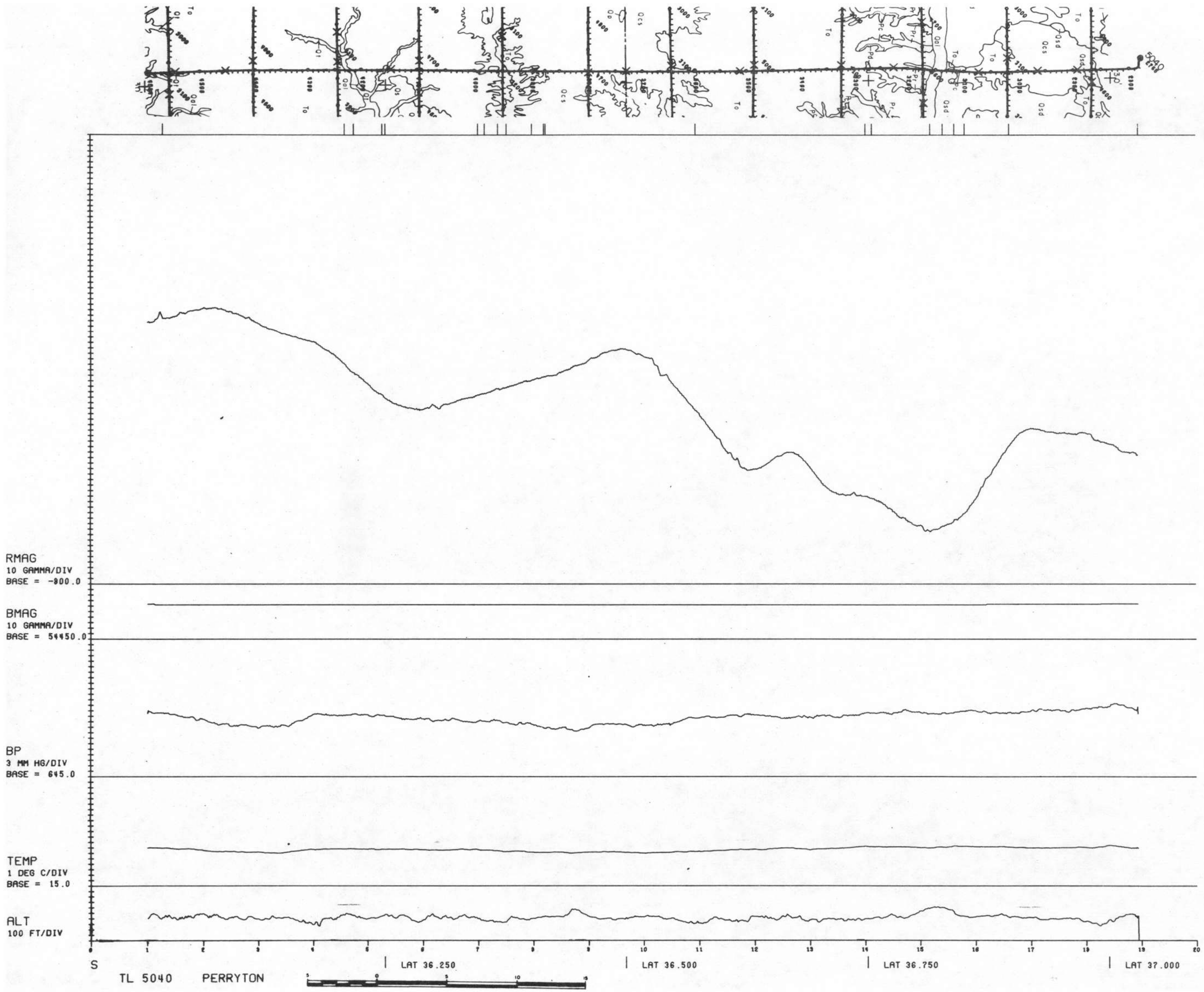
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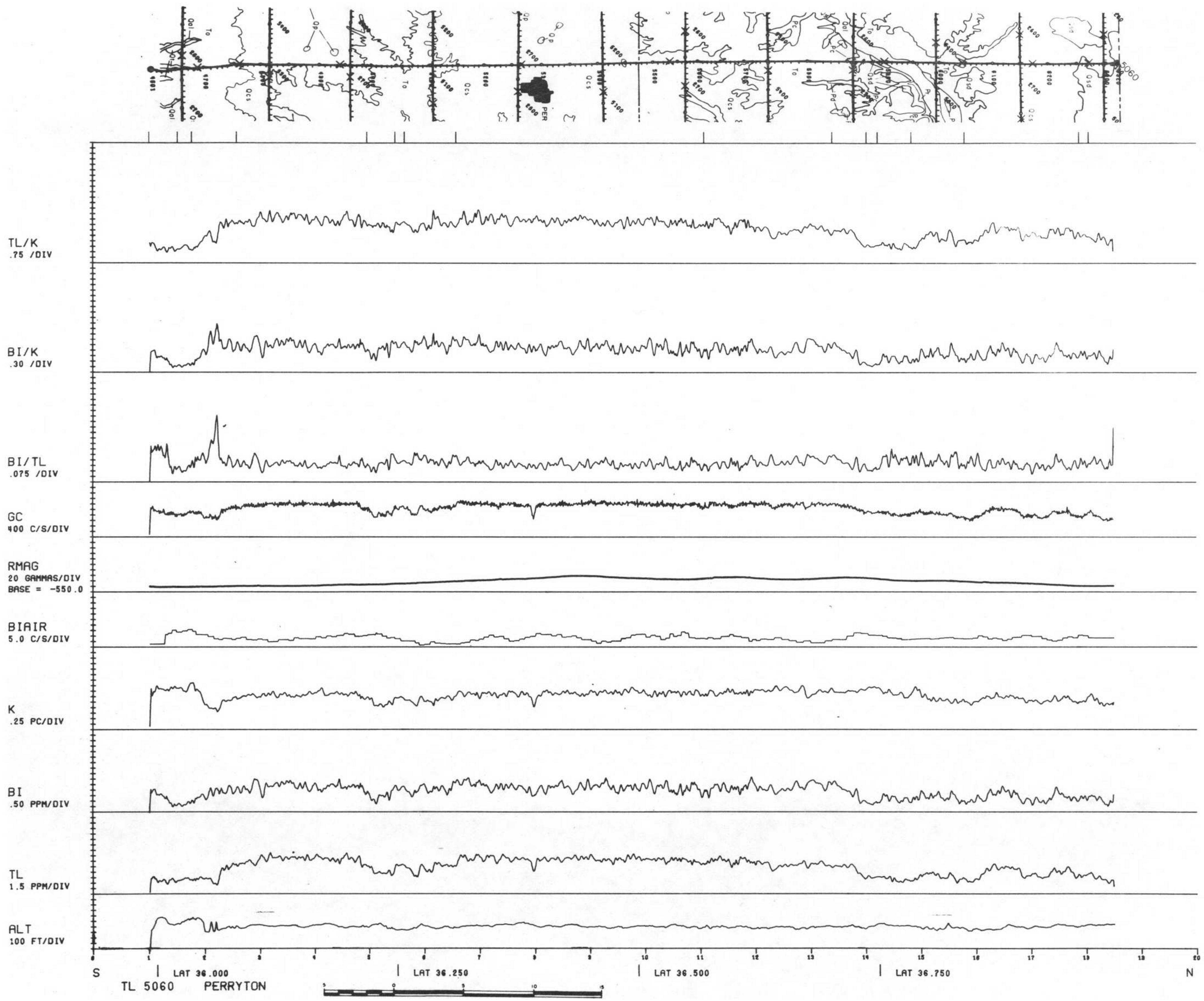

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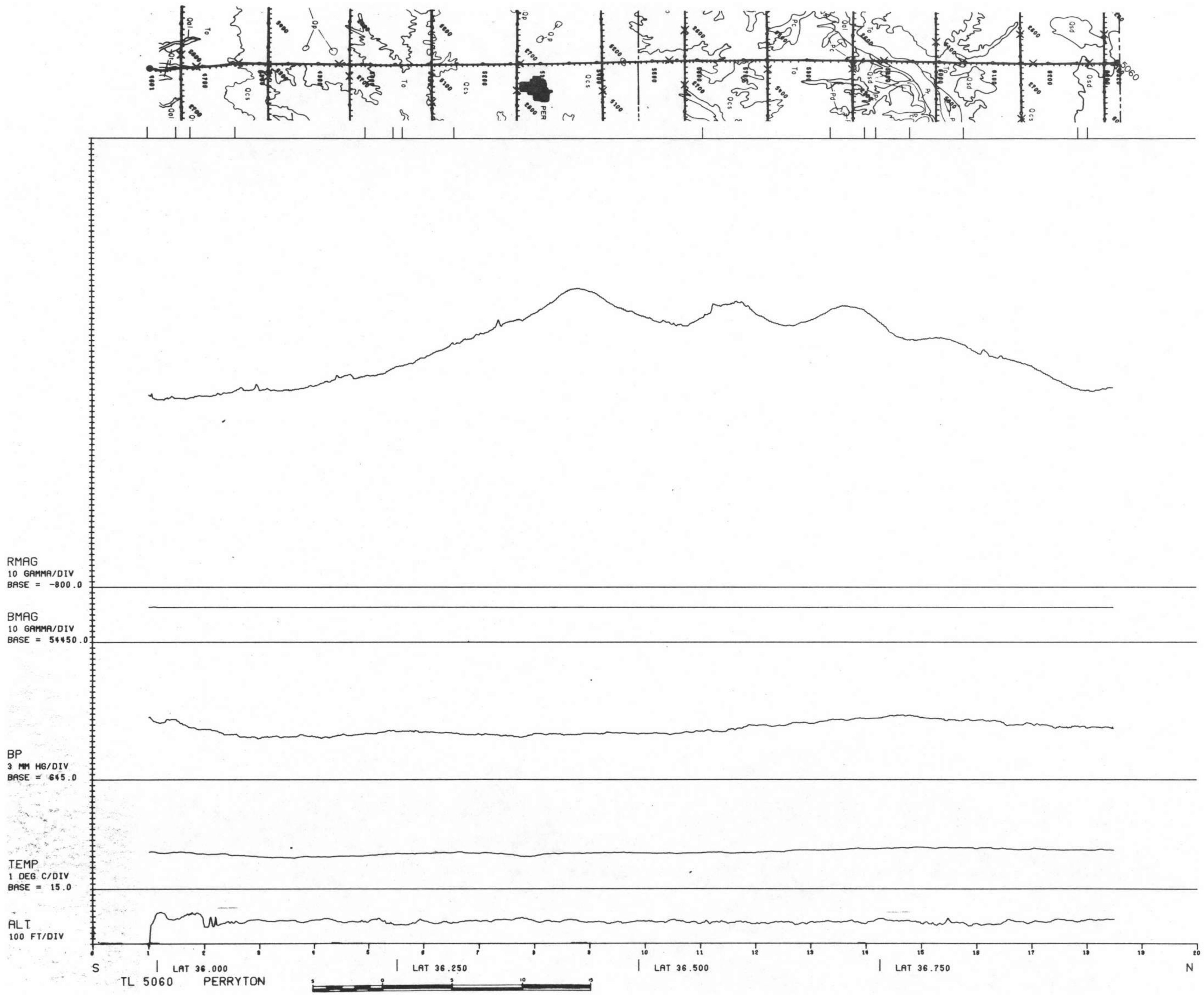
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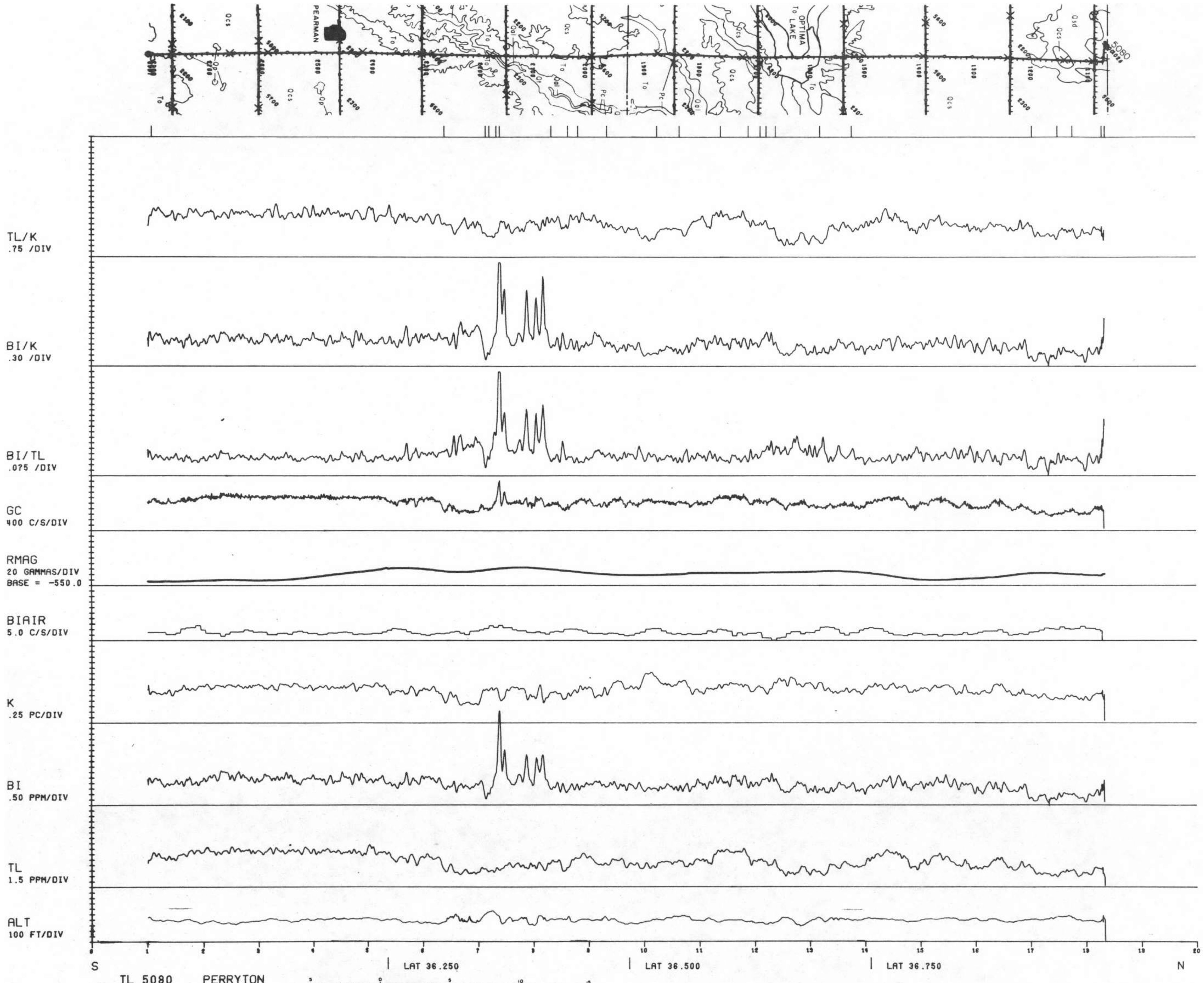
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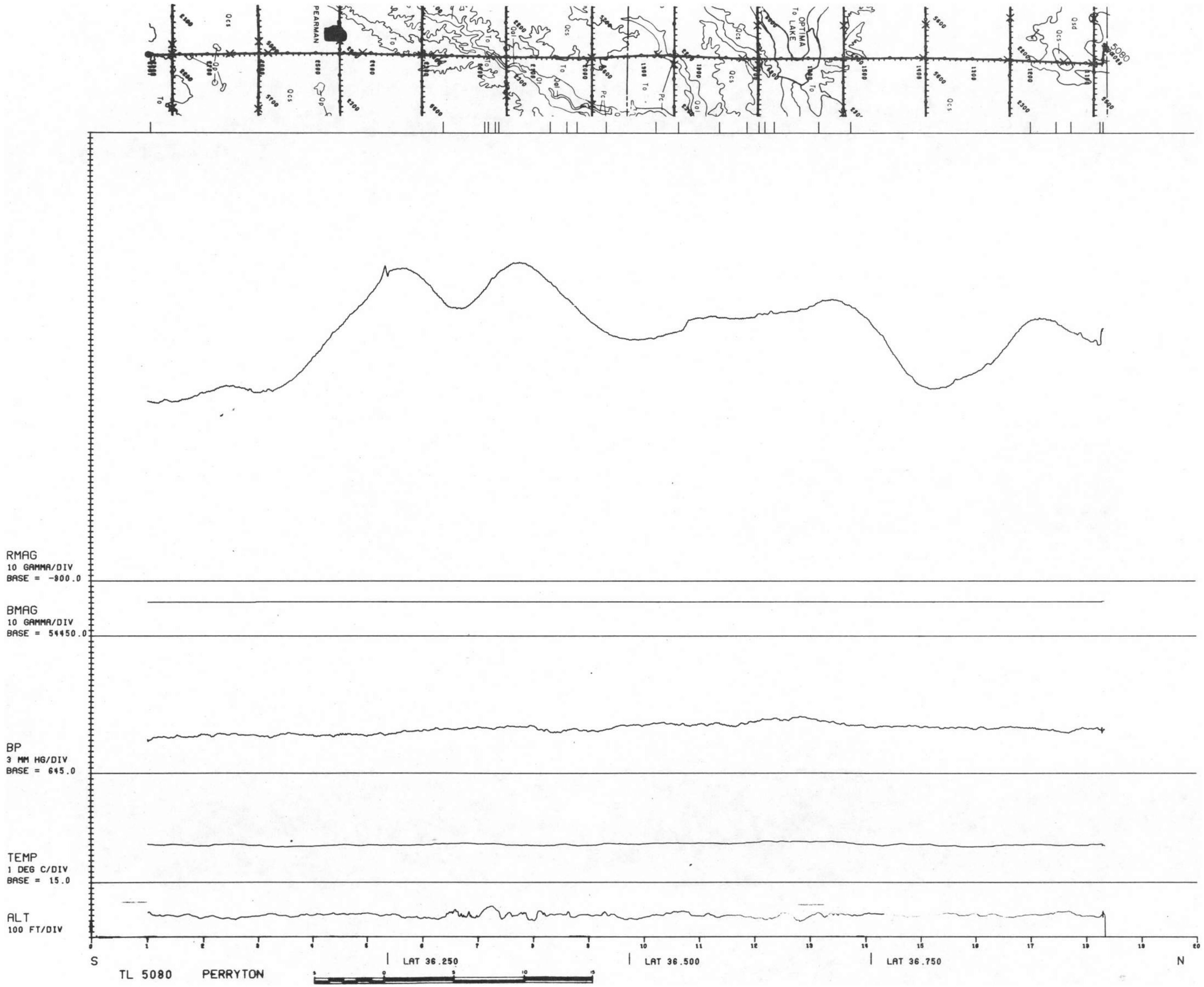
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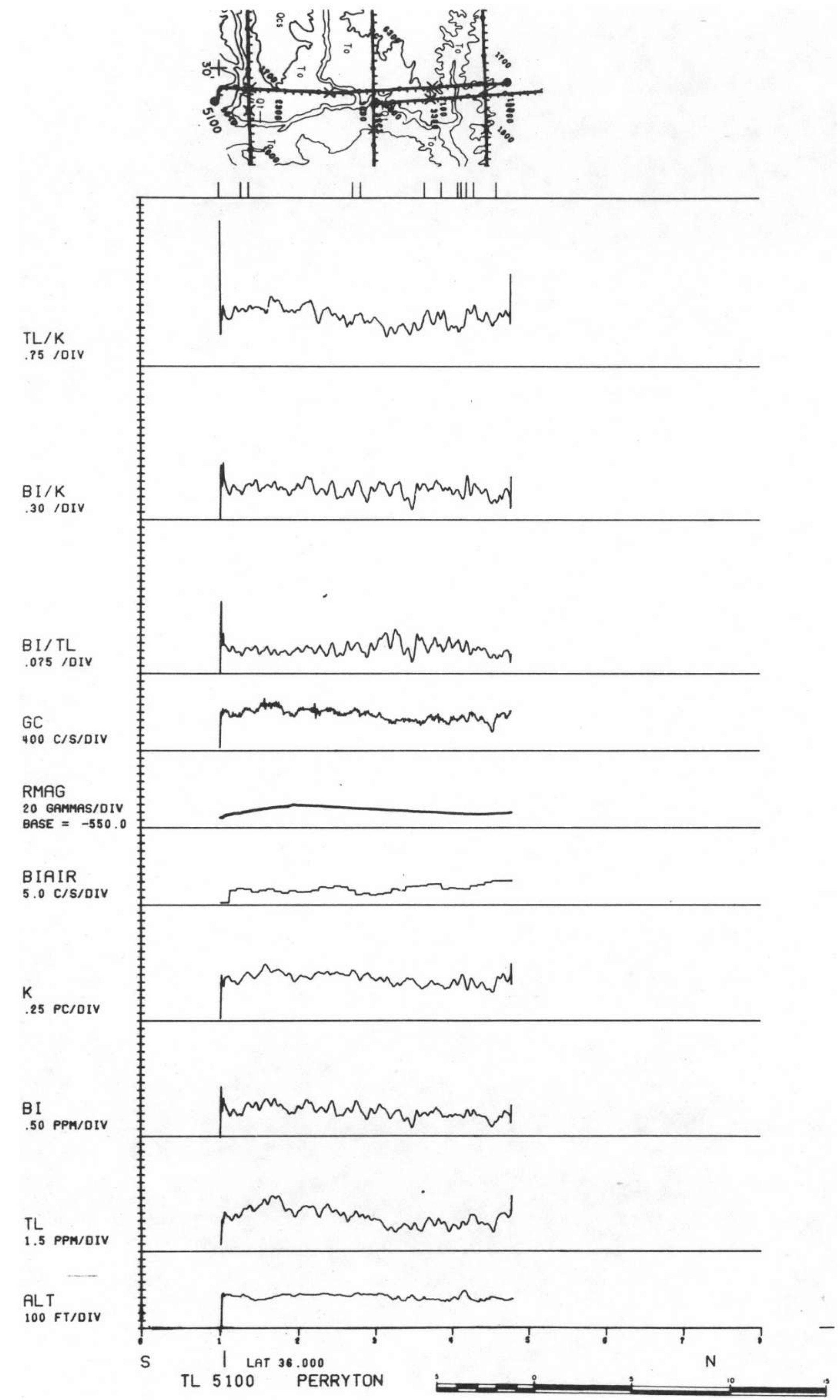
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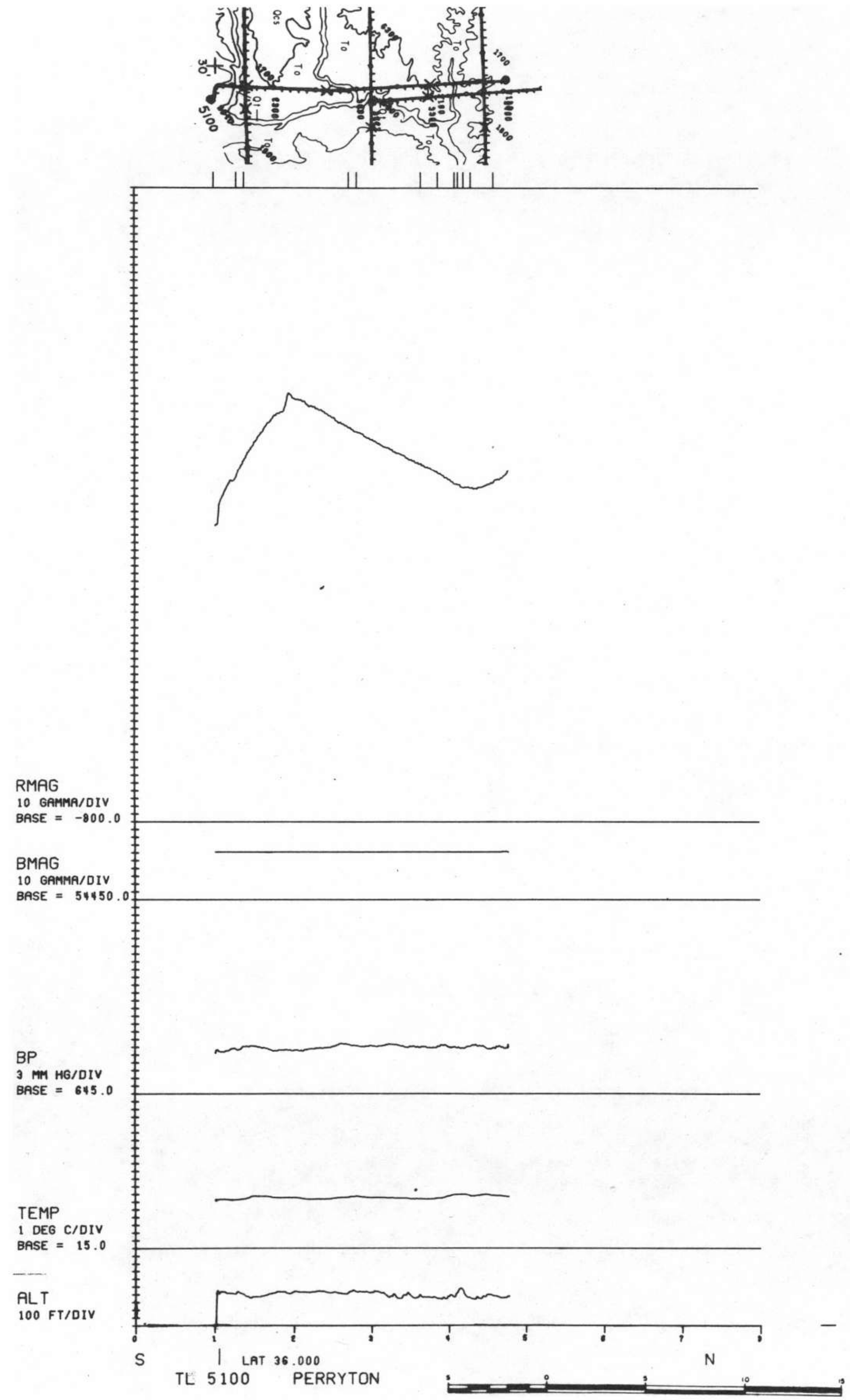
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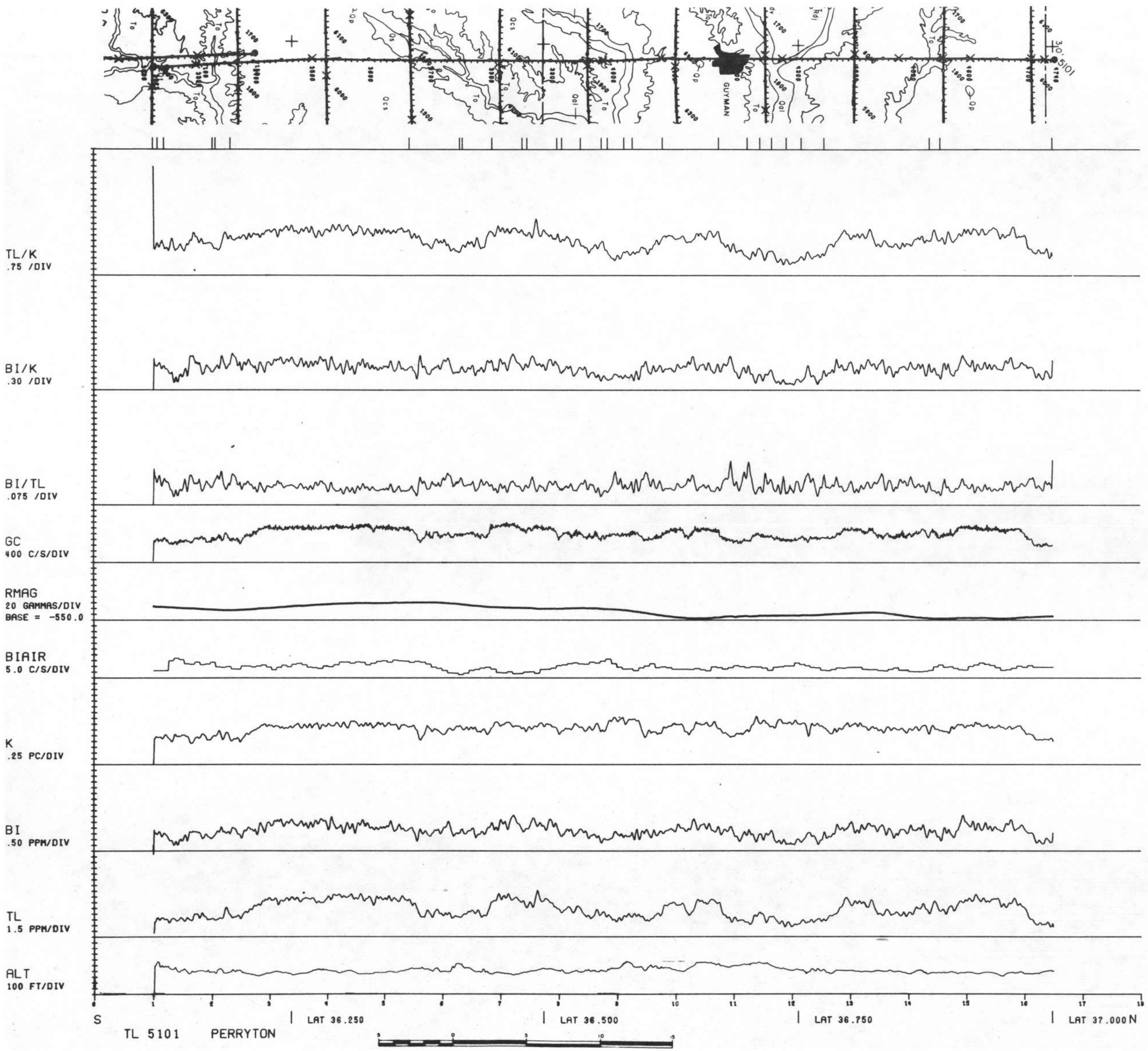

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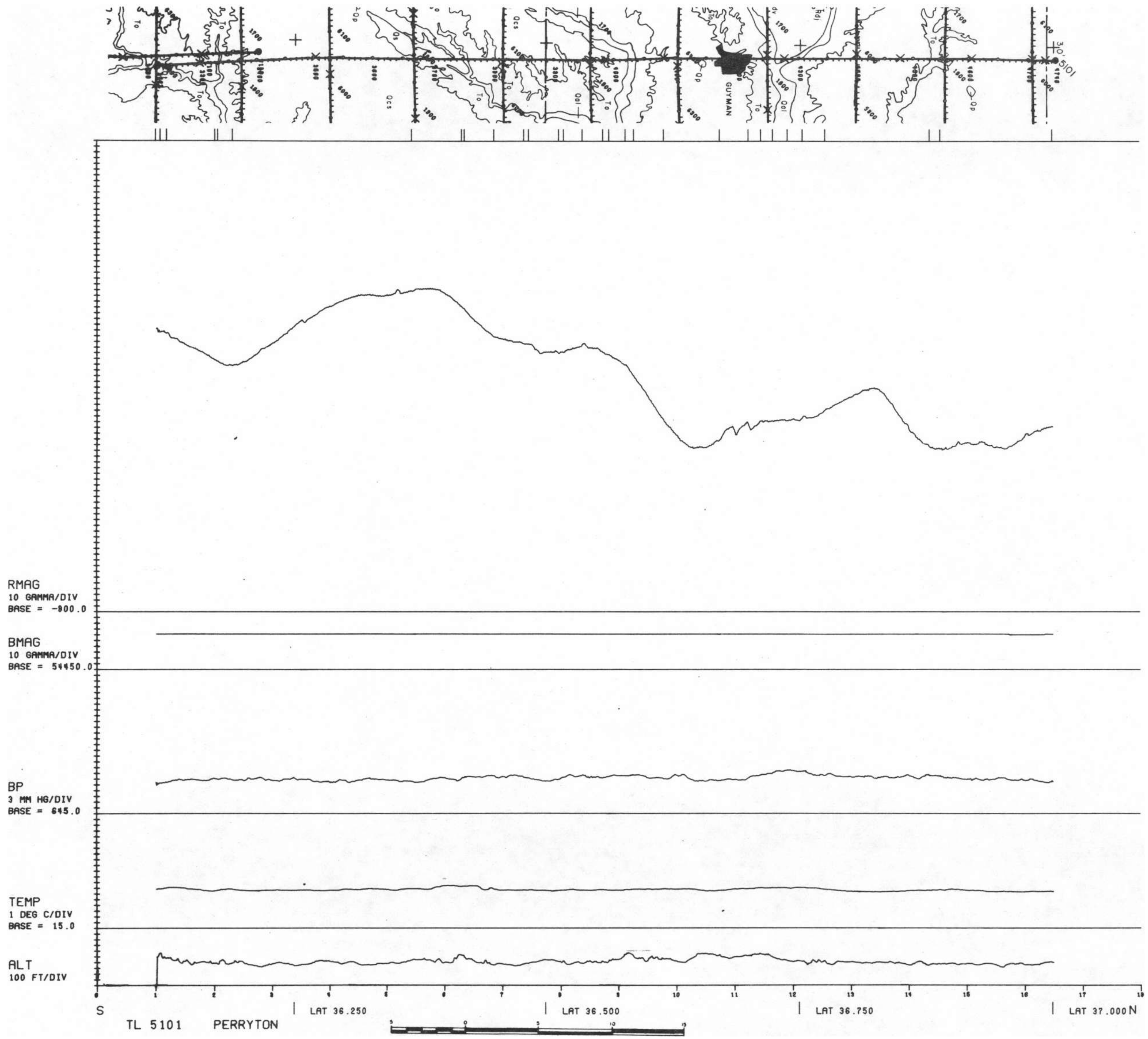
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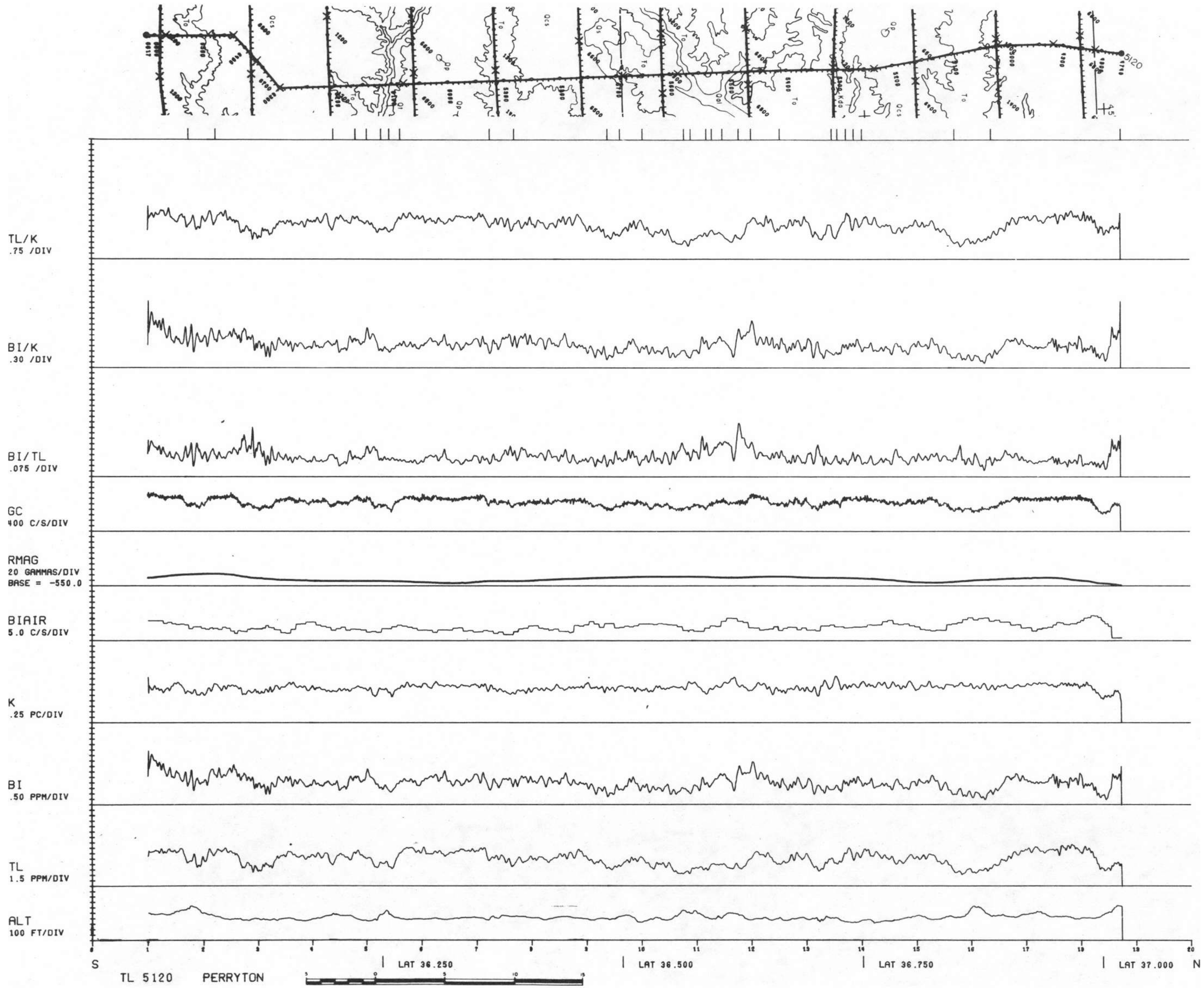

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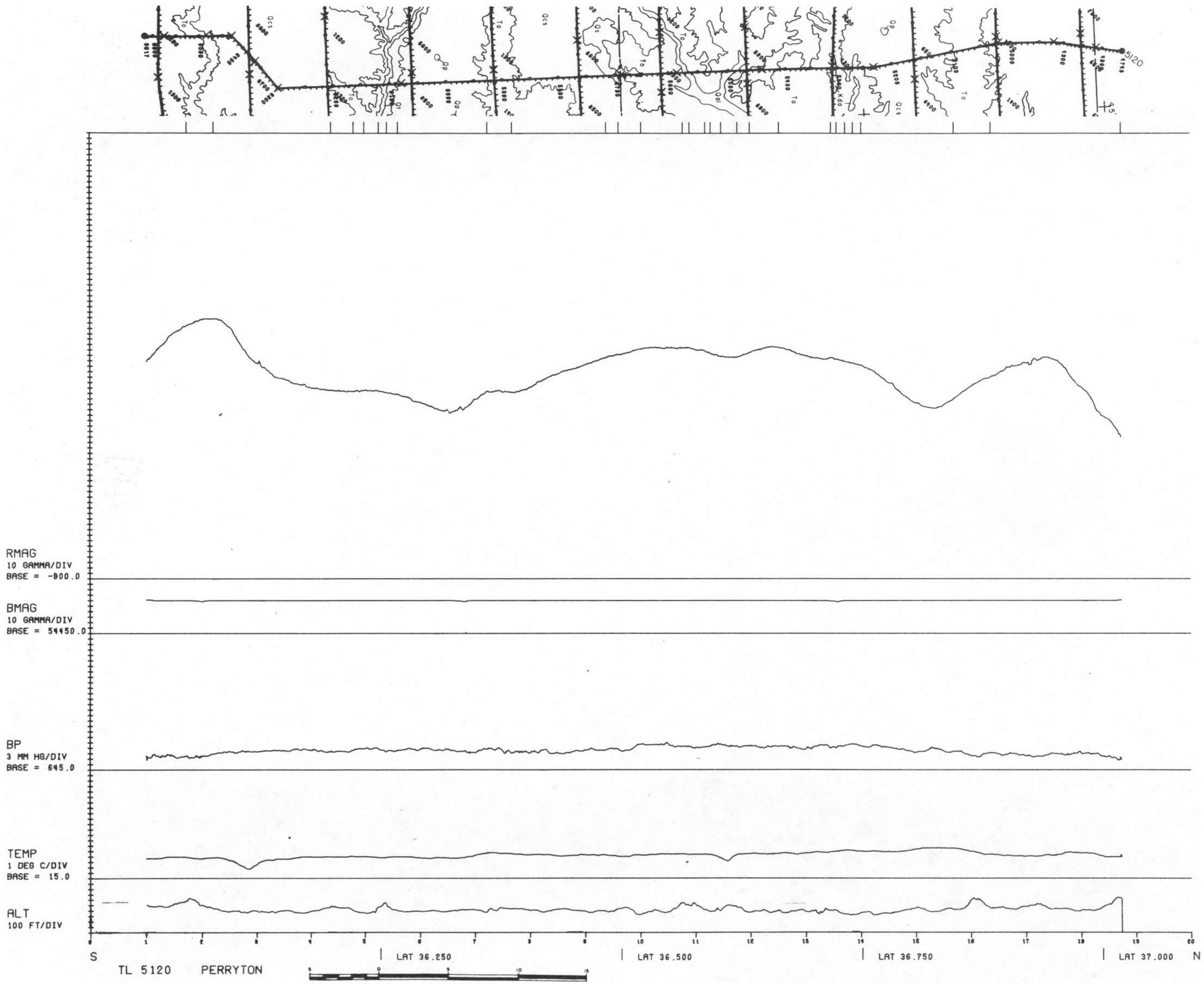

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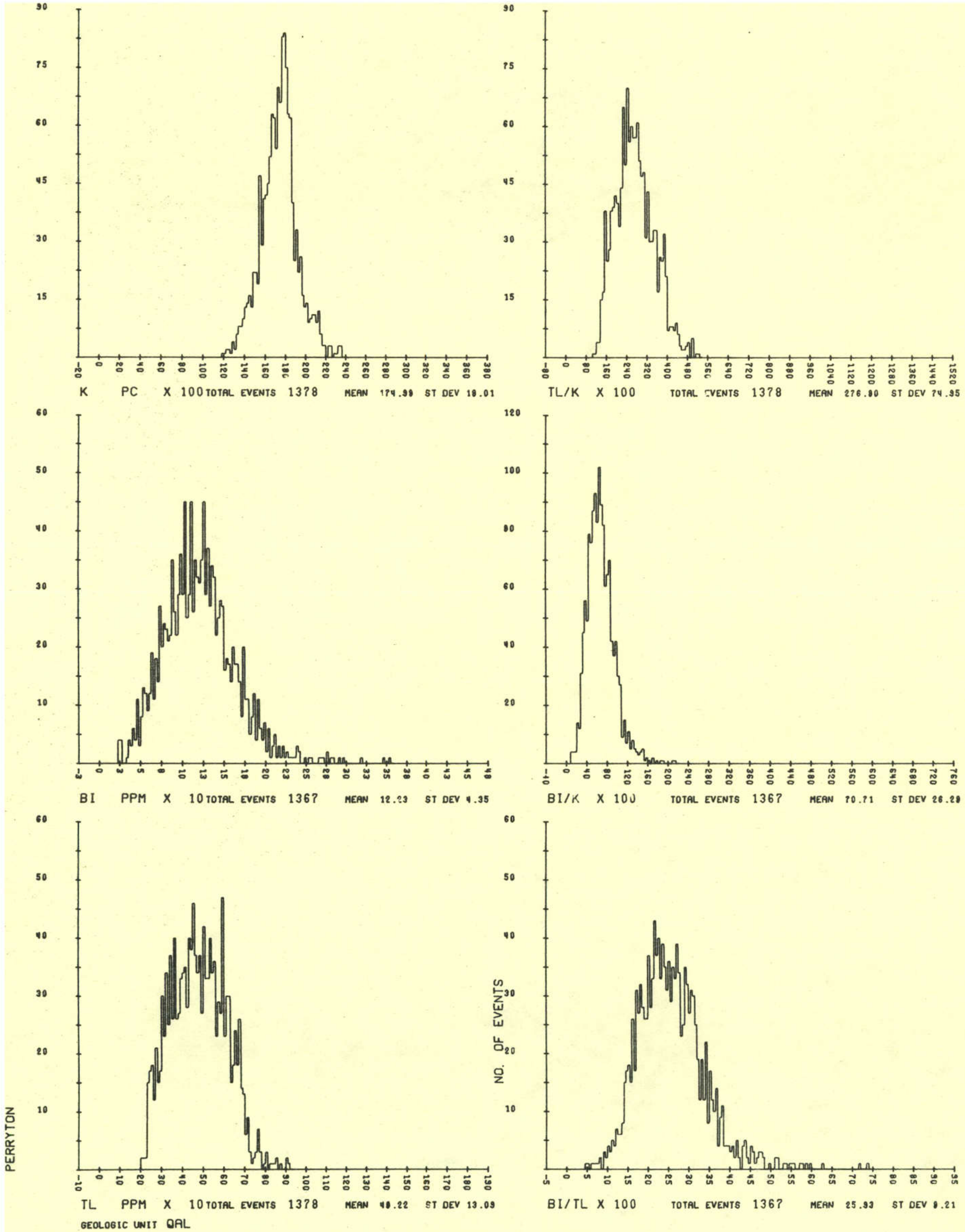
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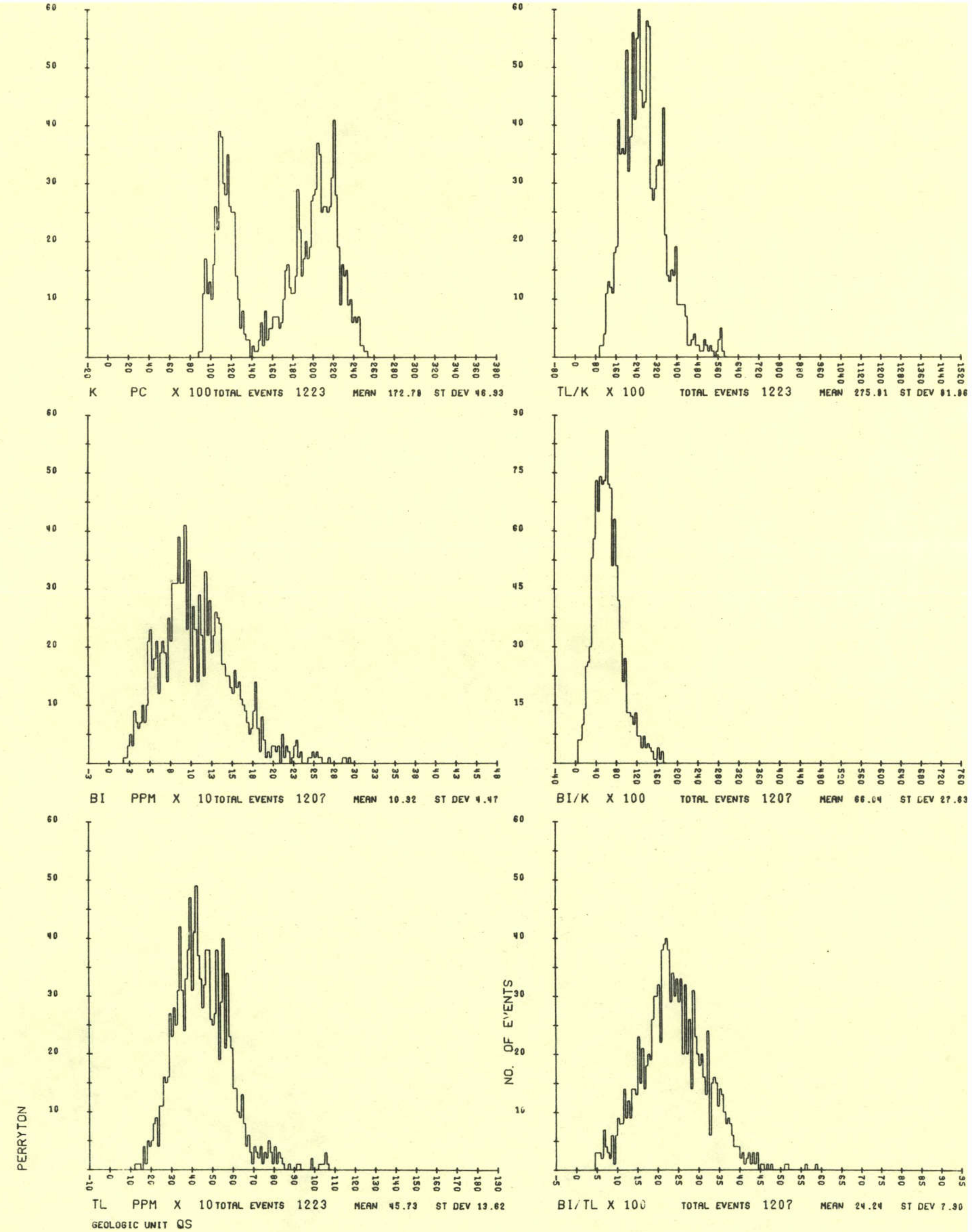
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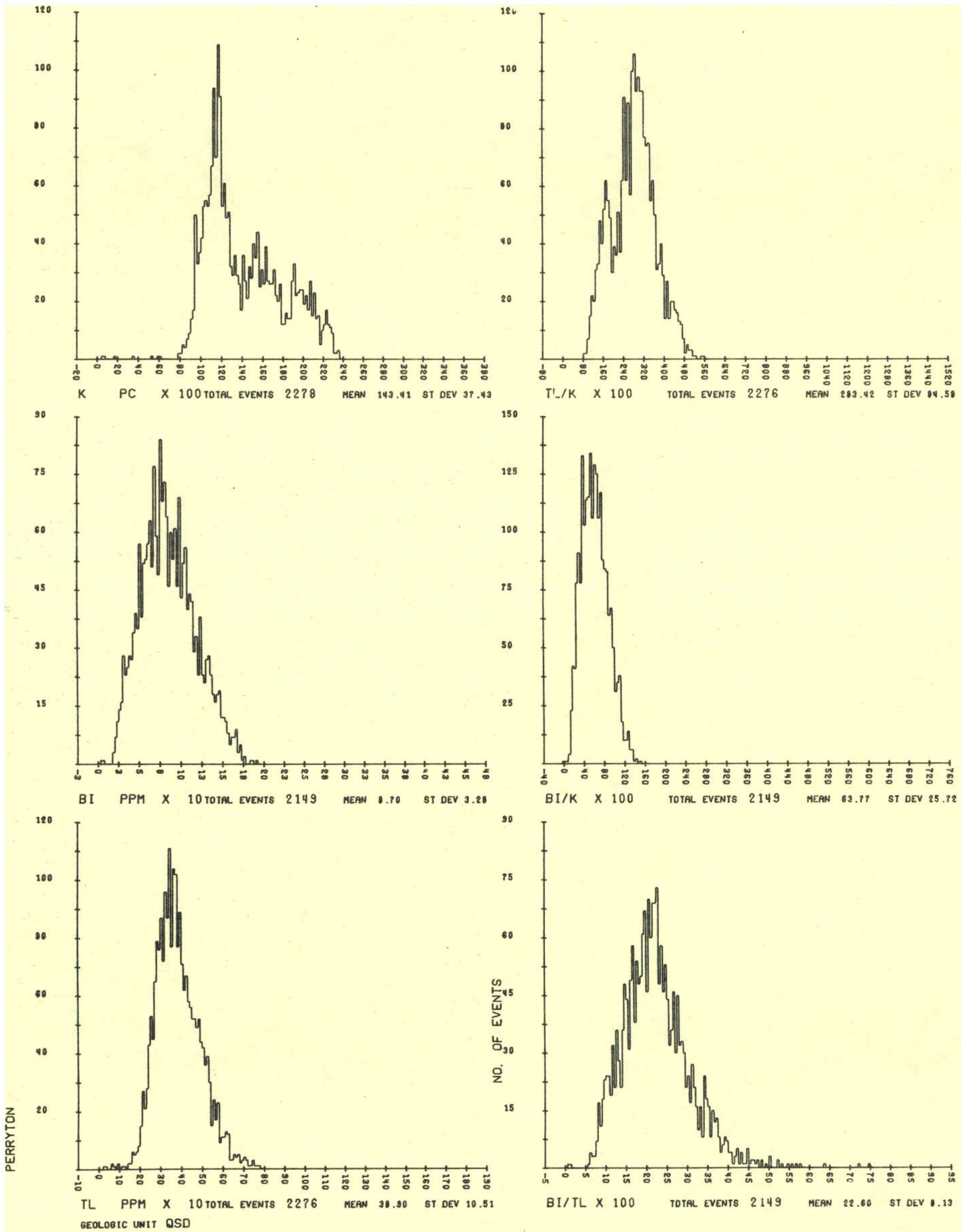
TL/K X 100 TOTAL EVENTS 1223 MEAN 275.91 ST DEV 91.86
BI PPM X 10 TOTAL EVENTS 1207 MEAN 10.92 ST DEV 4.47
BI/K X 100 TOTAL EVENTS 1207 MEAN 66.04 ST DEV 27.83
TL PPM X 10 TOTAL EVENTS 1223 MEAN 45.73 ST DEV 13.62
BI/TL X 100 TOTAL EVENTS 1207 MEAN 24.24 ST DEV 7.90
GEOLOGIC UNIT QS

A2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TL/K X 100 TOTAL EVENTS 2276 MEAN 283.42 ST DEV 94.59
BI PPM X 10 TOTAL EVENTS 2149 MEAN 8.70 ST DEV 3.28
BI/K X 100 TOTAL EVENTS 2149 MEAN 63.77 ST DEV 25.72
PERRYTON
NO. OF EVENTS
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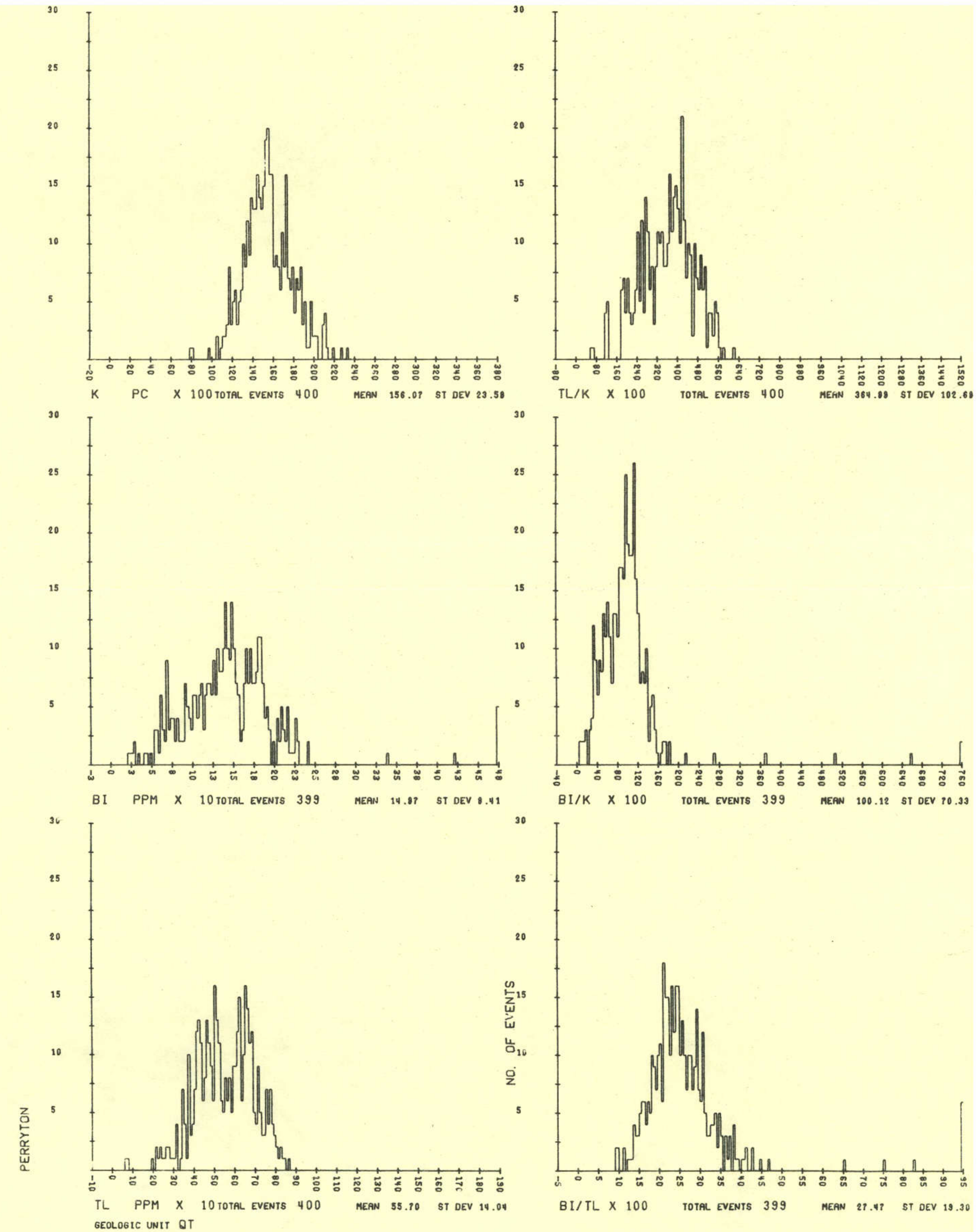
BI/TL X 100 TOTAL EVENTS 2149 MEAN 22.60 ST DEV 9.13
GEOLOGIC UNIT QSD

A3


K PC X 100 TOTAL EVENTS 400 MEAN 156.07 ST DEV 23.58
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BI PPM X 10 TOTAL EVENTS 399 MEAN 14.87 ST DEV 8.41
BI/K X 100 TOTAL EVENTS 399 MEAN 100.12 ST DEV 70.33
PERRYTON
NO. OF EVENTS
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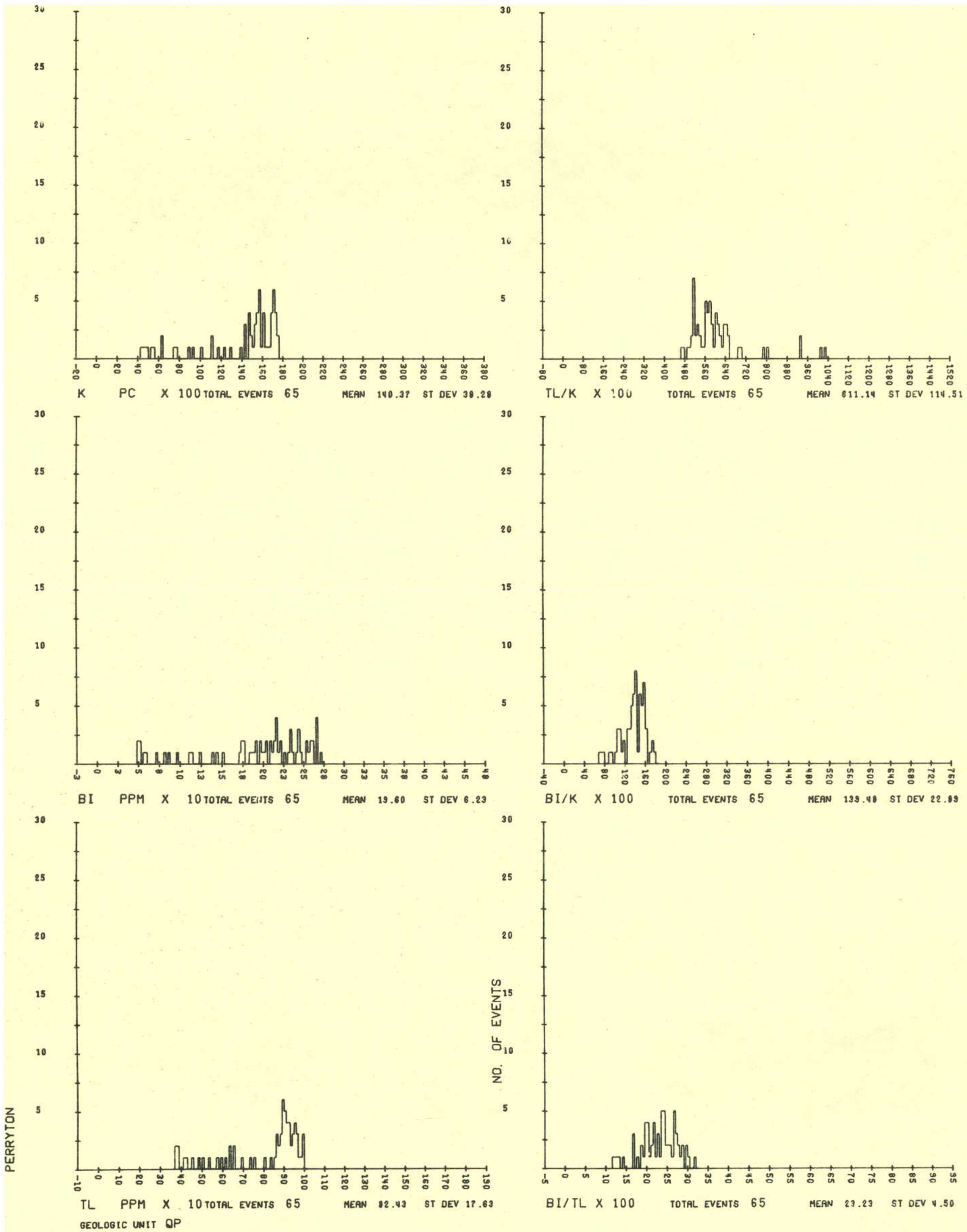
BI/TL X 100 TOTAL EVENTS 399 MEAN 27.47 ST DEV 19.30
GEOLOGIC UNIT QT

A4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TL/K X 100 TOTAL EVENTS 65 MEAN 611.14 ST DEV 114.51
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BI/K X 100 TOTAL EVENTS 65 MEAN 139.49 ST DEV 22.89
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BI/TL X 100 TOTAL EVENTS 65 MEAN 23.23 ST DEV 4.50
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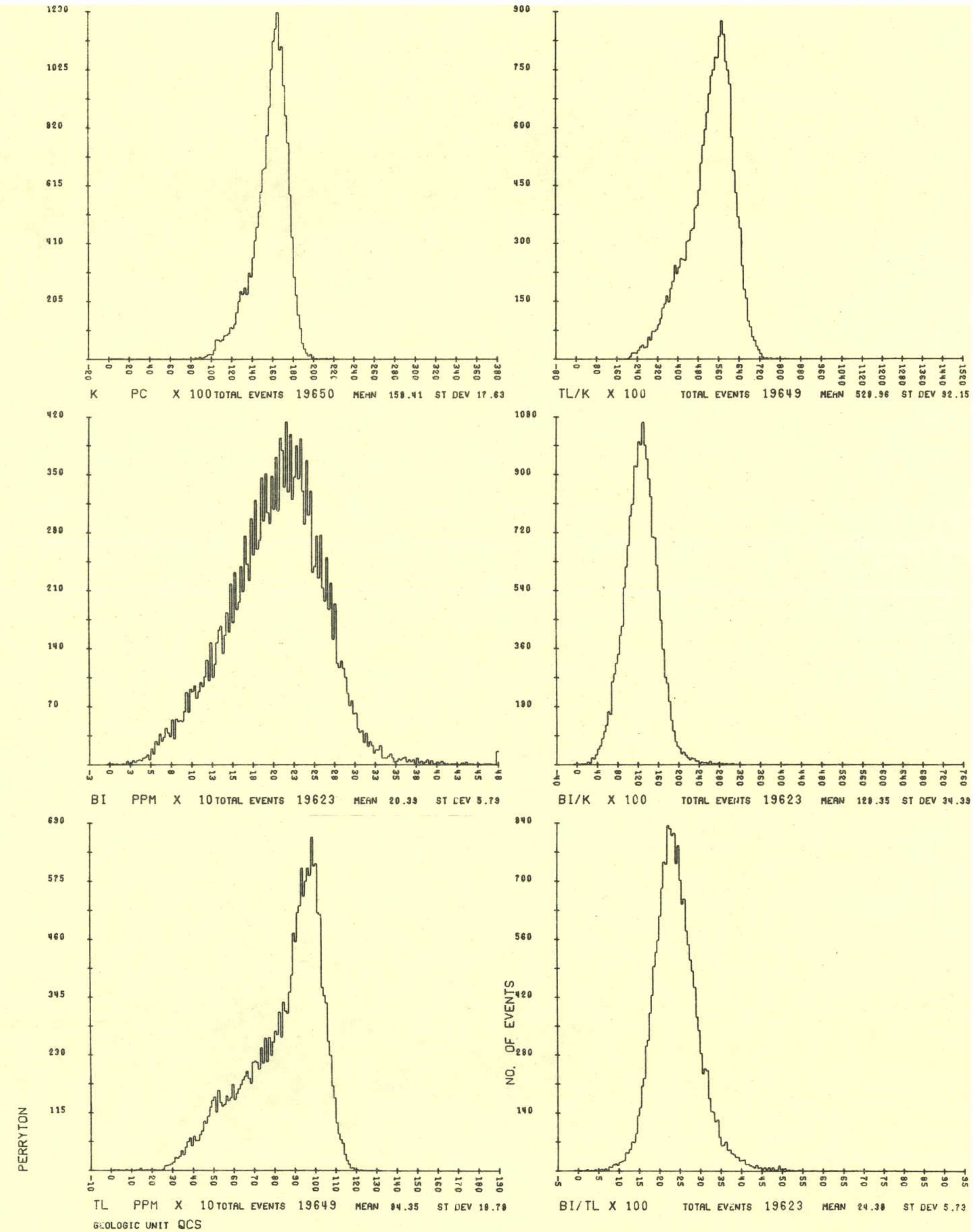
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TL/K X 100 TOTAL EVENTS 19649 MEAN 529.96 ST DEV 92.15
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BI/K X 100 TOTAL EVENTS 19623 MEAN 128.35 ST DEV 34.39
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BI/TL X 100 TOTAL EVENTS 19623 MEAN 24.39 ST DEV 5.73
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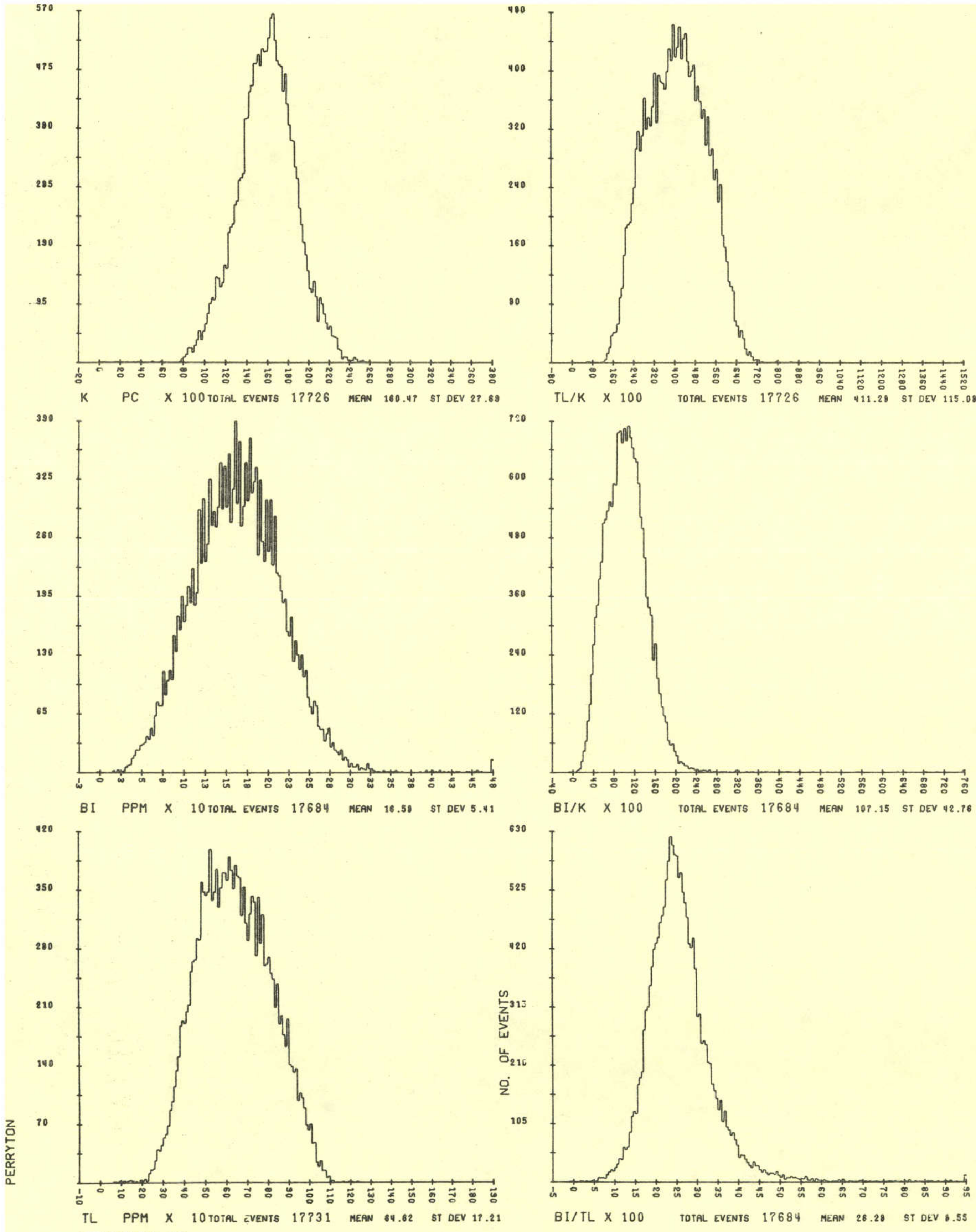
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BI PPM X 10 TOTAL EVENTS 17684 MEAN 16.59 ST DEV 5.41
BI/K X 100 TOTAL EVENTS 17684 MEAN 107.15 ST DEV 42.76
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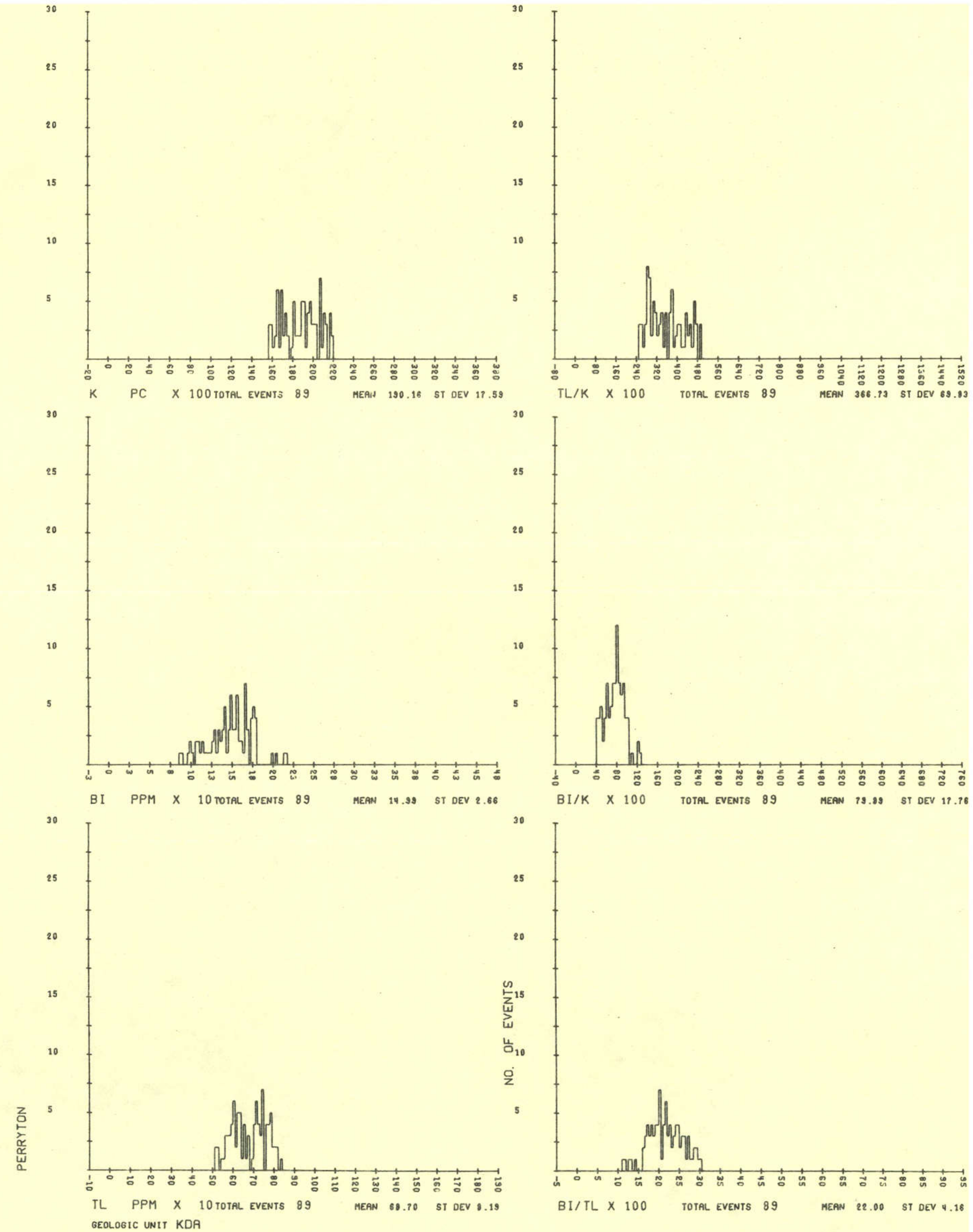
BI/TL X 100 TOTAL EVENTS 17684 MEAN 26.28 ST DEV 8.55
GEOLOGIC UNIT TO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BI/K X 100 TOTAL EVENTS 89 MEAN 79.89 ST DEV 17.76
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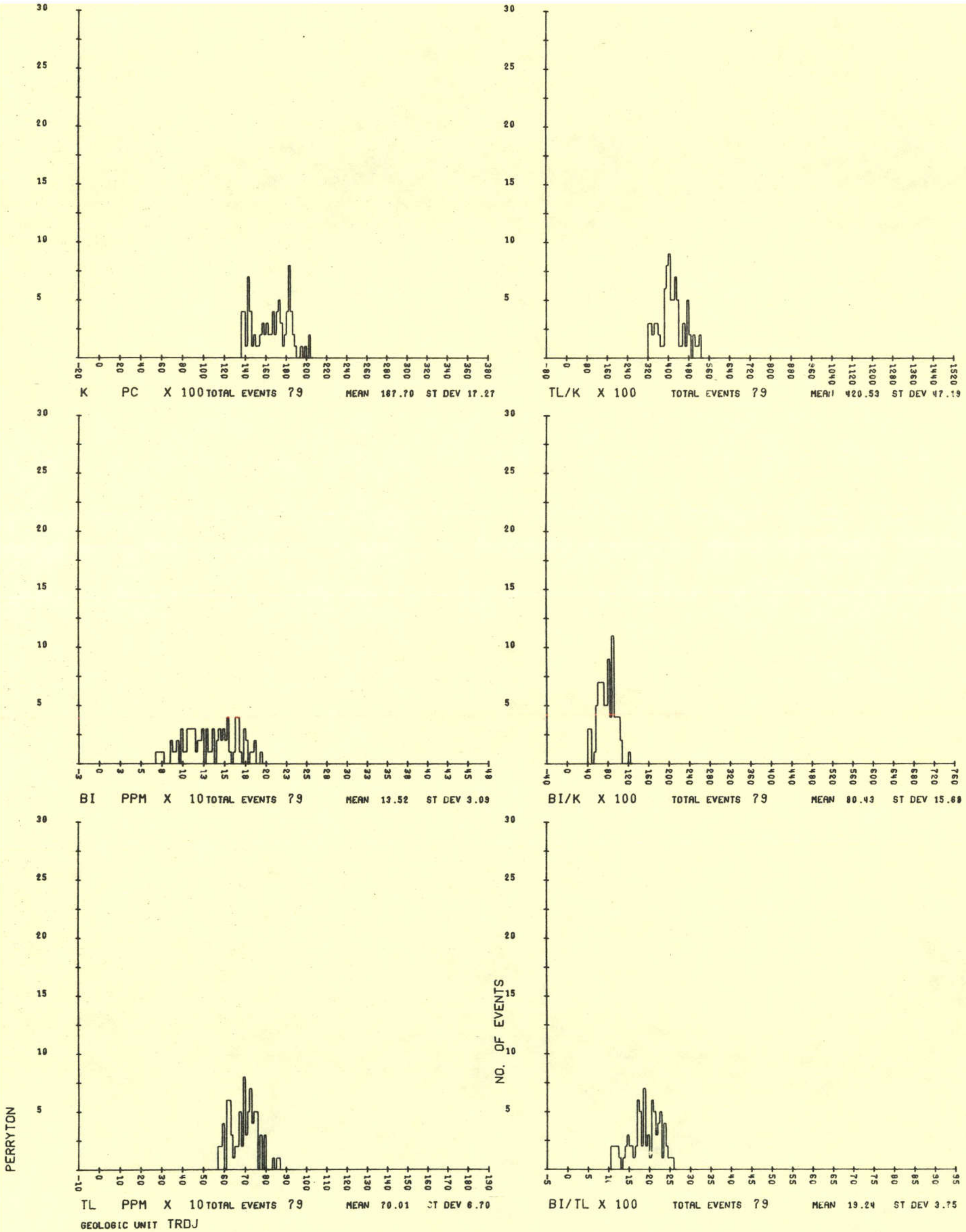
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BI/K X 100 TOTAL EVENTS 79 MEAN 80.43 ST DEV 15.69
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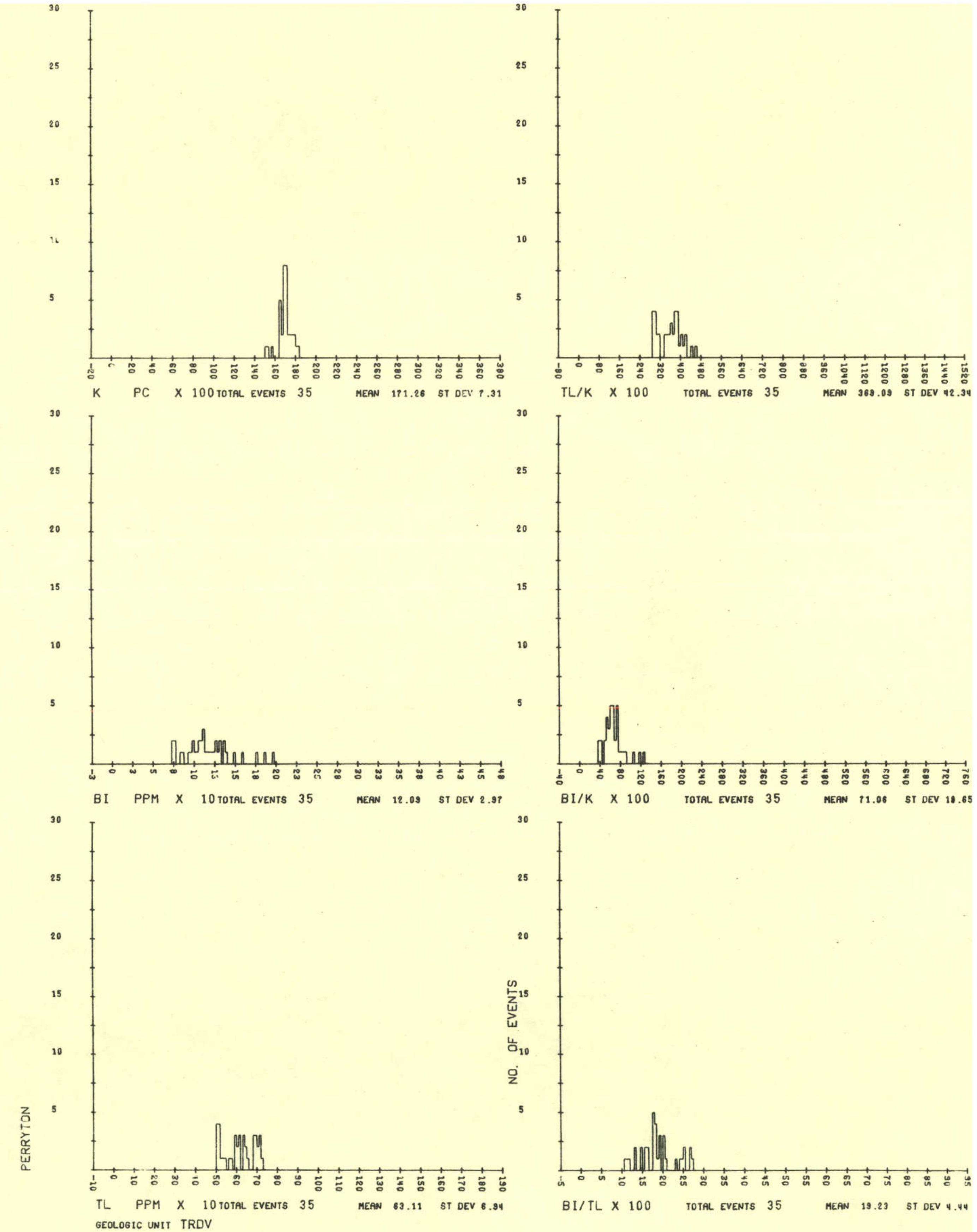
BI/TL X 100 TOTAL EVENTS 79 MEAN 19.24 ST DEV 3.75
GEOLOGIC UNIT TRDJ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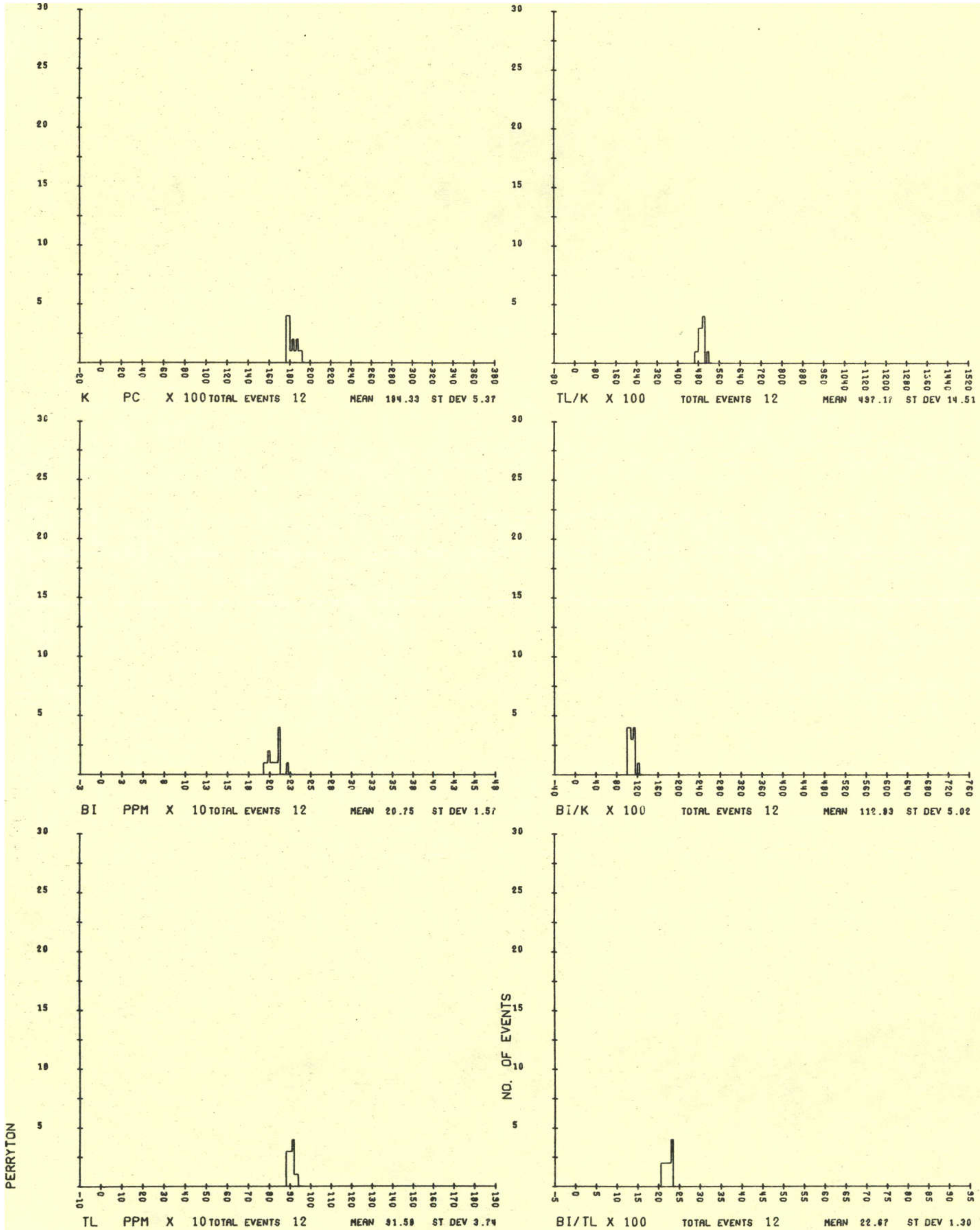
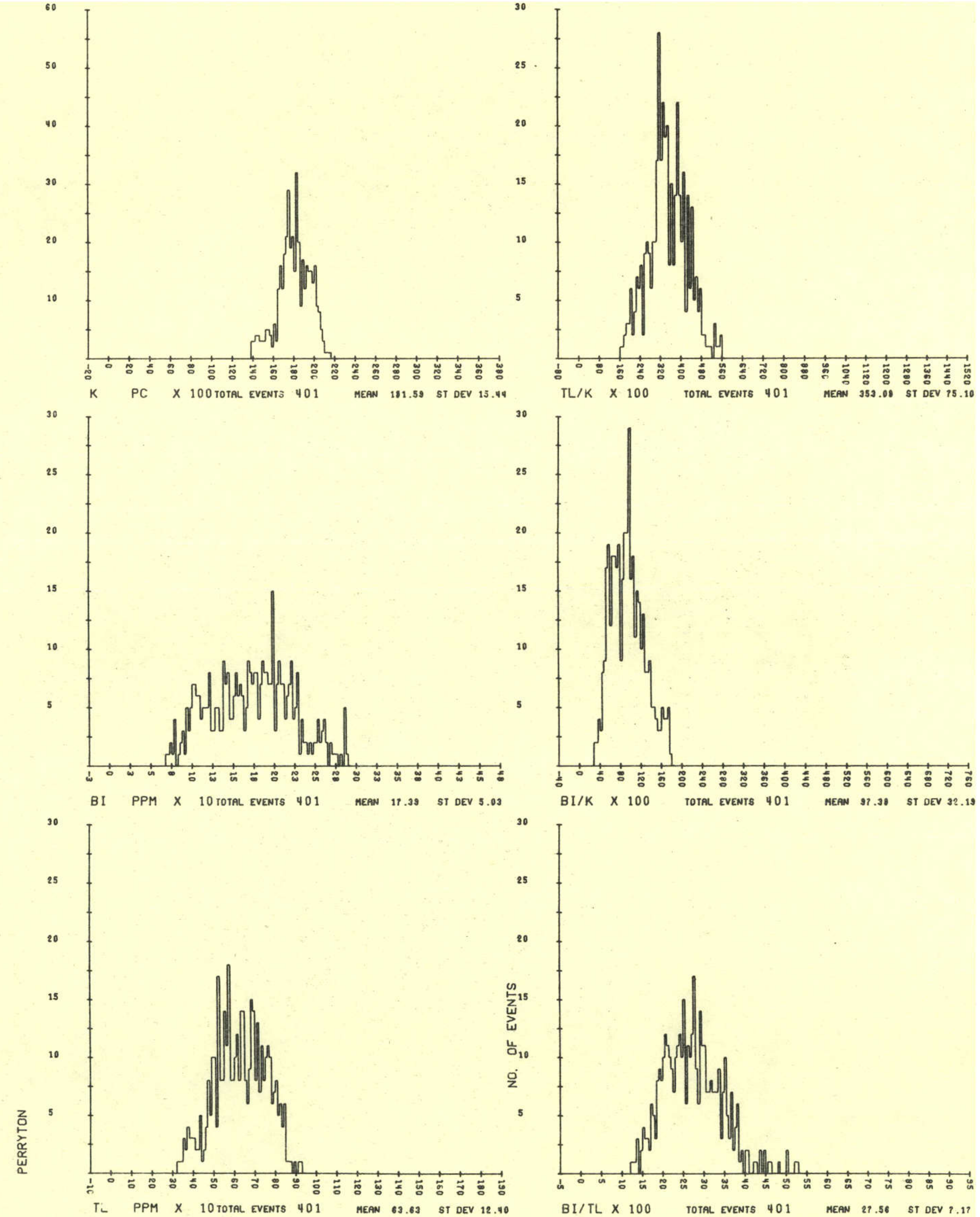
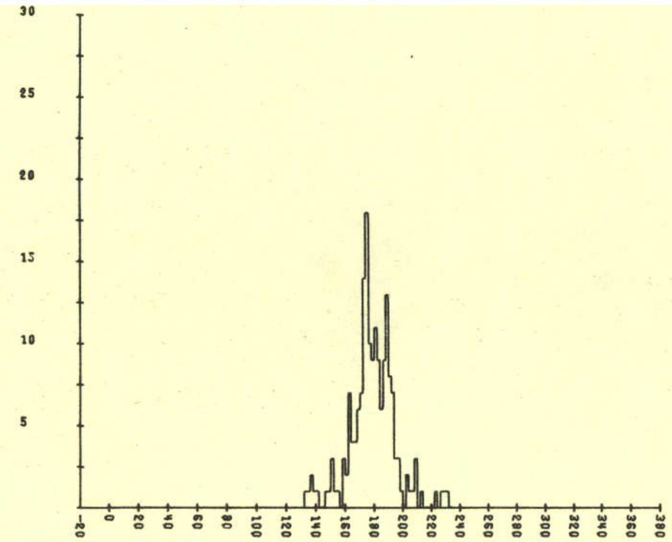
TL/K X 100 TOTAL EVENTS 35 MEAN 369.09 ST DEV 42.34
BI PPM X 10 TOTAL EVENTS 35 MEAN 12.09 ST DEV 2.97
BI/K X 100 TOTAL EVENTS 35 MEAN 71.06 ST DEV 19.65
TL PPM X 10 TOTAL EVENTS 35 MEAN 63.11 ST DEV 6.94
BI/TL X 100 TOTAL EVENTS 35 MEAN 19.23 ST DEV 4.44
GEOLOGIC UNIT TRDV



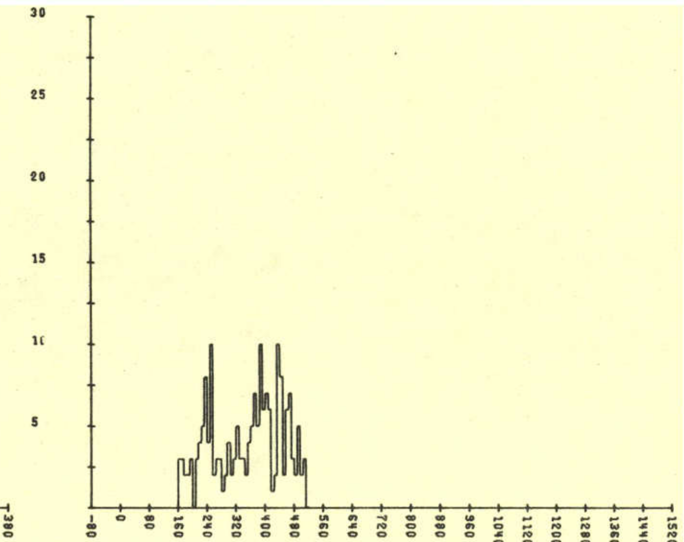
GEOLOGIC UNIT PD



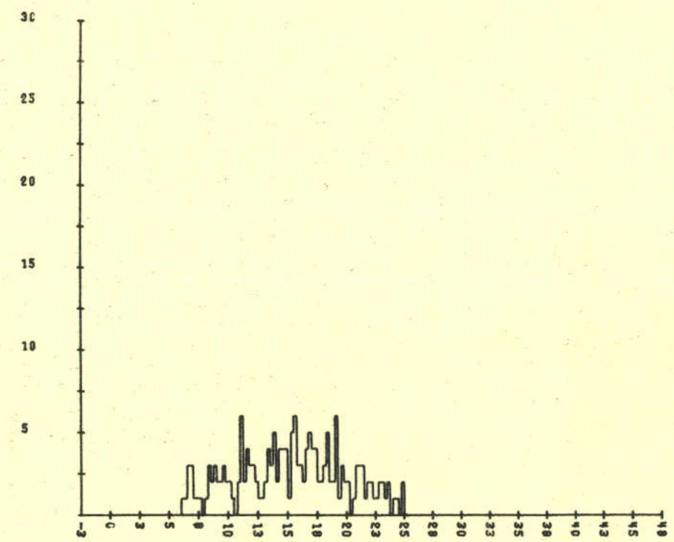
GEOLOGIC UNIT PC



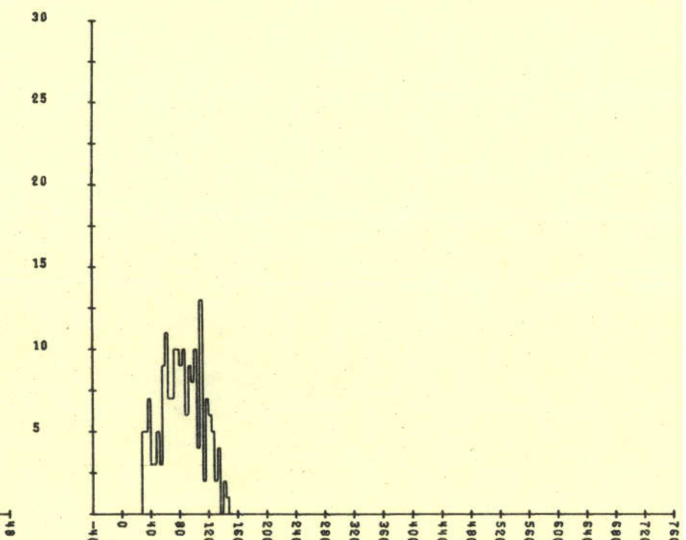
K PC X 100 TOTAL EVENTS 178 MEAN 180.00 ST DEV 18.04



TL/K X 100 TOTAL EVENTS 178 MEAN 356.79 ST DEV 93.49

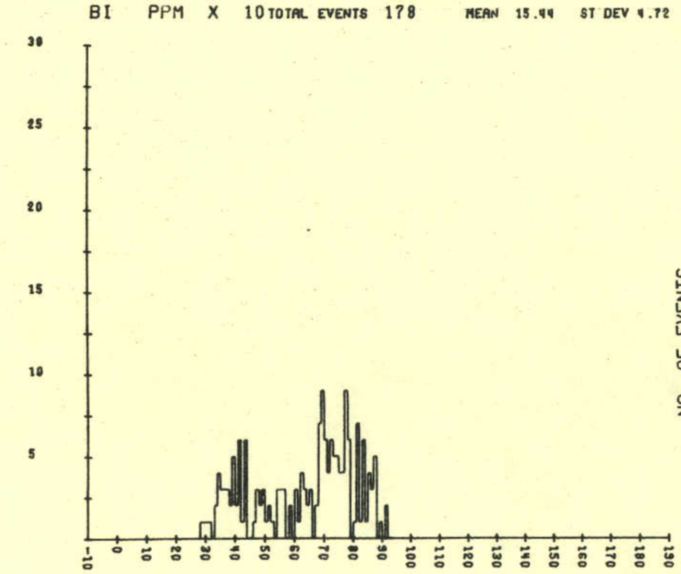


BI PPM X 10 TOTAL EVENTS 178 MEAN 15.44 ST DEV 4.72

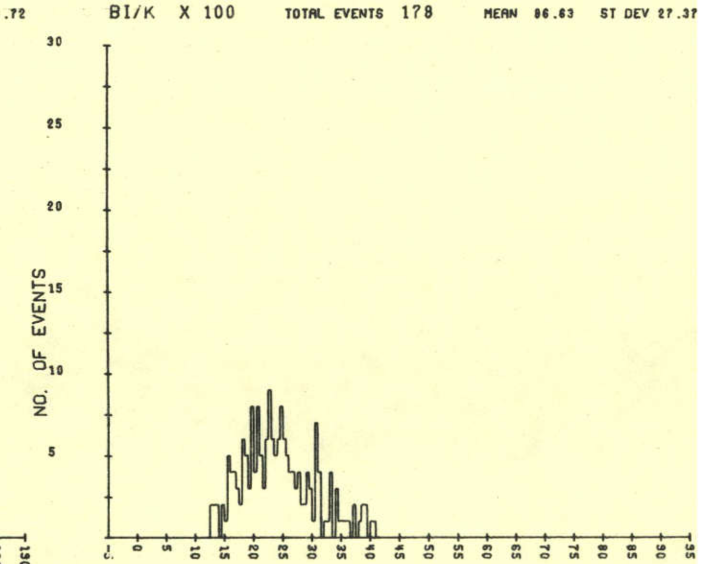


BI/K X 100 TOTAL EVENTS 178 MEAN 86.63 ST DEV 27.37

PERRYTON



TL PPM X 10 TOTAL EVENTS 178 MEAN 64.11 ST DEV 17.10



BI/TL X 100 TOTAL EVENTS 178 MEAN 24.60 ST LEV 6.37

GEOLOGIC UNIT PR

SECTION V

GEODATA DATA AQUISITION AND PROCESSING

SECTION V.

GEODATA DATA ACQUISITION AND PROCESSING

A. DATA ACQUISITION SYSTEM

A brief description of the computer-linked Geodata Data Acquisition System (GDAS), used in the present survey, is presented here. The five primary components of the GDAS, which are mounted aboard a Douglas Super DC-3 aircraft, Figure V.1, are:

1) An array of nine (9) 11½" dia. by 4" thick $NaI(T\ell)$ detectors;

2) a NOVA mini-computer system

3) a Collins ALT-50 radar altimeter system;

4) a proton precession magnetometer; and

5) a Bendix DRA-12C doppler navigation system.

The nine-crystal detector array has been calibrated to measure the gamma radiation spectrum between 0-6 MeV. The contents of the 3 to 6 MeV interval is monitored in order to reduce the contributions of the cosmic events in the 0-3 MeV interval, which is of primary interest in this survey. Eight of the nine detectors are mounted to measure the 4π solid angle gamma radiation spectrum emanating from the earth's surface. The ninth detector, which is partially shielded underneath by a 3.5-inch lead plate, is situated to measure the ^{214}Bi radiation incoming from the upper 2π solid angle.

Each crystal detector has an estimated volume of 415.5 cubic inches, resulting in a total volume for the entire 4π system of 3324 cubic inches. The estimated volume to velocity ratio for this sytem is 23.7, where the average speed for the DC3-S is approximately 140 mph.

The energy resolution of the GDAS as calculated from the ^{137}Cs 662 keV photopeak was 10.7%, where each individual crystal was 9.0% or better. Automatic digital gain calibration for the eight detector array and the single detector system was accomplished by stabilizing on the ^{40}K photopeak data.

The NOVA computer, shown in the system block diagram of Figure V.2. is the control center of the GDAS. The data is gathered by the computer for every one-second period in a manner giving no dead time when readout to the magnetic tapes for storage. Two magnetic tape recorders are used; one to record the total spectral data and the computer tabulated results (LDT), and the other to record only the computer tabulated results (CDT).

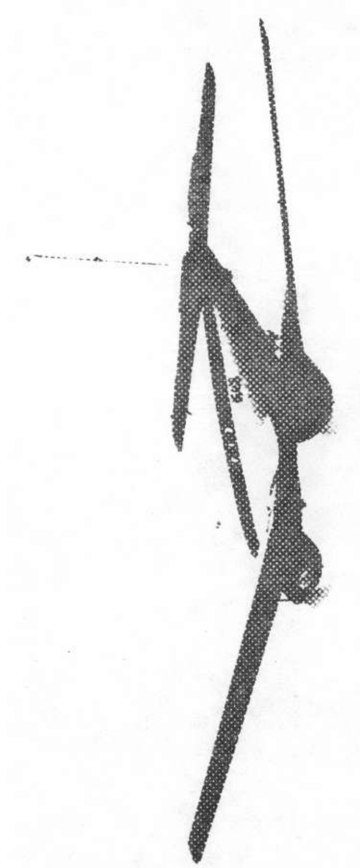


Figure V.1 Survey Aircraft

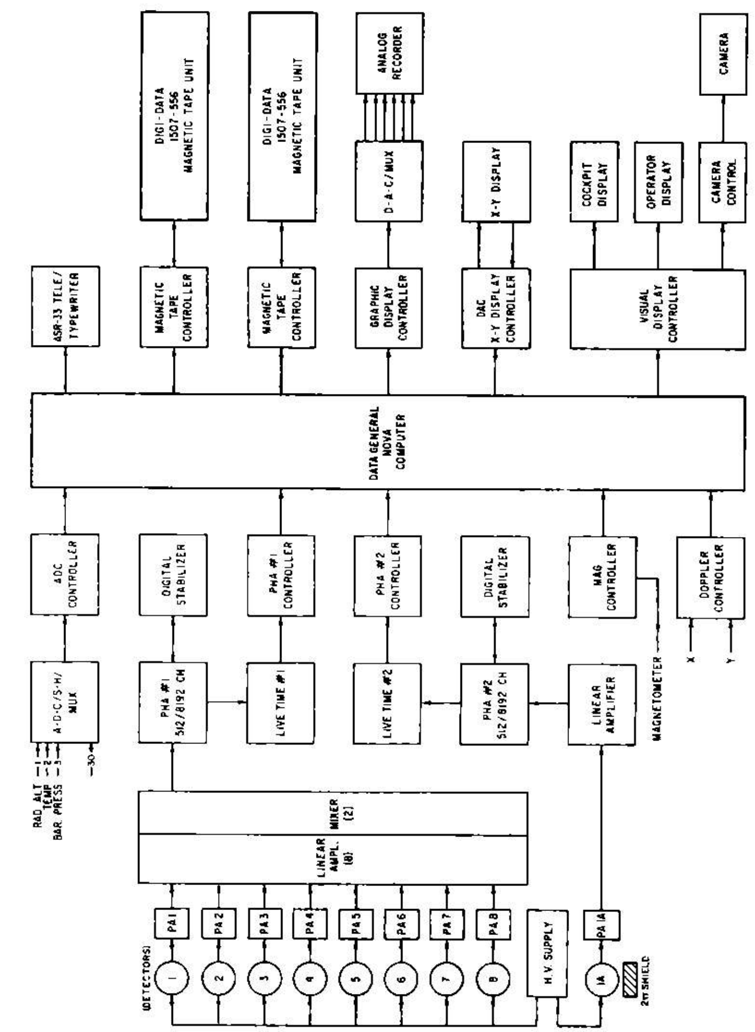


Figure V.2 System Block Diagram

Digital-to-analog conversion of the resultant intensities, their ratios and the magnetic field data are plotted on multi-track paper, allowing immediate examination for anomalous data.

The spectral data from the single detector system gathers and records the 2π spectral data every nine seconds. This 2π data is necessary to determine the amount of atmospheric ^{214}Bi radiation in the 4π spectral data. A third segment of the computer's core gathers and sums the total 2π and 4π gamma radiation spectra for each flight line, which can then be plotted as shown in Figure V.3 (EOFL spectrum).

Due to the dependence of the gamma ray data on altitude, a highly accurate radar altimeter is used. The Collins ALT-50 system is designed to make a series of 8 measurements per second, where the resulting altitude is the average.

Since the gathered data are dependent on the current ambient temperature and pressure readings, a Senso-Tek barometric pressure sensor and a Hy-Col thermocouple sensor were used to monitor conditions outside the aircraft.

A proton precession magnetometer sensor, having a 0.25 gamma readout resolution and less than a 1.0 gamma noise envelope, is sampled every second to yield a measurement of the total intensity of the earth's magnetic field below the aircraft. The sensor is carried as a "bird" on a 100-foot cable in order to minimize the magnetic effects of the aircraft.

A Bendix DRA-12C navigation system with a ±100th/nautical mile accuracy provides a doppler navigation cross-track and along-track analog signal to be recorded each second onto magnetic tape. Two other methods are used to properly locate the aircraft's track: visual sightings and photography. The first method is employed by the navigator who marks flight map location reference points with computer-displayed record numbers. The second method is a 35mm film that records a continuous, recoverable track which has a 20% overlap/frame at an elevation of 400 feet.

There are three basic operating modes of the GDAS that the operator can manipulate:

1) CALIBRATE, which allows proper gain calibration for the detectors;

2) OPERATE, which allows data to be collected, summed and recorded; and

3) PLAYBACK, which allows the operator to examine the newly acquired data.

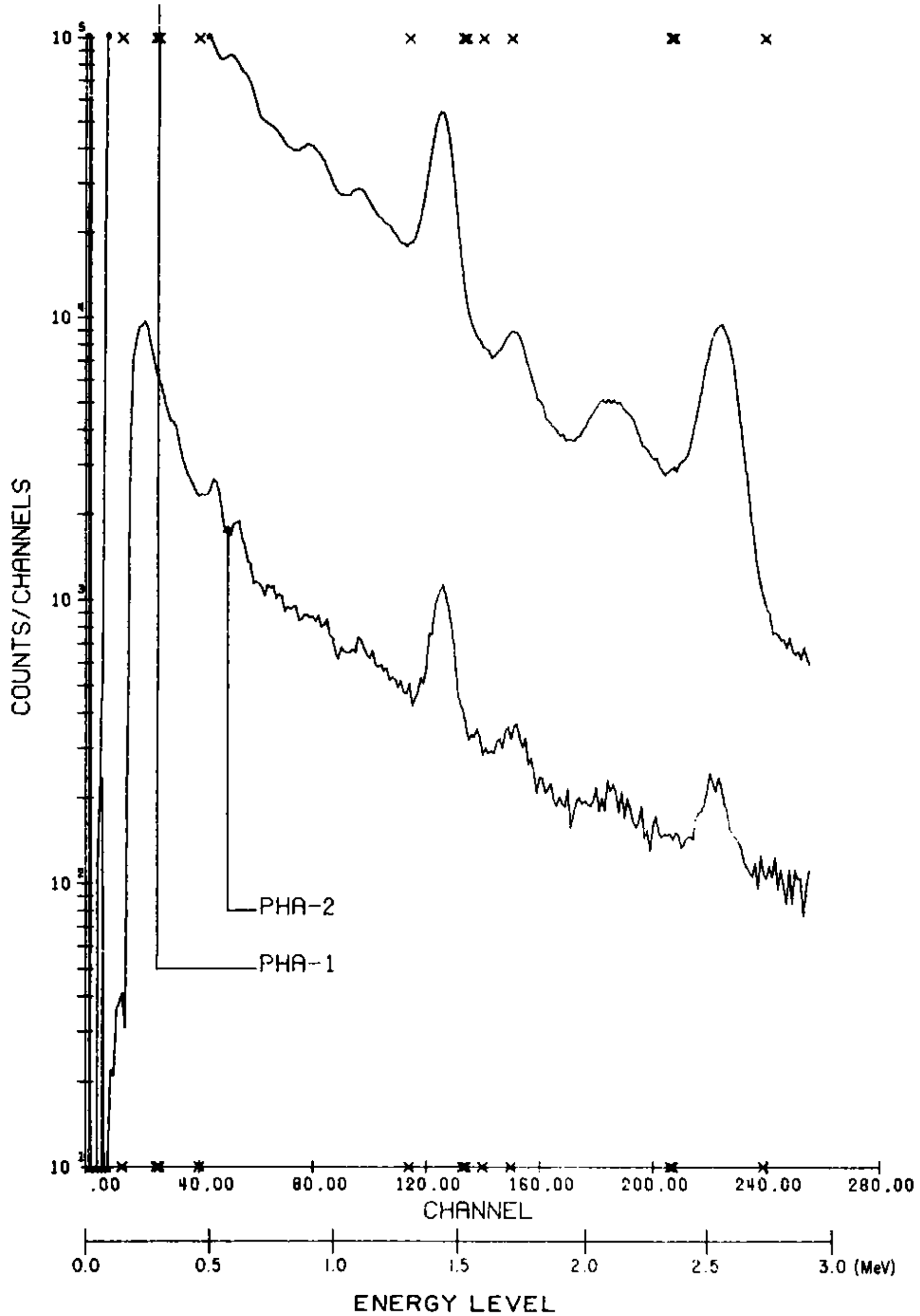


Figure V.3 Typical End-of-Flight-Line Spectral Plot

B. DATA PROCESSING

1. Data Reduction

The field data tapes produced by the data acquisition system (Section V.A) contain the 4π and 2π gamma radiation spectra, measured between 0 to 6 MeV. The resulting gamma ray spectra are composite spectra of the several different isotopes that emit gamma rays within the detectors' energy range. The method used in this work to determine the concentrations of the different isotopes monitored is discussed in this section.

In this work, there are four different isotopes which contributed to the resultant composite spectra under consideration. In order of the highest to lowest energy emitter, they are: cosmic, eTh, eU and K counting rates.

Isotope	Energy Interval (MeV)
Cosmic	3.0 to 6.0
^{208}Tl	2.410 to 2.796
^{214}Bi	1.661 to 1.860
^{40}K	1.357 to 1.556

Due to the occurrence of Compton scatter at all gamma ray energy intervals, a 4 x 4 matrix method approach is used to "spectrally strip" the group summed counting rates into their individual counting rates attributed only to the isotope associated with that energy interval.

This matrix method approach is theoretically applicable to a spectrum containing any number of isotopic gamma rays. For convenience, the four isotopes will be denoted as: COS, TL, BI and K. The channel group sum for each energy interval can be considered to consist of fractional components of each of its constituents. For instance, one can write for the TL channel group sum:

$$aCOS + 1.0TL + fBI + 0.0K = MTL$$

where MTL is the channel group sum count;

and the coefficients, which are known as Compton coefficients, for each variable represent the responses of the data gathering system to each isotope over the entire energy spectrum.

Similarly, equations can be written for the energy interval group sums for MCOS, MBI and MK, as shown below in matrix notation by

$$
\begin{bmatrix} 1.0 & 0.0 & 0.0 & 0.0 \\ a & 1.0 & f & 0.0 \\ b & \alpha & 1.0 & g \\ c & \beta & \gamma & 1.0 \end{bmatrix}
\begin{bmatrix} COS \\ TL \\ BI \\ K \end{bmatrix} =
\begin{bmatrix} MCOS \\ MTL \\ MBI \\ MK \end{bmatrix}
$$

where each element of the 4 x 4 matrix is a Compton coefficient. By inverting the 4 x 4 matrix and multiplying on the left by the channel group sum matrix, the resulting column matrix, whose elements are COS, TL, BI, and K, represents the counts in each energy interval attributed only to the indicated isotope source.

Table V.1 contains the data reduction parameters, coefficients and backgrounds used in this survey. The listed Compton coefficients were determined from data acquired during high altitude flights and from "known" test pad data concentrations in Grand Junction, Colorado.

The resulting reduced counting rates for COS, TL, BI and K must then be normalized with respect to the measured live time counting rate of the data acquisition system. This is necessary in order to restore the linear relationship between the photopeak counts and the source's intensity. This procedure is accomplished by dividing the reduced counts by the live time, LTC1:

thus,

$$
\begin{aligned}
COS1 &= COS/LTC1 \\
TL1 &= TL/LTC1 \\
BI1 &= BI/LTC1 \\
K1 &= K/LTC1
\end{aligned}
$$

The next step in the data processing involves the subtraction of the background counts present onboard the aircraft. The background counts, which exist in the aircraft and its equipment, are determined from high altitude data where the data acquisition is free from all ground sources and atmospheric ^{214}Bi contamination. The background counts, denoted as B_{TL}, B_{BI} and B_K, used in this work are listed in Table V.1. During the processing, the backgrounds are checked by observing the resulting counting rates over large bodies of water, where the rates would have near zero intensities. The gross count's background counting rate, B_{GC}, over channels 35-239, is also given in Table V.1.

After the backgrounds have been subtracted from the live time corrected photopeak counts, thus

$$
\begin{aligned}
\overline{TL1} &= TL1 - B_{T\ell} \\
\overline{BI1} &= BI1 - B_{Bi} \\
\overline{K1} &= K1 - B_K
\end{aligned}
$$

The resulting counting rates for $\overline{TL1}$ and $\overline{K1}$ represent the counts contributed only by the sources below the aircraft on the earth's surface. In the case of $\overline{BI1}$, an additional source of ^{214}Bi radiation, which is caused by atmospheric ^{214}Bi, BIAIR, is still eminent.

The 2π detector system data is used to determine the magnitude of the BIAIR to be subtracted. Since the predominate variable source affecting the 2π detector is the atmospheric ^{214}Bi, it is possible to utilize most of the 2π spectrum in the BIAIR determination, and thereby produce some improvement in the statistical error. The energy interval used for the 2π crystal is between 1.05 to 2.79 MeV. Within this interval, the aircraft's background, $B_{2\pi}$, and its Compton coefficient, $C_{2\pi}$, have been determined from the high altitude data. (See Table V.1).

The BIAIR associated with the unshielded detector array is determined, using the shielded detector by the relation:

$$
BIAIR = \frac{G(x)}{(1 - k_2 G(x))} \left[VC - C_{2\pi} \cdot COS1 - b_{2\pi} - RVALM\right]
$$

where

G(x) — is the relationship between the 4π and 2π solid angles, the channel group sums and the number of detectors in the detector arrays;

VC — is the 2π total count group sum of channels 91-239, c/s:

COS1 — is the 4π cosmic count, greater than 3.0 MeV, c/s;

and,

$$
RVALM = k_1 \overline{TL1} + k_2 \overline{BI1} + k_3 \overline{K1}
$$

where k_1, k_2, k_3 are constant factors that correct for the penetration/spill of the emanated surface radiation. These penetration/spill constants are dependent on the amount of lead shielding used on the 2π crystal. The values used in this work are listed in Table V.1.

$\overline{TL1}$, $\overline{BI1}$ and $\overline{K1}$ have already been defined as the 4π reduced data counting rates, c/s.

Finally, the ^{214}Bi counting rate caused only by the surface sources is given by

$$
BISUR = \overline{BI1} - BIAIR
$$

Briefly summarizing, $\overline{TL1}$, BISUR and $\overline{K1}$ are the counting rates as measured at the height of the aircraft. All interfering counts from cosmic, backgrounds and atmospheric ^{214}Bi have been removed.

Since the various counting rates are dependent upon the height of the aircraft above the surface terrain, it is necessary to correct the associated isotope's counting rate to an altitude of 400 feet above the surface terrain. This is accomplished through the equations indicated below:

$$
TLS = \overline{TL1} \cdot e^{-\mu_1 (400 - \frac{\rho}{\rho_o} x)}
$$

$$
BIS = BISUR \cdot e^{-\mu_2 (400 - \frac{\rho}{\rho_o} x)}
$$

$$
KS = \overline{K1} \cdot e^{-\mu_3 (400 - \frac{\rho}{\rho_o} x)}
$$

and

$$
GC(\text{gross count}) = (\overline{GC} - B_{GC} - S \cdot BIAIR) \cdot e^{-\mu_4 (400 - \frac{\rho}{\rho_o} x)}
$$

where

$\overline{GC}$ — is the live time corrected gross count, channels 35-239,

S — is the ratio of the BI data, channels 35-239 to channels 143-159,

B_{GC} — is the gross count background,

TLS,BIS,KS	are the respective photopeak's counting rates at 400 feet;
ρ_o	is the air density at standard temperature and pressure; 0.001293 gm/cc
ρ	is the air density at the time the survey data was flown;
μ_1,μ_2,μ_3,μ_4	are the respective linear attenuation coefficients;
x	is the aircraft's height above the surface terrain in feet.

The attenuation coefficients and other constants used in the altitude normalization are listed in Table V.1.

After each flight line of data has undergone the above data reduction, the average values for each radiation variable and variable ratios for each of the flight lines were plotted to demonstrate the consistency of the average values and that a smooth flow continues from day to day, and from the start to the finish of each day.

Diurnal variations of the magnetic field base station intensity were measured and applied to the field data. (See Section II.D and Appendix I.C). The magnetic heading corrections for the aircraft and its equipment used in this survey were determined by flying a predetermined path at a survey altitude in first an east to west direction, then in a west to east direction. The same procedure is used on a north to south path. Based on the data obtained in this fashion, see Table V.1, the heading corrections were removed from all the data. The magnetic field data were then IGRF corrected to give the residual magnetic field. The International Geomagnetic Reference Field subtracted was provided by the U.S. Geological Survey with reference to the IAGA Bulletin #38, "Grid Values and Charts by the IGRF 1975.0", National Technical Information Service Report #PB265483.

The system sensitivities at 400 feet used in this survey are shown in Table V.1.

2. Description of the Data Processing

The processing flow chart representative of the work performed in this survey is shown in Figure V.4.

As stated in Section V.A., the original field data tapes were recorded to contain the various tag words, 4π and 2π spectral

TABLE V-1: DATA REDUCTION PARAMETERS AND CONSTANTS - N540S - 1980

AIRCRAFT BACKGROUNDS				COSMIC CORRECTION RATIOS	
Detector	Parameter	Window	Value (CPS)	Parameter	Value
Terrestrial (4π)	B_K	Potassium	29.98	c	0.2069
	B_{Bi}	Uranium	9.40	b	0.1651
	$B_{T\ell}$	Thorium	5.83	a	0.2202
	B_{GC}	Gross	286.69	-	-
Atmospheric (2π)	$B_{2\pi}$	Uranium	8.33	$C_{2\pi}$	0.2232

DERIVED STRIPPING COEFFICIENTS AND RATIOS			
Coefficient	Value	Coefficient	Value
α	0.2755	k_1	0.030
β	0.4058	k_2	0.0
γ	0.8595	k_3	0.0
f	0.0693	S	17.5
g	0.0156	-	-

LINEAR ABSORPTION COEFFICIENTS		
Radio Element	Parameter	Value ($x10^{-3}$ per ft.)
Potassium	μ_1	2.448
Uranium	μ_2	1.329
Thorium	μ_3	1.899
Gross	μ_4	1.430

MAGNETIC HEADING CORRECTION	
Flight Direction	Correction (gammas)
West to East	+3.56
East to West	-3.56
North to South	-1.0
South to North	+1.0

RADIOELEMENT	SYSTEM SENSITIVITIES AT 400 FEET
Potassium (cps/%K)	98.06
Uranium (cps/ppm eU)	13.52
Thorium (cps/ppm eTh)	7.15

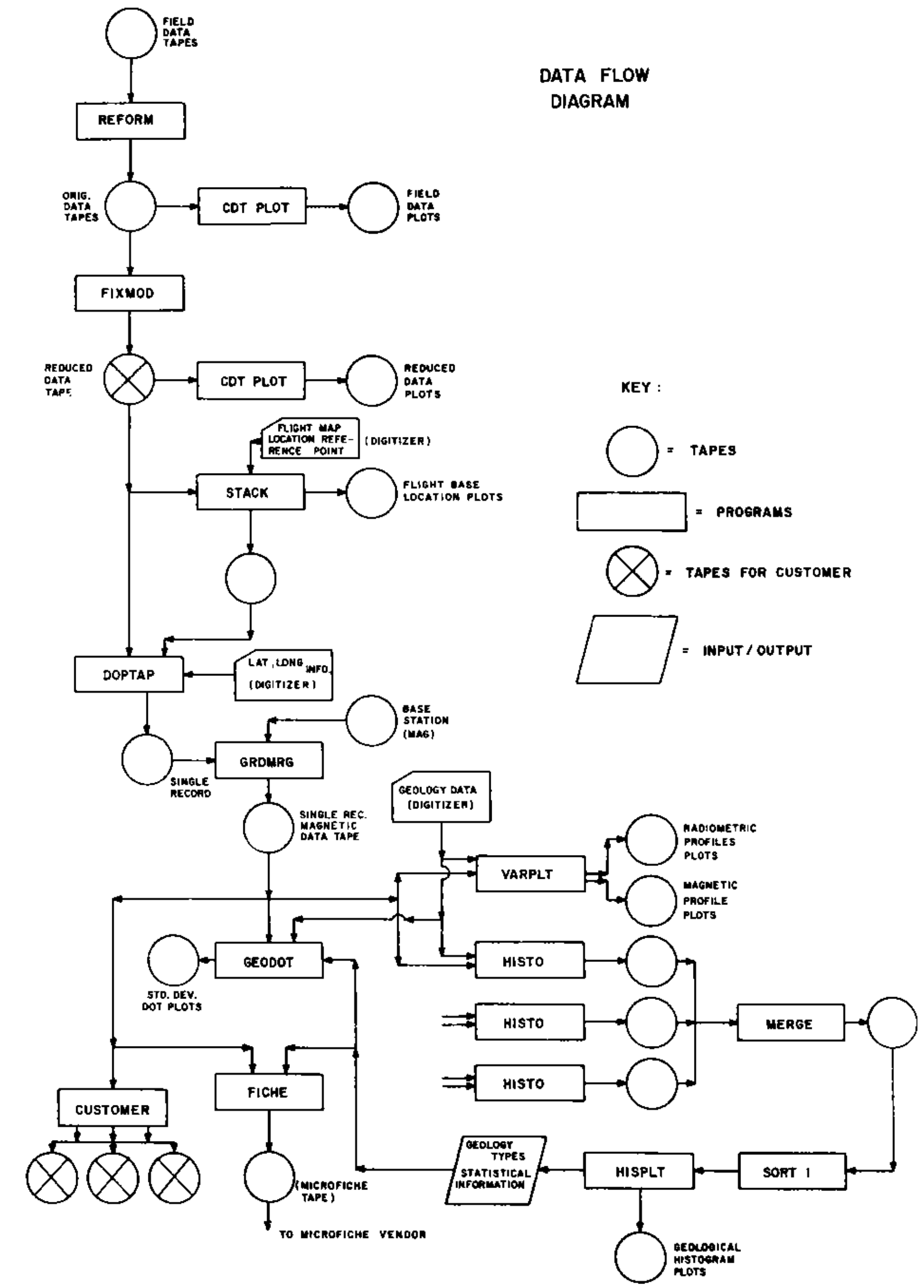


Figure V.4 Data Reduction Flow Chart

data and the trailer record sums for each flight line. The purpose of the REFORM program is to sum the raw spectral data (LDT) into the proper group sum energy intervals for each second for each line. The CDTPLT program is a data certification program that produces the EOFL spectral plots, Figure V.3, and profiles of each of the channel group sums, which are plotted as a function of each line's record numbers.

A brief summary of each program and its uses is given below:

PROGRAM	FUNCTION
REFORM	Produces energy group sums and EOFL spectra.
FIXMOD	Primary processing for "spectral stripping" matrix reduction, live time normalization, background and BIAIR subtraction, and altitude corrections.
STACK	Flight path recovery to produce record location map at a scale of 1:250,000.
DOPTAP	Single record processing with latitude/longitude positioning, IGRF and single point statistical adequacy computations, and magnetic heading corrections.
GNDMRG	Merges aircraft magnetometer and ground magnetometer in proper time sequence and applies diurnal corrections to the field data.
VARPLT	Produces radiometric and magnetic stacked profile plot tapes.
HISTO,MERGE, and SORT1	Preliminary programs to prepare/sort data as a function of geologic type for the entire area.
HISPLT	Produces geological histograms,mean and standard deviation tables,and plot tape for the entire area.
GEODOT	Produces plot tape for standard deviation "dot plots" related to geologic type.
FICHE	Produces average record and single record reduced data listings and microfiche tapes, which are sent to microfiche vendor.
CUSTOMER	Produces all customer required tapes.

3. Data Presentation

The surveyed area was positioned geographically to completely cover the specific National Topographic Map. Each topographic map has been used as the flight base and sufficient geographical and 15' location information has been shown. The flight line pattern has been superpositioned onto these created base maps, where the standard deviation levels for each independent variable and each ratio of these variables have been plotted (NGRMS), based on the data contained within the total map area. Every fifth data point along each map line has its standard deviation value shown at the location of that value. Therefore, there are six NGRMS sheets which indicate the location and magnitude of anomalous data.

The multivariable map line profile, which represents 10 variables as a function of their latitude and longitude location for each line, is presented at a scale of 1:500,000. Each profile presents:

1. Aircraft altitude above the surface
2. eTh (^{208}Tℓ from ^{232}Th decay series)
3. eU (^{214}Bi from ^{238}U decay series)
4. K (^{40}K from natural potassium)
5. BIAIR (atmospheric ^{214}Bi)
6. Residual magnetic field
7. Gross count (greater than 400 keV)
8. eU/eTh (^{214}Bi/^{208}Tℓ) ratio
9. eU/K (^{214}Bi/^{40}K) ratio
10. eTh/K (^{208}Tℓ/^{40}K) ratio
11. Geologic data, including aircraft flight path

The residual magnetic field map line profile, which represents five variables as a function of their latitude and longitude location for each line, plus geologic data at a scale of 1:500,000 is presented as:

1. Aircraft altitude
2. Atmospheric temperature
3. Atmospheric pressure
4. Residual magnetic field data
5. Magnetic field base line station data
6. Geological data, including aircraft flight path

The output of these various computations supplies, beyond two profile sets, the following data:

* Histograms of the radiation data distribution within each geologic unit.

* Histograms of the average velocity distribution for each one-second record for each map and tie line.
* Histograms of the average altitude distribution for each one-second record for each map and tie line.
* Tables giving the average radiation concentration of each geologic unit for each flight line.
* Average radiation concentration for each variable as a function of flight line, including the atmospheric ^{214}Bi.
* Set of maps showing the standard deviation data as a function of location and radiation variable.
* Printer plot contour maps of eTh, eU, K, eU/K, eU/eTh, eTh/K and the magnetics at a scale of 1:500,000.

4. Statistical Analysis Procedures

It is necessary to exclude from the statistical analysis all variables which have too low a counting rate to be statistically valid, and data which were obtained at altitudes above 1,000 feet. To this end, a statistical adequacy test was run on all data for each data record. If a given value of Tℓ, Bi or K failed the test, that variable value, and any ratio value associated with it, were not used in the statistical determinations of mean and standard deviation values. In addition, such values are indicated on the radiometric profiles by a vertical (tick) mark along the base line for the variable, and are flagged in the single record and averaged record listings (microfiche). The ratio values are set to zero in the Radiometric Profile Plots. The flags in the listings appear under the heading AKUT for altitude, ^{40}K, ^{214}Bi and ^{208}Tℓ, respectively. The flags are zero for statistically valid data, and one for rejected data in the case of K, U and T. For altitude (A), a zero indicates altitudes to 700 feet, a one (1) indicates altitudes between 700 and 1,000 feet, and a two (2) indicates altitudes above 1,000 feet.

The tests used to reject data were as follows:

(1) $\overline{T\ell I} < 1.5 \sqrt{T\ell w - \overline{T\ell I}} = 1.5\sigma T$

(2) $BISUR < 1.5 \sqrt{Biw - BISUR} = 1.5\sigma B$

(3) $\overline{KI} < 1.5 \sqrt{Kw - \overline{KI}} = 1.5\sigma K$

where the "w" subscript refers to the respective window counting rates from the raw data and $\overline{T\ell I}$, BISUR and $\overline{KI}$ have previously been defined. If any of the above inequalities were true, the associated variable was flagged, and that value was rejected in all statistical determinations.

The values of the radicals in the above equations, which are indicated as σT, σB, σK and the barred values, were calculated on the basis of a single record value for determining flags in the single record listings and the 7-point weighted values for determining flags in the averaged records listings.

The mean value and standard deviations were calculated assuming the data to have a normal distribution within a geologic type. The equation used in determining the variance is:

$$\sigma^2 = \frac{1}{N-1} \left\{ \sum_{i=1}^{N} x_i^2 - N\overline{x^2} \right\}$$

where N is the number of statistically valid samples for a given geologic type, x_i is the value of the variable for sample number i, and $\overline{x}$ is the mean value of the variable for the geologic type. Values from the entire survey of the area are used in these computations.

APPENDICES

<u>I PRODUCTION SUMMARY</u>

<u>II TAPE FORMAT STATEMENTS</u>

<u>III COMPUTER LISTINGS</u>

<u>IV LINE PRINTER CONTOURS</u>

AI.A PRODUCTION SUMMARY - SURVEY TIME PERIOD

ML/TL	DATE FLOWN	SURVEY LINE MILES	AVERAGE SPEED/DAY	AVERAGE ALTITUDE/DAY
ML20 TL(5020-5120)	May 4	537.06	143	406
ML40-140	May 6	676.36	141	399
ML160-240	May 9	559.08	139	397

AI.B TEST LINE RESULTS

MAY 1980

UNIT	PRE COS	POS COS	Tl	Tl	Bi	Bi	K	K	GC	GC	BiAir	BiAir	ALT	ALT
4	35.07	35.89	47.01	47.60	24.77	22.28	150.53	159.42	1900.	1928.	9.52	5.96	407.	430.
6*	36.54	36.53	47.32	44.26	22.93	20.26	143.65	140.38	1808.	1775.	19.72	9.39	403.	397.
9	35.89	37.30	47.22	45.65	22.59	20.69	141.59	136.04	1805.	1820.	10.41	9.86	378.	403.

*Denotes change in base line for test.

1

AI.C DIURNAL CORRECTIONS TO LINE DATA

LINE	DIURNAL CORRECTIONS IN GAMMAS	LINE	DIURNAL CORRECTIONS IN GAMMAS	LINE	DIURNAL CORRECTIONS IN GAMMAS
ML 20	0	ML 100	6	ML 180	6
ML 40	0	ML 120	-1	ML 200	1
ML 60	8	ML 140	-12	ML 220	-7
ML 80	9	ML 160	6	ML 240	-16

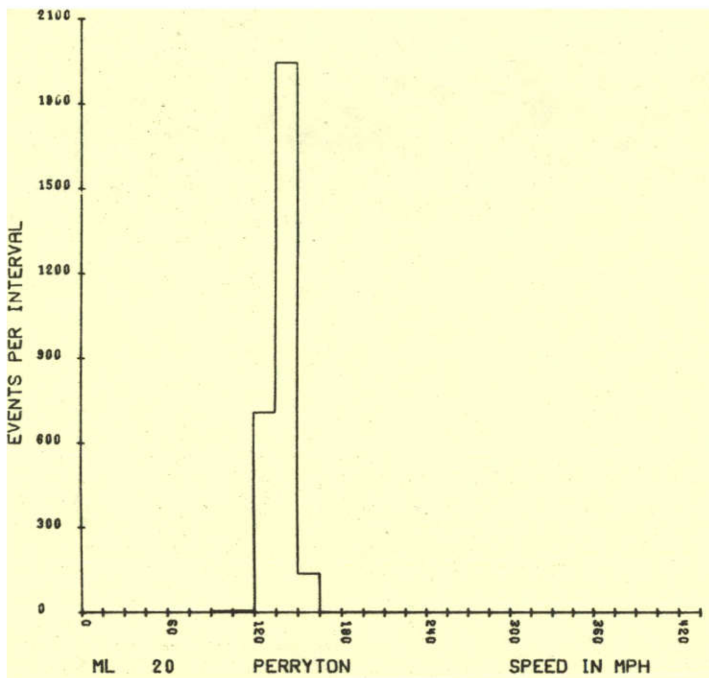
AI.D EXPLANATORY NOTES

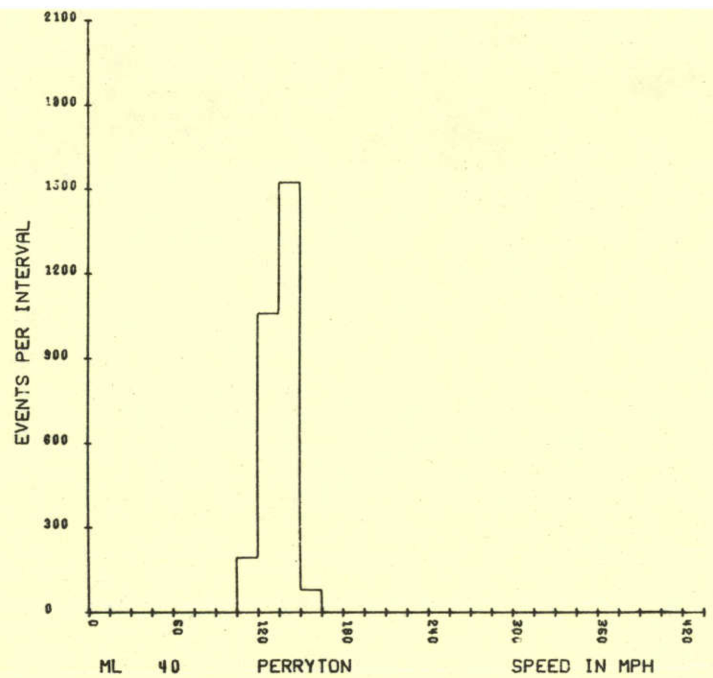
There were no problems with this quad.

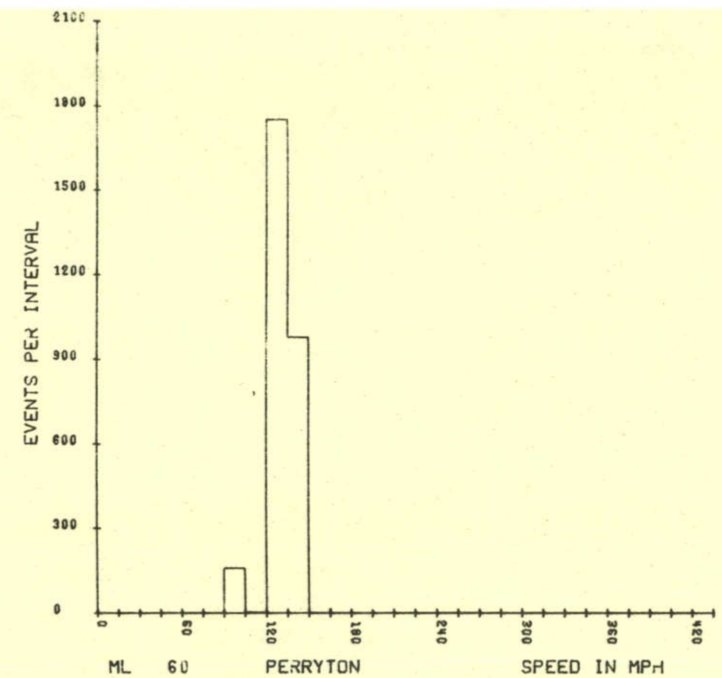
1

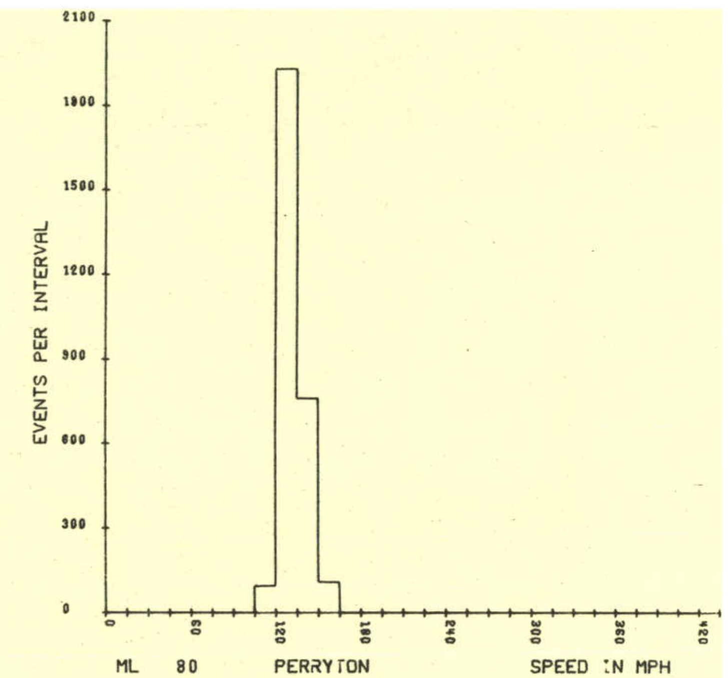
AI.E AVERAGE SPEED AND ALTITUDE DATA SUMMARY

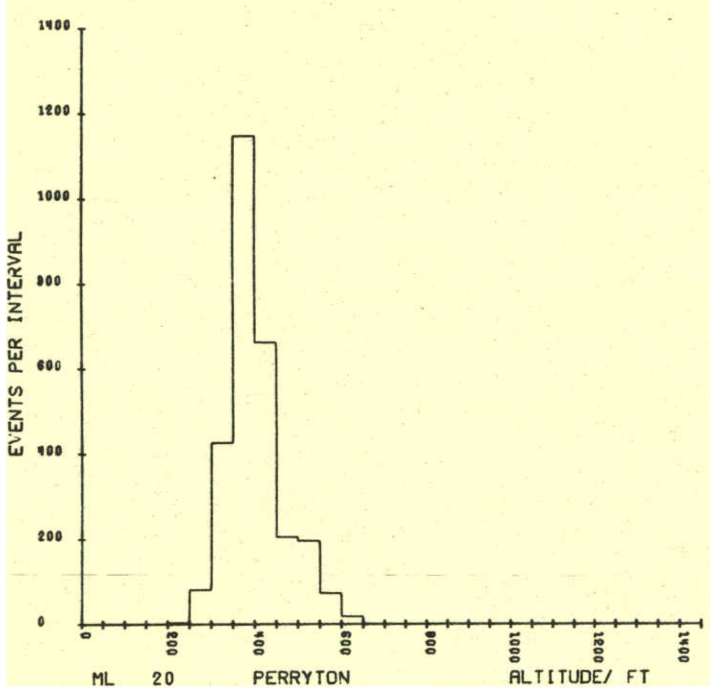
LINE	AVERAGE SPEED (MPH)	AVERAGE ALTITUDE (FEET)	LINE	AVERAGE SPEED (MPH)	AVERAGE ALTITUDE (FEET)
ML 20	147	426	ML 220	143	390
ML 40	143	393	ML 240	137	400
ML 60	138	403	TL 5020	143	388
ML 80	140	400	TL 5040	140	413
ML 100	140	406	TL 5060	144	401
ML 120	140	395	TL 5080	140	390
ML 140	144	399	TL 5100	148	402
ML 160	137	394	TL 5101	144	408
ML 180	141	397	TL 5120	140	423
ML 200	139	404			

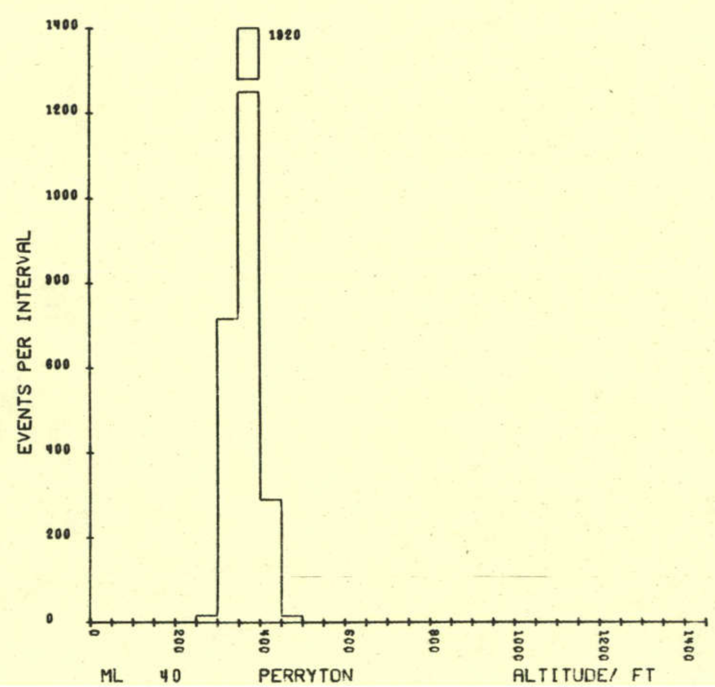

EVENTS PER INTERVAL
ML 20 PERRYTON SPEED IN MPH

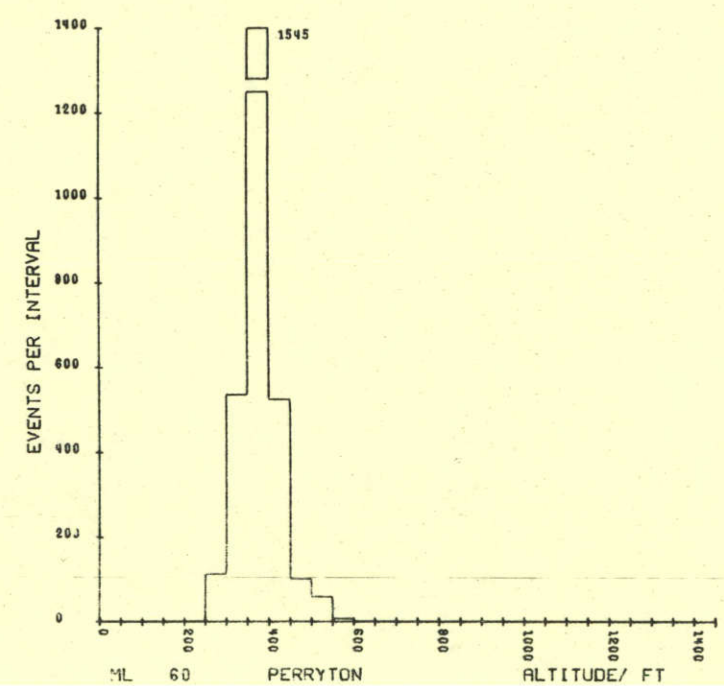

EVENTS PER INTERVAL
ML 40 PERRYTON SPEED IN MPH

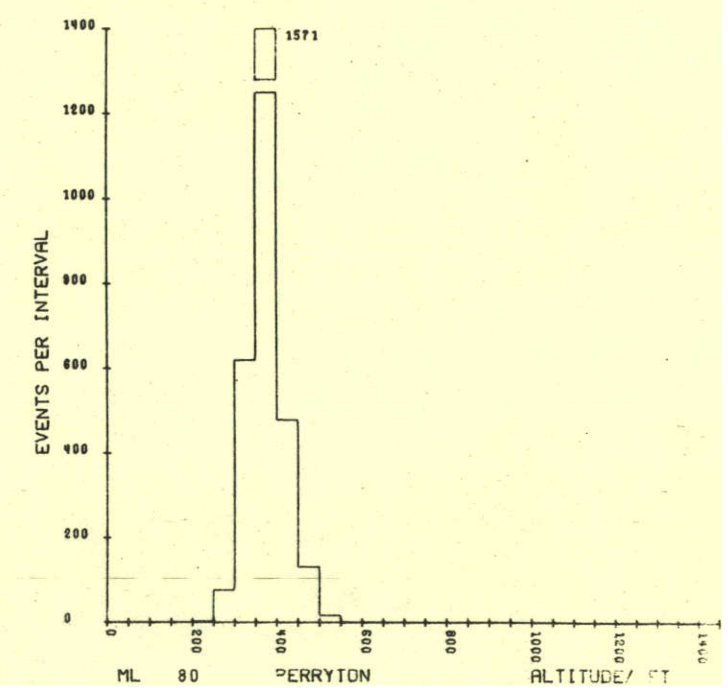

EVENTS PER INTERVAL
ML 60 PERRYTON SPEED IN MPH

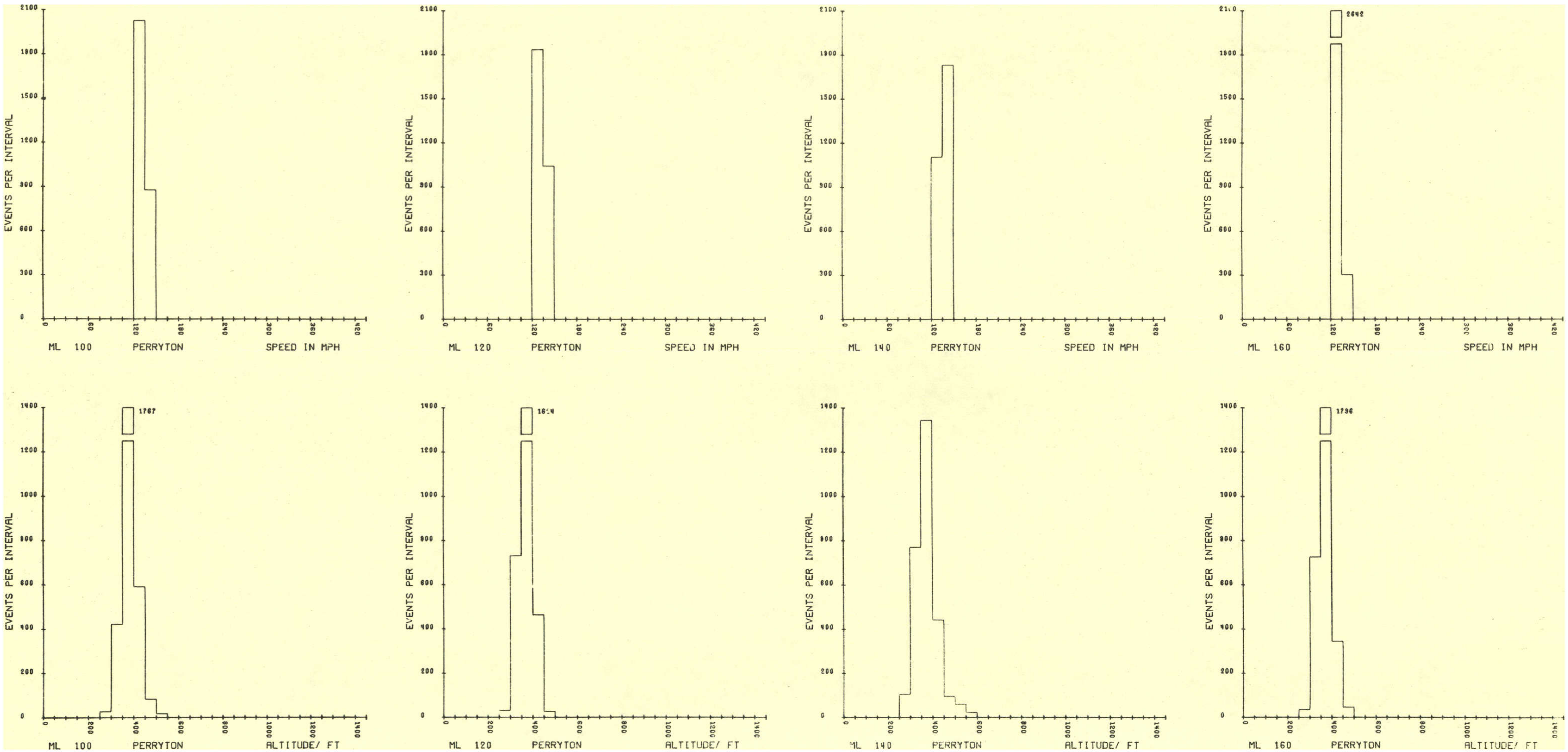

EVENTS PER INTERVAL
ML 80 PERRYTON SPEED IN MPH


EVENTS PER INTERVAL
ML 20 PERRYTON ALTITUDE/ FT

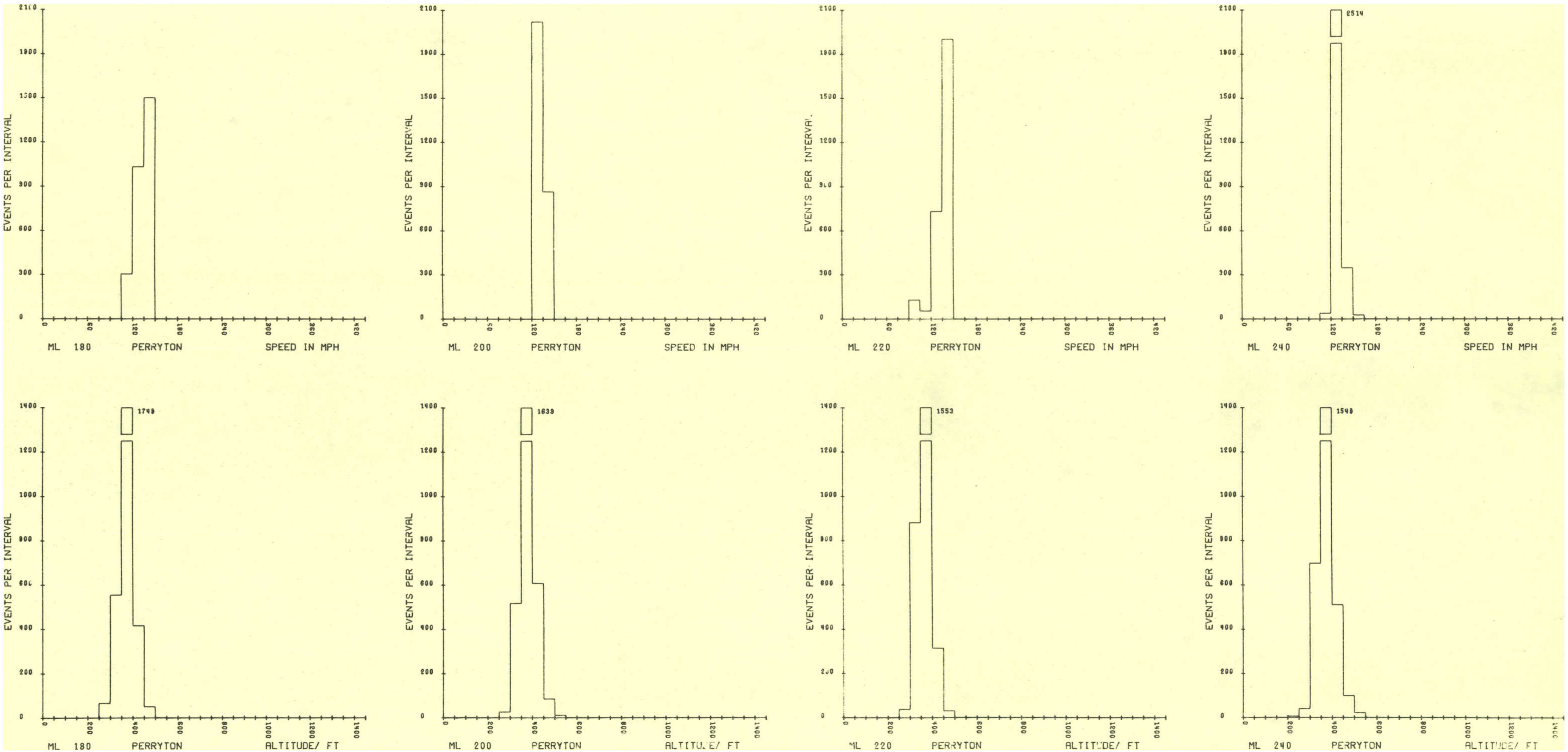

EVENTS PER INTERVAL
1920
ML 40 PERRYTON ALTITUDE/ FT

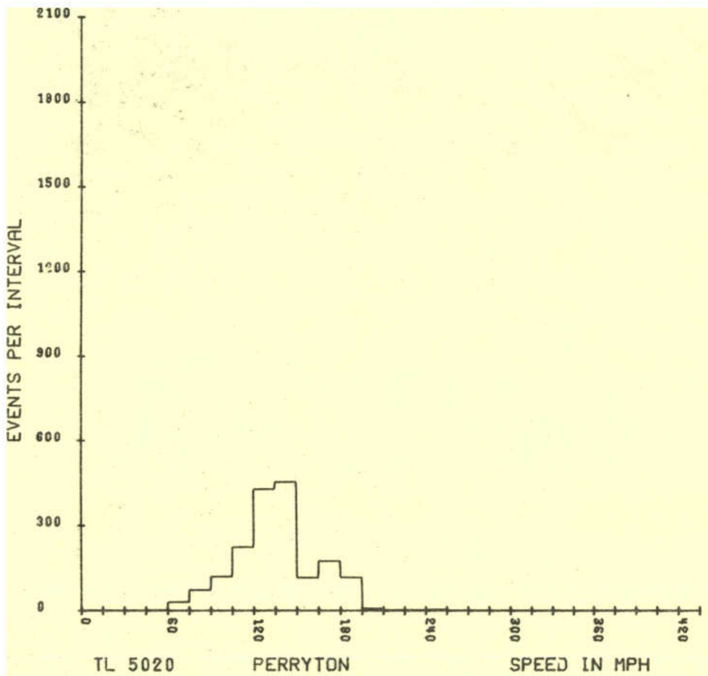

EVENTS PER INTERVAL
1545
ML 60 PERRYTON ALTITUDE/ FT

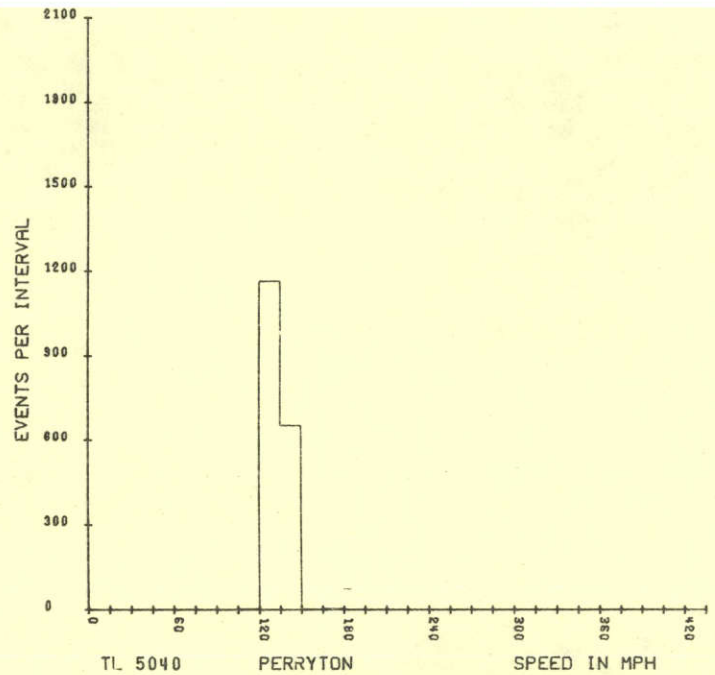

EVENTS PER INTERVAL
1571
ML 80 PERRYTON

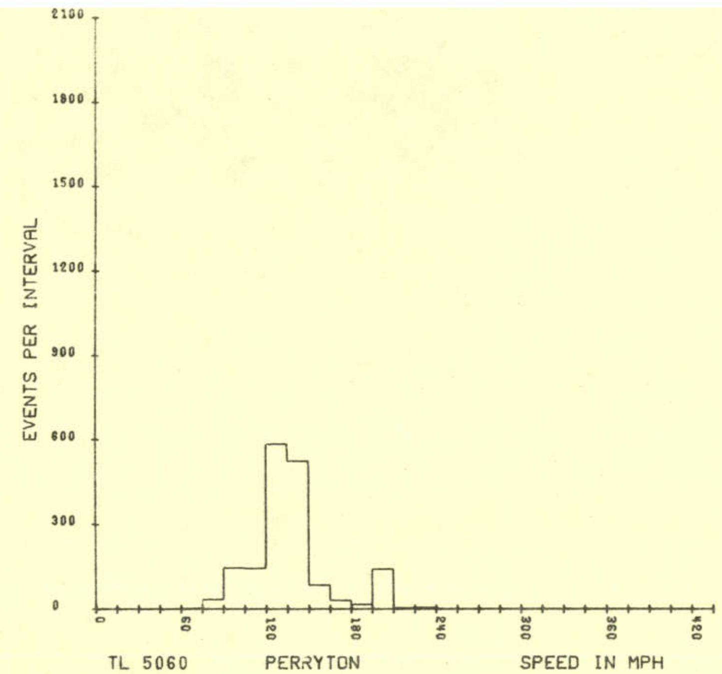


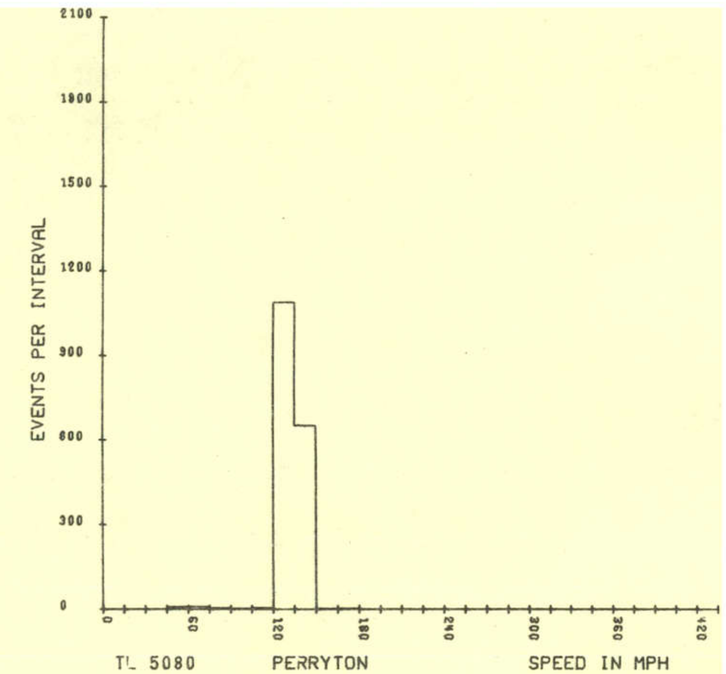
EVENTS PER INTERVAL
ML 100 PERRYTON SPEED IN MPH
ML 120 PERRYTON SPEED IN MPH
ML 140 PERRYTON SPEED IN MPH
ML 160 PERRYTON SPEED IN MPH
2642
ML 100 PERRYTON ALTITUDE/ FT
ML 120 PERRYTON ALTITUDE/ FT
ML 140 PERRYTON ALTITUDE/ FT
ML 160 PERRYTON ALTITUDE/ FT
1767
1736

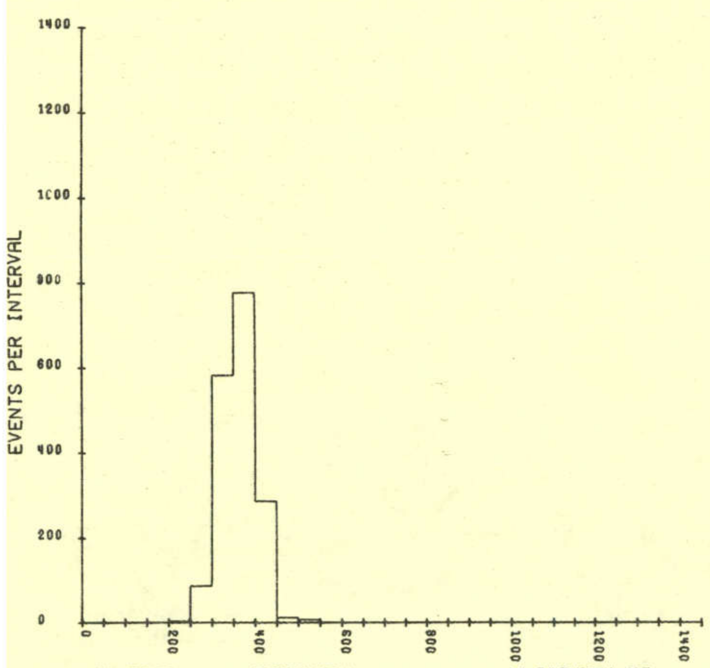

EVENTS PER INTERVAL
ML 180 PERRYTON SPEED IN MPH
ML 200 PERRYTON SPEED IN MPH
ML 220 PERRYTON SPEED IN MPH
ML 240 PERRYTON SPEED IN MPH
2514
1749
1633
1553
1549
ML 180 PERRYTON ALTITUDE/ FT
ML 200 PERRYTON ALTITUDE/ FT
ML 220 PERRYTON ALTITUDE/ FT
ML 240 PERRYTON ALTITUDE/ FT

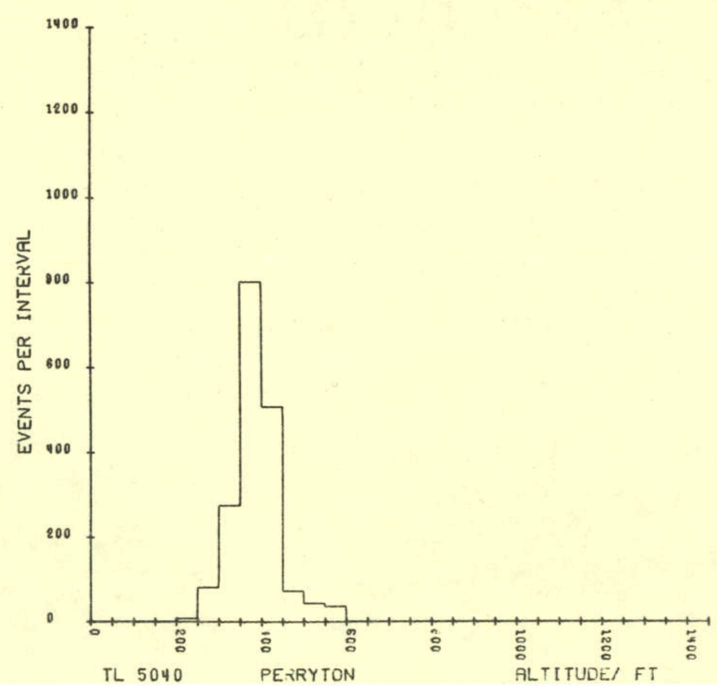

EVENTS PER INTERVAL
TL 5020
PERRYTON
SPEED IN MPH

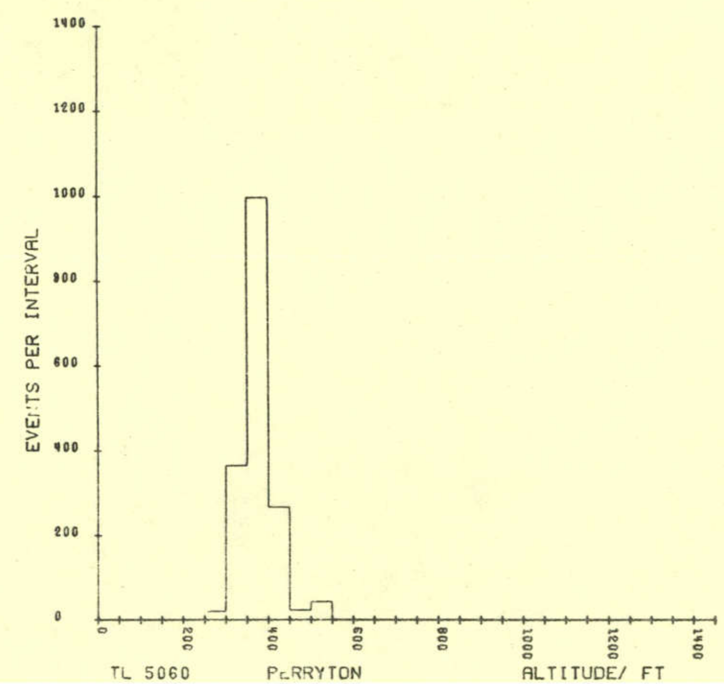

EVENTS PER INTERVAL
TL 5040
PERRYTON
SPEED IN MPH

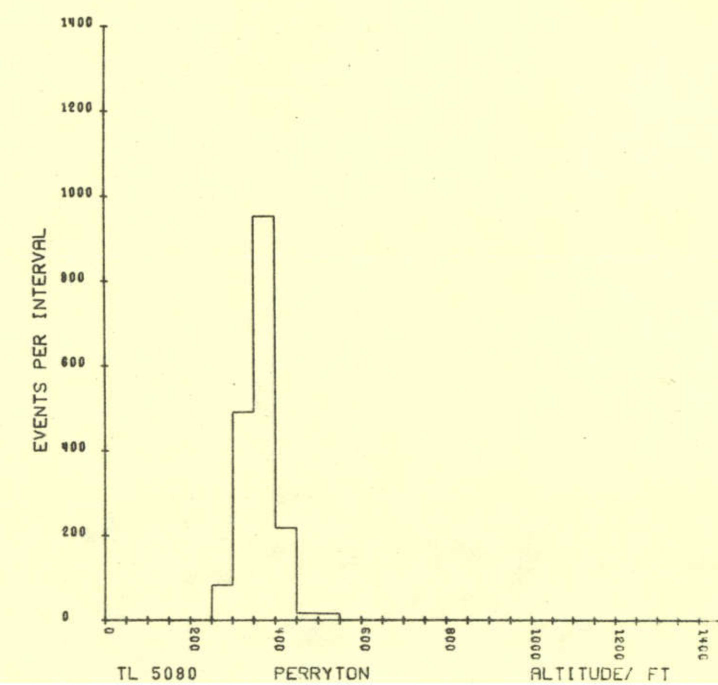

EVENTS PER INTERVAL
TL 5060
PERRYTON
SPEED IN MPH

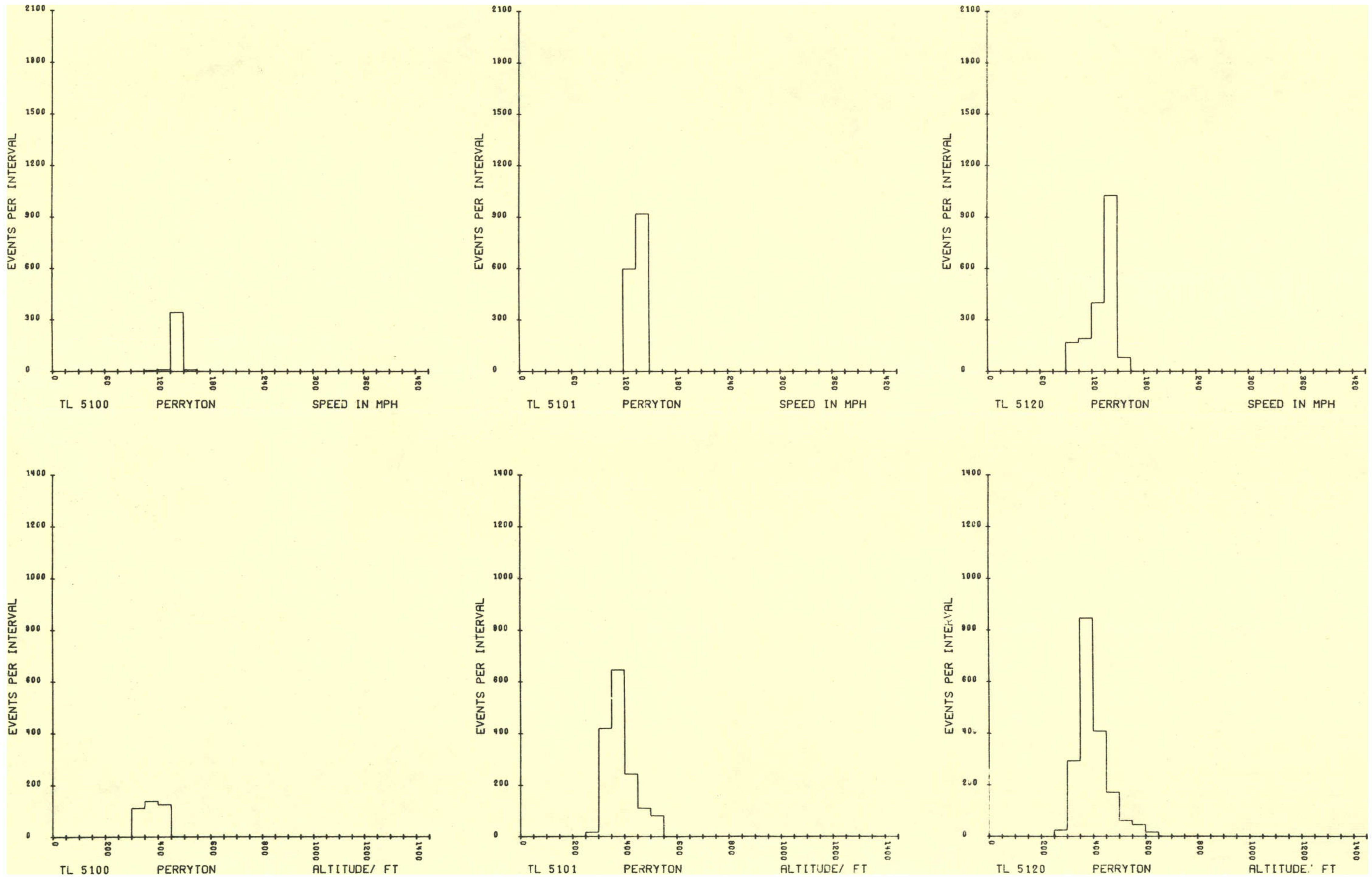

EVENTS PER INTERVAL
TL 5080
PERRYTON
SPEED IN MPH


EVENTS PER INTERVAL
TL 5020
PERRYTON
ALTITUDE/ FT


EVENTS PER INTERVAL
TL 5040
PERRYTON
ALTITUDE/ FT


EVENTS PER INTERVAL
TL 5060
PERRYTON
ALTITUDE/ FT


EVENTS PER INTERVAL
TL 5080
PERRYTON
ALTITUDE/ FT


EVENTS PER INTERVAL
TL 5100
PERRYTON
SPEED IN MPH
TL 5101
PERRYTON
SPEED IN MPH
TL 5120
PERRYTON
SPEED IN MPH
TL 5100
PERRYTON
ALTITUDE/ FT
TL 5101
PERRYTON
ALTITUDE/ FT
TL 5120
PERRYTON
ALTITUDE/ FT

APPENDIX II

TAPE FORMAT STATEMENTS

A. DESCRIPTION OF DATA TAPES

A1. General

All data tapes are 9-track, 800 BPI (NRZI), odd parity, EBCDIC code. Each tape contains a gum label giving the survey project name, month and year of survey, tape type, subcontractor name, date tape created, tape reel count, tape recording characteristics, block size in Bytes and location of tape format information.

The general description for each of the tape types is as follows:

Block Number	Description
1	Format Description
2	Tape Identification
3	First Data Block
4	Second Data Block
.	.
.	.
.	Last Data Block
EOF	

A2. Raw Spectral Data Tapes

Block Size (Physical Record): 6600 characters
Logical Record, Data : 1100 characters

1. Format Description Block (Block 1)

The Format Description utilizes 4248 characters. The remaining 2352 characters of this block are blanks.

Line Number	Character Number 123456789012345678901234567890123456789012345678901234567890123456789012		
1	01 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)		
2			
3	RAW SPECTRAL DATA TAPE		
4			
5	FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK ON TAPE)		
6			
7	ITEM	FORMAT	DESCRIPTION
8	1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
9	2	A20	NAME OF SUBCONTRACTOR
10	3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)

Line Number	Character Number 123456789012345678901234567890123456789012345678901234567890123456789012		
11	4	I1	AERIAL SYSTEM IDENTIFICATION CODE
12	5	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER
13	6	I3	BFEC CALIBRATION REPORT NUMBER
14	7	F6.3	4PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
15			PLACES IN SECONDS
16	8	F6.3	2PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
17			PLACES IN SECONDS
18	9	I3	NUMBER OF CHANNELS (0-3 MEV) FOR 4PI SYSTEM
19	10	I3	NUMBER OF CHANNELS (0-3 MEV) FOR 2PI SYSTEM
20	11	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
21	12	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
22	13	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
23	14	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE WAS
24			COLLECTED
25	15-17	I4,I6,I3	REPEAT OF ITEMS 12-14 FOR SECOND FLIGHT LINE ON THIS
26			TAPE
27	*	*	*
28	*	*	*
29	*	*	*
30	306-308	I4,I6,I3	REPEAT OF ITEMS 12-14 FOR 99TH FLIGHT LINE ON THIS
31			TAPE
32			
33	FORMAT FOR RAW SPECTRAL DATA RECORD (THIRD THRU LAST BLOCK ON TAPE)		
34			
35	ITEM	FORMAT	DESCRIPTION
36	1	I1	AERIAL SYSTEM IDENTIFICATION CODE
37	2	I4	FLIGHT LINE NUMBER
38	3	I6	RECORD IDENTIFICATION NUMBER
39	4	I6	GMT TIME OF DAY (HHMMSS)
40	5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
41	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
42	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
43	8	F7.1	TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE
44			IN GAMMAS
45	9	A8	SURFACE GEOLOGIC MAP UNIT CODE
46	10	I4	QUALITY FLAG CODES
47	11	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN
48			DEGREES CELSIUS
49	12	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
50	13	F5.3	LIVE TIME COUNTING PERIOD TO THREE DECIMAL PLACES IN
51			SECONDS
52	14	I4	SUMMED RAW OUTPUT FROM COSMIC CHANNELS (3-6 MEV) IN
53			COUNTS
54	15	I4	RAW OUTPUT FROM CHANNEL 1 IN COUNTS
55	16	I4	RAW OUTPUT FROM CHANNEL 2 IN COUNTS
56	*	*	*
57	*	*	*
58	*	*	*
59	270	I4	RAW OUTPUT FROM CHANNEL 256 IN COUNTS
-	-	-	2352 BLANK CHARACTERS

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 30 of the Format Description Block A2.1, and 1396 characters are produced. The remaining 5204 characters in this block are blanks.

If fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. Raw Spectral Data Blocks

The information and format for the logical records in these blocks are indicated in lines 36 through 59 of the Format Description Block A2.1. One logical record contains 1100 characters. There are six such logical records per 6600 character physical record or block.

The 2π data logical record is recorded after the corresponding 4π data collection intervals at a frequency dependent on the 2π system data collection interval. For example, if the 4π data collection interval is 1 second and the 2π data collection interval is 10 seconds, then 10 records of 4π data are recorded followed by 1 record of the 2π data which was collected during the preceding 10 seconds. The format for the 2π data is identical to that of the 4π data, except for lines 40 through 49 of the Format Description Block given above. These variables are expressed in the 2π record as all nines in the format specified for I and F fields, and all zeros for A fields.

A3. Single Record Reduced Data Tapes

Block Size (Physical Record): 6900 characters
Logical Record, Data : 138 characters

1. Format Description Block (Block 1)

The Format Description utilizes 6768 characters. The remaining 132 characters of this block are blanks.

Line Number	Character Number 1234567890123456789012345678901234567890123456789012345678901234567890123456789012
1	02 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2	
3	SINGLE RECORD REDUCED DATA TAPE
4	
5	FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6	

Line Number	Character Number 1234567890123456789012345678901234567890123456789012345678901234567890123456789012		
7	ITEM	FORMAT	DESCRIPTION
8	1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
9	2	A20	NAME OF SUBCONTRACTOR
10	3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11	4	I1	NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
12			THIS QUADRANGLE
13	5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14	6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
15			FIRST SYSTEM
16	7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
17			TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
18			IN CPS PER PERCENT K FOR FIRST SYSTEM
19	8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
20			TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
21			IN CPS PER PPM EQUIVALENT U
22	9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
23			TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
24			IN CPS PER PPM EQUIVALENT TH
25	10	I6	BLANK FIELD (999999)
26	11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
27			PLACES IN SECONDS FOR FIRST SYSTEM
28	12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
29			PLACES IN SECONDS FOR FIRST SYSTEM
30	13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST
31			AERIAL SYSTEM
32	14	I3	NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST
33			AERIAL SYSTEM
34	15-24	(SAME)	REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
35	*	*	*
36	*	*	*
37	*	*	*
38	85-94	(SAME)	REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
39	95	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
40	96	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
41	97	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
42	98	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS
43			COLLECTED
44	99-101	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS
45			TAPE
46	*	*	*
47	*	*	*
48	*	*	*
49	390-392	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
50			TAPE
51			
52	FORMAT FOR SINGLE RECORD REDUCED DATA RECORD (THIRD THRU LAST BLOCK)		
53			
54	ITEM	FORMAT	DESCRIPTION
55	1	I1	AERIAL SYSTEM IDENTIFICATION CODE
56	2	I4	FLIGHT LINE NUMBER
57	3	I6	RECORD IDENTIFICATION NUMBER
58	4	I6	GMT TIME OF DAY (HHMMSS)
59	5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES

Line Number	Character Number 1234567890123456789012345678901234567890123456789012345678901234567890123456789012		
60	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
61	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
62	8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
63			TO ONE DECIMAL PLACE IN GAMMAS
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE
65	10	I4	QUALITY FLAG CODES
66	11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM
67			(K-40) TO ONE DECIMAL PLACE IN PERCENT K
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL
69			PLACE IN PERCENT K
70	13	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL URANIUM
71			(BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
72	14	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL
73			PLACE IN PPM EQUIVALENT U
74	15	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL THORIUM
75			(TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
76	16	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL
77			PLACE IN PPM EQUIVALENT TH
78	17	F6.1	URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN
79			PPM EQUIVALENT U PER PPM EQUIVALENT TH
80	18	F6.1	URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN
81			PPM EQUIVALENT U PER PERCENT K
82	19	F6.1	THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN
83			PPM EQUIVALENT TH PER PERCENT K
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL
85			PLACE IN COUNTS PER SECOND
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL
87			PLACE IN COUNTS PER SECOND
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL
89			PLACE IN PPM EQUIVALENT U
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
92	24	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN
93			DEGREES CELSIUS
94	25	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 49 of the Format Description Block A3.1, and 1922 characters are produced. The remaining 4978 characters of this block are blanks.

If less than nine aerial systems are used, the space allocated for additional systems is filled with 9's in the format specified for each item using I and F fields, and with zeros for A fields.

Similarly, if fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. Single Record Reduced Data Blocks

The information and format for the logical records in these blocks are indicated in lines 55 through 94 of the Format Description Block A3.1. One logical record contains 138 characters. There are 50 such logical records per 6900 character physical record or block.

The data appearing in locations specified by lines 68, 72, 76, 86 and 90 of the Format Description Block A3.1 are 9's in the format specified in each case.

A4. Statistical Analysis Tapes (Data and Summary)
File 1: Statistical Analysis Data

Block Size (Physical Record): 8000 characters
Logical Record, Data : 160 characters

1. Format Description Block (Block 1)

The Format Description utilizes 7560 characters. The remaining 440 characters are blanks.

Line Number	Character Number 12345678901234567890123456789012345678901234567890123456789012		
1	03 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)		
2			
3	STATISTICAL ANALYSIS DATA TAPE		
4			
5	FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)		
6			
7	ITEM	FORMAT	DESCRIPTION
8	1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
9	2	A20	NAME OF SUBCONTRACTOR
10	3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11	4	I1	NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
12			THIS QUADRANGLE
13	5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14	6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
15			FIRST SYSTEM
16	7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
17			TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
18			IN CPS PER PERCENT K
19	8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
20			TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
21			IN CPS PER PPM EQUIVALENT U
22	9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
23			TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
24			IN CPS PER PPM EQUIVALENT TH
25	10	I6	BLANK FIELD (999999)
26	11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
27			PLACES IN SECONDS FOR FIRST SYSTEM
28	12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
29			PLACES IN SECONDS FOR FIRST SYSTEM

Line Number	Character Number 12345678901234567890123456789012345678901234567890123456789012		
30	13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST
31			AERIAL SYSTEM
32	14	I3	NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST
33			AERIAL SYSTEM
34	15-24	(SAME)	REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
35	*	*	*
36	*	*	*
37	*	*	*
38	85-94	(SAME)	REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
39	95	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
40	96	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
41	97	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
42	98	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
43			COLLECTED
44	99-101	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS
45			TAPE
46	*	*	*
47	*	*	*
48	*	*	*
49	390-392	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
50			TAPE
51			
52	FORMAT FOR STATISTICAL ANALYSIS DATA RECORD (THIRD THRU LAST BLOCK)		
53			
54	ITEM	FORMAT	DESCRIPTION
55	1	I1	AERIAL SYSTEM IDENTIFICATION CODE
56	2	I4	FLIGHT LINE NUMBER
57	3	I6	RECORD IDENTIFICATION NUMBER
58	4	I6	GMT TIME OF DAY (HHMMSS)
59	5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
60	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
61	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
62	8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
63			TO ONE DECIMAL PLACE IN GAMMAS
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE
65	10	I5	QUALITY FLAG CODES
66	11	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL POTASSIUM
67			(K-40) TO ONE DECIMAL PLACE IN PERCENT K
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL
69			PLACE IN PERCENT K
70	13	F5.1	POTASSIUM STANDARD DEVIATION FROM THE MEAN TO ONE
71			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
72	14	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL URANIUM
73			(BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
74	15	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL
75			PLACE IN PPM EQUIVALENT U
76	16	F5.1	URANIUM STANDARD DEVIATION FROM THE MEAN TO ONE
77			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
78	17	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL THORIUM
79			(TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
80	18	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL
81			PLACE IN PPM EQUIVALENT TH

Line Number	Character Number 12345678901234567890123456789012345678901234567890123456789012		
82	19	F5.1	THORIUM STANDARD DEVIATION FROM THE MEAN TO ONE
83			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL
85			PLACE IN COUNTS PER SECOND
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL
87			PLACE IN COUNTS PER SECOND
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL
89			PLACE IN PPM EQUIVALENT U
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
92	24	F6.1	AVERAGED URANIUM-TO-THORIUM RATIO TO ONE DECIMAL
93			PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
94	25	F5.1	URANIUM-TO-THORIUM RATIO STANDARD DEVIATION FROM THE
95			MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
96	26	F6.1	AVERAGED URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
97			PLACE IN PPM EQUIVALENT U PER PERCENT K
98	27	F5.1	URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
99			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
100			SIGNED
101	28	F6.1	AVERAGED THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
102			PLACE IN PPM EQUIVALENT TH PER PERCENT K
103	29	F5.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
104			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY
105			SIGNED

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 49 of the Format Description Block A4.1, and 1922 characters are produced. The remaining 6078 characters of this block are blanks.

If less than nine aerial systems are used, the space allocated for additional systems is filled with 9's in the format specified for each item using I and F fields, and with zeros for A fields.

Similarly, if fewer than 99 flight lines exist, the unused flight line information, 13 characters per flight line, is filled with 9's through the 99th flight line.

3. Statistical Analysis Data Blocks

The information and format for the logical records in these blocks are indicated in lines 55 through 103 of the Format Description Block A4.1. One logical record contains 160 characters. There are 50 such logical records per 8000 character physical record or block.

The data appearing in locations specified by lines 68, 74, 80, 86 and 90 of the Format Description Block A4.1 are 9's in the format specified in each case.

File 2: Statistical Analysis Summary

Block Size (Physical Record): 7000 characters
Logical Record (Data) : 140 characters

1. Format Description Block (Block 1)

The Format Description utilizes 4320 characters. The remaining 2680 characters are blanks.

```
Line                                  Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

1       05 0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODE)
2
3       STATISTICAL ANALYSIS SUMMARY TAPE (OR FILE)
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7       ITEM   FORMAT    DESCRIPTION
8       1      A40       QUADRANGLE NAME AS PROJECT IDENTIFICATION
9       2      A20       NAME OF SUBCONTRACTOR
10      3      I4        APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11      4      I6        NUMBER OF GEOLOGIC MAP UNITS USED FOR THIS
12                       QUADRANGLE
13
14      FORMAT FOR STATISTICAL ANALYSIS SUMMARY DATA RECORD (THIRD THRU LAST
15      BLOCK)
16
17      ITEM   FORMAT    DESCRIPTION
18      1      A8        SURFACE GEOLOGIC MAP UNIT IDENTIFYING CODE
19      2      I6        TOTAL RECORDS FOR GEOLOGIC MAP UNIT
20      3      I6        NUMBER OF POTASSIUM RECORDS COMPUTED FOR GEOLOGIC
21                       UNIT
22      4      F6.1      POTASSIUM CONCENTRATION MEAN TO ONE DECIMAL
23                       PLACE IN PERCENT K
24      5      F6.1      POTASSIUM CONCENTRATION STANDARD DEVIATION TO ONE
25                       DECIMAL PLACE IN PERCENT K
26      6      A3        POTASSIUM CONCENTRATION DISTRIBUTION CODE
27      7      I6        NUMBER OF URANIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
28      8      F6.1      URANIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE
29                       IN PPM EQUIVALENT U
30      9      F6.1      URANIUM CONCENTRATION STANDARD DEVIATION TO ONE
31                       DECIMAL PLACE IN PPM EQUIVALENT U
32      10     A3        URANIUM CONCENTRATION DISTRIBUTION CODE
33      11     I6        NUMBER OF THORIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
34      12     F6.1      THORIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN
35                       PPM EQUIVALENT TH
36      13     F6.1      THORIUM CONCENTRATION STANDARD DEVIATION TO ONE
37                       DECIMAL PLACE IN PPM EQUIVALENT TH
```



```
Line                                  Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

38      14     A3        THORIUM CONCENTRATION DISTRIBUTION CODE
39      15     I6        NUMBER OF URANIUM-TO-THORIUM RATIO RECORDS COMPUTED
40                       FOR GEOLOGIC UNIT
41      16     F6.1      URANIUM-TO-THORIUM RATIO MEAN TO ONE DECIMAL PLACE
42                       IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
43      17     F6.1      URANIUM-TO-THORIUM RATIO STANDARD DEVIATION TO ONE
44                       DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT
45                       TH
46      18     A3        URANIUM-TO-THORIUM RATIO DISTRIBUTION CODE
47      19     I6        NUMBER OF URANIUM-TO-POTASSIUM RATIO RECORDS
48                       COMPUTED FOR GEOLOGIC UNIT
49      20     F6.1      URANIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
50                       IN PPM EQUIVALENT U PER PERCENT K
51      21     F6.1      URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
52                       DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
53      22     A3        URANIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
54      23     I6        NUMBER OF THORIUM-TO-POTASSIUM RATIO RECORDS
55                       COMPUTED FOR GEOLOGIC UNIT
56      24     F6.1      THORIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
57                       IN PPM EQUIVALENT TH PER PERCENT K
58      25     F6.1      THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
59                       DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
60      26     A3        THORIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
```

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 11 of the Format Description Block A6.1, and 70 characters are produced. The remaining 6930 characters of this block are blanks.

3. Statistical Analysis Summary Data Blocks

The information and format for the logical records in these blocks are indicated in lines 18 through 60 of the Format Description Block A6.1. One logical record contains 140 characters. There are 50 such logical records per 7000 character physical record or block.

A5. Magnetic Data Tapes

Block Size (Physical Record): 8000 characters
Logical Record (Data) : 80 characters

1. Format Description Block (Block 1)

The Format Description utilizes 3384 characters. The remaining 4616 characters are blanks.


```
Line                                  Character Number
Number  12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

1       04 0978  (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3       MAGNETIC DATA TAPE
4
5       FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7       ITEM     FORMAT   DESCRIPTION
8       1        A40      QUADRANGLE NAME AS PROJECT IDENTIFICATION
9       2        A20      NAME OF SUBCONTRACTOR
10      3        I4       APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11      4        I3       NUMBER OF FLIGHT LINES ON THIS TAPE
12      5        I4       FIRST FLIGHT LINE ON THIS TAPE
13      6        I6       FIRST RECORD NUMBER OF FIRST FLIGHT LINE
14      7        I3       JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
15                        COLLECTED
16      8        F8.4     LATITUDE OF GROUND BASE STATION TO FOUR DECIMAL
17                        PLACES IN DEGREES FOR FIRST FLIGHT LINE
18      9        F8.4     LONGITUDE OF GROUND BASE STATION TO FOUR DECIMAL
19                        PLACES IN DEGREES FOR FIRST FLIGHT LINE
20      10-14    (SAME)   REPEAT OF ITEMS 5-9 FOR SECOND FLIGHT LINE ON THIS
21                        TAPE
22      *        *                          *
23      *        *                          *
24      *        *                          *
25      495-499  (SAME)   REPEAT OF ITEMS 5-9 FOR 99TH FLIGHT LINE ON THIS
26                        TAPE
27
28      FORMAT FOR MAGNETIC DATA RECORD (THIRD THRU LAST BLOCK)
29
30      ITEM     FORMAT   DESCRIPTION
31      1        I1       AERIAL SYSTEM IDENTIFICATION CODE
32      2        I4       FLIGHT LINE NUMBER
33      3        I6       RECORD IDENTIFICATION NUMBER
34      4        I6       GMT TIME OF DAY (HHMMSS)
35      5        F8.4     LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
36      6        F8.4     LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
37      7        F6.1     TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
38      8        F5.1     OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
39      9        A8       SURFACE GEOLOGIC MAP UNIT CODE
40      10       F7.1     TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE
41                        IN GAMMAS
42      11       F7.1     RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
43                        TO ONE DECIMAL PLACE IN GAMMAS
44      12       F7.1     DIURNAL MAGNETIC INTENSITY VARIATION TO ONE DECIMAL
45                        PLACE IN GAMMAS
46      13       F7.1     MAGNETIC DEPTH-TO-BASEMENT TO ONE DECIMAL PLACE
47                        IN METERS (IF REQUIRED)
```

2. Tape Identification Block (Block 2)

The information and format for this block are indicated in lines 8 through 25 of the Format Description Block A5.1, and 2938 characters are produced. The remaining 5062 characters of this block are blanks.

If fewer than 99 flight lines exist, the unused flight line information, 29 characters per flight line, is filled with 9's through the 99th flight line in the format indicated.

3. Magnetic Data Blocks

The information and format for the logical records in these blocks are indicated in lines 31 through 46 of the Format Description Block A5.1. One logical record contains 80 characters. There are 100 such logical records per 8000 character physical record or block.

If the magnetic depth-to-basement is not required, this item is expressed as 99999.9.

B. DESCRIPTION OF LISTINGS

B1. Single record reduced data listings: include the following information on Microfiche:

ITEM	DESCRIPTION
REC	Sequential record number
Lat	Location Y in latitude
Long	Location X in longitude
RMag	Residual magnetic field, gammas
Alt	Surface altitude
GEO UNIT	Geologic Type
AKUT	A=Altitude; K=Potassium; U=Uranium T=Thorium - Results of statistical adequacy test
COS	Cosmic c/s
BiAir	Airborne ^{214}Bi, 4π data
GC	Gross count, .4 MeV - 2.8 MeV
Tℓ	^{208}Tℓ c/s
Bi	^{214}Bi c/s
K	^{40}K c/s
BI:Tℓ	Ratio
BI:k	Ratio
Tℓ:K	Ratio
TEMP	Outside Air Temperature (^{o}C)
BP	Atmospheric Pressure (In. Hg)

B2. Averaged record data listings: include the following information on Microfiche:

ITEM	DESCRIPTION
REC	Sequential Record number
GEO UNIT	Geologic type
AKUT	A=Altitude; K=Potassium; U=Uranium; T=Thorium - Results of statistical adequacy test
Long	Longitude of X location of geologic type
Lat	latitude of Y location of geologic type
RMag	Residual magnetic field, gammas
COS	Cosmic, 4π
BiAir	Atmospheric Bi, 4π
GC	Gross count, c/s

ITEM	DESCRIPTION
Tℓ	Tℓ value, c/s
Rank	Tℓ standard deviation rank
Bi	Bi value, c/s
Rank	Bi standard deviation rank
K	K value, c/s
Rank	K standard deviation rank
Bi/Tℓ	Ratio value
Rank	Bi/Tℓ standard deviation rank
Bi/K	Ratio value
Rank	Bi/K standard deviation rank
Tℓ/K	Ratio value
Rank	Tℓ/K standard deviation rank

GEODATA INT. INC.   SINGLE REC LISTING   1980

PERRYTON   NJ 14-10   MAPLINE 20

PERRYTON   MAPLINE 20

RCN	GEOUNIT	AKUT	LAT	LONG	RMAG	COS	GC	BIAIR	ALT	TEMP	BP	TL	BI	K	BI/TL	BI/K	TL/K
1001	QCS	0000	36.0066	102.0042	-393.8	47	2466	1.6	552	18.7	650.2	9.7	4.4	1.5	0.45	2.95	6.53
1002	QCS	0000	36.0066	102.0035	-513.8	16	318	1.6	-61	18.9	651.3	1.5	0.2	0.1	0.14	1.81	12.57
1003	QCS	0000	36.0065	102.0028	-513.5	60	2505	1.6	495	19.0	649.2	10.6	3.3	1.4	0.31	2.30	7.34
1004	QCS	0000	36.0071	102.0024	-510.5	66	2489	1.6	514	19.0	650.8	9.4	3.0	1.7	0.32	1.76	5.57
1005	QCS	0000	36.0080	102.0020	-512.5	76	2714	1.6	527	19.1	652.3	7.0	5.3	1.7	0.75	3.12	4.16
1006	QCS	0000	36.0092	102.0019	-513.5	63	2301	1.6	495	19.0	649.2	9.9	1.9	1.6	0.19	1.19	6.12
1007	QCS	0000	36.0100	102.0019	-513.4	55	2492	1.6	514	19.1	652.8	7.7	3.7	1.7	0.48	2.20	4.57
1008	QCS	0000	36.0109	102.0015	-512.7	64	2547	1.6	535	19.1	649.2	9.7	2.6	1.6	0.27	1.63	6.07
1009	QCS	0000	36.0118	102.0014	-511.9	42	2297	1.6	544	19.1	650.8	9.5	3.2	1.5	0.33	2.18	6.52
1010	QCS	0000	36.0127	102.0014	-512.4	59	2457	1.6	552	19.1	649.2	10.9	3.3	1.9	0.31	1.78	5.85
1011	QCS	0000	36.0136	102.0014	-510.9	66	2565	1.6	560	18.9	649.7	10.9	4.3	1.3	0.39	3.26	8.29
1012	QCS	0000	36.0144	102.0014	-510.1	56	2478	1.6	564	19.1	650.2	12.7	2.4	1.9	0.19	1.31	6.82
1013	QCS	0000	36.0150	102.0013	-510.3	49	2431	1.6	573	19.1	648.2	12.4	2.3	1.4	0.18	1.58	8.60
1014	QCS	0000	36.0159	102.0013	-508.5	72	2659	1.6	573	19.1	650.2	11.9	2.7	1.9	0.23	1.47	6.37
1015	QCS	0000	36.0165	102.0012	-506.8	61	2469	1.6	564	19.1	648.2	10.1	3.3	1.5	0.33	2.21	6.67
1016	QCS	0000	36.0171	102.0012	-506.3	59	2265	1.6	569	19.1	649.2	7.1	2.4	1.5	0.34	1.62	4.73
1017	QCS	0000	36.0180	102.0012	-504.8	67	2380	1.6	564	19.0	647.2	10.8	2.1	1.6	0.20	1.32	6.64
1018	QCS	0000	36.0185	102.0011	-502.8	65	2280	1.6	569	19.0	648.2	5.2	3.6	1.6	0.69	2.25	3.27
1019	QCS	0000	36.0188	102.0011	-501.3	53	2200	1.6	577	19.1	649.2	9.8	3.0	1.4	0.30	2.10	6.96
1020	QCS	0000	36.0194	102.0011	-501.5	69	2365	1.6	573	18.9	648.7	7.3	2.9	1.5	0.40	1.87	4.72
1021	QCS	0000	36.0197	102.0010	-500.0	54	2444	1.6	573	19.1	648.7	8.8	3.6	1.4	0.40	2.52	6.26
1022	QCS	0000	36.0203	102.0006	-498.0	63	2568	1.6	573	19.0	649.2	7.8	3.7	1.8	0.47	2.06	4.36
1023	QCS	0000	36.0206	102.0006	-496.5	60	2415	1.6	569	19.0	650.2	8.0	3.8	1.7	0.48	2.30	4.77
1024	QCS	0000	36.0209	102.0002	-495.0	54	2505	1.6	569	19.2	650.8	10.3	2.8	2.0	0.27	1.43	5.26
1025	QCS	0000	36.0211	101.9999	-492.7	51	2461	1.6	569	19.0	651.3	12.3	1.8	1.6	0.14	1.09	7.54
1026	QCS	0000	36.0211	101.9995	-490.5	66	2524	1.6	573	19.2	652.3	8.5	2.0	1.9	0.23	1.03	4.38
1027	QCS	0000	36.0214	101.9991	-488.0	48	2508	1.6	569	19.1	652.3	10.5	1.3	2.0	0.12	0.62	5.14
1028	QCS	0000	36.0214	101.9984	-486.8	71	2342	13.7	564	19.1	650.2	8.4	2.7	1.7	0.32	1.54	4.84
1029	QCS	0000	36.0214	101.9980	-484.3	64	2379	13.7	564	18.9	648.7	11.0	2.0	1.7	0.18	1.19	6.61
1030	QCS	0000	36.0213	101.9973	-481.8	75	2515	13.7	552	19.1	648.2	14.3	0.8	1.8	0.06	0.45	7.86
1031	QCS	0000	36.0216	101.9966	-478.8	63	2072	13.7	548	19.1	649.7	6.3	0.9	1.6	0.14	0.54	3.86
1032	QCS	0000	36.0216	101.9959	-476.6	58	2501	13.7	552	19.1	651.3	11.2	2.4	1.8	0.21	1.33	6.31
1033	QCS	0000	36.0216	101.9955	-474.6	51	2301	13.7	556	19.2	650.2	10.2	2.3	1.5	0.22	1.51	6.72
1034	QCS	0000	36.0216	101.9948	-471.8	59	2505	13.7	560	19.1	648.2	10.3	1.6	1.8	0.16	0.93	5.90
1035	QCS	0000	36.0215	101.9940	-470.3	63	2471	13.7	560	19.1	646.2	10.5	1.8	1.8	0.18	1.00	5.68
1036	QCS	0000	36.0215	101.9933	-469.4	55	2184	13.7	560	19.2	648.2	9.5	1.8	1.3	0.19	1.35	7.23
1037	QCS	0000	36.0215	101.9926	-468.6	56	2221	15.7	560	19.1	650.8	7.6	3.1	1.6	0.41	1.98	4.81
1038	QCS	0000	36.0215	101.9919	-467.4	42	2161	15.7	556	19.1	652.3	8.7	2.4	1.7	0.28	1.42	5.03
1039	QCS	0000	36.0214	101.9912	-467.4	63	2303	15.7	556	19.2	650.8	7.7	1.3	1.9	0.17	0.72	4.14
1040	QCS	0000	36.0214	101.9904	-466.4	57	2423	15.7	556	19.3	652.3	11.7	2.1	1.8	0.18	1.22	6.66
1041	QCS	0000	36.0214	101.9897	-465.7	58	2342	15.7	552	19.0	652.3	8.4	1.1	1.8	0.13	0.60	4.57
1042	QCS	0000	36.0214	101.9890	-465.2	68	2336	15.7	552	19.1	651.3	12.3	1.8	1.5	0.15	1.23	8.15
1043	QCS	0000	36.0213	101.9883	-463.7	68	2362	15.7	556	19.2	649.7	10.5	1.8	2.1	0.18	0.90	5.09
1044	QCS	0000	36.0213	101.9875	-462.0	65	2291	15.7	552	19.2	648.7	9.1	1.7	1.6	0.19	1.09	5.83
1045	QCS	0000	36.0213	101.9868	-460.2	56	2265	15.7	556	19.1	646.7	9.7	1.6	1.5	0.16	1.02	6.35
1046	QCS	0000	36.0213	101.9861	-457.2	55	2345	14.9	552	19.3	649.7	9.5	1.9	1.9	0.20	0.99	4.91
1047	QCS	0000	36.0212	101.9854	-454.9	59	2572	14.9	552	19.1	649.2	9.9	1.5	2.0	0.15	0.75	5.05
1048	QCS	0000	36.0212	101.9847	-453.5	53	2290	14.9	548	19.1	648.2	10.1	1.0	2.2	0.10	0.44	4.64
1049	QCS	0000	36.0212	101.9839	-451.2	57	2310	14.9	552	19.3	651.8	9.8	1.1	1.9	0.11	0.57	5.05
1050	QCS	0000	36.0212	101.9832	-449.5	51	2323	14.9	548	19.2	650.2	9.5	1.8	1.4	0.19	1.28	6.57
1051	QCS	0000	36.0211	101.9825	-448.0	57	2354	14.9	552	19.3	648.2	10.8	3.2	1.8	0.30	1.73	5.87
1052	QCS	0000	36.0211	101.9818	-445.8	52	2359	14.9	548	19.2	652.3	10.5	3.4	1.8	0.32	1.86	5.75
1053	QCS	0000	36.0211	101.9810	-443.5	53	2387	14.9	539	19.2	648.2	10.8	2.4	1.7	0.22	1.41	6.40
1054	QCS	0000	36.0211	101.9803	-441.5	47	2217	14.9	539	19.1	652.8	8.3	2.0	1.5	0.24	1.31	5.43
1055	QCS	0000	36.0210	101.9796	-439.0	55	2346	12.9	548	19.2	651.3	7.8	1.8	2.0	0.24	0.93	3.94
1056	QCS	0000	36.0210	101.9789	-437.0	44	2521	12.9	539	19.0	650.2	10.5	3.0	1.9	0.29	1.58	5.47
1057	QCS	0000	36.0210	101.9782	-435.8	71	2480	12.9	539	19.2	649.2	9.8	2.0	2.3	0.20	0.86	4.19

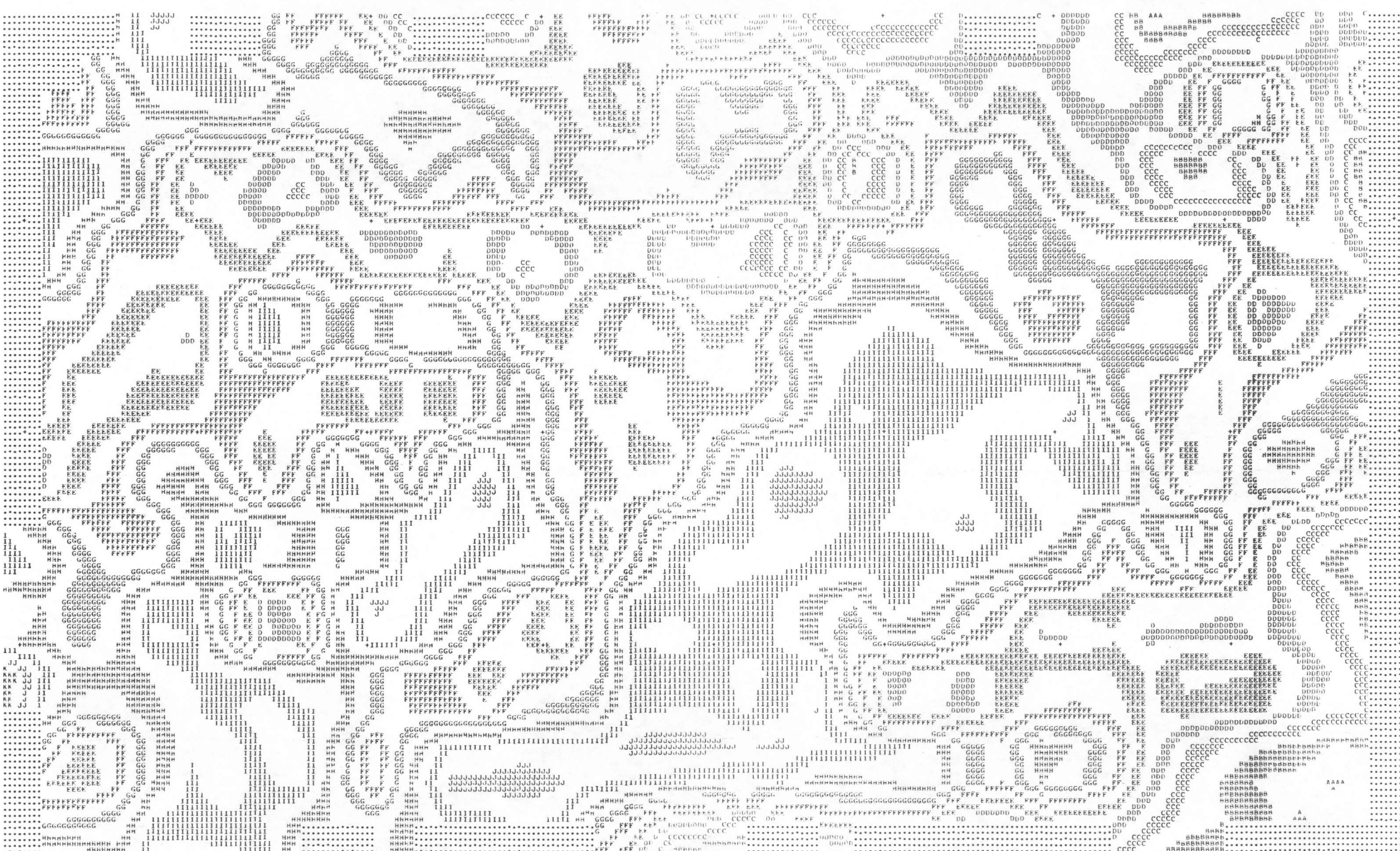
GEODATA INT. INC.   AVERAGE REC LISTING   1980

PERRYTON   NJ 14-10   MAPLINE 20

PERRYTON   MAPLINE 20

RCN	GEOUNIT	AKUT	LAT	LONG	RMAG	COS	GC	BIAIR	TL RANK	BI RANK	K RANK	BI/TL RANK	BI/K RANK	TL/K RANK
1001	QCS	0000	36.0066	102.0042	-393.8	47	2466	1.6	9.7+ 1	4.4+ 4	1.5- 1	0.45+ 4	2.95+ 5	6.53+ 1
1002	QCS	0000	36.0066	102.0035	-513.8	16	318	1.6	1.5- 4	0.2- 3	0.1- 8	0.14- 2	1.81+ 2	12.57+ 8
1003	QCS	0000	36.0065	102.0028	-513.5	60	2505	1.6	10.6+ 1	3.3+ 2	1.4- 1	0.31+ 1	2.30+ 3	7.34+ 2
1004	QCS	0000	36.0071	102.0024	-510.5	66	2489	1.6	8.2- 0	3.1+ 2	1.4- 1	0.38+ 2	2.19+ 3	5.74+ 0
1005	QCS	0000	36.0080	102.0020	-512.5	76	2714	1.6	8.4- 0	3.3+ 2	1.5- 0	0.39+ 3	2.13+ 2	5.43+ 0
1006	QCS	0000	36.0092	102.0019	-513.5	63	2301	1.6	8.9+ 0	3.3+ 2	1.6+ 0	0.37+ 2	2.00+ 2	5.45+ 0
1007	QCS	0000	36.0100	102.0019	-513.4	55	2492	1.6	8.9+ 0	3.2+ 2	1.6+ 0	0.36+ 2	1.96+ 2	5.45+ 0
1008	QCS	0000	36.0109	102.0015	-512.7	64	2547	1.6	9.4+ 0	3.2+ 2	1.6+ 0	0.34+ 2	1.98+ 2	5.81+ 1
1009	QCS	0000	36.0118	102.0014	-511.9	42	2297	1.6	10.0+ 1	3.2+ 2	1.6+ 0	0.32+ 1	1.98+ 2	6.21+ 1
1010	QCS	0000	36.0127	102.0014	-512.4	59	2457	1.6	10.6+ 1	3.2+ 2	1.6+ 0	0.30+ 1	2.00+ 2	6.57+ 1
1011	QCS	0000	36.0136	102.0014	-510.9	66	2565	1.6	11.2+ 2	3.2+ 2	1.6+ 0	0.28+ 1	1.97+ 2	7.00+ 2
1012	QCS	0000	36.0144	102.0014	-510.1	56	2478	1.6	11.6+ 2	3.0+ 2	1.6+ 0	0.26+ 0	1.84+ 2	7.11+ 2
1013	QCS	0000	36.0150	102.0013	-510.3	49	2431	1.6	11.5+ 2	2.9+ 1	1.6+ 0	0.25+ 0	1.76+ 1	7.06+ 2
1014	QCS	0000	36.0159	102.0013	-508.5	72	2659	1.6	11.0+ 1	2.8+ 1	1.6+ 0	0.25+ 0	1.69+ 1	6.78+ 2
1015	QCS	0000	36.0165	102.0012	-506.8	61	2469	1.6	10.1+ 1	2.7+ 1	1.6+ 0	0.27+ 0	1.70+ 1	6.28+ 1
1016	QCS	0000	36.0171	102.0012	-506.3	59	2265	1.6	9.2+ 0	2.8+ 1	1.6- 0	0.30+ 1	1.75+ 1	5.85+ 1
1017	QCS	0000	36.0180	102.0012	-504.8	67	2380	1.6	8.7+ 0	2.8+ 1	1.6- 0	0.32+ 1	1.79+ 1	5.56+ 0
1018	QCS	0000	36.0185	102.0011	-502.8	65	2280	1.6	8.1- 0	2.9+ 2	1.5- 0	0.36+ 2	1.93+ 2	5.33+ 0
1019	QCS	0000	36.0188	102.0011	-501.3	53	2200	1.6	8.2- 0	3.0+ 2	1.5- 0	0.37+ 2	2.00+ 2	5.36+ 0
1020	QCS	0000	36.0194	102.0011	-501.5	69	2365	1.6	8.1- 0	3.2+ 2	1.5- 0	0.40+ 3	2.09+ 2	5.26- 0
1021	QCS	0000	36.0197	102.0010	-500.0	54	2444	1.6	8.2- 0	3.4+ 2	1.6+ 0	0.41+ 3	2.13+ 2	5.19- 0
1022	QCS	0000	36.0203	102.0006	-498.0	63	2568	1.6	8.7+ 0	3.3+ 2	1.7+ 0	0.38+ 2	2.01+ 2	5.25- 0
1023	QCS	0000	36.0206	102.0006	-496.5	60	2415	1.6	9.0+ 0	3.2+ 2	1.7+ 1	0.35+ 2	1.83+ 2	5.25- 0
1024	QCS	0000	36.0209	102.0002	-495.0	54	2505	1.6	9.6+ 1	2.8+ 1	1.8+ 1	0.29+ 1	1.54+ 1	5.37+ 0
1025	QCS	0000	36.0211	101.9999	-492.7	51	2461	1.6	9.9+ 1	2.4+ 1	1.8+ 1	0.24- 0	1.30+ 0	5.44+ 0
1026	QCS	0000	36.0211	101.9995	-490.5	66	2524	1.6	9.9+ 1	2.1+ 0	1.8+ 2	0.21- 1	1.15- 0	5.38+ 0
1027	QCS	0000	36.0214	101.9991	-488.0	48	2508	1.6	10.3+ 1	1.9- 0	1.8+ 2	0.18- 1	1.02- 1	5.54+ 0
1028	QCS	0000	36.0214	101.9984	-486.8	71	2342	13.7	10.1+ 1	1.8- 0	1.8+ 1	0.18- 1	0.99- 1	5.63+ 0
1029	QCS	0000	36.0214	101.9980	-484.3	64	2379	13.7	10.3+ 1	1.7- 1	1.8+ 1	0.16- 1	0.95- 1	5.83+ 1
1030	QCS	0000	36.0213	101.9973	-481.8	75	2515	13.7	10.6+ 1	1.6- 1	1.7+ 1	0.15- 2	0.92- 1	6.09+ 1
1031	QCS	0000	36.0216	101.9966	-478.8	63	2072	13.7	10.2+ 1	1.6- 1	1.7+ 1	0.16- 1	0.96- 1	5.99+ 1
1032	QCS	0000	36.0216	101.9959	-476.6	58	2501	13.7	10.3+ 1	1.7- 1	1.7+ 1	0.17- 1	1.02- 1	6.07+ 1
1033	QCS	0000	36.0216	101.9955	-474.6	51	2301	13.7	10.2+ 1	1.8- 0	1.7+ 1	0.18- 1	1.09- 1	6.09+ 1
1034	QCS	0000	36.0216	101.9948	-471.8	59	2505	13.7	9.9+ 1	2.0- 0	1.7+ 0	0.20- 1	1.18- 0	5.99+ 1
1035	QCS	0000	36.0215	101.9940	-470.3	63	2471	13.7	9.8+ 1	2.1+ 0	1.6+ 0	0.21- 1	1.26- 0	5.97+ 1
1036	QCS	0000	36.0215	101.9933	-469.4	55	2184	13.7	9.3+ 0	2.1+ 0	1.6+ 0	0.23- 0	1.31+ 0	5.73+ 0
1037	QCS	0000	36.0215	101.9926	-468.6	56	2221	15.7	9.0+ 0	2.2+ 0	1.6+ 0	0.25+ 0	1.34+ 0	5.44+ 0
1038	QCS	0000	36.0215	101.9919	-467.4	42	2161	15.7	8.9+ 0	2.1+ 0	1.7+ 1	0.24- 0	1.25- 0	5.25- 0
1039	QCS	0000	36.0214	101.9912	-467.4	63	2303	15.7	9.1+ 0	1.9- 0	1.7+ 1	0.21- 1	1.13- 0	5.29+ 0
1040	QCS	0000	36.0214	101.9904	-466.4	57	2423	15.7	9.7+ 1	1.8- 0	1.8+ 1	0.19- 1	1.04- 1	5.50+ 0
1041	QCS	0000	36.0214	101.9897	-465.7	58	2342	15.7	10.0+ 1	1.7- 1	1.8+ 1	0.17- 1	0.95- 1	5.65+ 0
1042	QCS	0000	36.0214	101.9890	-465.2	68	2336	15.7	10.3+ 1	1.7- 1	1.7+ 1	0.16- 1	0.97- 1	5.94+ 1
1043	QCS	0000	36.0213	101.9883	-463.7	68	2362	15.7	10.2+ 1	1.7- 1	1.7+ 1	0.17- 1	0.98- 1	5.87+ 1
1044	QCS	0000	36.0213	101.9875	-462.0	65	2291	15.7	9.9+ 1	1.7- 1	1.7+ 1	0.17- 1	0.98- 1	5.74+ 0
1045	QCS	0000	36.0213	101.9868	-460.2	56	2265	15.7	9.9+ 1	1.7- 1	1.8+ 1	0.17- 1	0.94- 1	5.57+ 0
1046	QCS	0000	36.0213	101.9861	-457.2	55	2345	14.9	9.7+ 1	1.6- 1	1.9+ 2	0.16- 1	0.84- 1	5.24- 0
1047	QCS	0000	36.0212	101.9854	-454.9	59	2572	14.9	9.7+ 1	1.5- 1	1.9+ 2	0.15- 2	0.78- 1	5.18- 0
1048	QCS	0000	36.0212	101.9847	-453.5	53	2290	14.9	9.9+ 1	1.5- 1	1.9+ 2	0.15- 2	0.78- 1	5.17- 0
1049	QCS	0000	36.0212	101.9839	-451.2	57	2310	14.9	10.0+ 1	1.7- 1	1.9+ 2	0.17- 1	0.92- 1	5.31+ 0
1050	QCS	0000	36.0212	101.9832	-449.5	51	2323	14.9	10.1+ 1	2.1+ 0	1.8+ 1	0.20- 1	1.14- 0	5.62+ 0
1051	QCS	0000	36.0211	101.9825	-448.0	57	2354	14.9	10.2+ 1	2.4+ 1	1.8+ 1	0.24- 0	1.37+ 0	5.78+ 1
1052	QCS	0000	36.0211	101.9818	-445.8	52	2359	14.9	10.0+ 1	2.6+ 1	1.7+ 1	0.26+ 0	1.48+ 1	5.76+ 1
1053	QCS	0000	36.0211	101.9810	-443.5	53	2387	14.9	9.8+ 1	2.5+ 1	1.7+ 1	0.26+ 0	1.46+ 1	5.63+ 0
1054	QCS	0000	36.0211	101.9803	-441.5	47	2217	14.9	9.5+ 1	2.4+ 1	1.8+ 1	0.26+ 0	1.35+ 0	5.26- 0
1055	QCS	0000	36.0210	101.9796	-439.0	55	2346	12.9	9.3+ 0	2.4+ 1	1.9+ 2	0.25+ 0	1.27- 0	5.02- 0
1056	QCS	0000	36.0210	101.9789	-437.0	44	2521	12.9	9.5+ 1	2.4+ 1	1.9+ 2	0.25+ 0	1.28- 0	5.03- 0
1057	QCS	0000	36.0210	101.9782	-435.8	71	2480	12.9	9.6+ 1	2.4+ 1	1.9+ 2	0.25+ 0	1.29+ 0	5.08- 0

CONTOUR INTERVAL= 0.45 FT? LAT 35.000 LONG-102.000

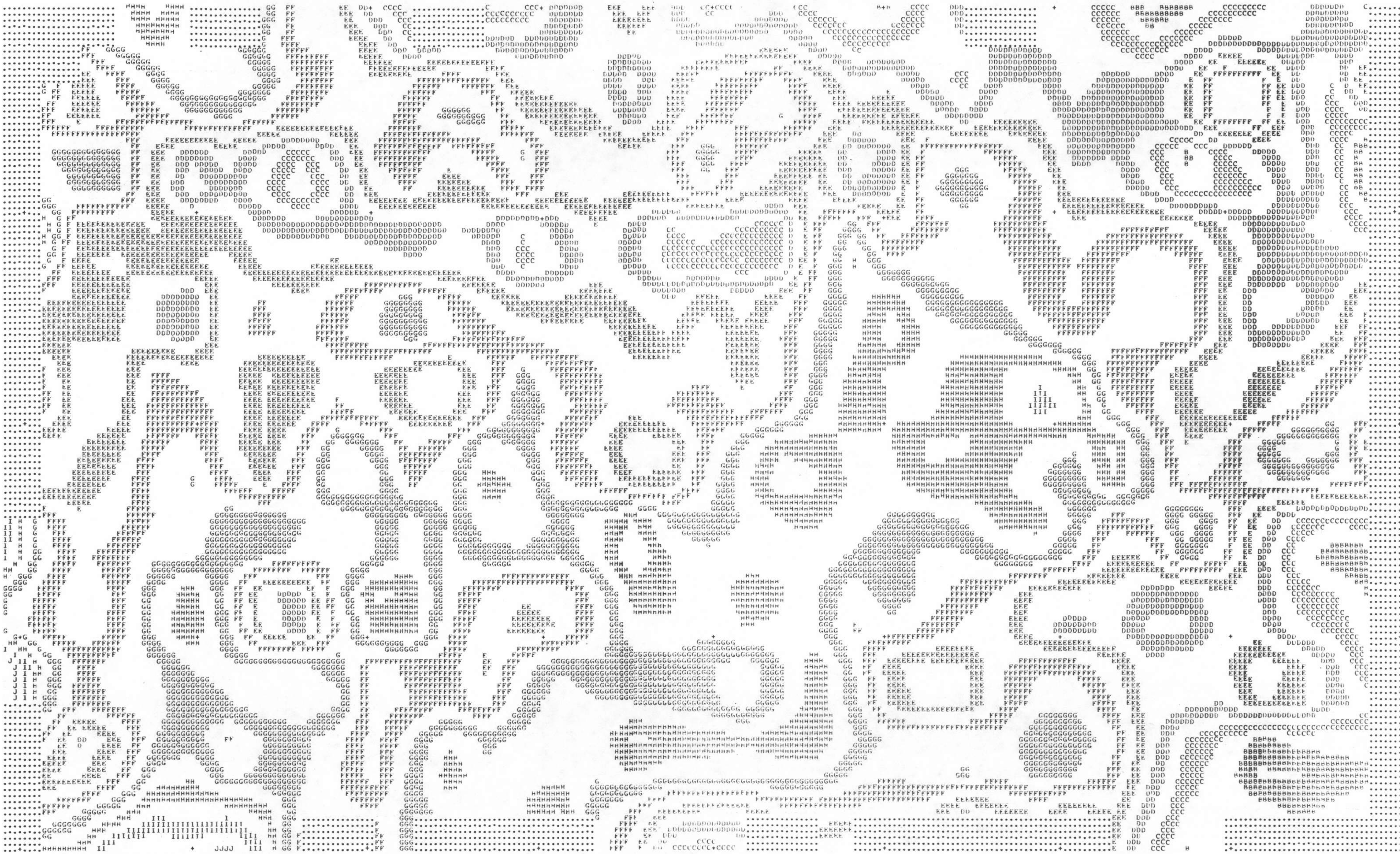


AIV-1 Line Printer Contour

GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< 2.70	3.15<B< 3.60	4.05<C< 4.50	4.95<D< 5.40	5.85<E< 6.30	6.75<F< 7.20
	7.65<G< 8.10	8.55<H< 9.00	9.45<I< 9.90	10.35<J< 10.80	11.25<K< 11.70

CONTOUR INTERVAL= 0.15 AU LAT 36.000 LONG-102.000

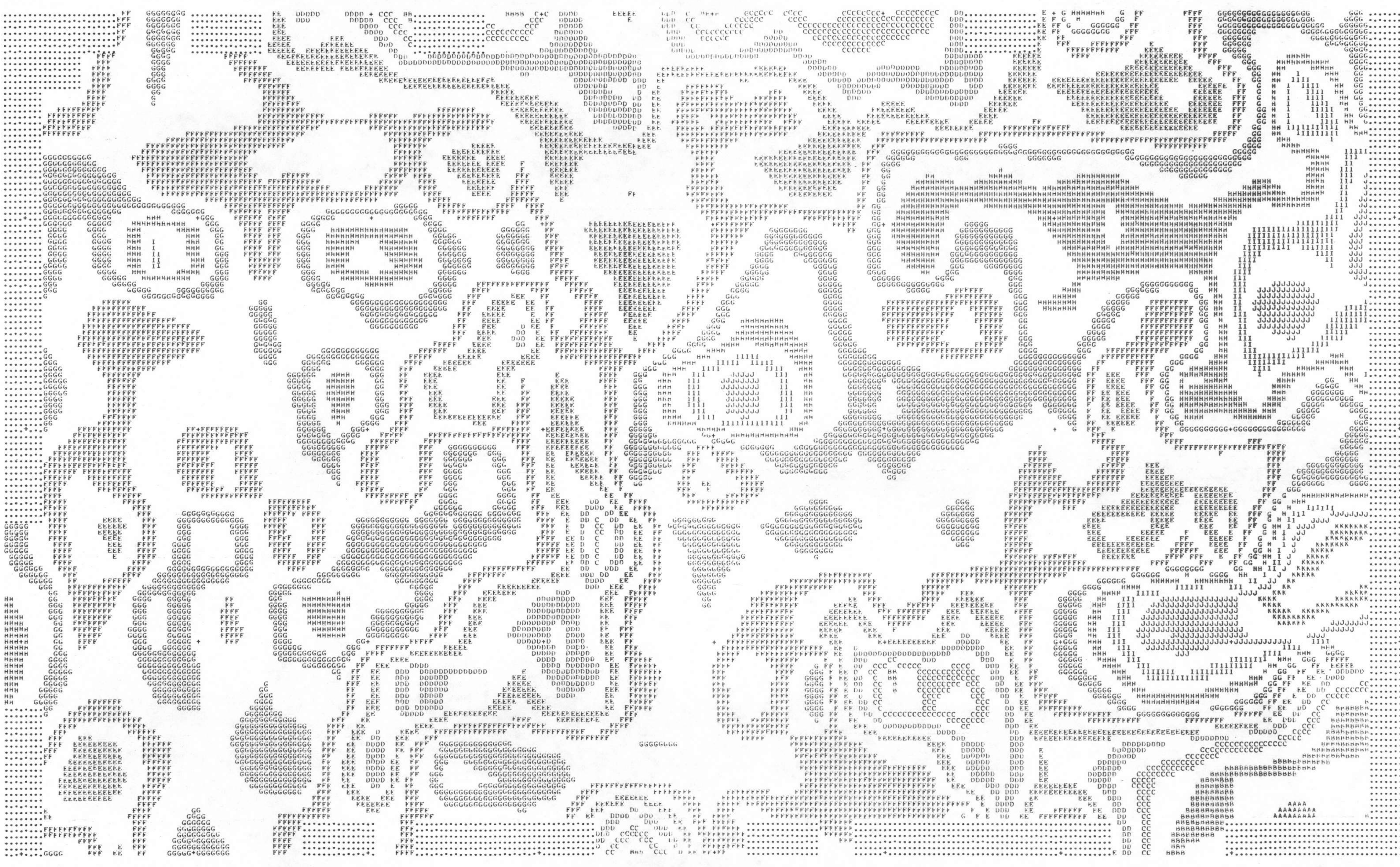


GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< 0.45 0.60<B< 0.75 0.90<C< 1.05 1.20<D< 1.35 1.50<E< 1.65 1.80<F< 1.95
2.10<G< 2.25 2.40<H< 2.55 2.70<I< 2.85 3.00<J< 3.15

AIV-2 Line Printer Contour

CONTOUR INTERVAL= 0.06 K LAT 36.000 LONG-102.000

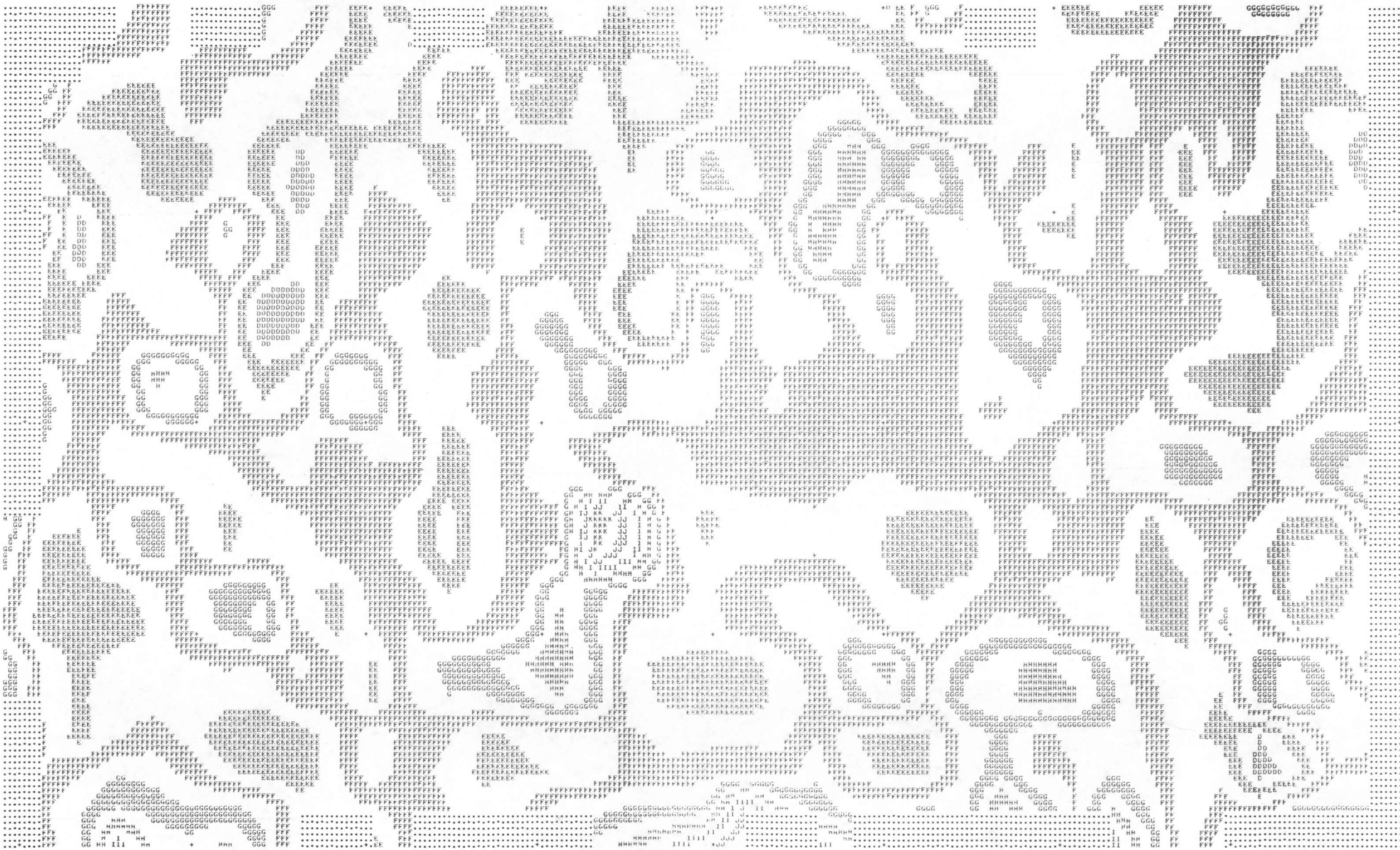


AIV-3 Line Printer Contour

GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< 1.020	1.080<B< 1.140	1.200<C< 1.260	1.320<D< 1.380	1.440<E< 1.500	1.560<F< 1.620
	1.680<G< 1.740	1.800<H< 1.860	1.920<I< 1.980	2.040<J< 2.100	2.160<K< 2.220

CONTOUR INTERVAL= 0.02 ED/EIH LAT 36.000 LONG-102.000

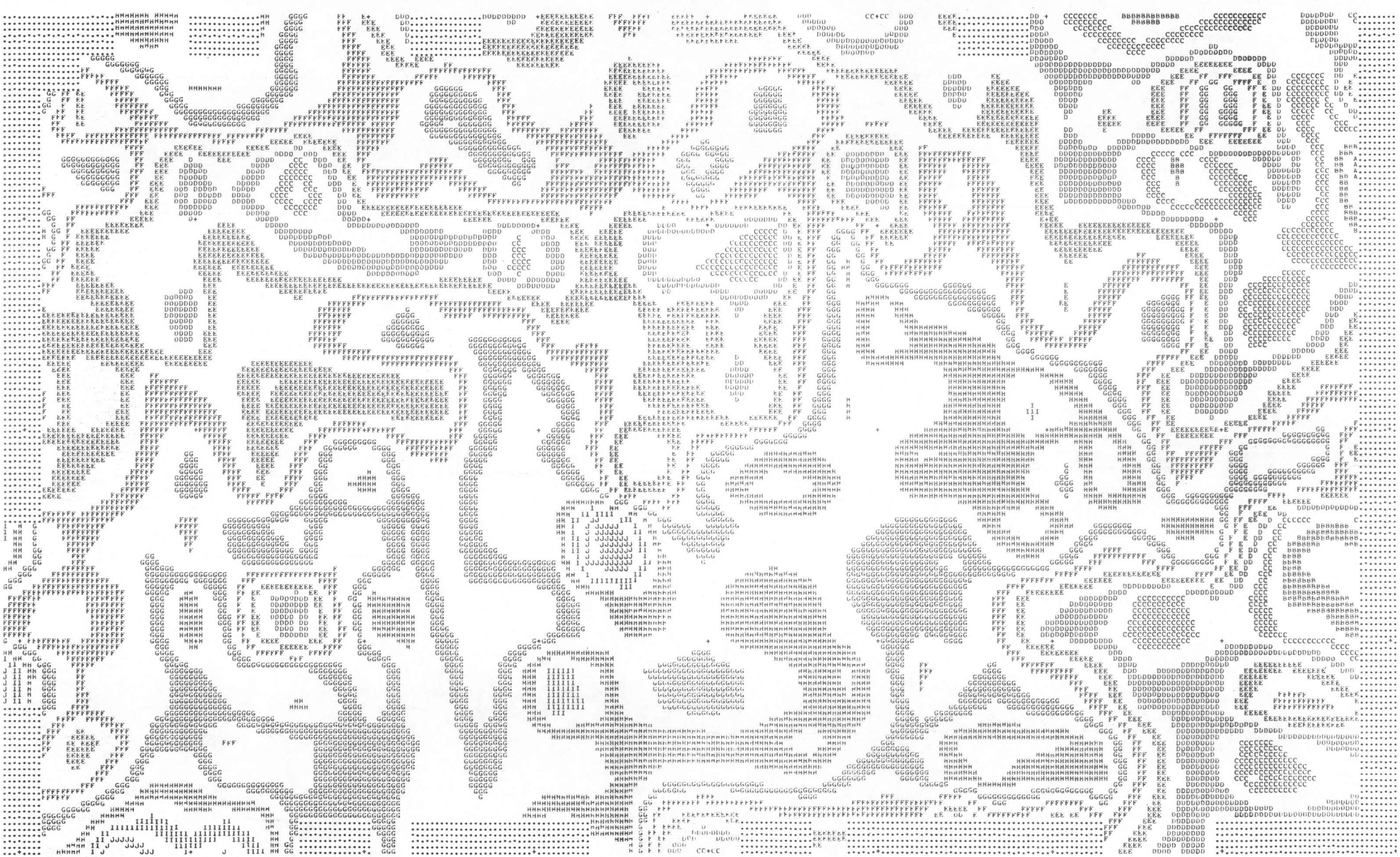


AIV-4 Line Printer Contour

GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< .105 .120<B< .135 .150<C< .165 .180<D< .195 .210<E< .225 .240<F< .255
.270<G< .285 .300<H< .315 .330<I< .345 .360<J< .375 .390<K< .405

CONTOUR INTERVAL= 0.09 ED/K LAT 36.000 LONG=102.000



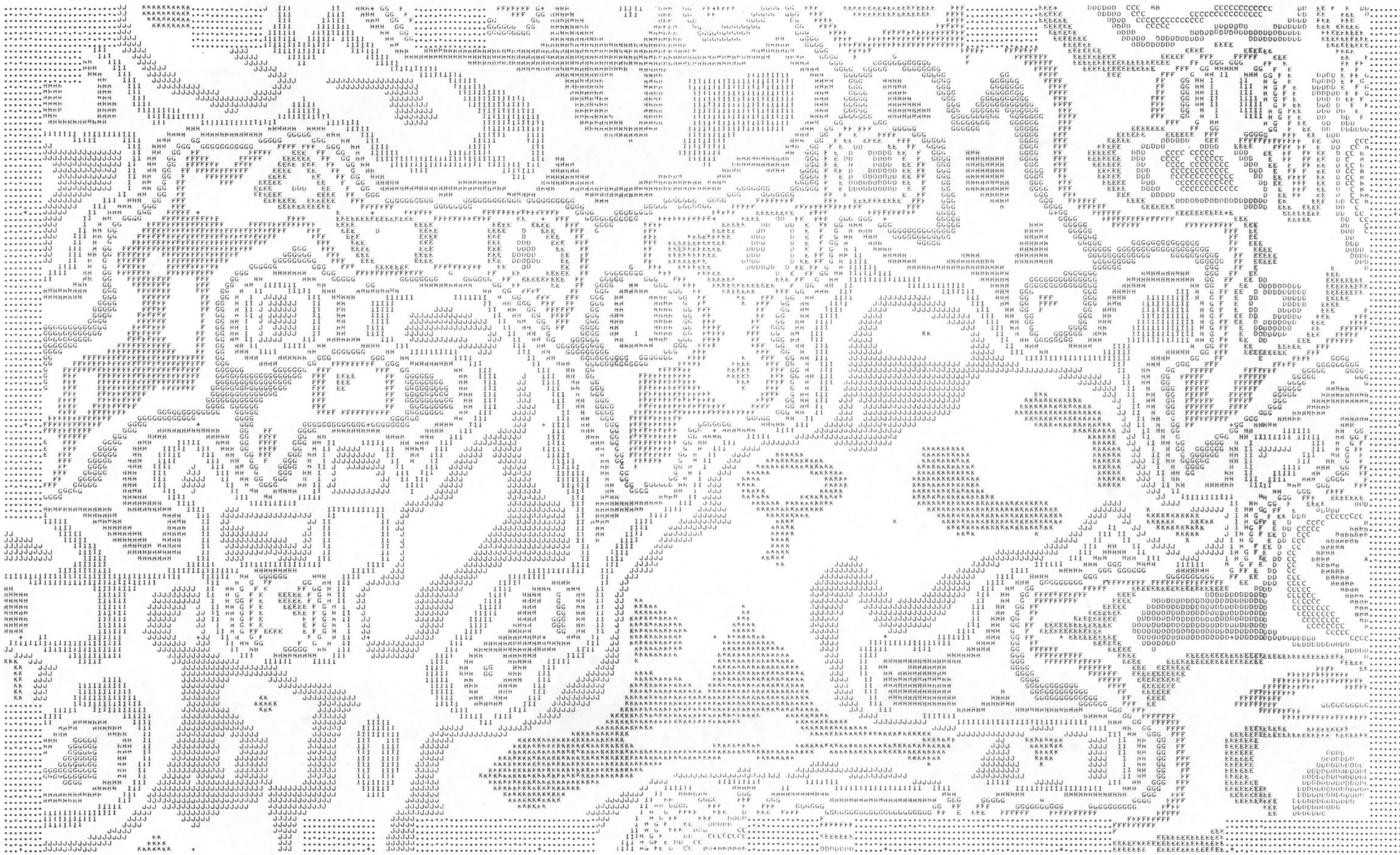
AIV-5 Line Printer Contour

GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< 0.270   0.360<B< 0.450   0.540<C< 0.630   0.720<D< 0.810   0.900<E< 0.990   1.080<F< 1.170

1.260<G< 1.350   1.440<H< 1.530   1.620<I< 1.710   1.800<J< 1.890

CONTOUR INTERVAL= 0.25 ETH/K LAT 36.000 LONG-102.000

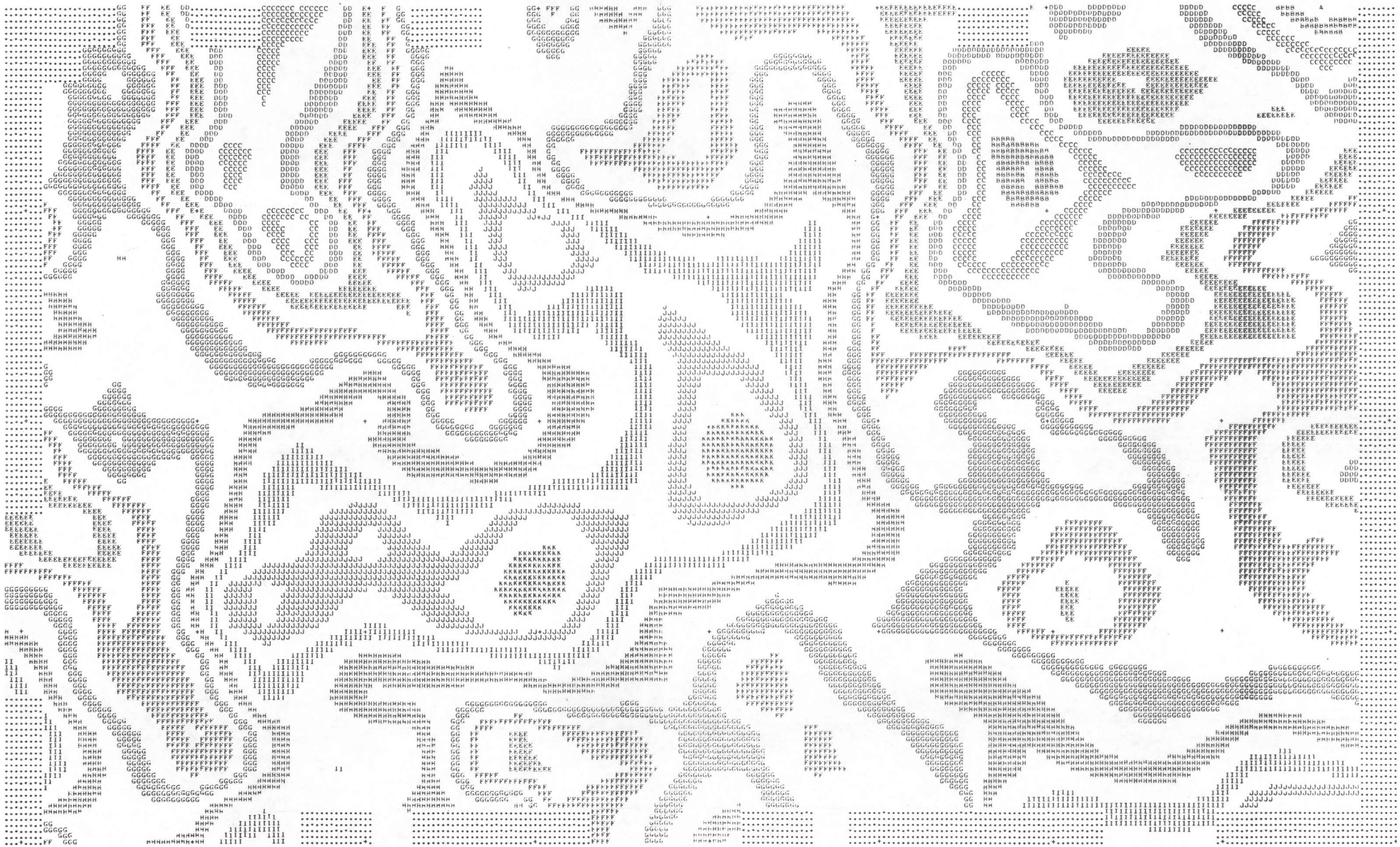


GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< 1.25 1.50<B< 1.75 2.00<C< 2.25 2.50<D< 2.75 3.00<E< 3.25 3.50<F< 3.75
4.00<G< 4.75 4.50<H< 4.75 5.00<I< 5.25 5.50<J< 5.75 6.00<K< 6.25

AIV-6 Line Printer Contour

CONTOUR INTERVAL= 28.00 RMAG LAT 36.000 LONG-102.000



GEODATA INTERNATIONAL, INC.
DALLAS, TEXAS

A< -728. -700.<B< -672. -644.<C< -616. -588.<D< -560. -532.<E< -504. -476.<F< -448.
-420.<G< -392. -364.<H< -336. -308.<I< -280. -252.<J< -224. -196.<K< -168.

AIV-7 Line Printer Contour

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