

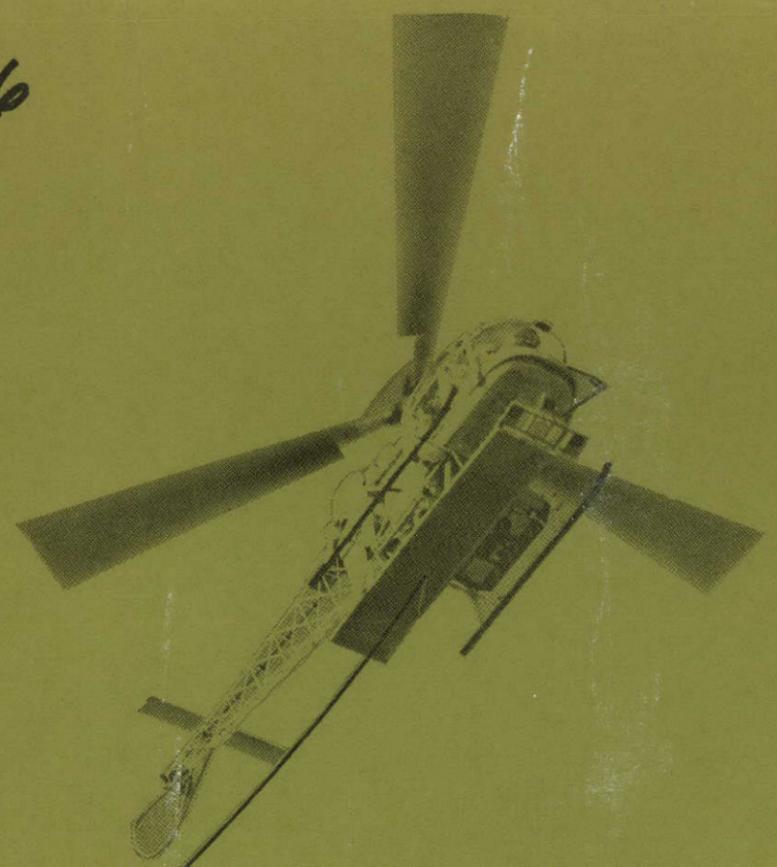
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AERIAL GAMMA RAY AND MAGNETIC SURVEY
IDAHO PROJECT

NEMO DETAIL AREA,
SOUTH DAKOTA

FINAL REPORT
VOLUME II



Prepared by:

 **EG&G GEOMETRICS**
Sunnyvale, California
April 1980

Work Performed Under
Bendix Field Engineering Corporation
Grand Junction Operations, Grand Junction, Colorado
Subcontract 79-323-S
and
Bendix Contract DE-AC13-76GJ01664

Prepared for the
Department of Energy
Grand Junction Office
Grand Junction, Colorado 81502

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ABSTRACT

The Nemo Detail area covers 40 square miles in the eastern portion of the Black Hills Uplift. The region's geology is a combination of Precambrian igneous and metamorphic rocks, and overlying Early Paleozoic sediments and metasediments. The Paleozoics cover most of the eastern half of the area.

A total of 7 groups of samples in the uranium window constitute anomalies as defined in Volume I. These anomalies occur in locales of relatively high uranium and thorium with respect to the balance of the detail area.

Magnetic data shows a wide range of gradients; but fail to show a significant degree of correlation with available geologic interpretations or the radiometric data.

Only one geochemical unit was defined on the basis of the radiometric criteria set forth in Volume I.

TABLE OF CONTENTS

	Page Nos.
I. INTRODUCTION	1
General	1
Physiography	1
II. GEOLOGY	1
Regional Structure	1
Precambrian Rocks	1
Paleozoic Rocks	2
Quaternary Surficial Materials	2
Uranium	2
III. INTERPRETATION OF GEOPHYSICAL DATA	2
Uranium Anomaly Detection	2
Magnetic Data	4
Geochemical Analysis	4
Multivariate Analysis	4
IV. BIBLIOGRAPHY	5
V. APPENDICES	
Appendix A - Flight Path Map	1N
Appendix B - Profiles	2N
Appendix C - Contour Maps	42N
Appendix D - Histograms	49N
Appendix E - Uranium Anomaly Summary and Statistical Table	50N

LIST OF FIGURES

	Page Nos.
Figure 1 Location Map	1
Figure 2 Uranium Anomaly/Interpretation Map	3

INTRODUCTION

General

The Nemo Detail Area covers a 40 square mile area in westernmost South Dakota, near the southwest corner of the Rapid City 1° x 2° quadrangle (see Figure 1).

A geologic compilation map of the Rapid City quadrangle by Mineral Resources Development Inc. (1979) served as the geologic base map used in the interpretation. That portion of the map covering the detail area was mapped by Bishop and Hoffman (1964). Geologic map descriptions were taken directly from the accompanying map legend. Additional stratigraphic and structural information was taken from Mallory (1972). Topographic maps of 1:24,000 scale were used to determine the locations and possible origins of statistical anomalies, and to delineate cultural features of importance to the interpretation process.

Physiography

The detail area lies on the eastern edge of the Black Hills. The area is dominated by lightly forested uplands of the Crystal Mountain-Steamboat Rock area in the Black Hills National Forest. Elevations range from 4,250 feet at the easternmost base level of Boxelder Creek, to 5,500 feet atop an unnamed hill east of Crystal Mountain. The major portion of the detail area lies within the Boxelder Creek watershed, though portions of the western edge are drained by the Stagebarn and Little Elk Creeks. The topography is dominated by gently rolling hills, though slightly more rugged areas are common in some localities throughout the detail area.

GEOLOGY

Regional Structure

The detail area lies near the axis of the Black Hills Uplift. In this portion of the uplift a large section of Precambrian rocks is exposed that ranges from Early to Middle Proterozoic in age. Portions of the area contain a thin veneer of early Paleozoic rocks.

Precambrian Rocks

The Precambrian sequence covers approximately 55% of the detail area and is largely confined to the southwestern half. The exposed

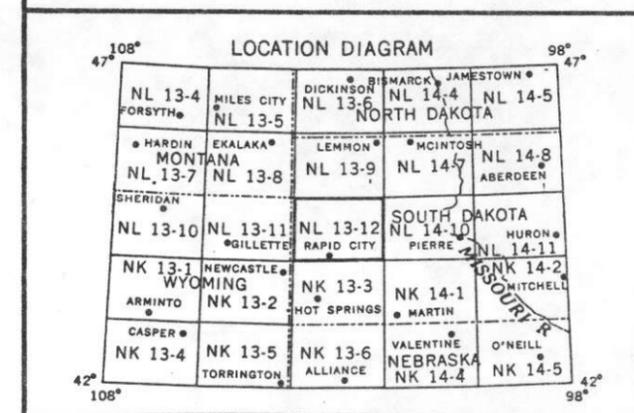
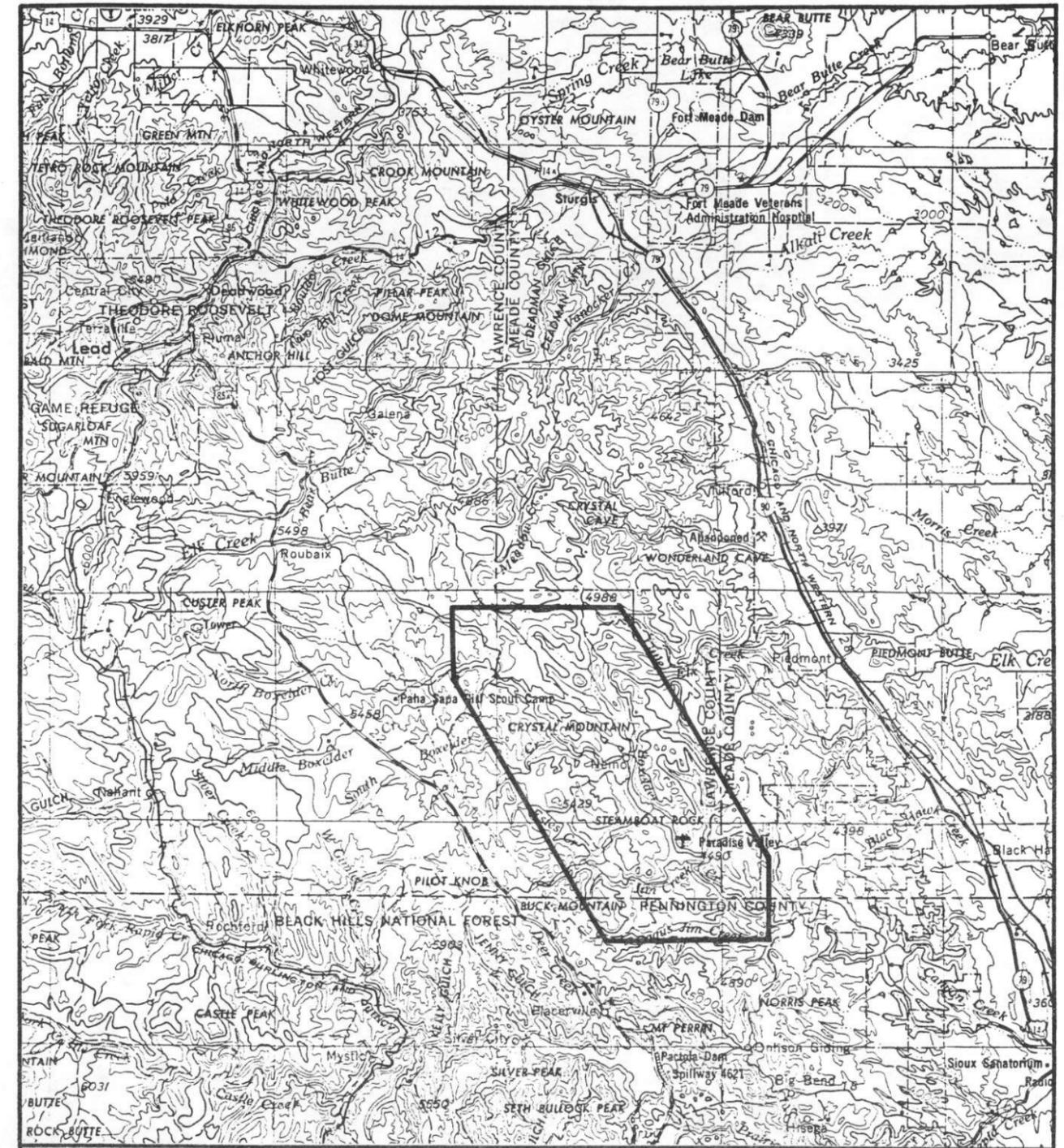


FIGURE 1
LOCATION MAP
NEMO DETAIL

Scale 1:250,000

sequence consists essentially of amphibolite facies metasediments and metaigneous rocks. Most extensive exposures are of quartzitic schists, mica schists, metadiorite and metagabbro as mapped. Impure marble, quartz hematite beds, and some lower grade metamorphics (such as slate) are also present in this sequence. The exact locations of the individual lithologies are not sufficiently well portrayed on the Mineral Resources Development Inc. map to merit more detailed discussion.

The northeastern corner of the detail area contains exposures of partially gneissoid granites and pegmatites that appear to be of Precambrian age.

Paleozoic Rocks

The Paleozoic sedimentary sequence covers most of the northeastern half of the detail area (approximately 40%). Two map units are present as mapped that represent four recognized formations of Cambrian to Mississippian age. The older map unit consists of limestones, partially glauconitic shale, sandstones, and limestone and quartz conglomerates of the Whitewood Limestone and Deadwood Formations. These two formations are of Cambrian and Ordovician age, and represent nonmarine and shallow marine sediments of early Paleozoic transgression/regression cycles.

Unconformably overlying these rocks are Devonian and Mississippian limestones, dolomites, and calcareous shales of the Pahasapa and Englewood Limestones. The Englewood Limestone represents shallow marine carbonates of the maximum extent of the Late Devonian transgression. The overlying Pahasapa Limestone is representative of a more restricted (perhaps isolated) marine environment.

Quaternary Surficial Materials

The Quaternary system, as portrayed by Mineral Resources Development Inc., covers approximately 5% of the area, and is mapped as alluvium in the lower Boxelder and Jim Creek drainages. Quaternary surficial cover may be more extensive and contain a wider variety of deposits than as mapped, but more detailed geologic studies of the area were not readily available at the time of this report.

Uranium

Though the Black Hills area contains numerous known uranium deposits, none are known to exist in the detail area. The nearby Lead Mining District (Au), with mineralization occurring in Precambrian (?) rocks is not known to contain significant amounts of uranium according to available literature, nor does it extend into the detail area.

Interpretation of Geophysical Data

Uranium Anomaly Detection

A total of 7 uranium "anomalies" meet the minimum criteria set forth in the data interpretation section. These are displayed, along with other pertinent information, on the Uranium Anomaly/Interpretation Map (Figure 2). The potassium, uranium, thorium, and ratio contour maps appear in Appendix C, and flight line profiles are found in Appendix B. The uranium anomaly summary table is found in Appendix E. Discussion of the abundances of potassium, uranium, and thorium are in terms of apparent equivalent percent and equivalent ppm. These equivalent units are derived from scaling of counts per second data by the sensitivities calculated for the detection system. They do not directly correspond to real geochemical data.

The survey-wide average concentration for uranium is 1.61 ppmeU (see histogram in Appendix D). Areas with concentrations of 3.0 ppmeU or more (more than standard deviations above the mean) are almost exclusively confined to two localities. One of these areas lies near the settlement of Tomahawk (peak concentrations of 5.62 ppmeU) and a region just west of Steamboat Rock, in the gully of a tributary of Jim Creek (peak concentration of 4.46 ppmeU). Both of these localities lie within a portion of the detail area mapped as Precambrian mixed metasediments (unit ARG as mapped by Mineral Resources Development, Inc., 1979). Average and below average concentrations persist over most of the rest of the detail area. Line 1010 appears to have slightly higher uranium concentrations than the traverse lines that cross it, as well as slightly lower BiAir and temperature ranges. This suggests some weather phenomenon may have interfered with the collection of the data on this line.

The average concentrations for potassium and thorium are 1.14 equivalent percent and 5.83 ppmeT respectively. Thorium shows a geographic range of high concentration values similar to uranium. Highest concentrations occur in the Tomahawk area at 23.99 ppmeT. Potassium does not show the same degree of correlation with uranium that thorium does. High concentration areas appear to overlie exposed mafic metaigneous rocks (amphibolite), whereas lowest concentration values generally correspond to the exposed Paleozoic section.

Anomalies are essentially confined to the high uranium count areas. The peak concentration value in anomaly 4 (in the Tomahawk area) is 3.08 ppmeU. In anomaly 6 (east of Steamboat Rock) peak concentrations are as high as 3.45 ppmeU. Highest peak concentrations are found in anomalies 2 and 5, both of which lie on the western edge of the detail area. These anomalies are spatially the largest in the detail area and contain many slightly anomalous samples (between 1 and 2 standard deviations above the mean). Peak concentrations in anomalies 2 and 5 are 3.97 ppmeU and 3.68 ppmeU respectively.

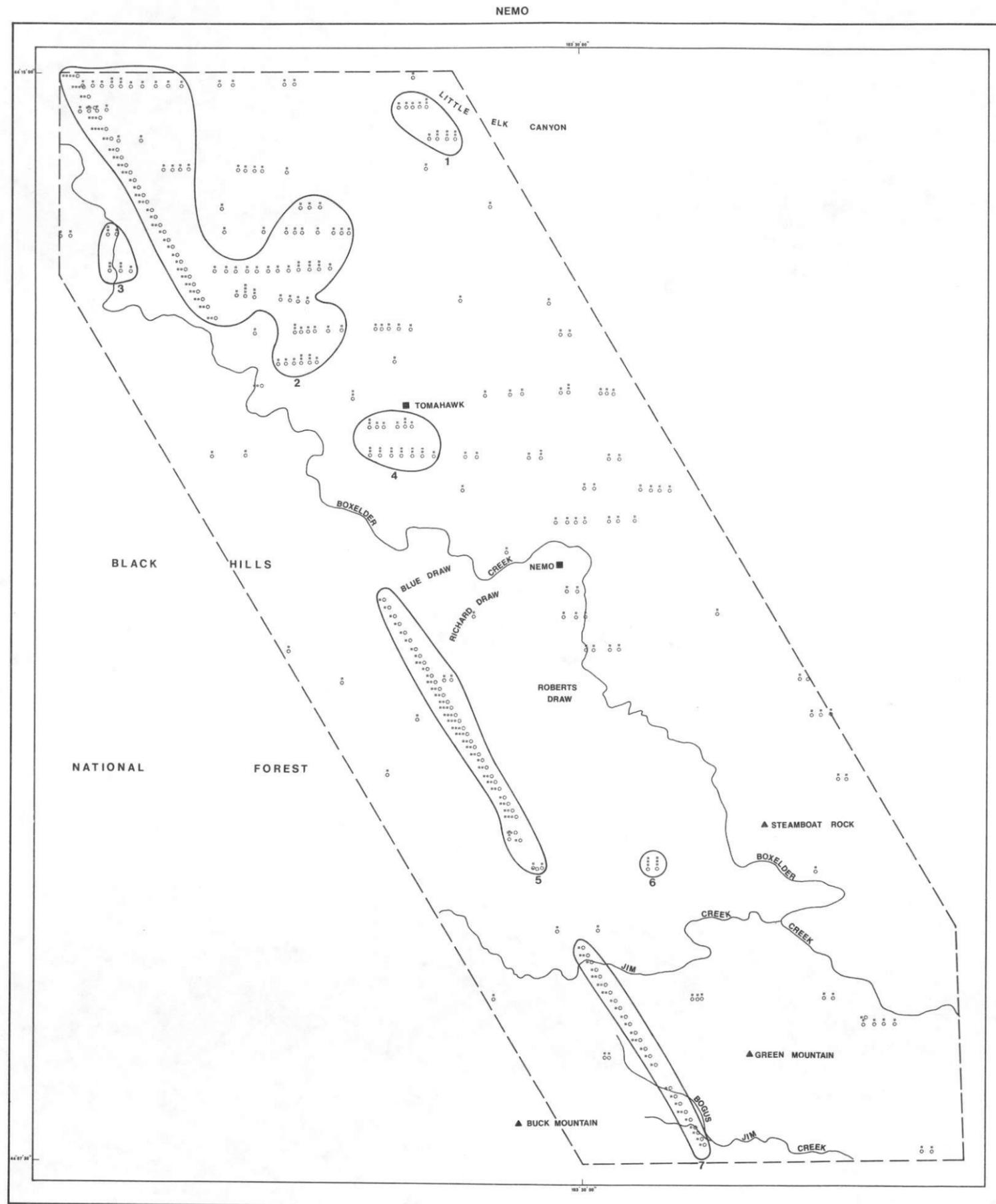


Figure 2 - Uranium Anomaly/Interpretation Map - Nemo Detail

URANIUM ANOMALY/ INTERPRETATION MAP

NEMO DETAIL
U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500

EXPLANATION

- - CITY OR TOWN
- - URANIUM SAMPLE MEETING FOLLOWING CRITERIA:
 - (1) $1.0 \leq U \leq \infty$
 - (2) $-1.0 \leq T \leq \infty$
 - (3) $1.0 \leq U/T \leq \infty$
- IN STANDARD DEVIATION UNITS.
EACH SQUARE REPRESENTS 1 STANDARD DEVIATION.
- - URANIUM ANOMALY:
A SINGLE SAMPLE OF 3 OR MORE STANDARD DEVIATIONS OR GROUP OF ADJOINING SAMPLES WHICH TOGETHER TOTAL 4 OR MORE STANDARD DEVIATIONS, $4.0 \leq \text{sum} \leq \infty$, WITH AT LEAST ONE SAMPLE OF 2 OR MORE STANDARD DEVIATIONS.



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In summary, further detailed geologic investigation may be warranted in the areas covered by anomalies 2, 4, 5, and 6. The lack of any available detailed geologic investigation reports for this region minimizes the significance of further interpretive statements that might be made.

Magnetic Data

The magnetic field contour map is shown in Appendix C. Portions of the magnetic data were removed from the data set because the gradients were too extreme (in excess of 1,000 gammas per sample) for the instrument to measure correctly. These areas appear as blank regions in the profiles. Despite the previously mentioned problem, the detail area shows remarkable contrast between high and low gradient areas. No truly definite correlation exists between the magnetic field and the mapped geology. This may in part be due to the generalized nature of the geologic map. Highest and lowest gradient areas cross all geologic contacts. Transitions between the high and low gradient areas appears gradational. The major trends of high gradient areas appears to roughly parallel the foliation trends in the Precambrian, where they are exposed, but the Paleozoic section in the east covers any underlying (Precambrian?) units that might compare more readily with the magnetic data.

No obvious relationship between the magnetic data and the radiometric data can be seen. Keeping in mind what the magnetometer and the spectrometer measure, the lack of any apparent relationship is not surprising.

Geochemical Analysis

Based upon the criteria set forth in the Geochemical Analysis section of Volume I, only one distinct geochemical unit is clearly definable in the study area. Though the potassium histogram shows an indistinct multimodality, the populations have too similar a concentration range to be separable by potassium alone. Multimodality is not readily apparent in any other radioelement or ratio.

The concentrations of the three radioelements is relatively higher in certain portions of the map, but the high concentration values appear in the histograms as part of a single population.

Available geologic maps of the area argue against a single radiometric population because of the wide variety of lithologic units present. More detailed geologic coverage might yield a different conclusion but such maps do not appear to be available. One possible conclusion about the similarity of the radiometric signatures in the area despite the apparent number of mappable geologic units is that the low overall

concentrations of the three radioelements force them into similarity. If all the rock units have low K, U, and T concentrations, the sample population for each unit is distributed much closer to the origin, (since no area can have negative concentrations) and thus tend to blend in with one another. This could be one of the most difficult problems to overcome in the areal geochemical mapping process.

Multivariate Analysis

All results of the principal component analysis are presented in Appendix E, including the variables used, the covariance matrix, and the principal component (eigenvector) matrix.

The original intent of the classification scheme outlined in the work statement was not specified by BFEC and therefore will not be addressed.

The first principal component accounts for only 28 percent of the total variance. This component is best correlated with variables 3, 7, 8, and 11 (essentially high K, U, and T). Though the covariance matrix does show the largest degree of correlation between these variables, the correlation is not high. The best correlation is made between variables 7 ($1.0 < U \leq 3.0$ stand. dev.) and 11 ($T > 1.0$ stand. dev.).

In order to create an understandable picture of the lithologic associations of potassium, uranium, and thorium, these data should be compared with a more detailed geologic study of the area (including petrographic and conventional geochemical analyses). Other metamorphic environments should be examined in a similar fashion. In this manner, some insight can be gained as to the mineralogical habits of the radioelements in metamorphic provinces.

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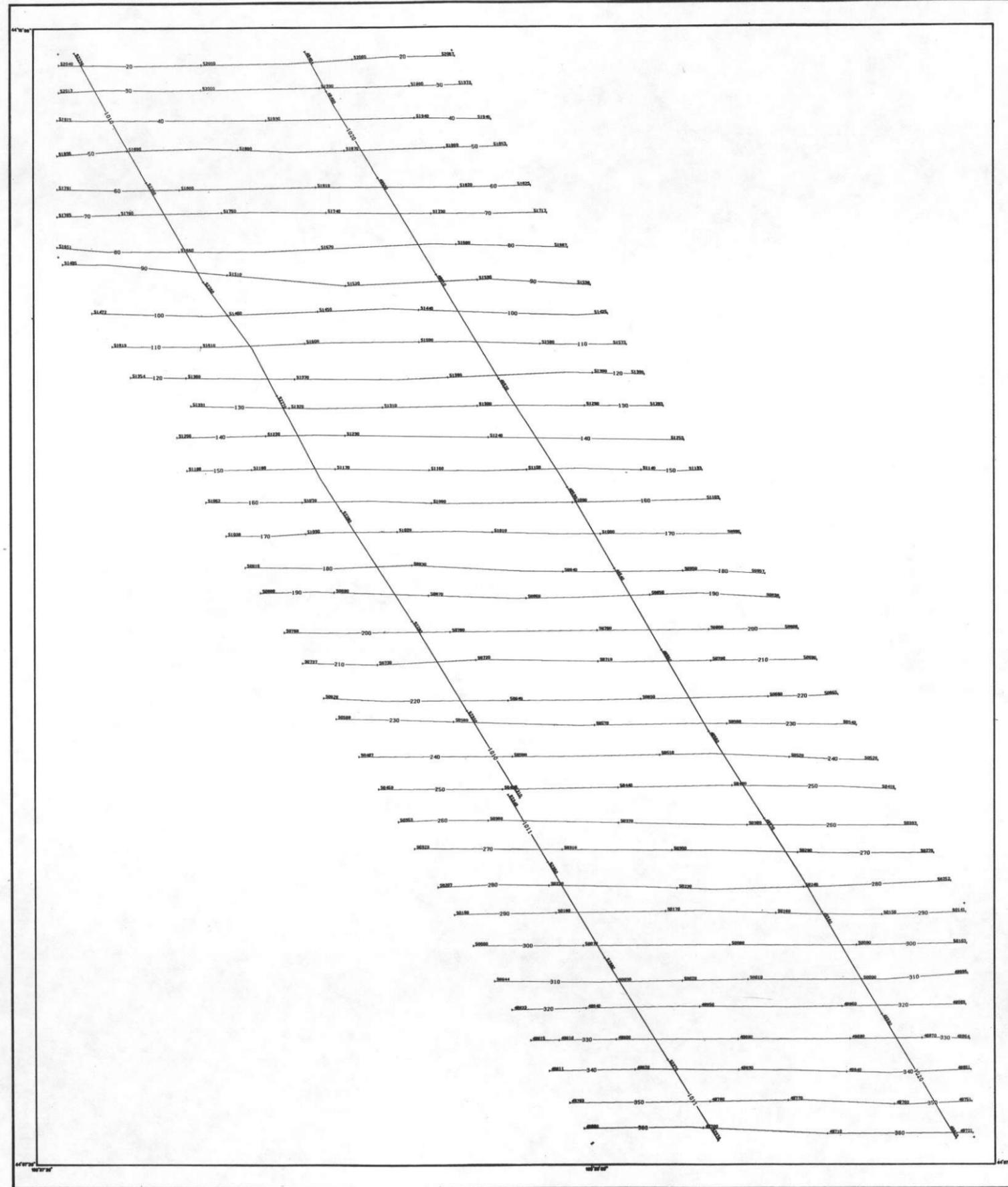
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APPENDIX A - Flight Path

NEMO

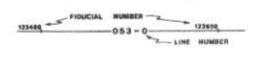


FLIGHT PATH RECOVERY

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500



FLIGHT LINE SPACING..... 0.25 MILES
FLIGHT ALTITUDE..... 400 FEET MTC
FLOWN AND COMPILED..... 1979-1980

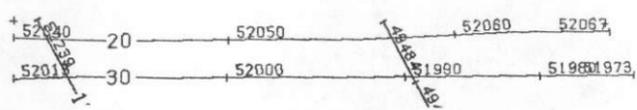
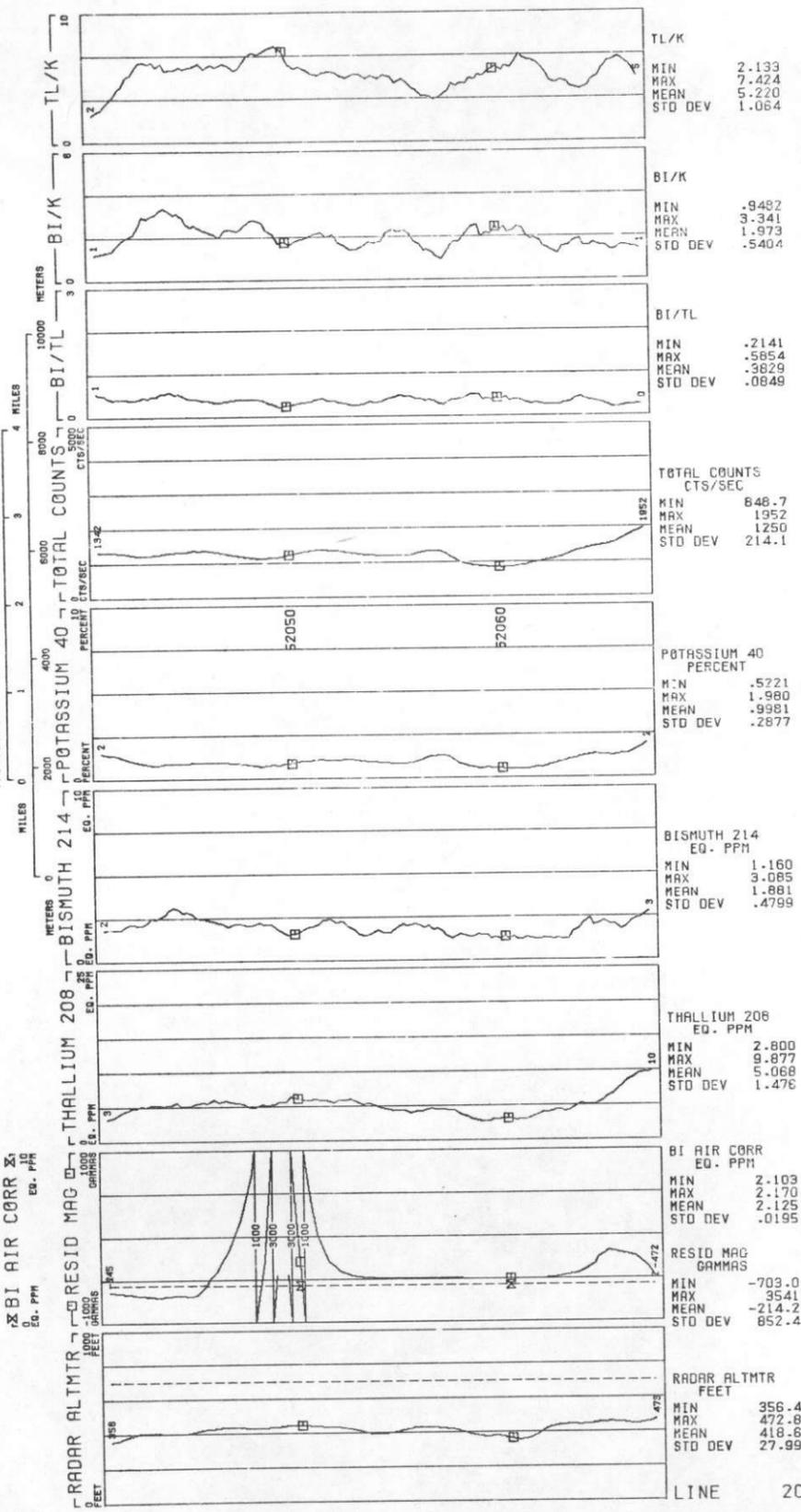


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APPENDIX B - Profiles

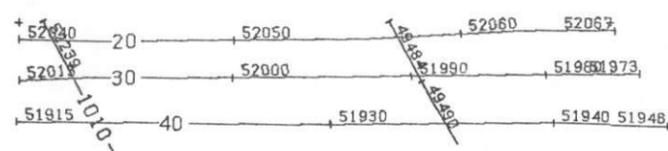
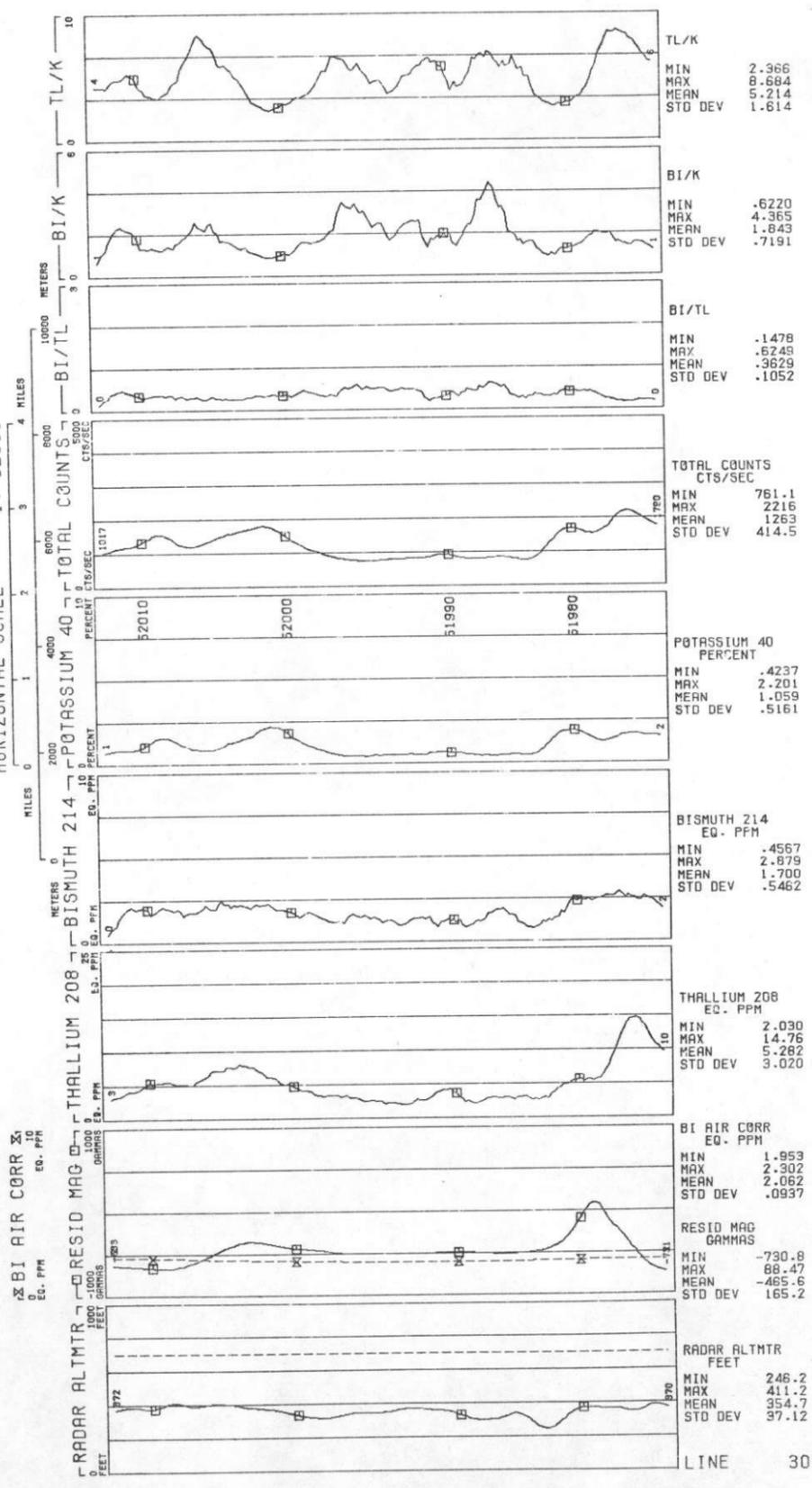
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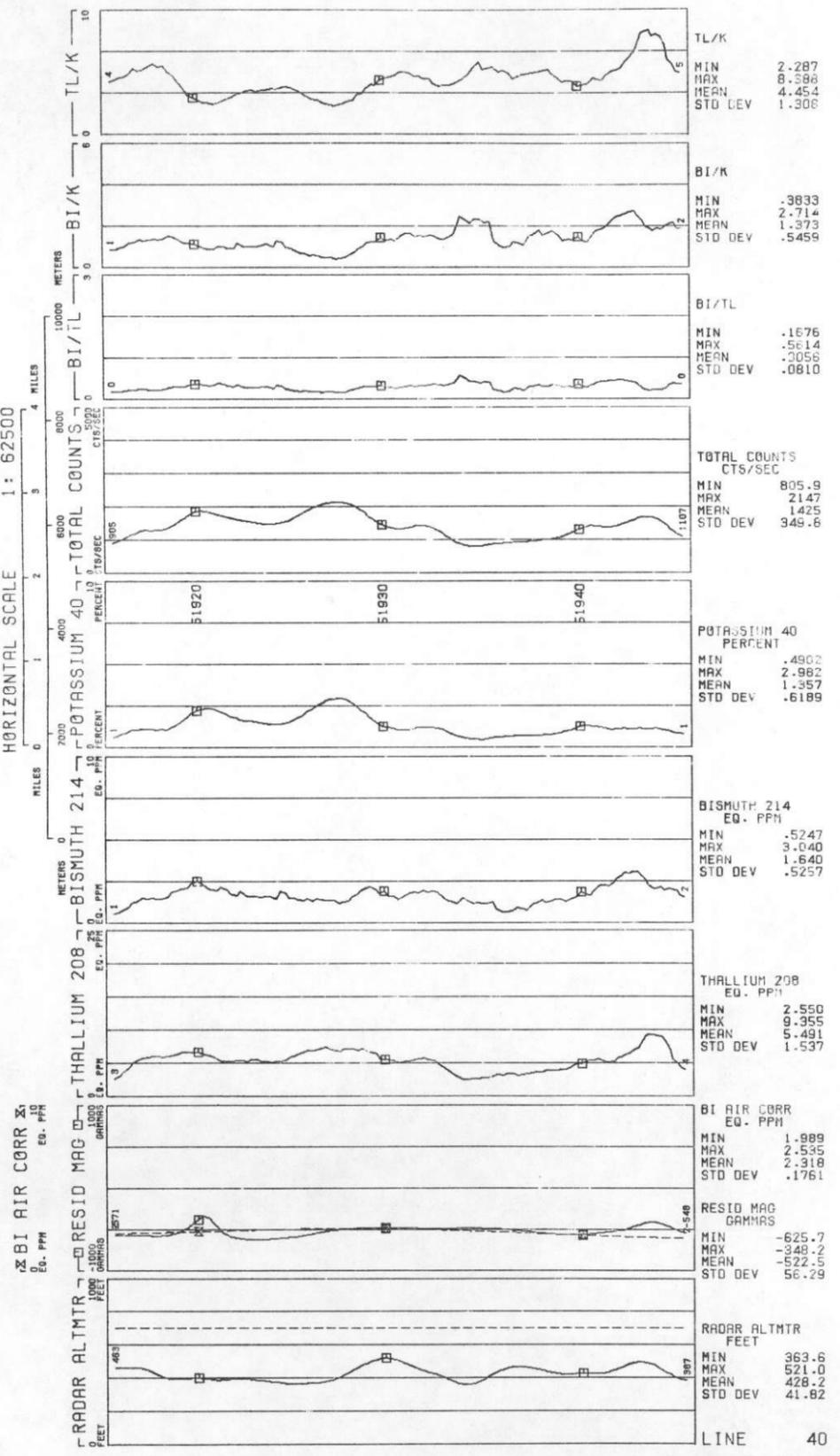
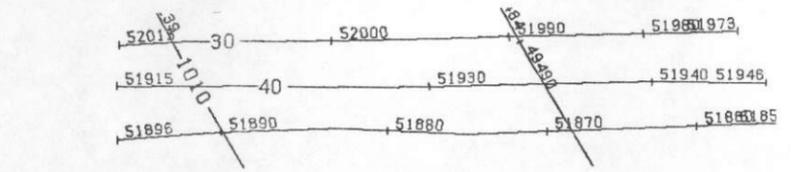
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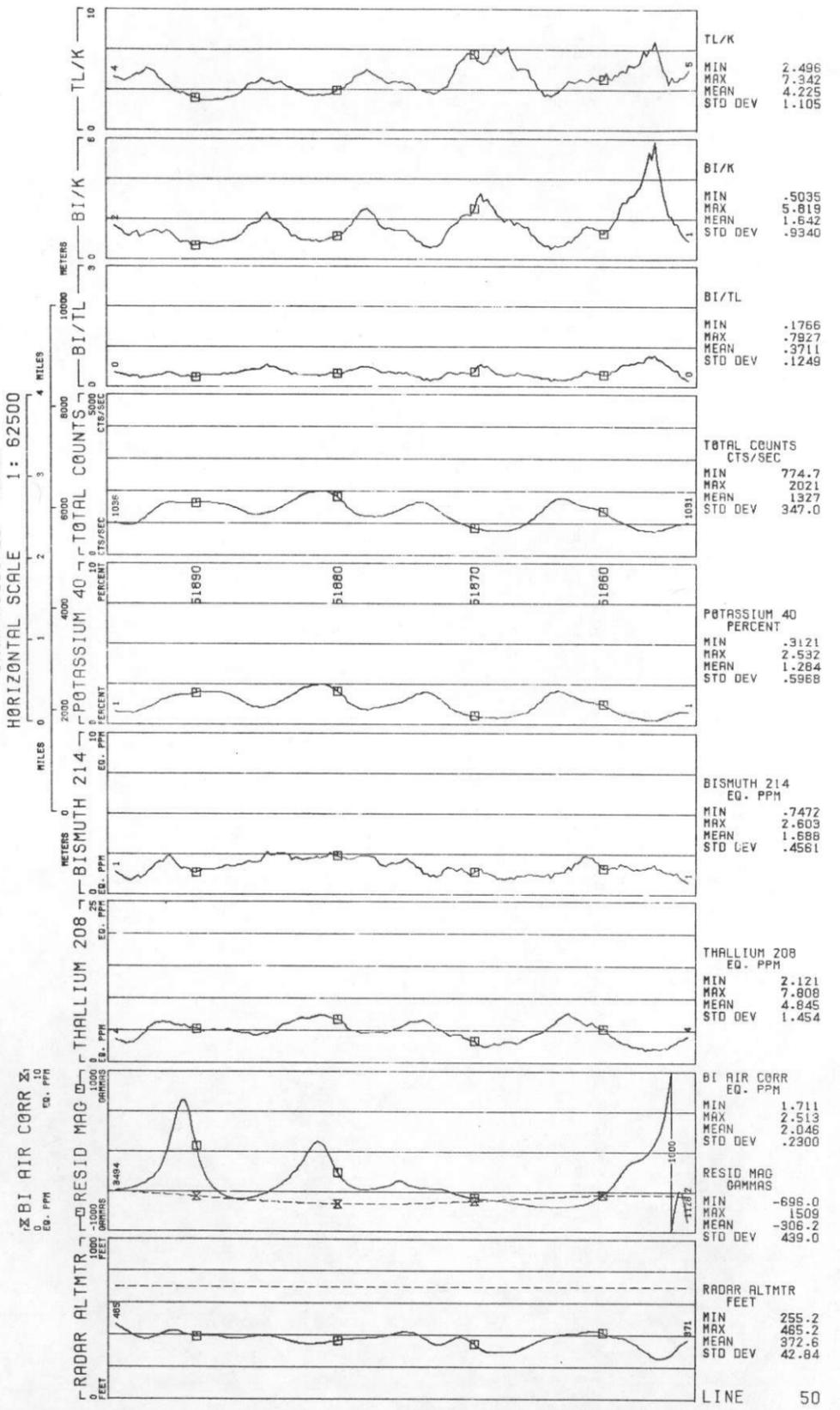
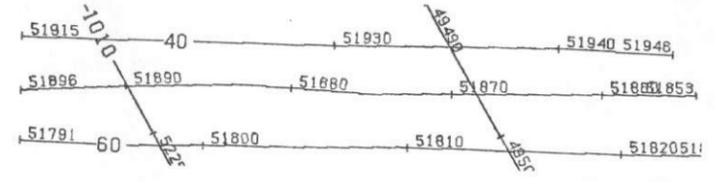
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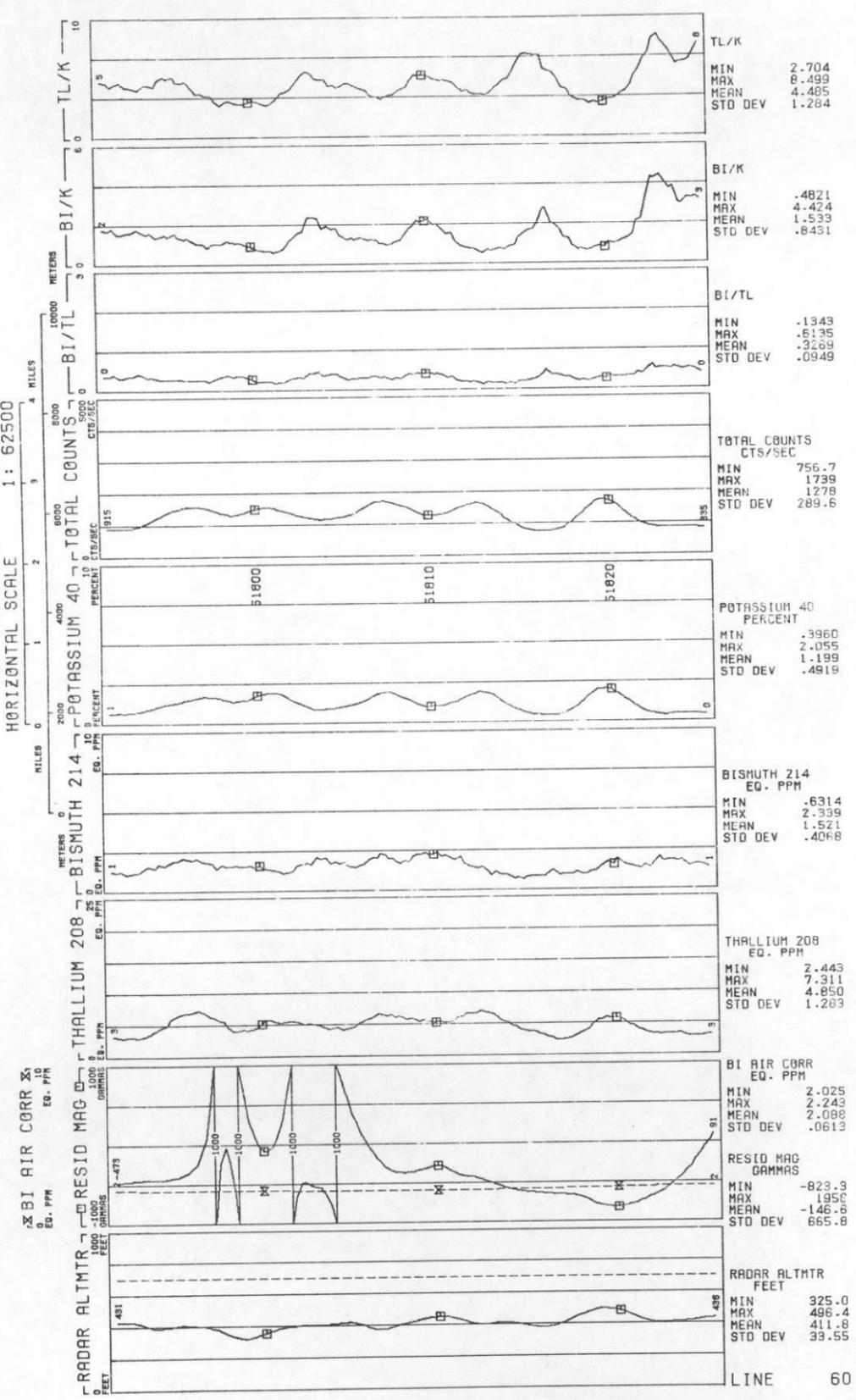
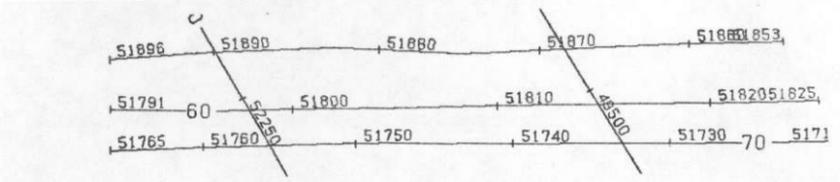


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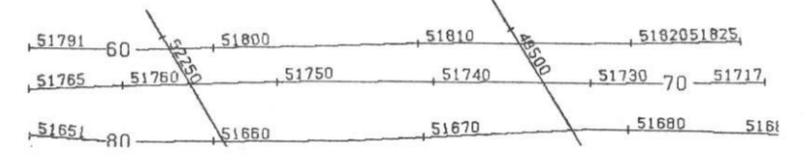
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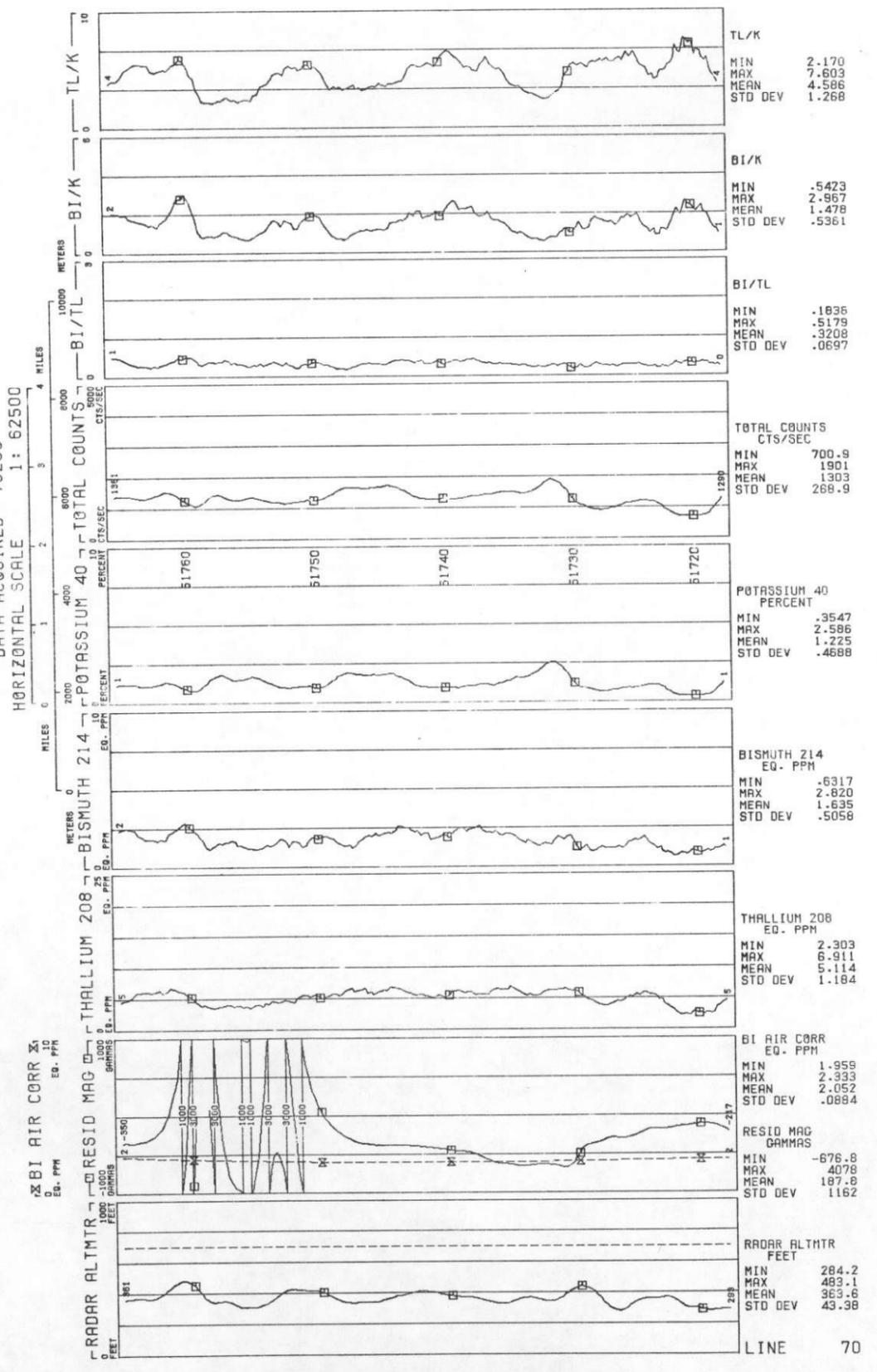
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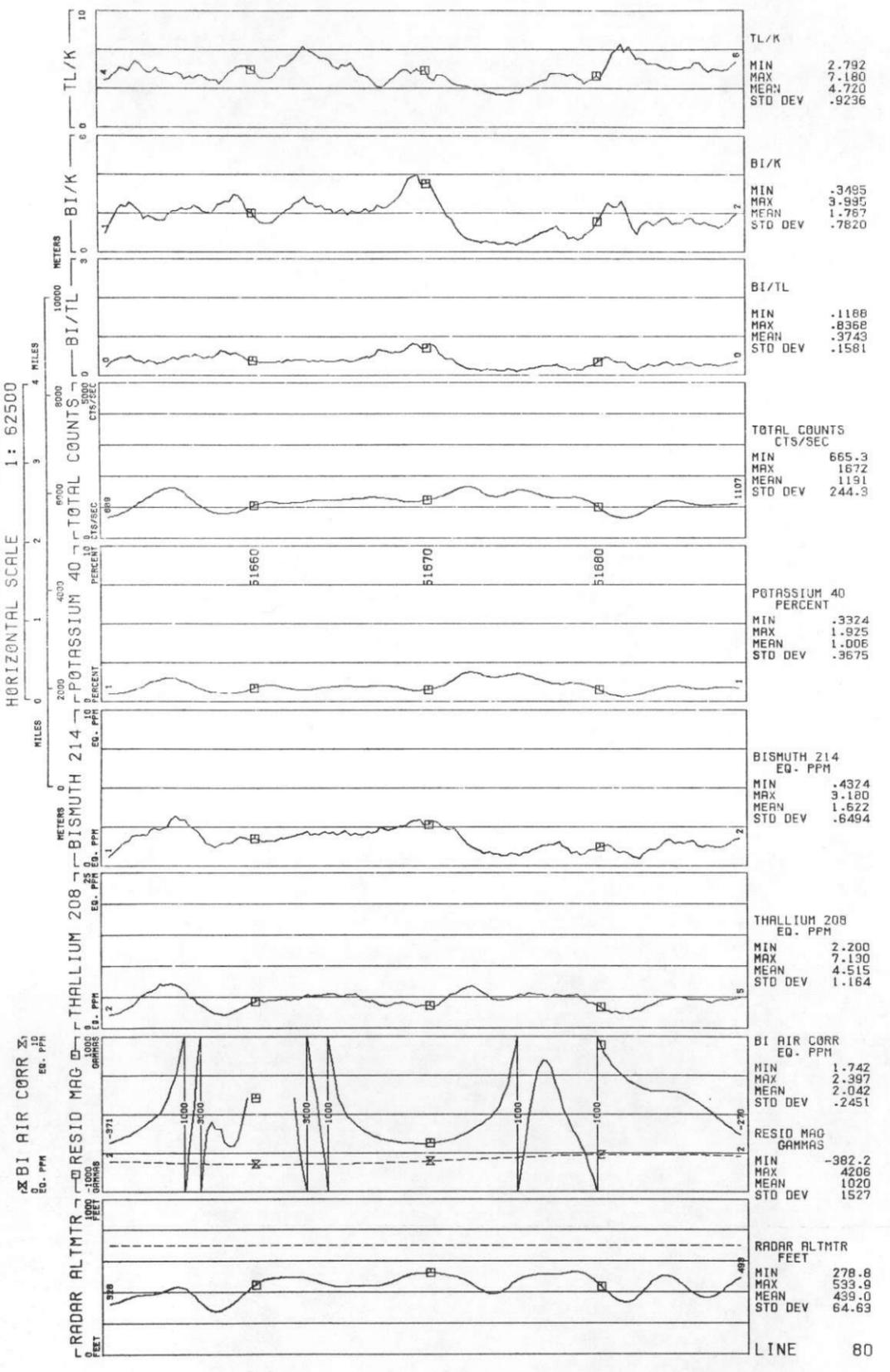
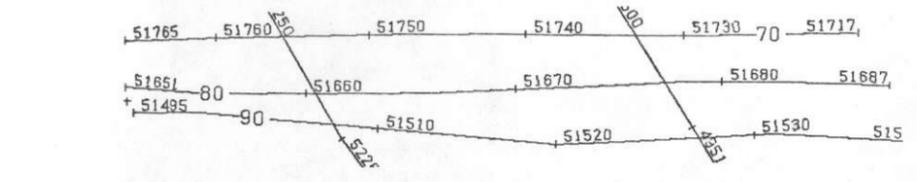


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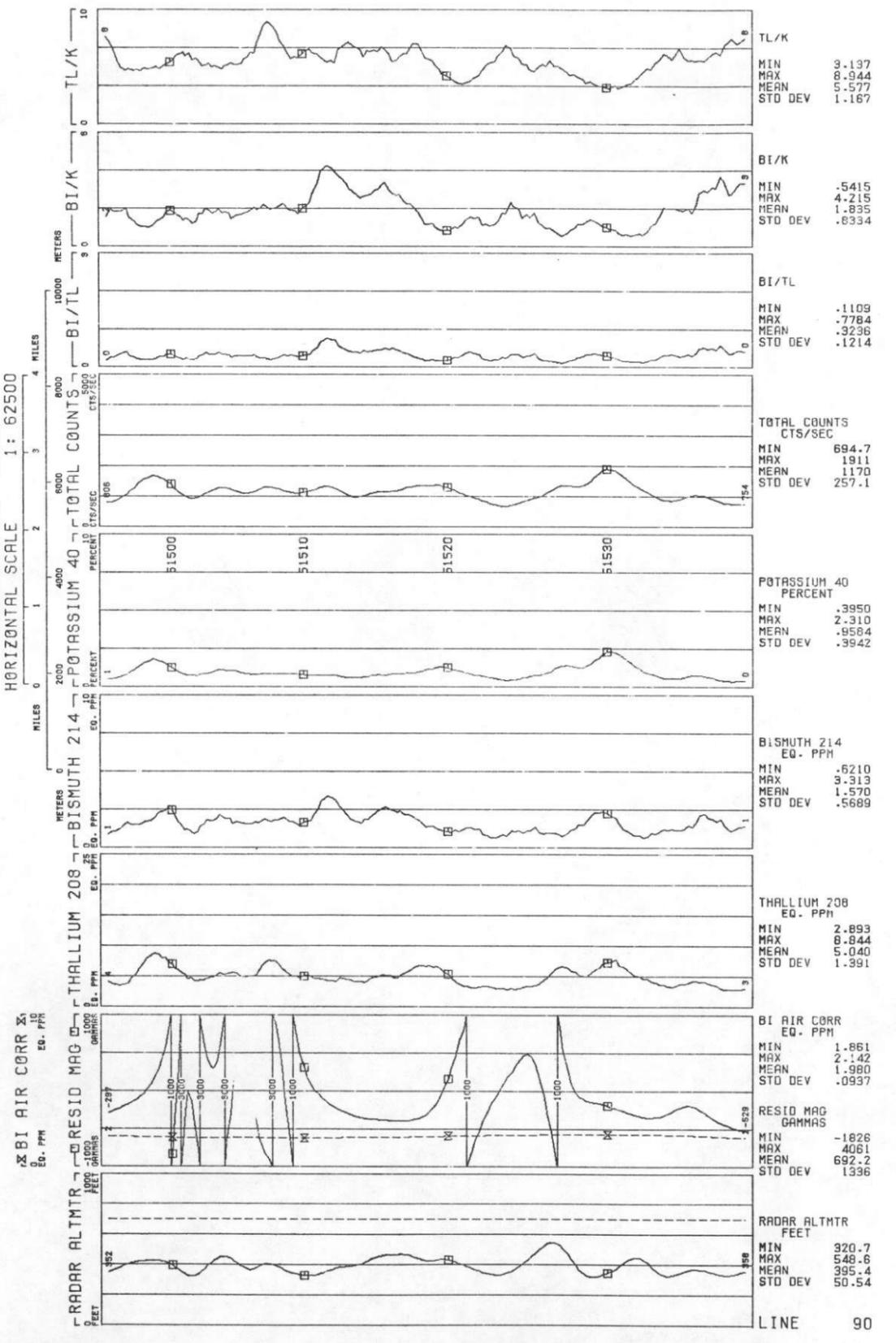
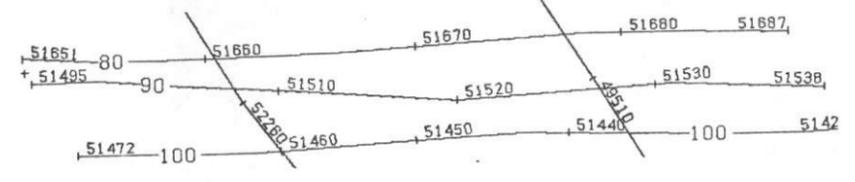


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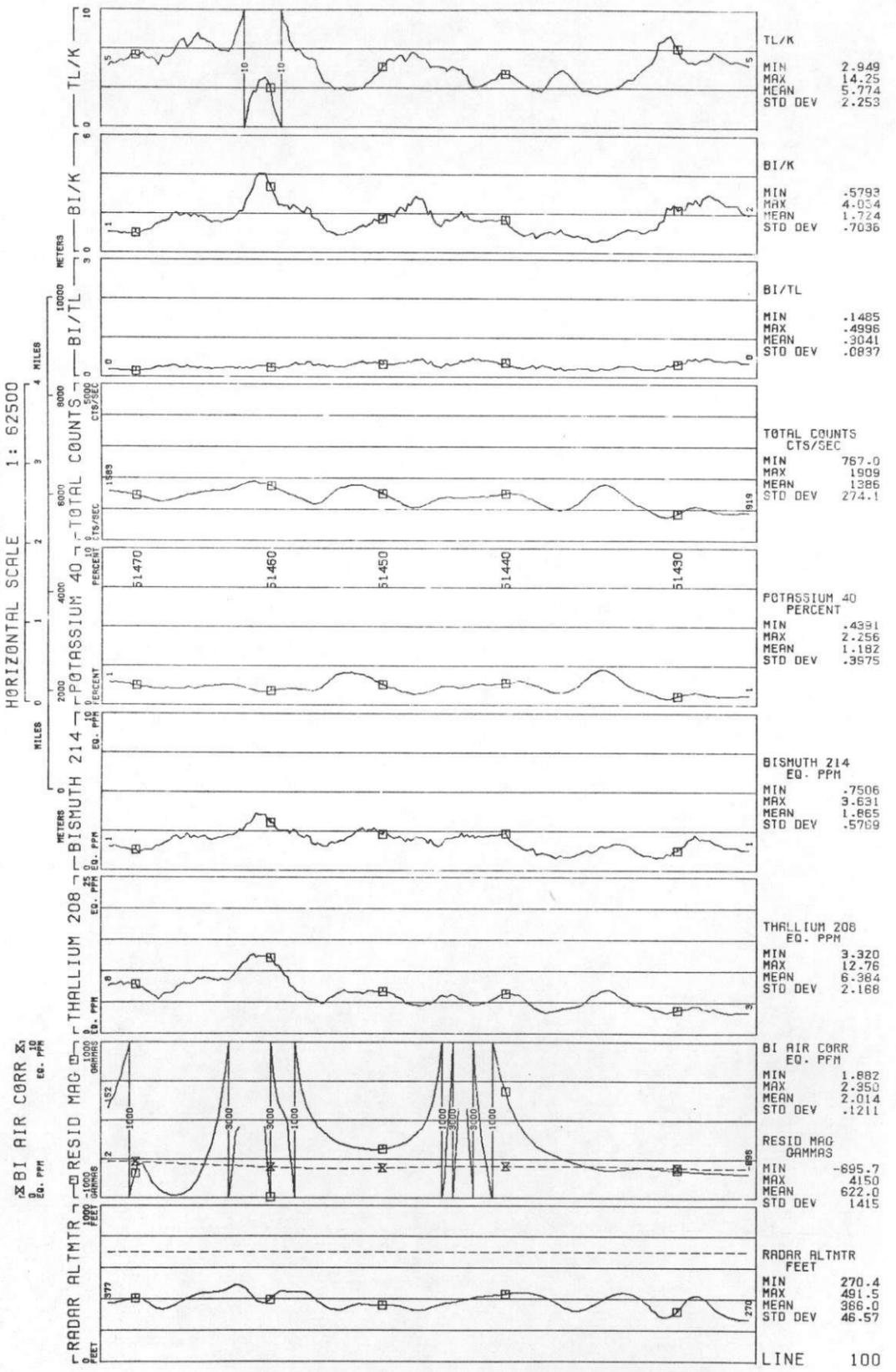
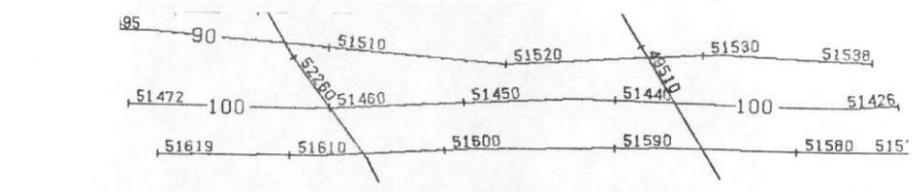


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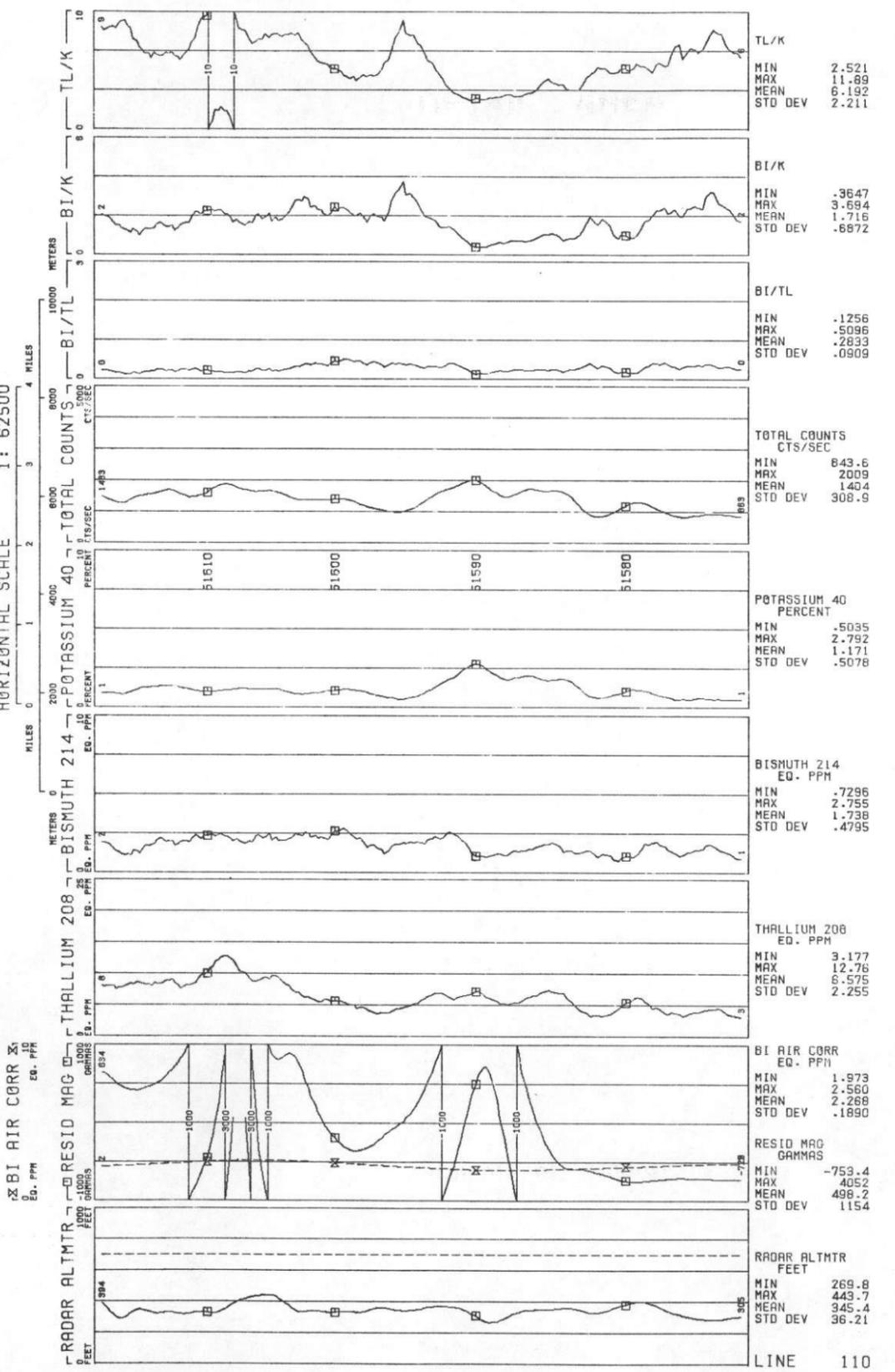
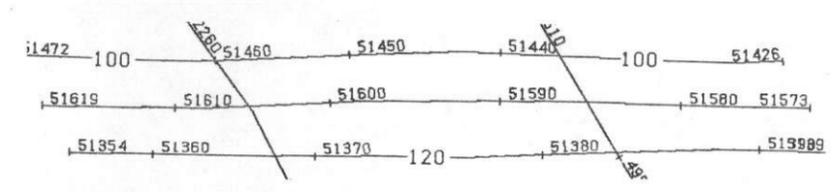


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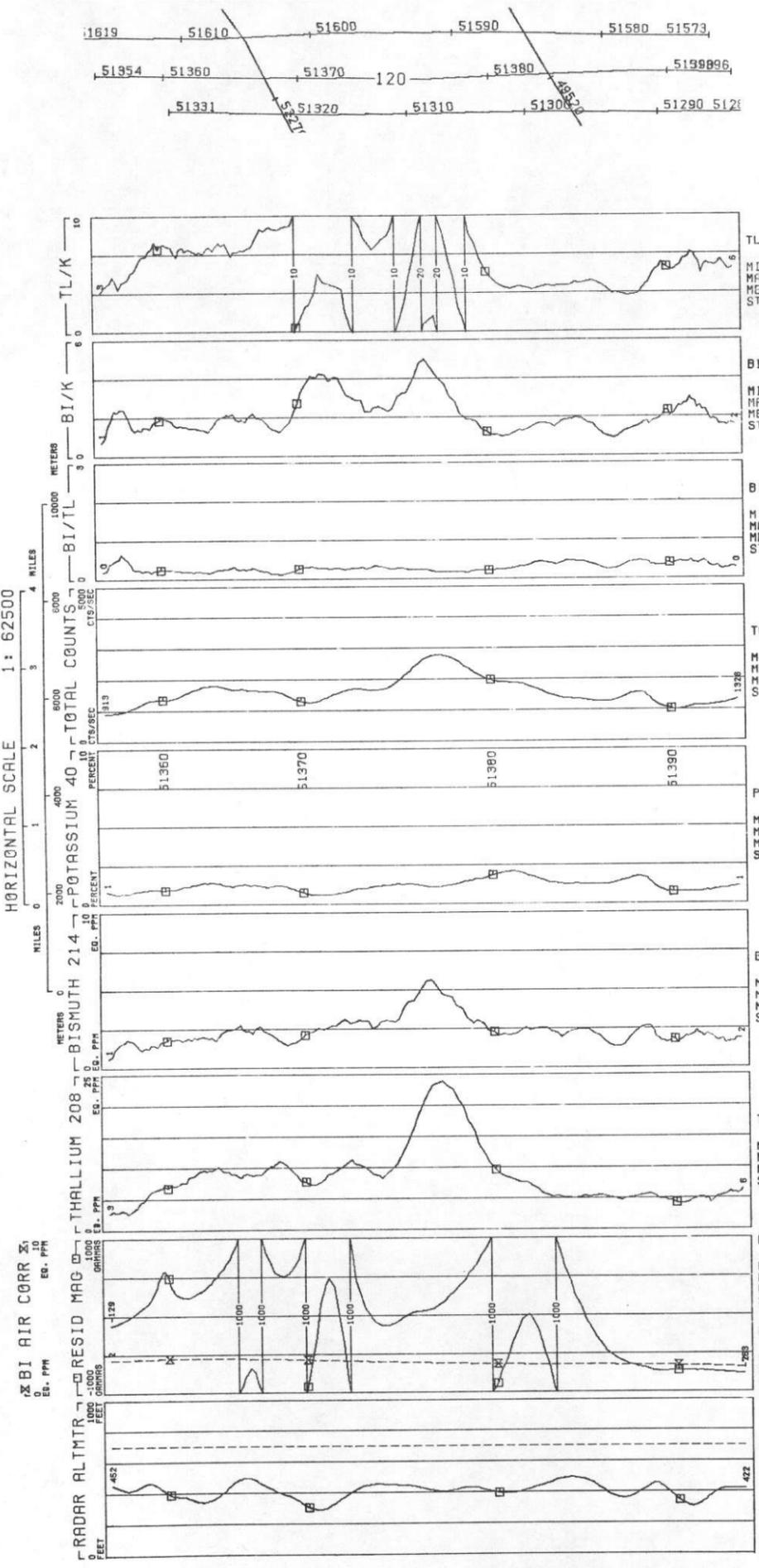
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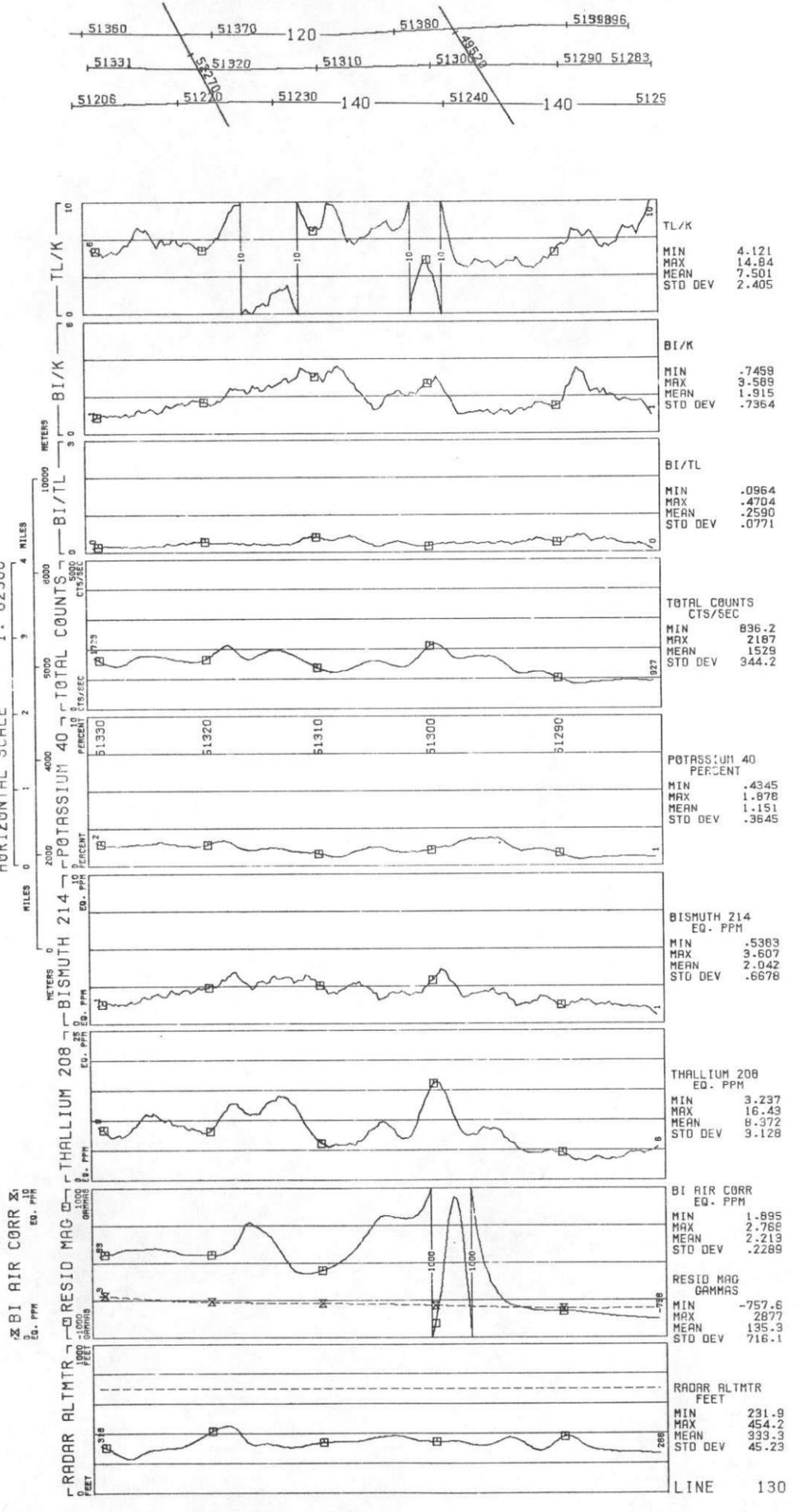


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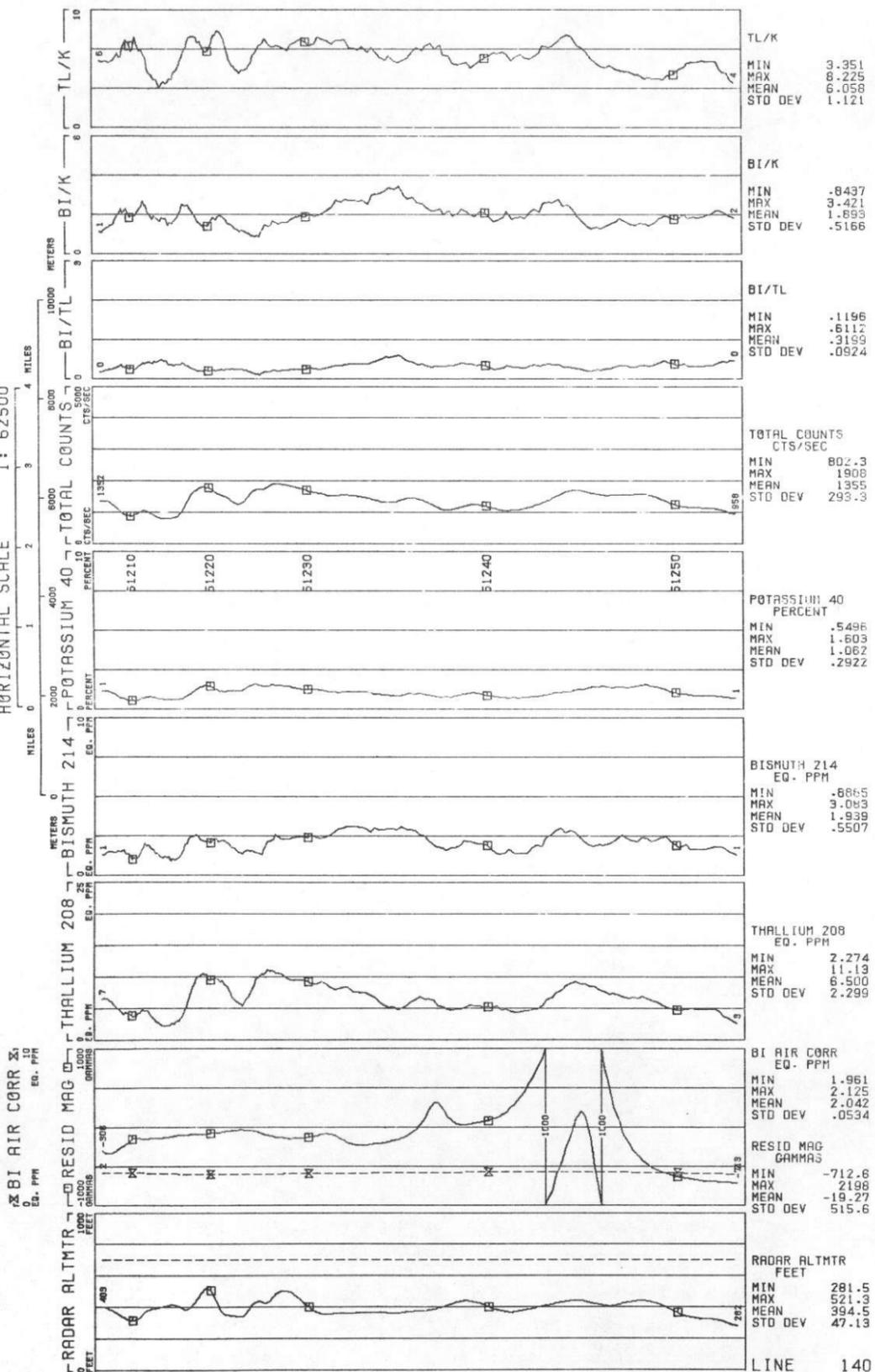
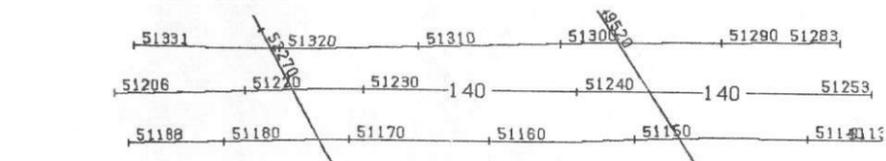
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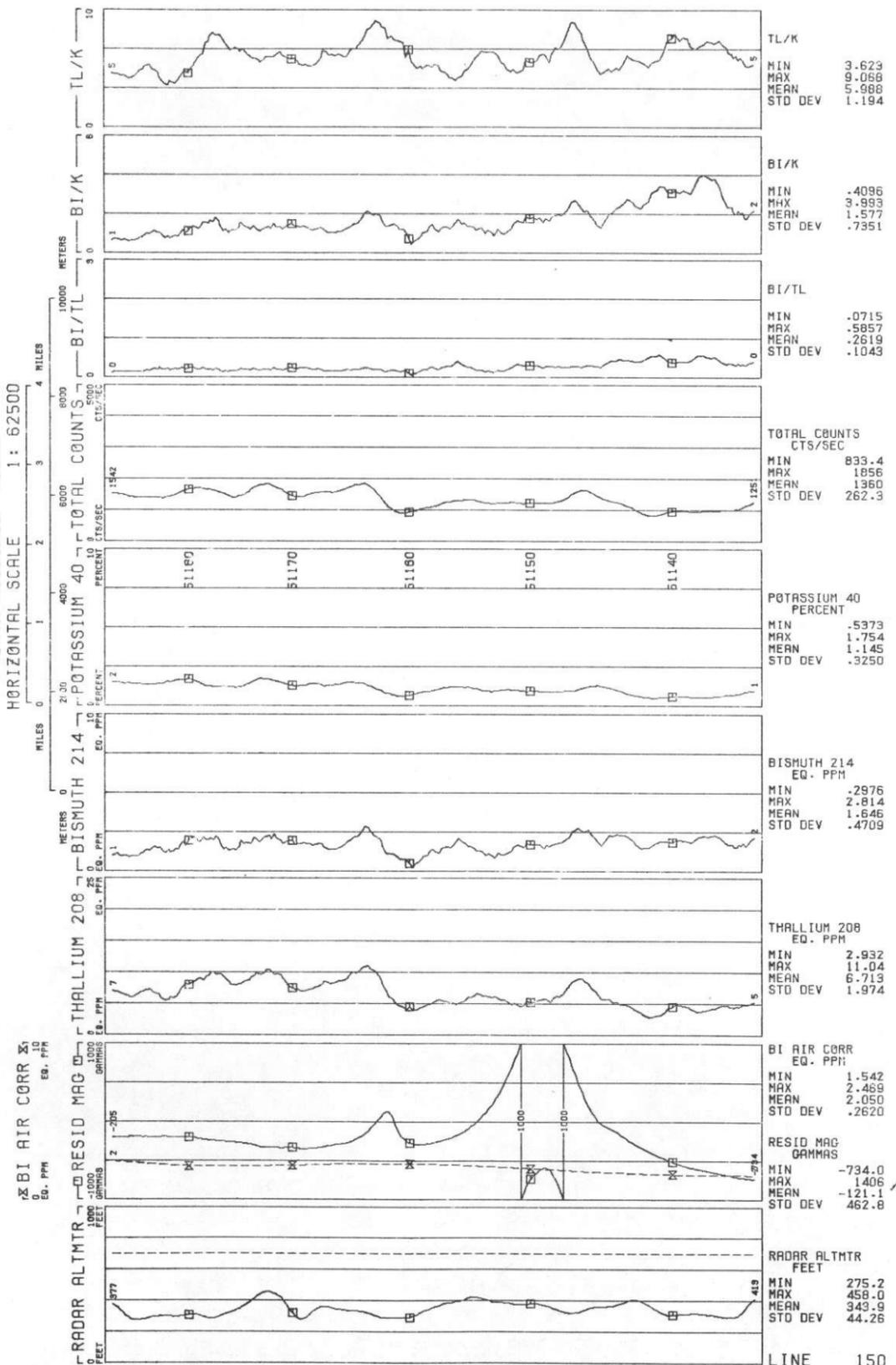
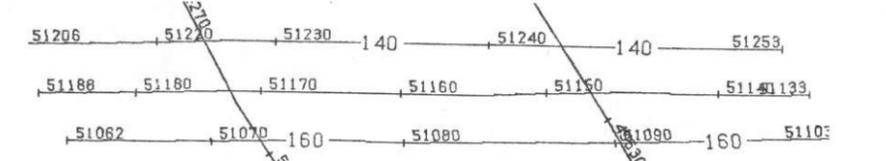


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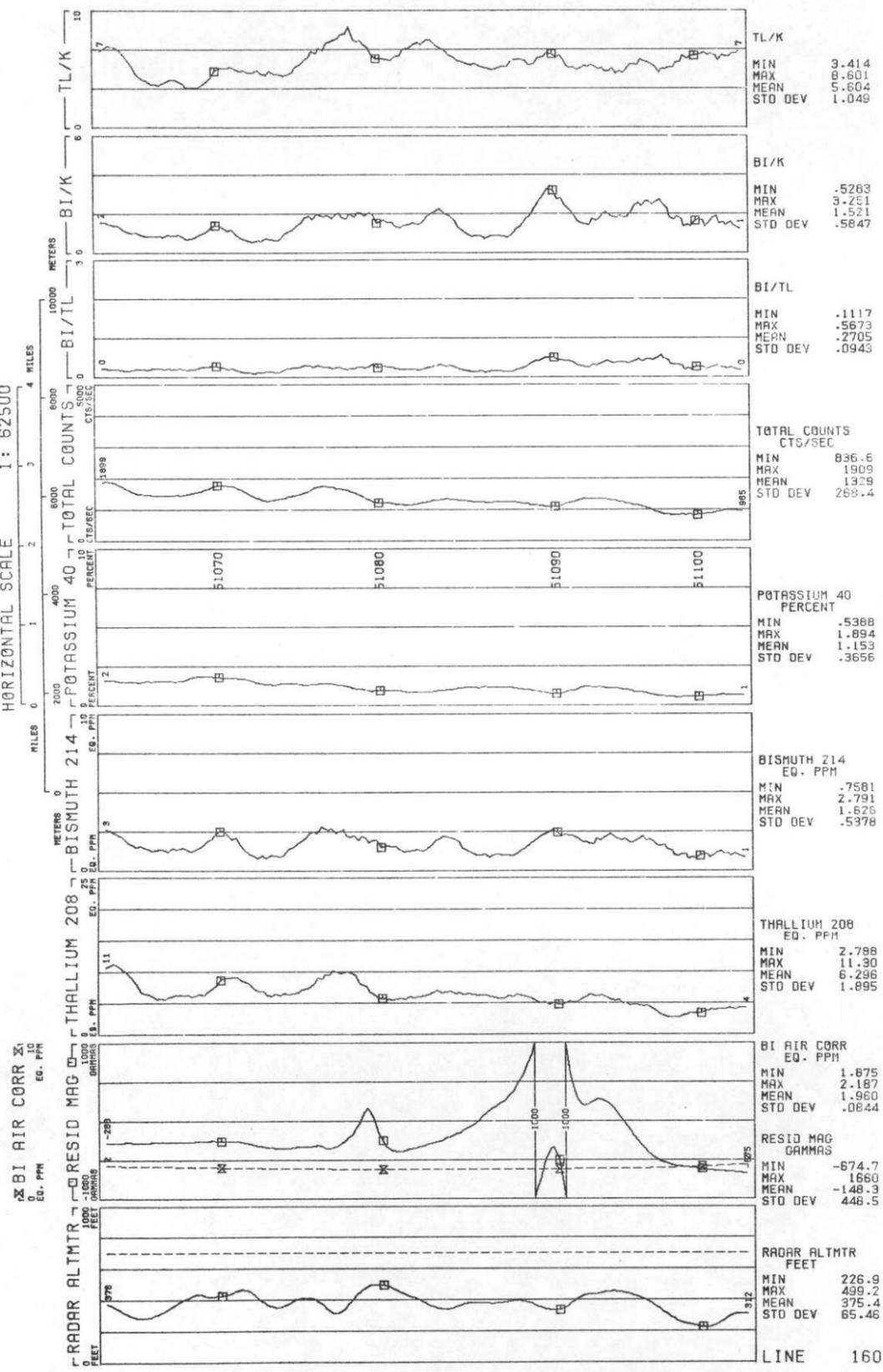
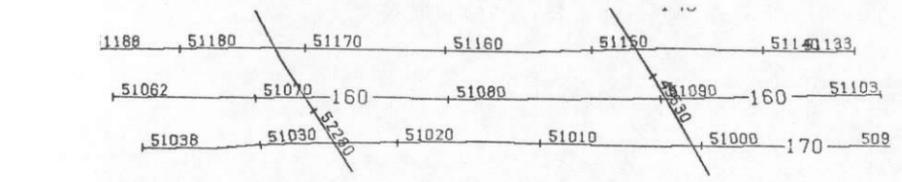
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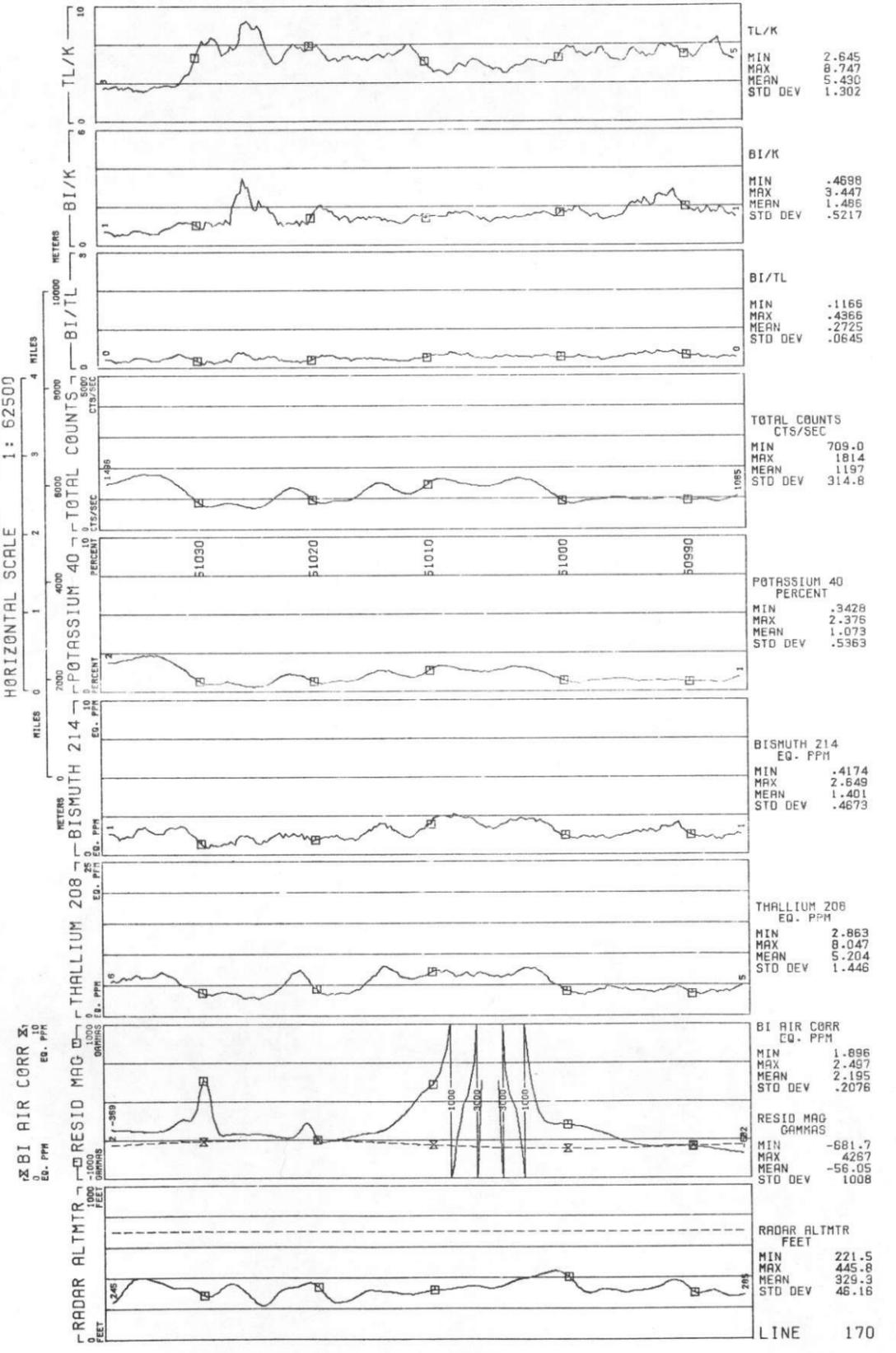
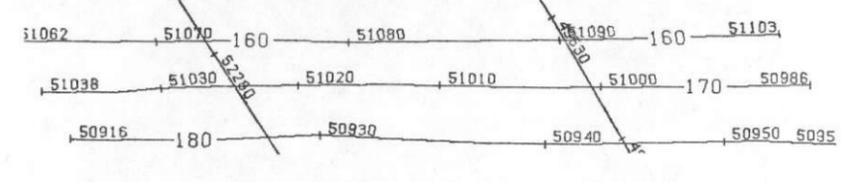
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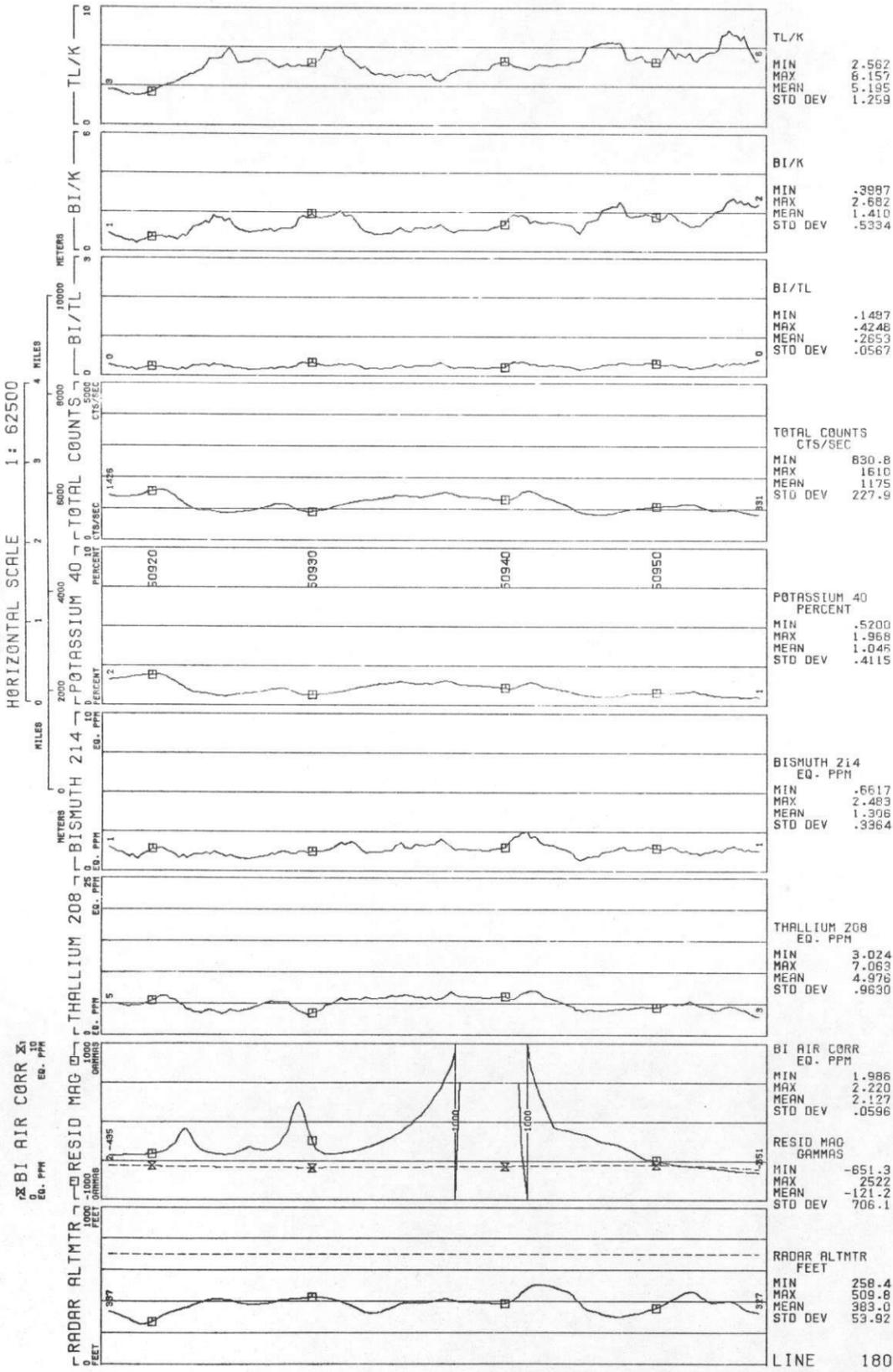
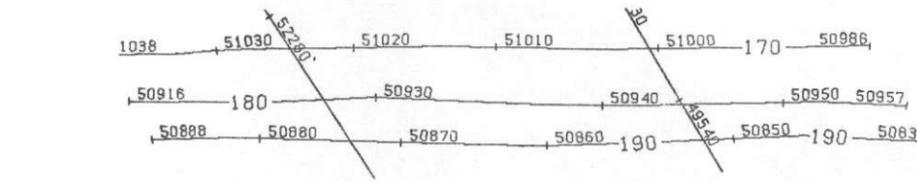


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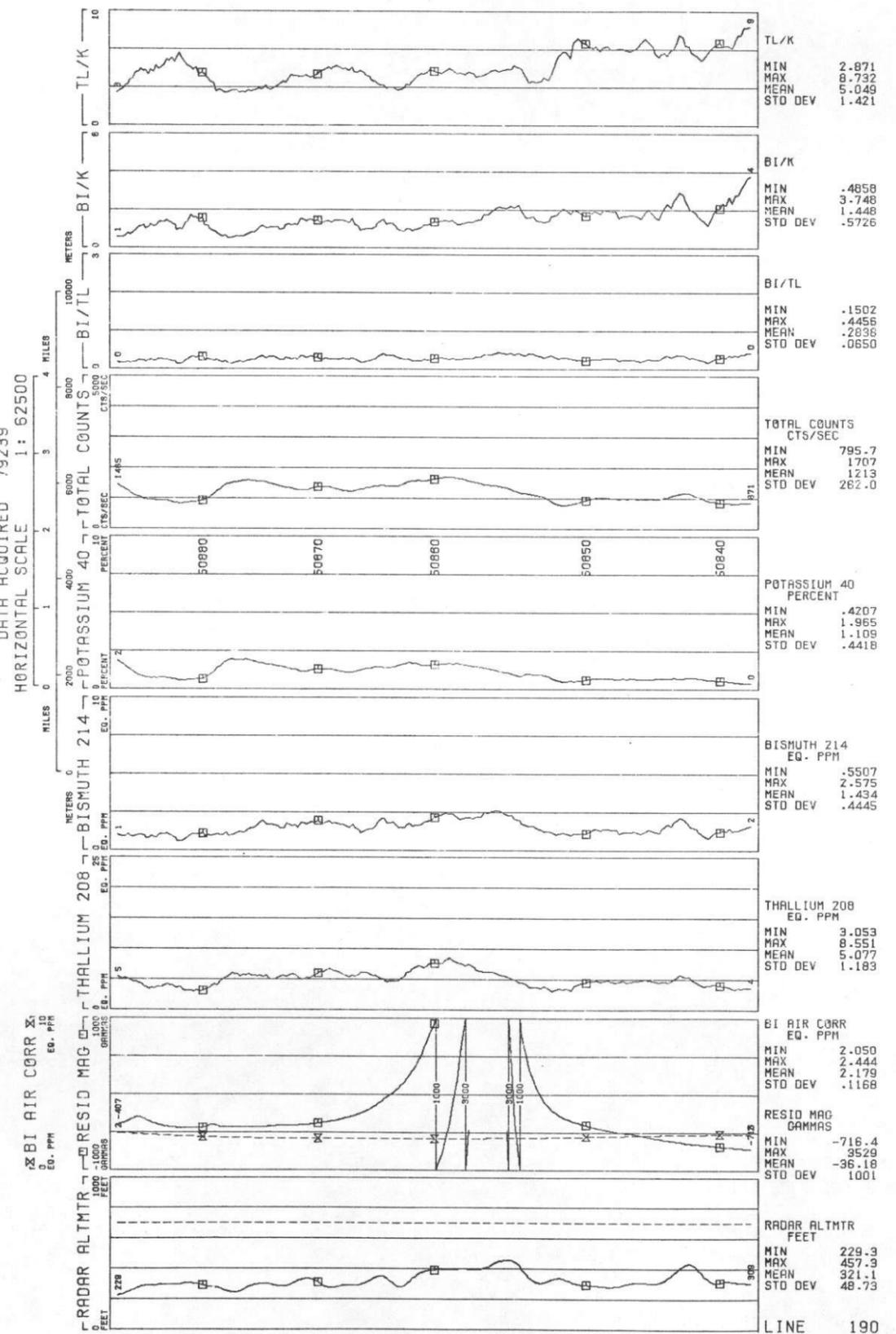
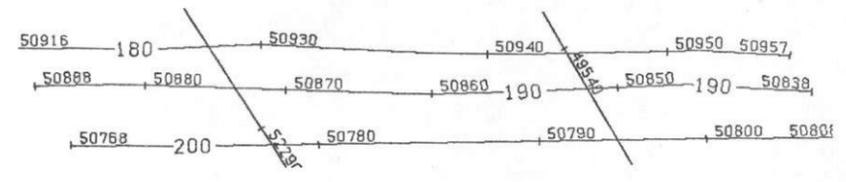
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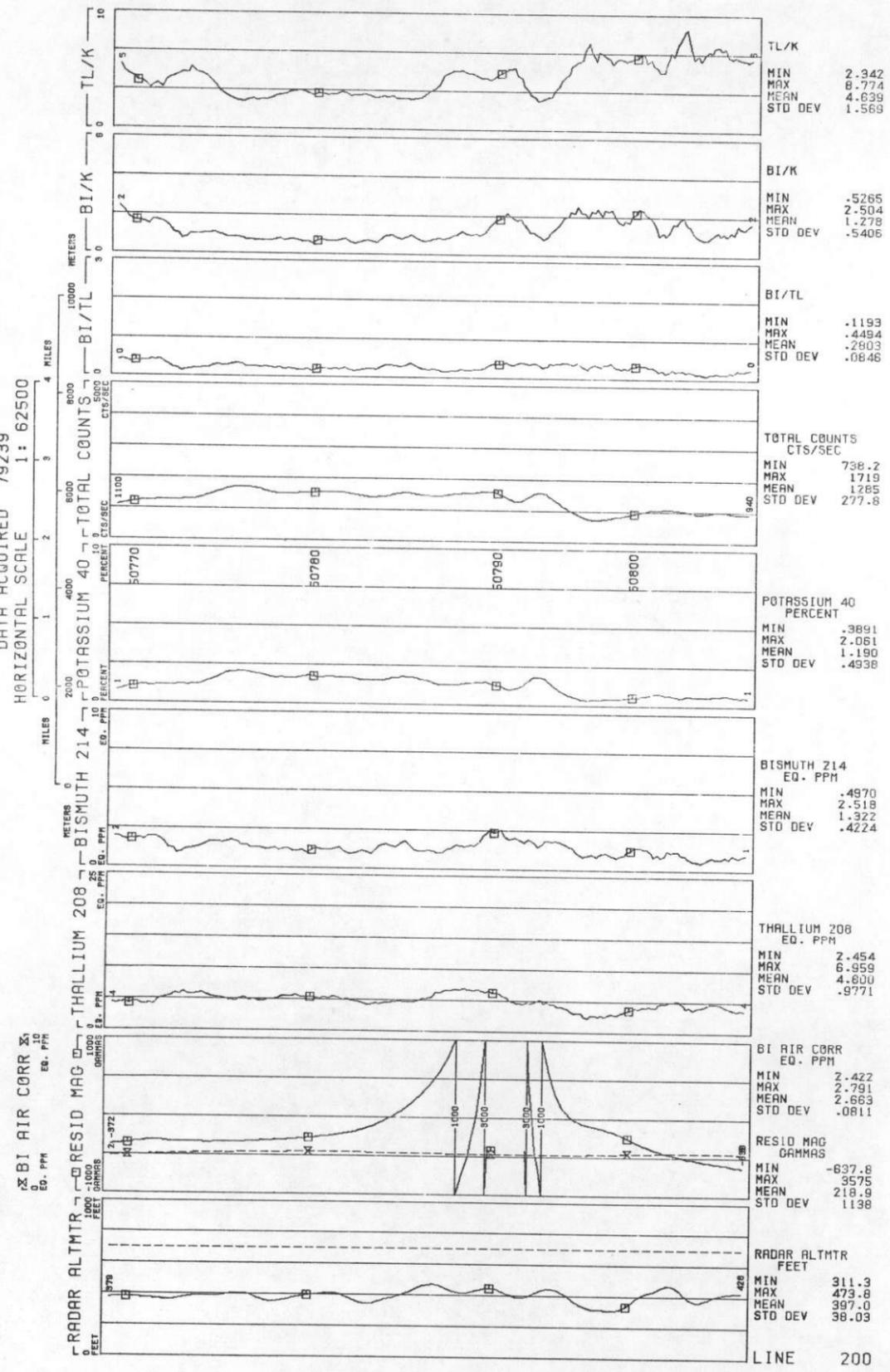
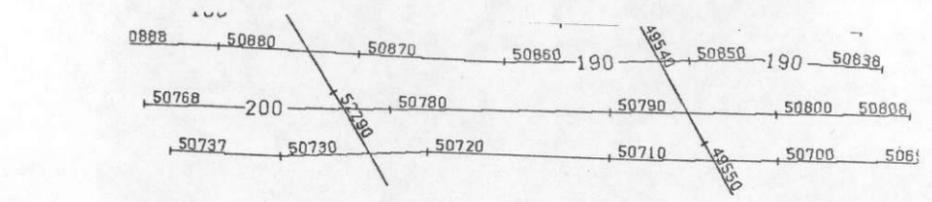


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 190

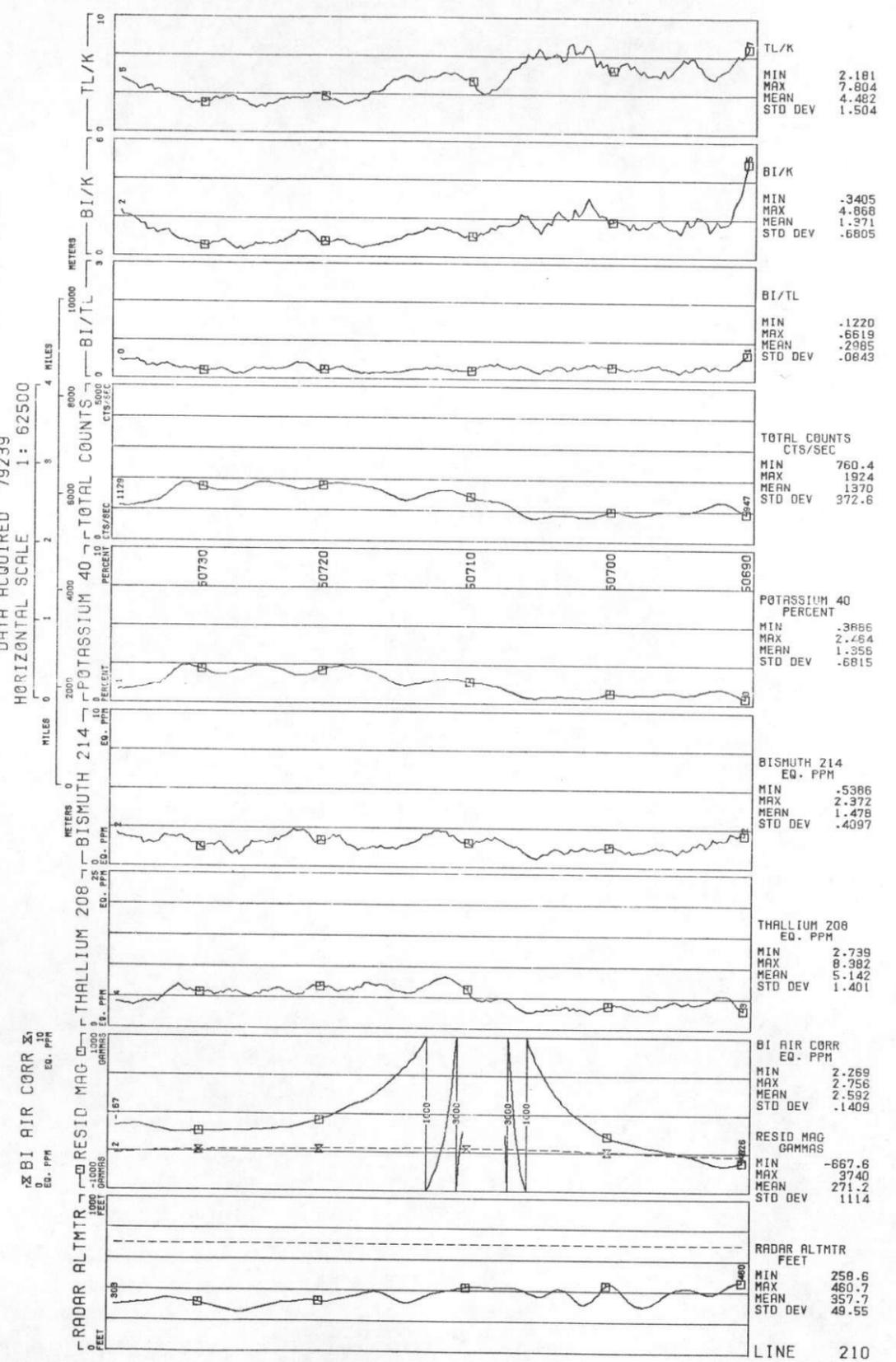
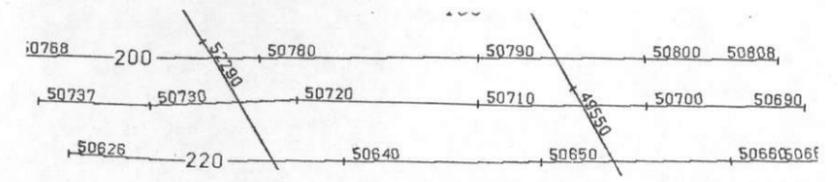
HORIZONTAL SCALE 1: 62500



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 200
DATA ACQUIRED 79239

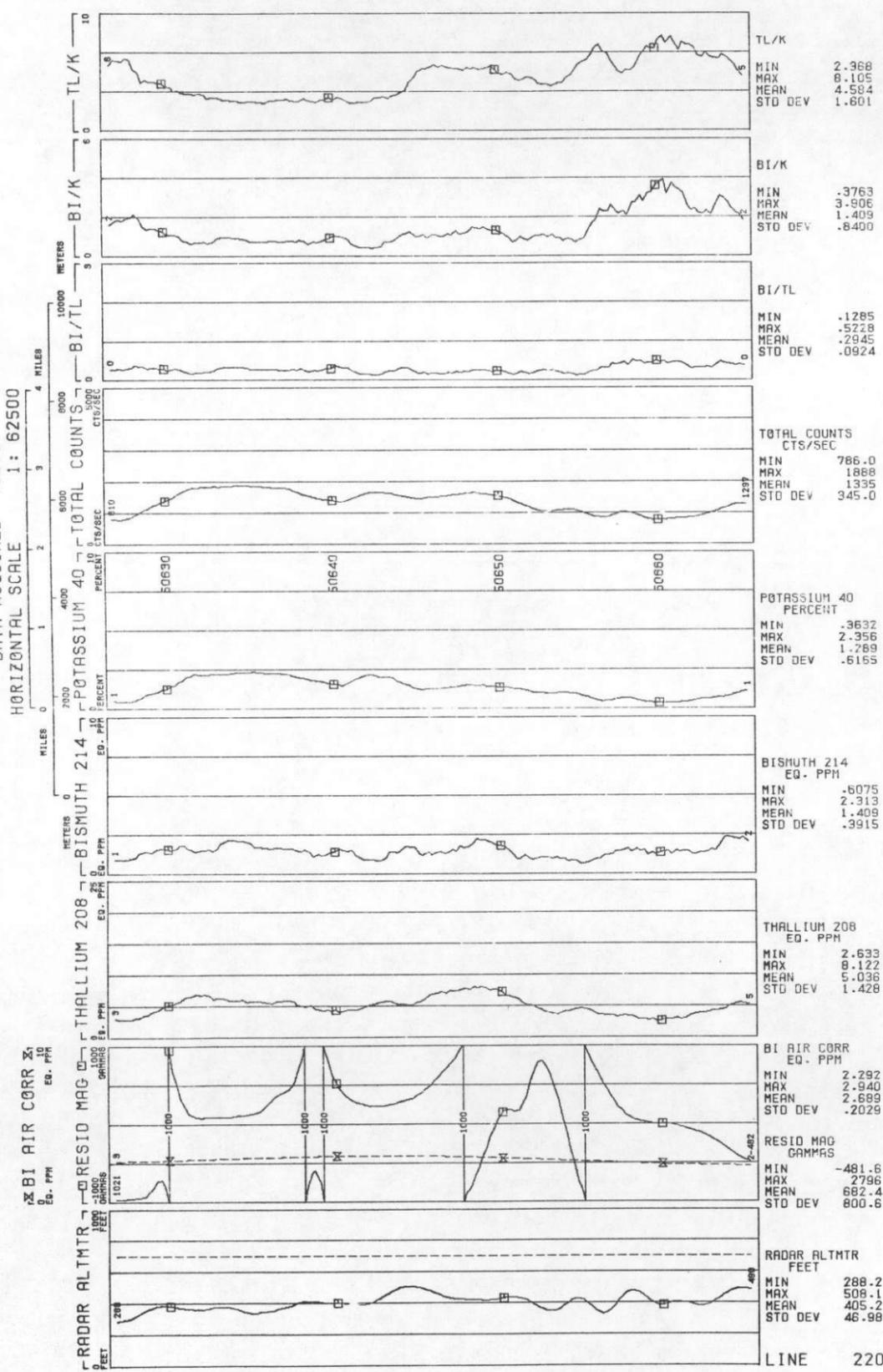
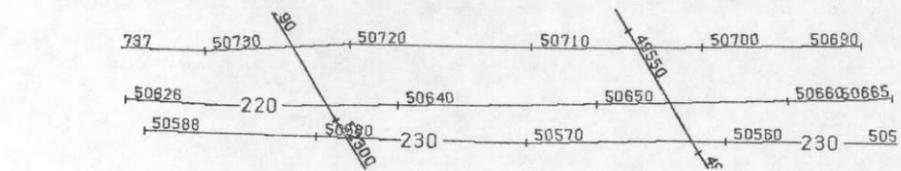


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 210
DATA ACQUIRED 79239



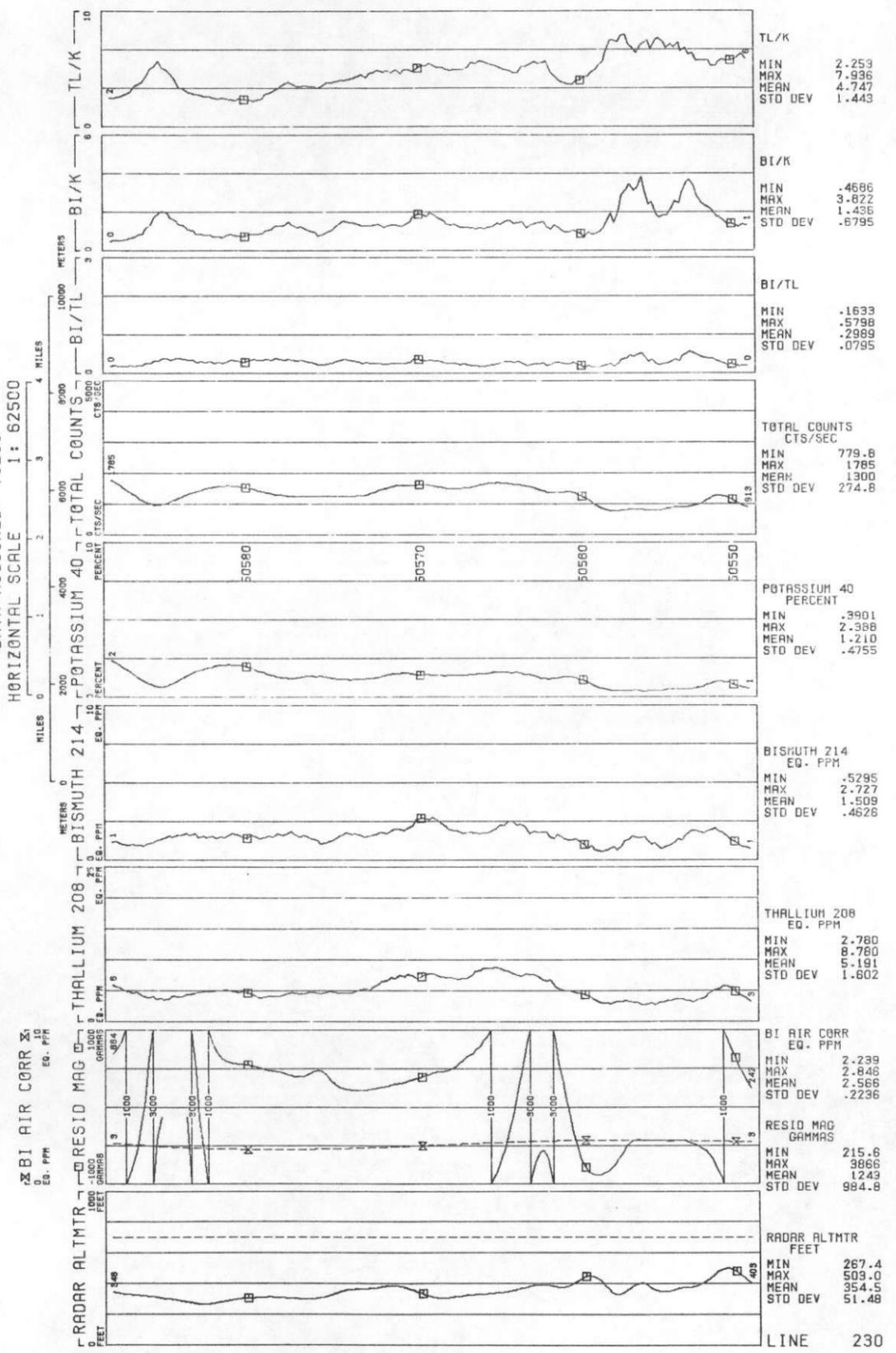
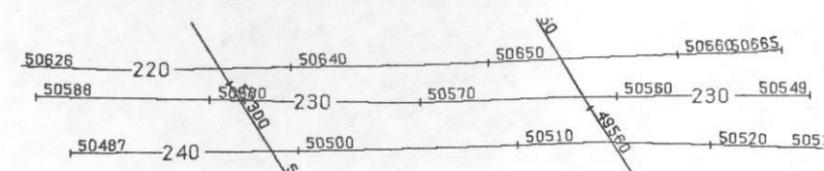
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 220

DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 230

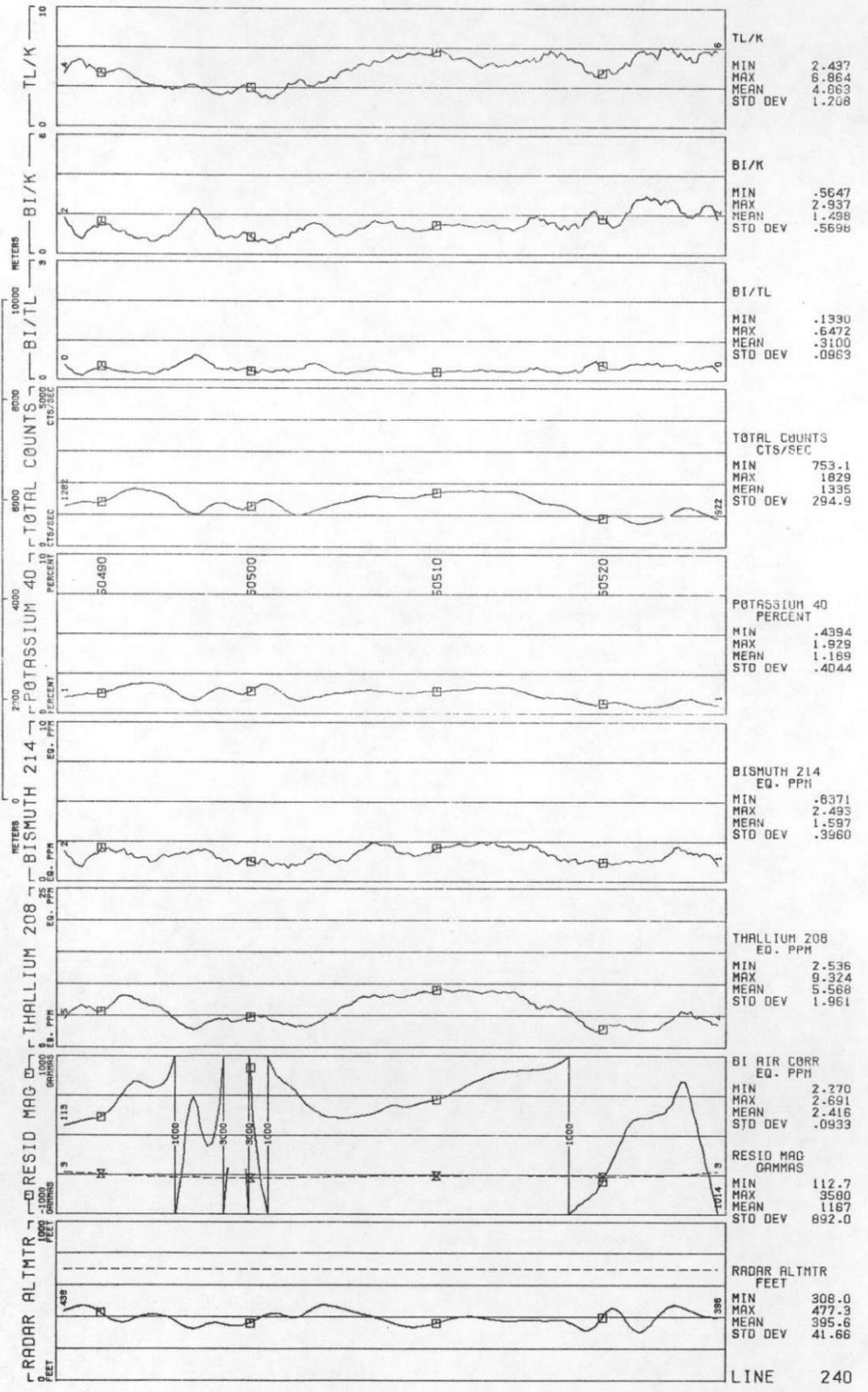
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 240

HORIZONTAL SCALE 1: 62500

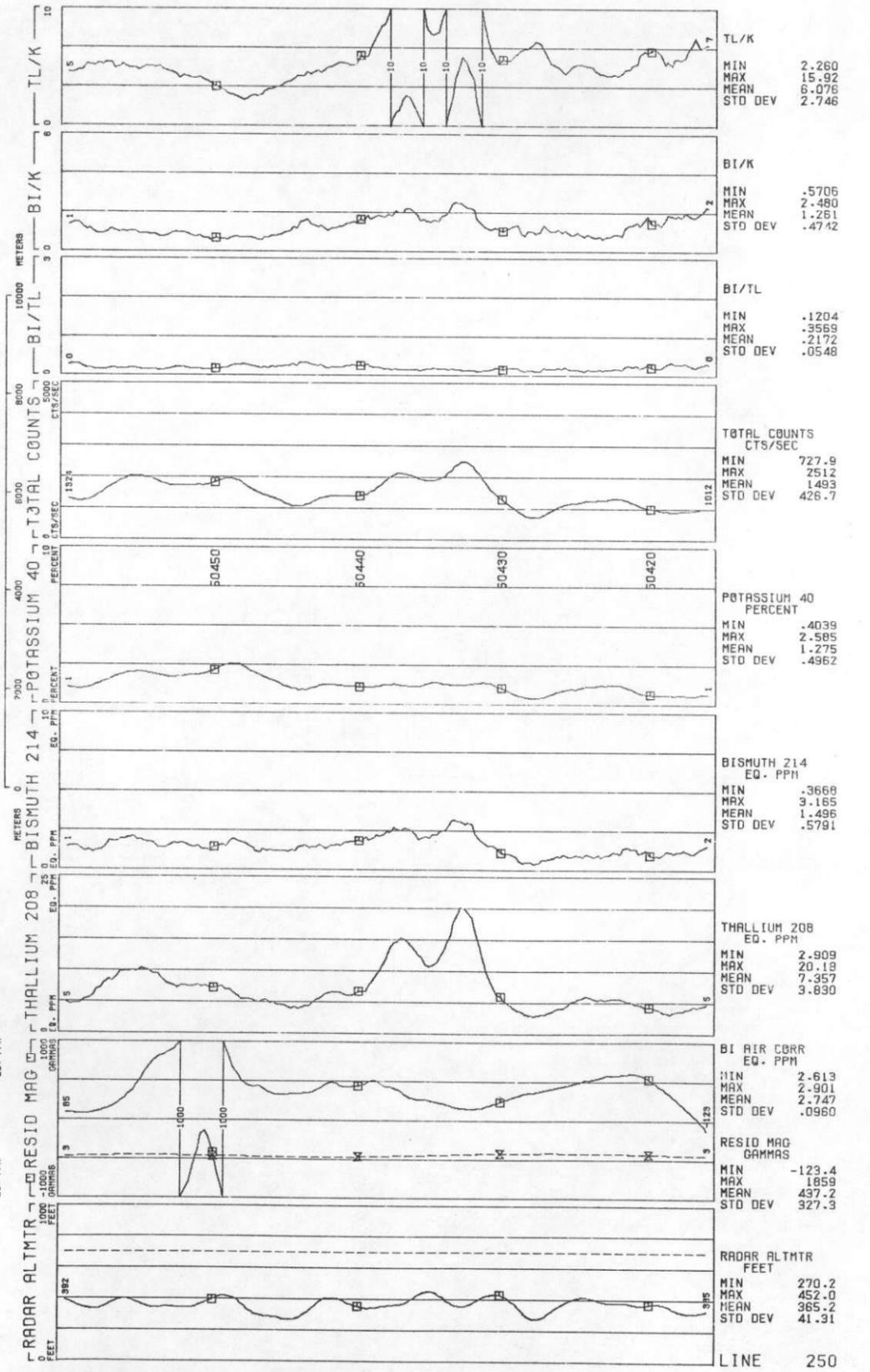
BI AIR CORR EQ. PPH



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 250

HORIZONTAL SCALE 1: 62500

BI AIR CORR EQ. PPH

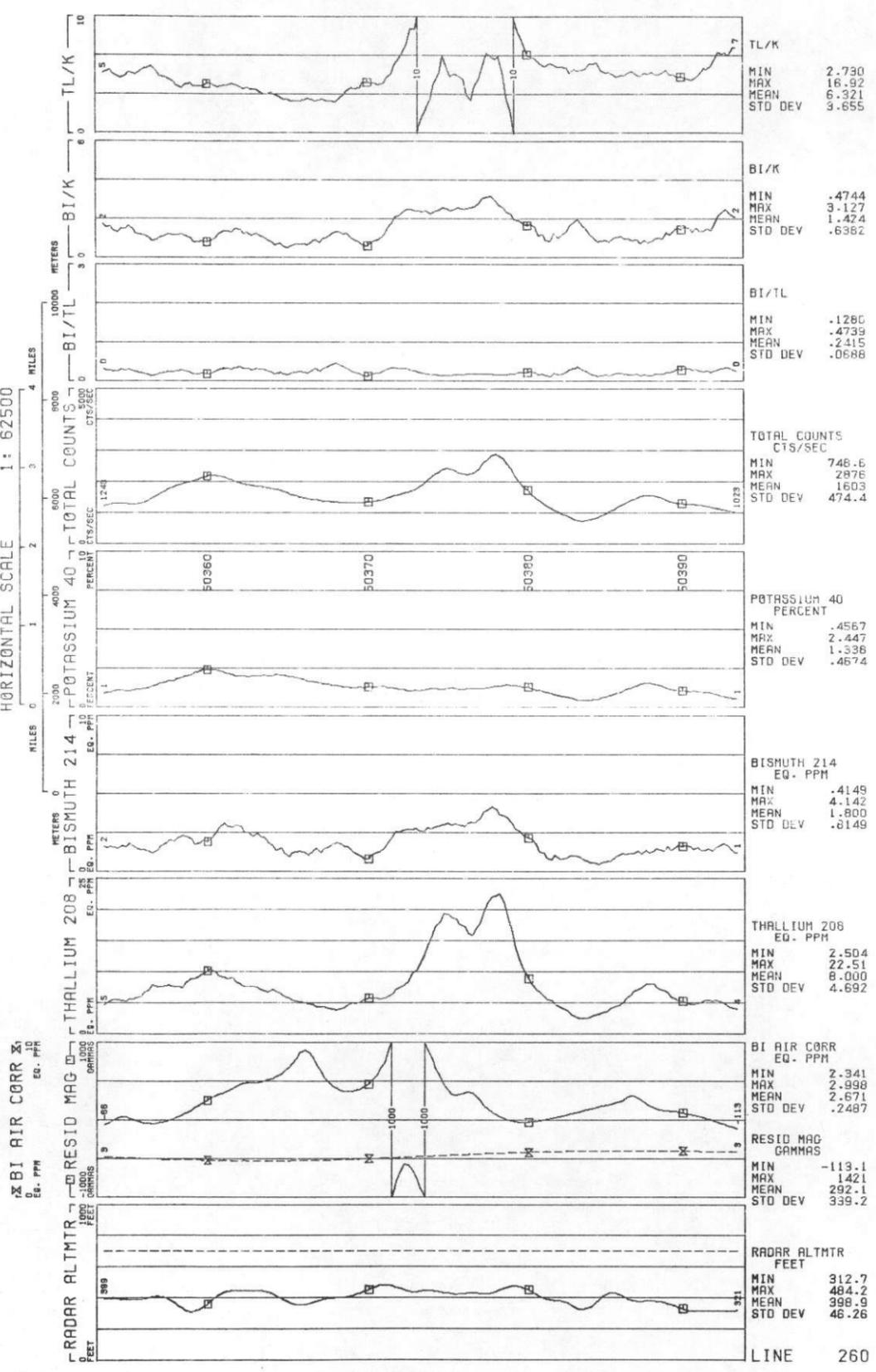
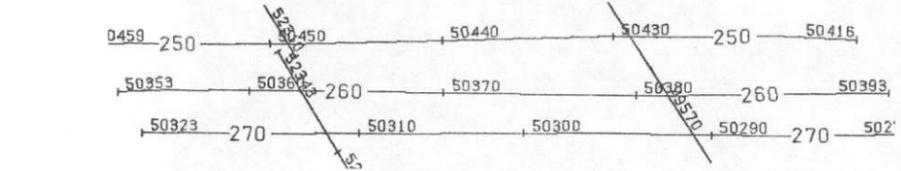


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

LINE 260

DATA ACQUIRED 79239

HORIZONTAL SCALE 1: 62500

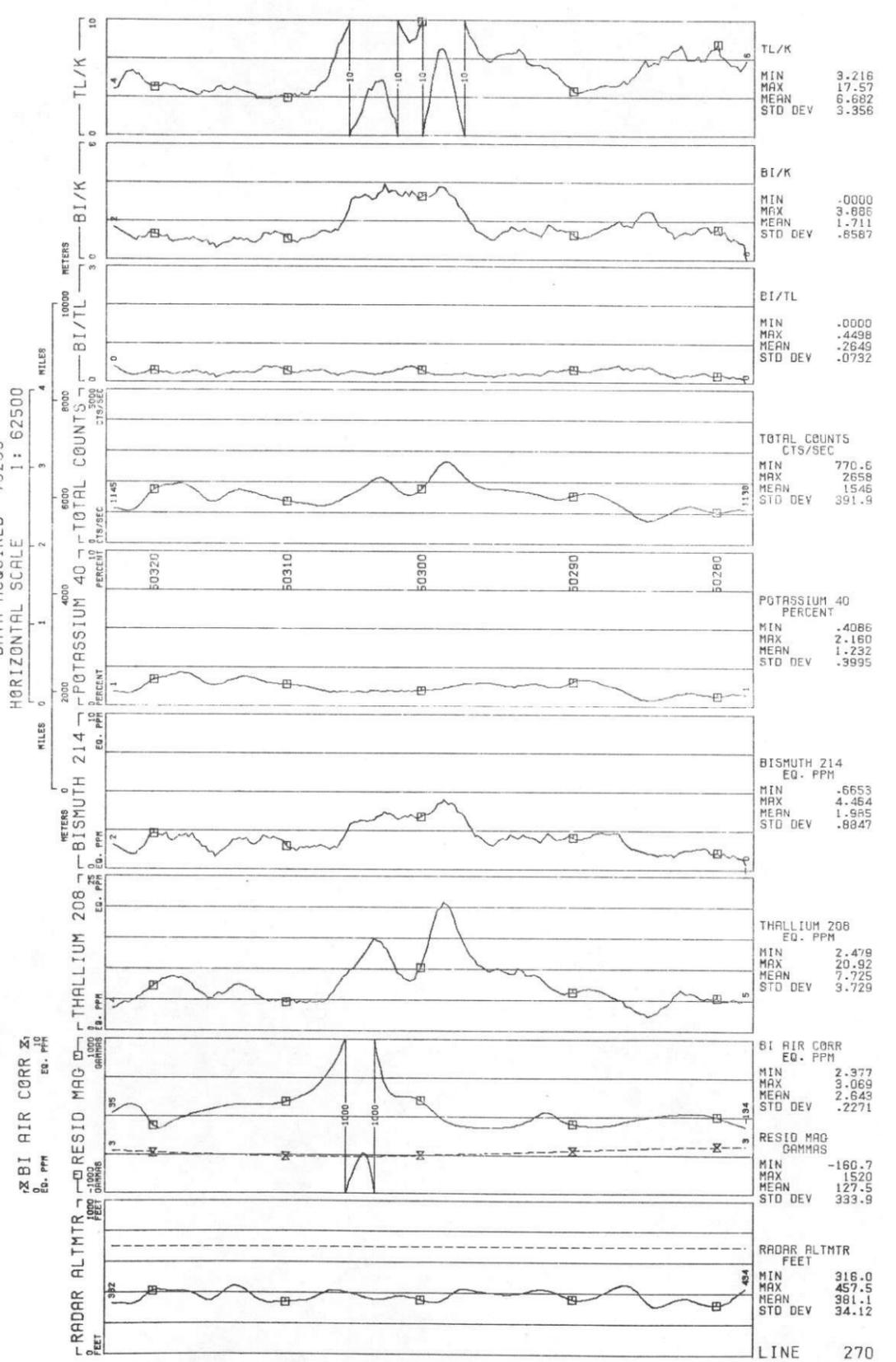
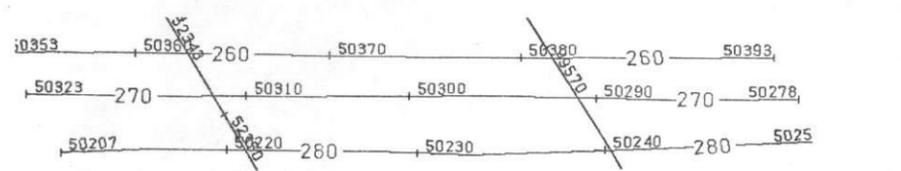


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

LINE 270

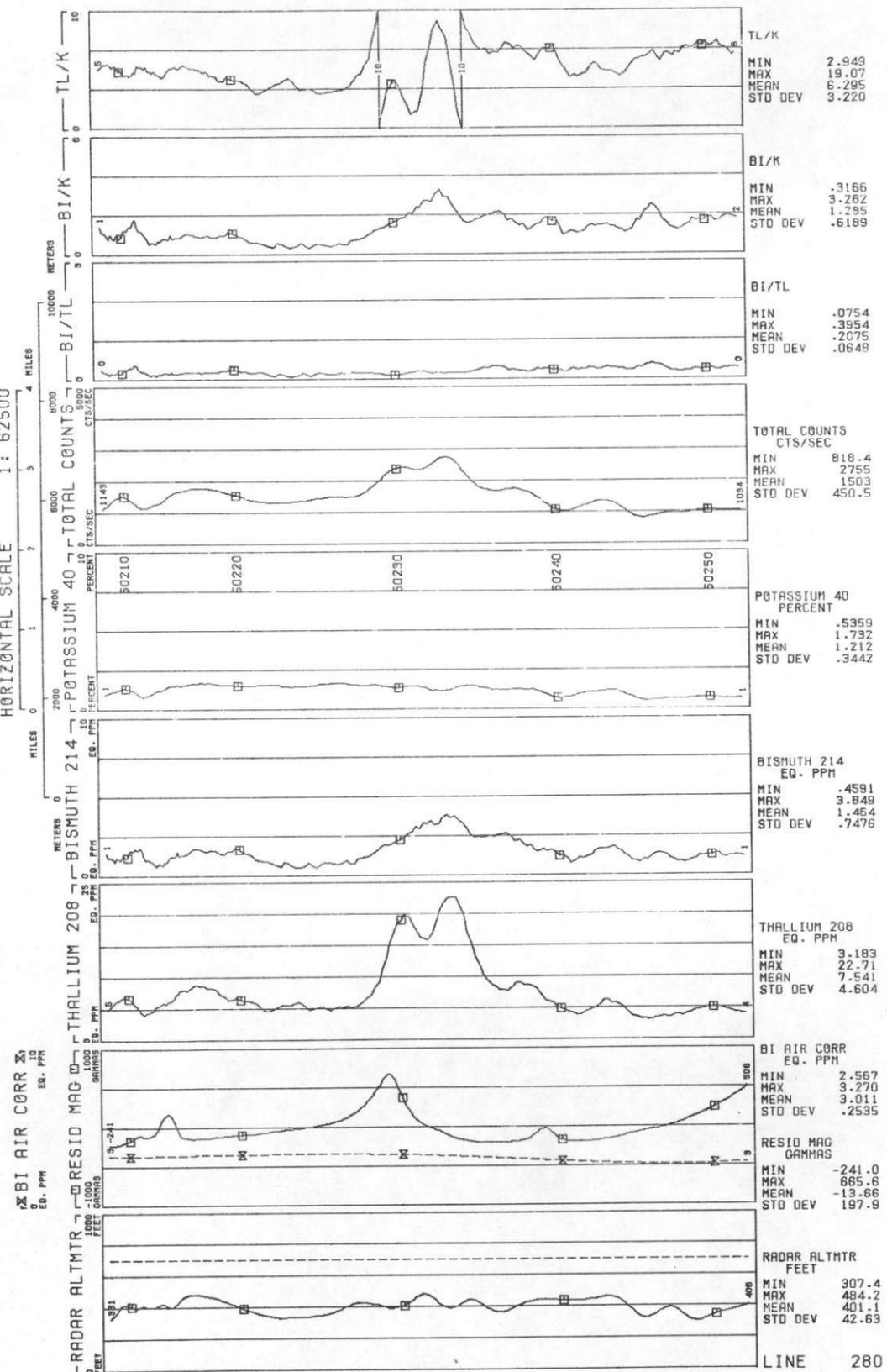
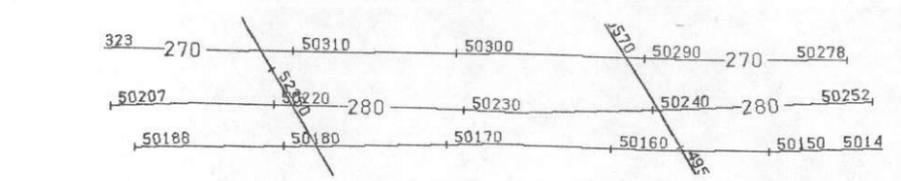
DATA ACQUIRED 79239

HORIZONTAL SCALE 1: 62500



LINE 280
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

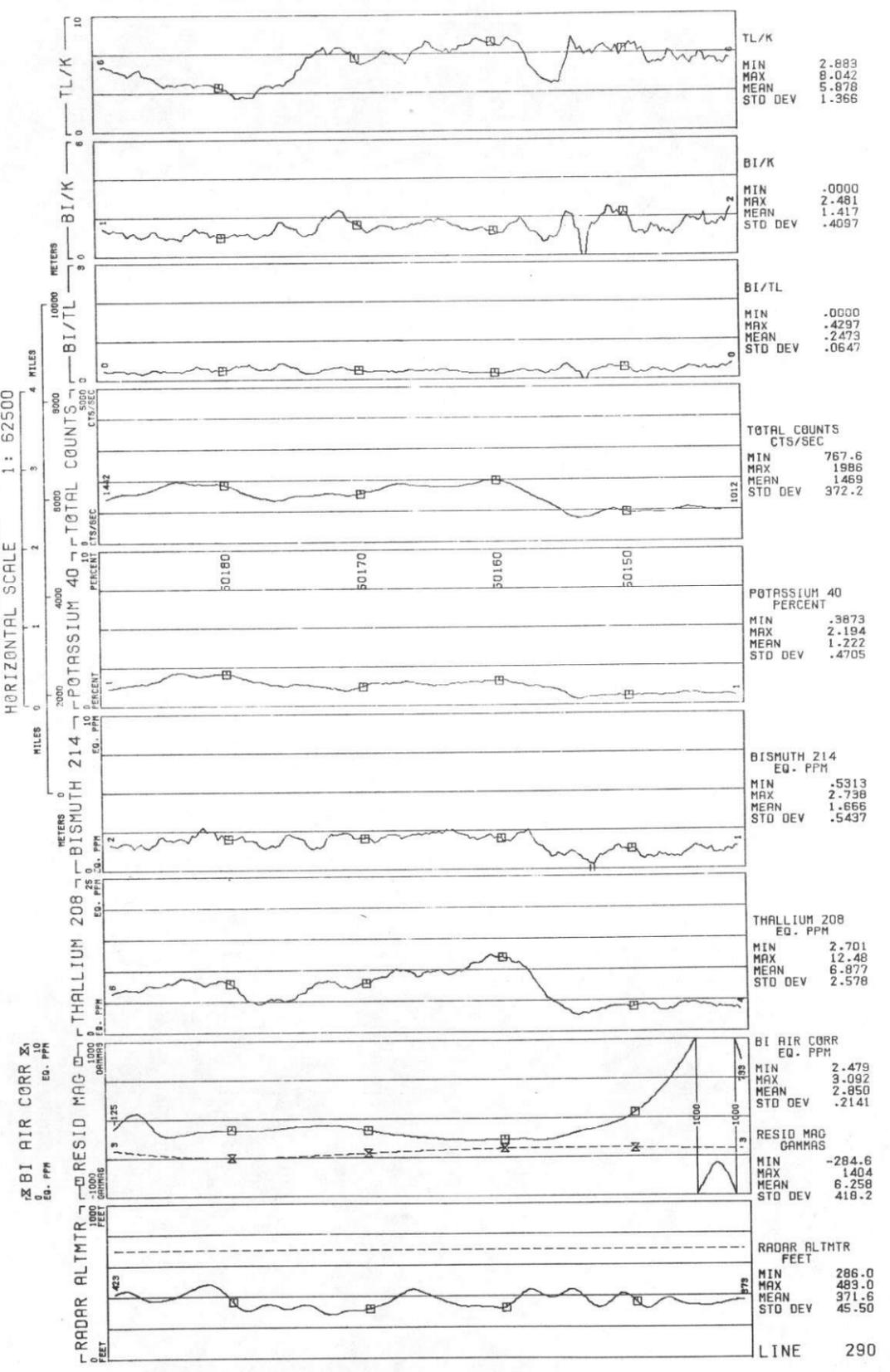
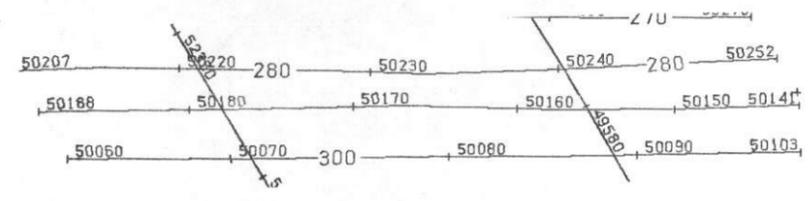
HORIZONTAL SCALE 1: 62500



LINE 280

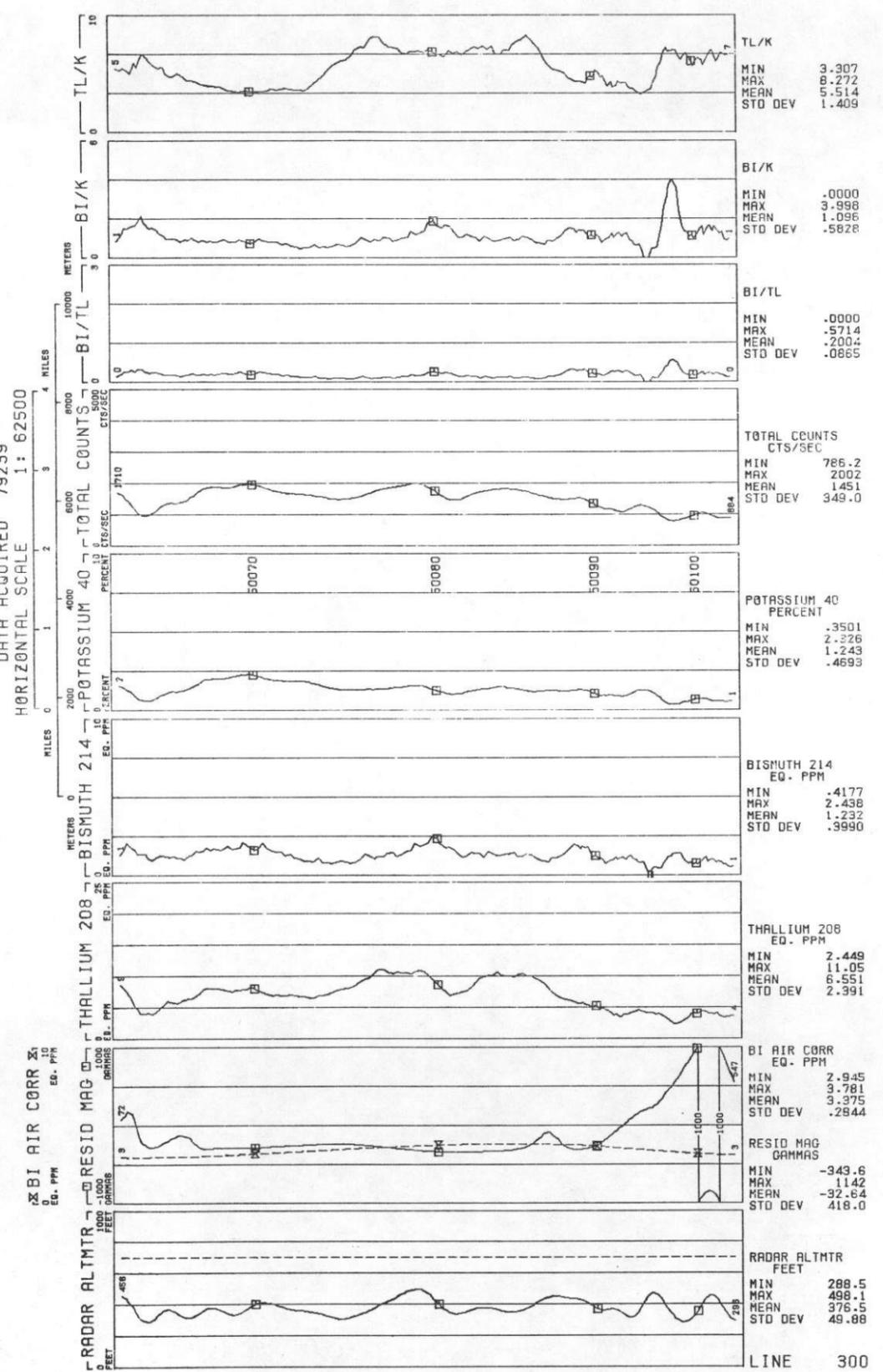
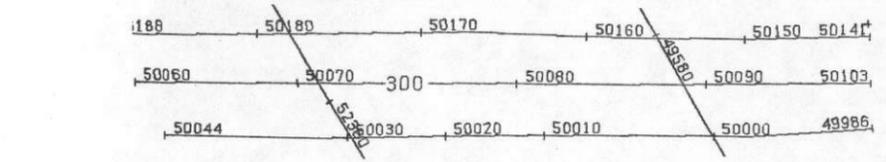
LINE 290
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

HORIZONTAL SCALE 1: 62500

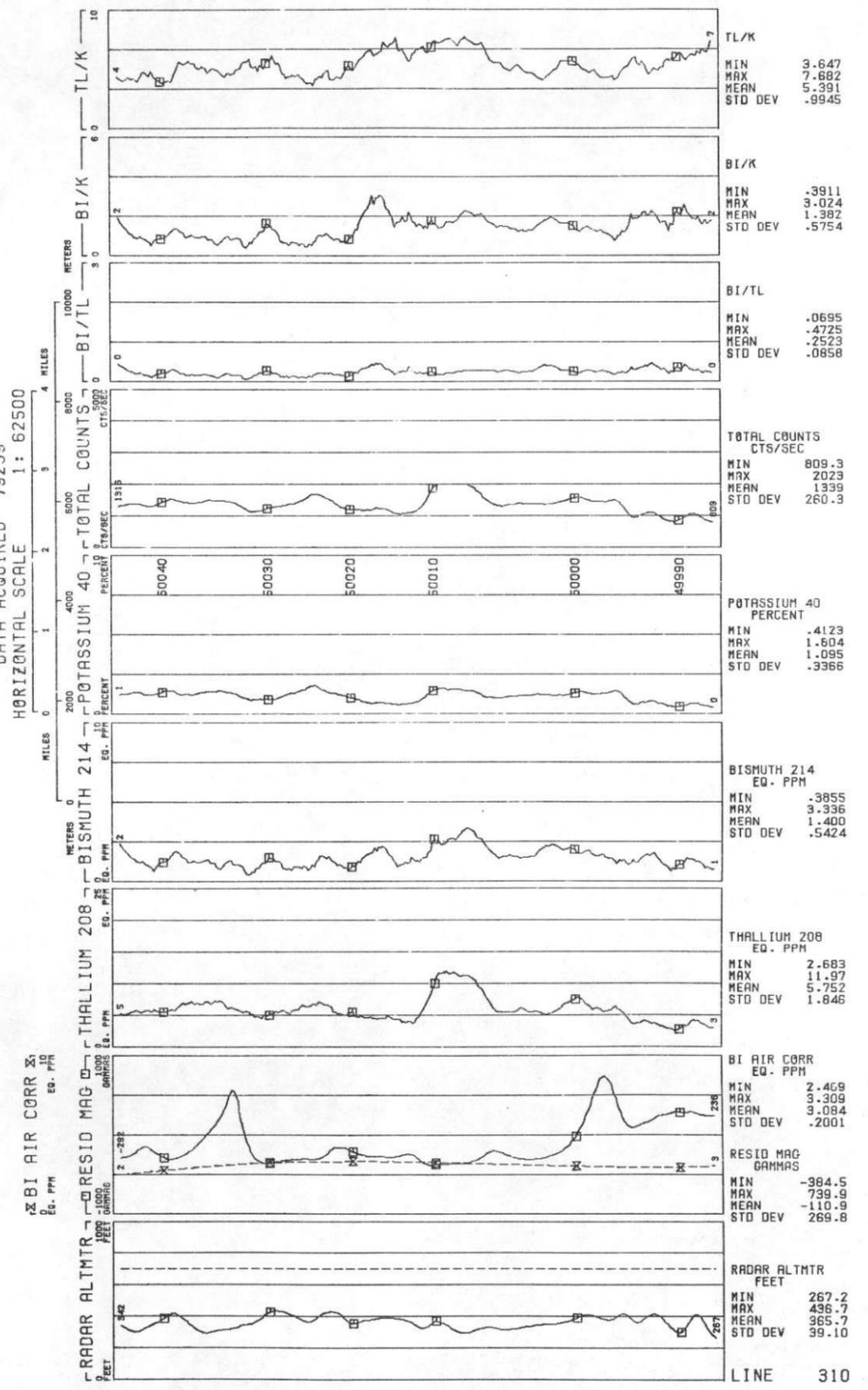
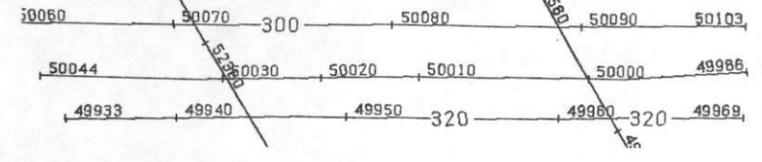


LINE 290

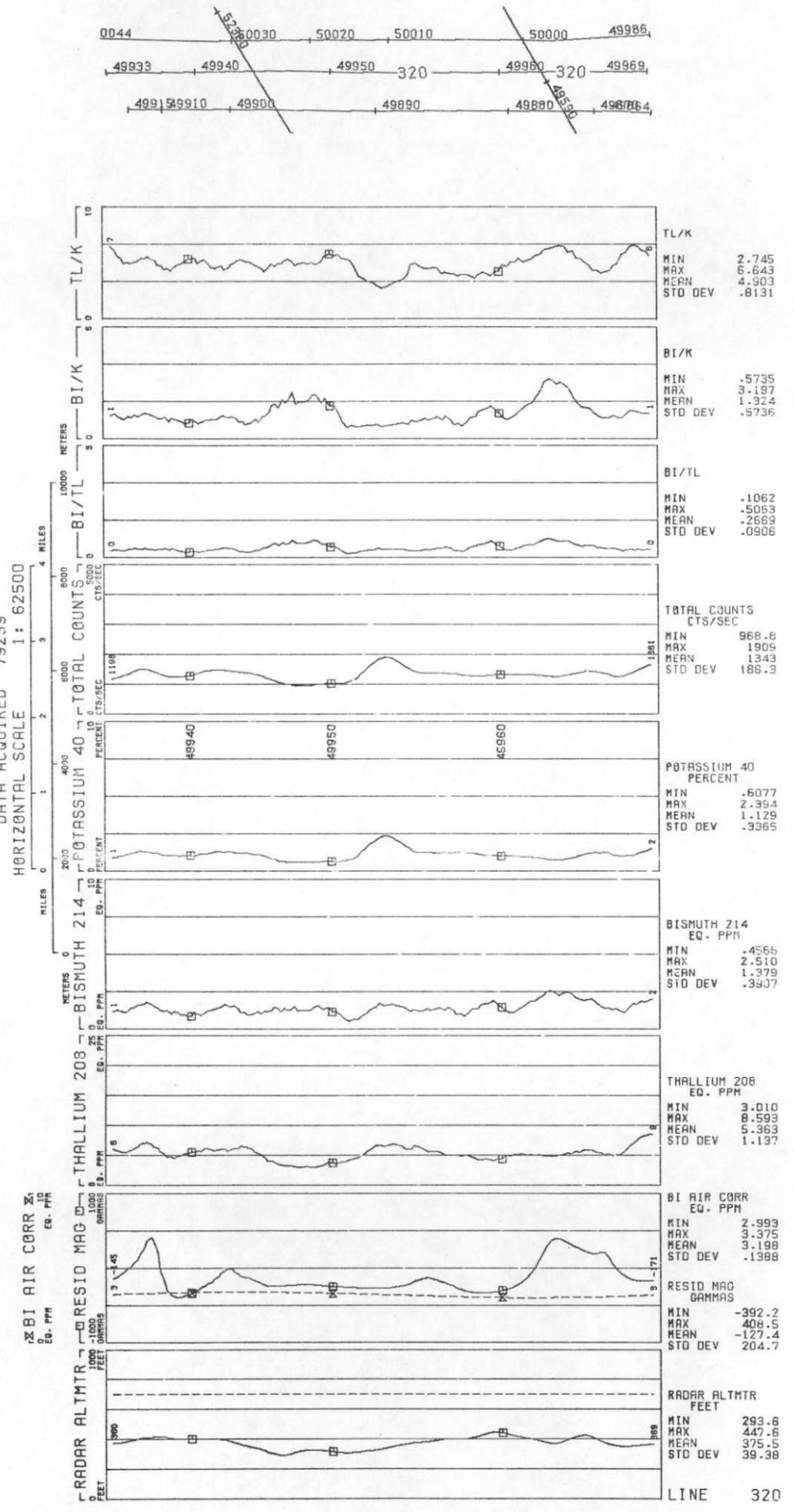
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 300



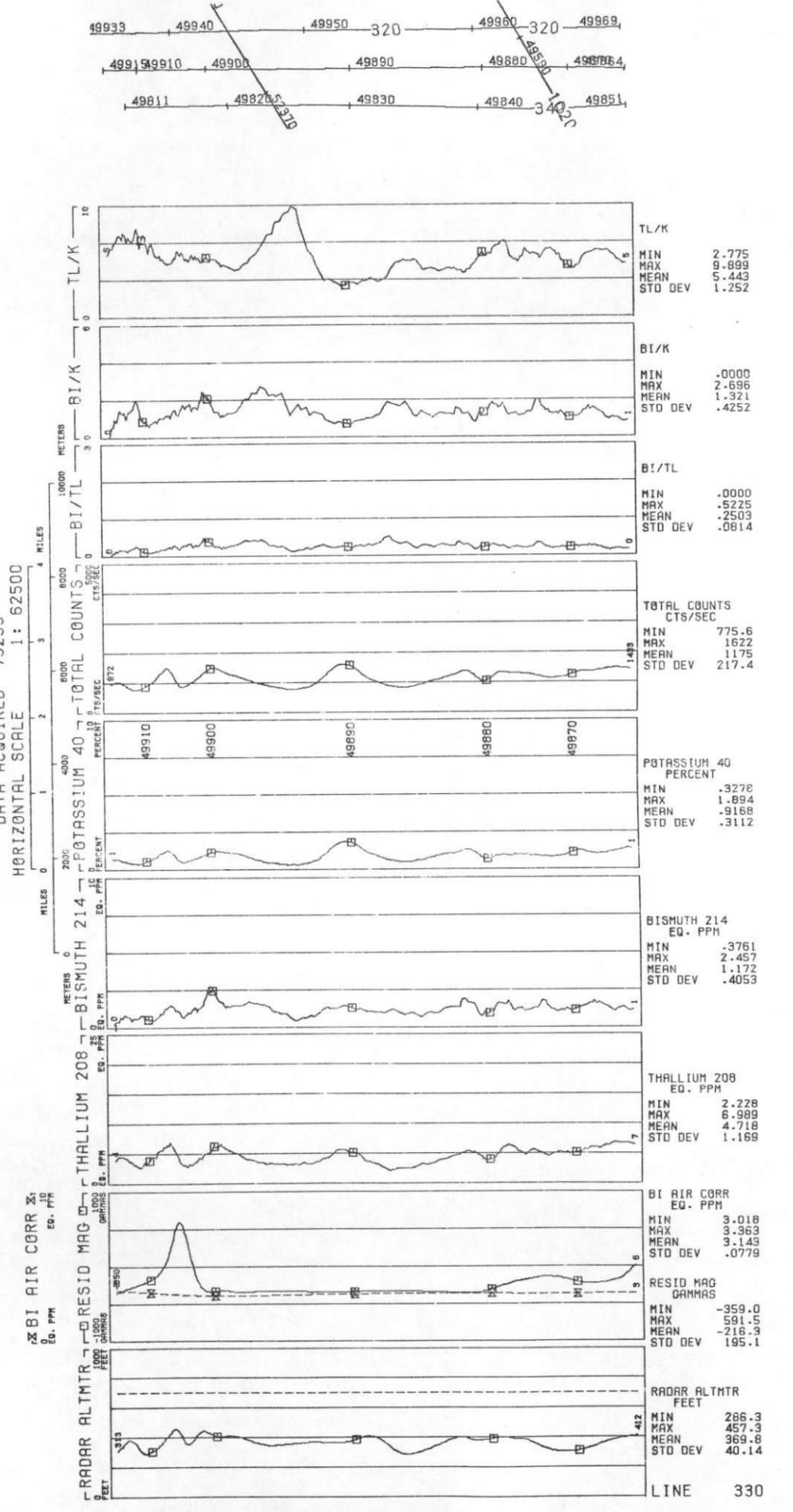
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 310



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 320
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 330
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



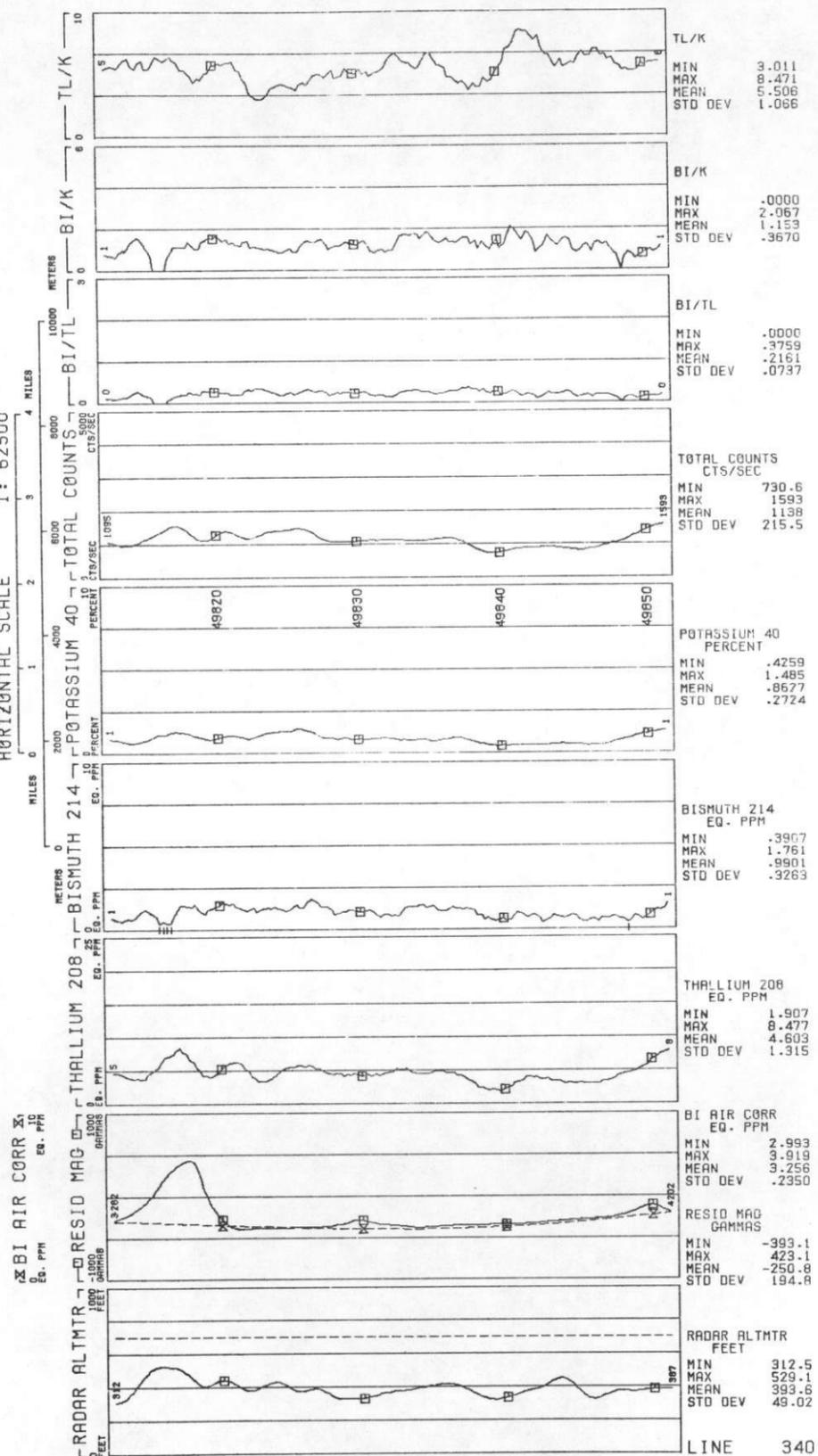
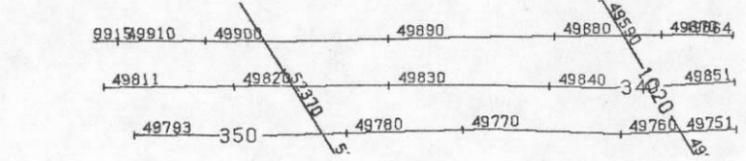
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

LINE 340

NEMO DETAIL AREA - GEOMETRICS

DATA ACQUIRED 79239

HORIZONTAL SCALE 1: 62500

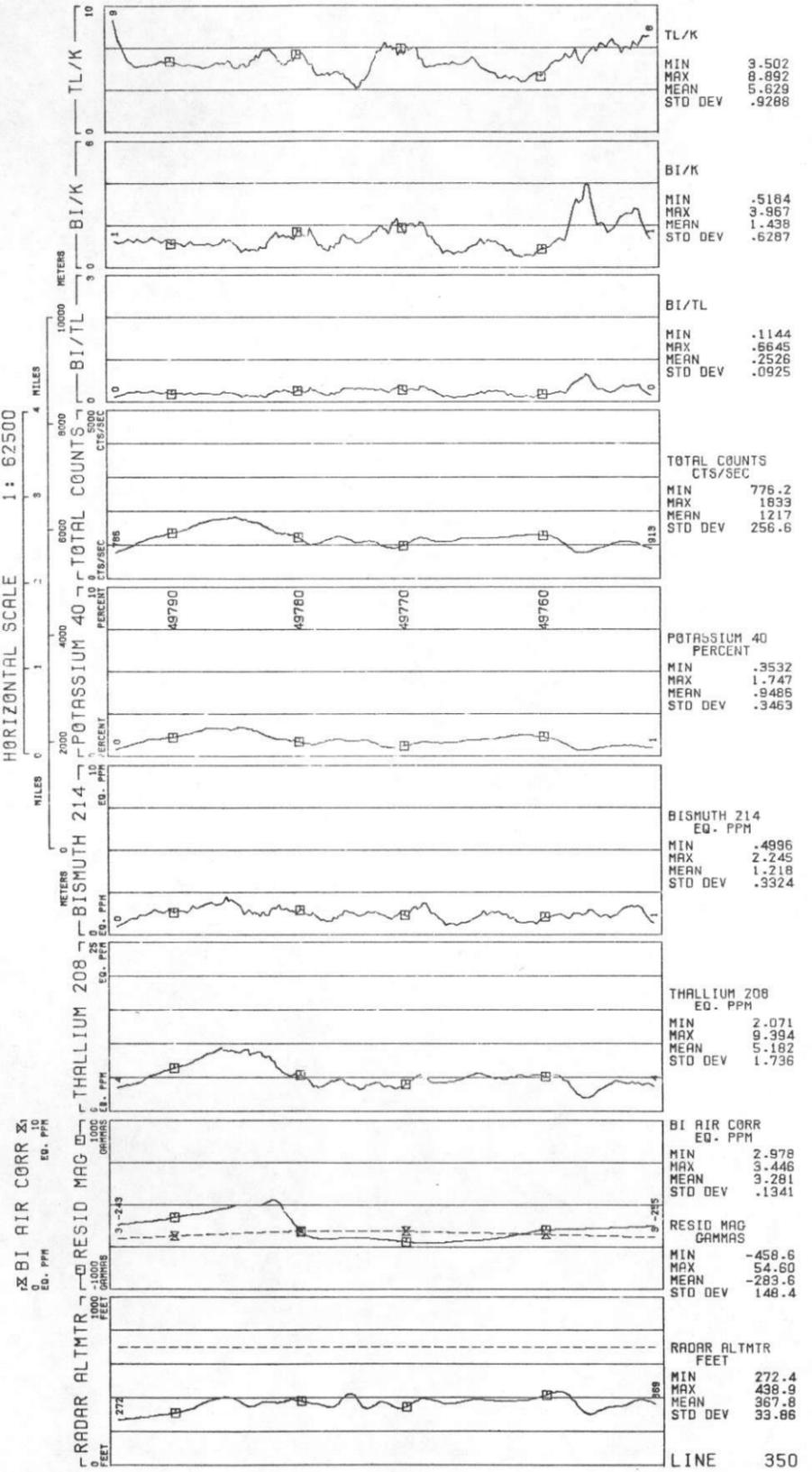
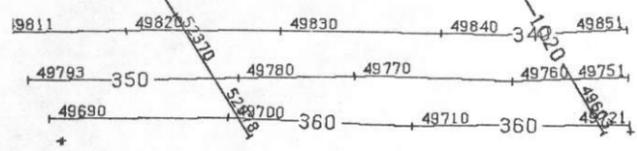


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

LINE 350

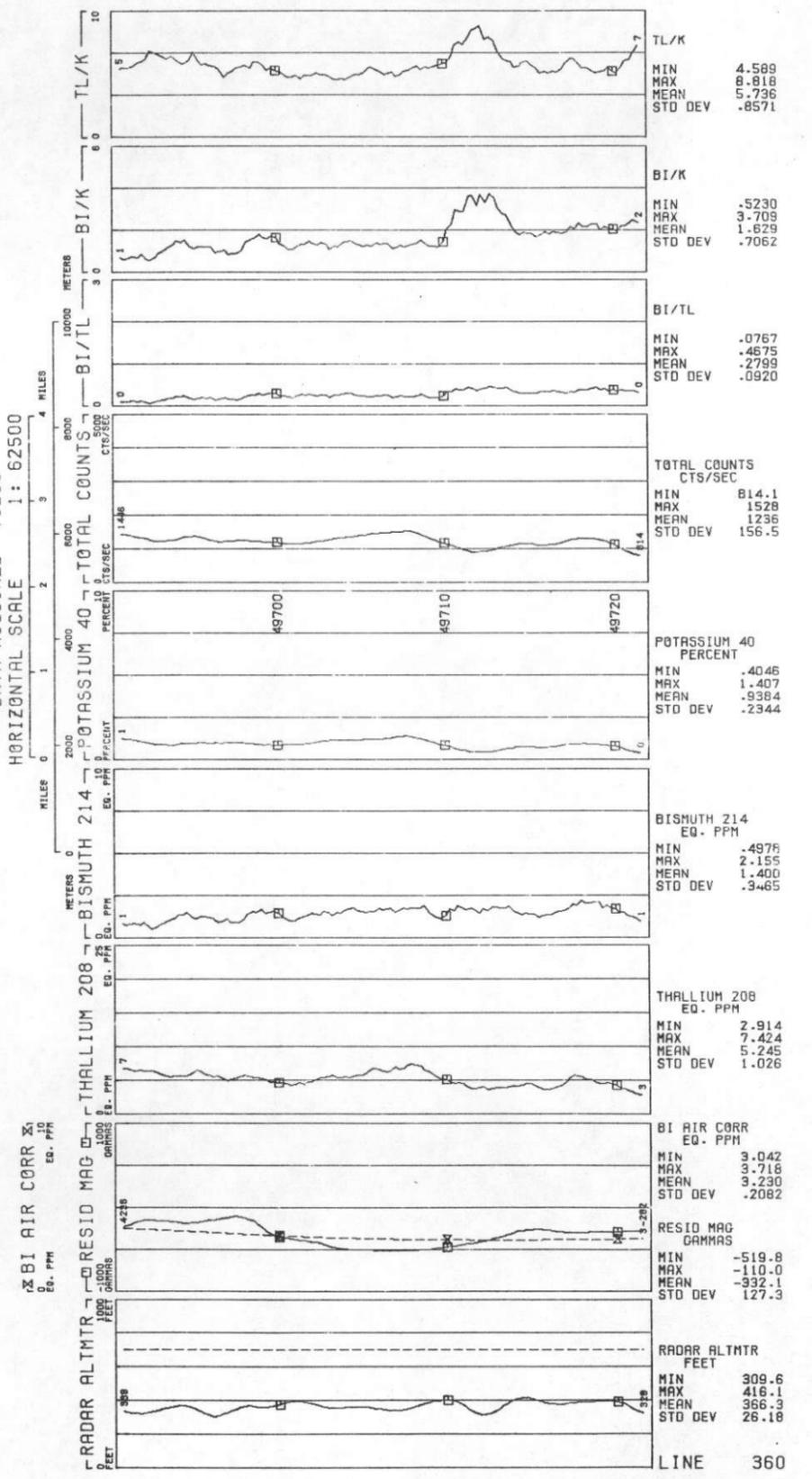
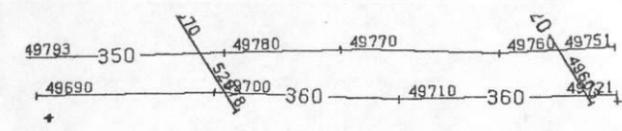
NEMO DETAIL AREA - GEOMETRICS

HORIZONTAL SCALE 1: 62500



IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 360
 DATA ACQUIRED 79239

HORIZONTAL SCALE 1 : 62500



LINE 360

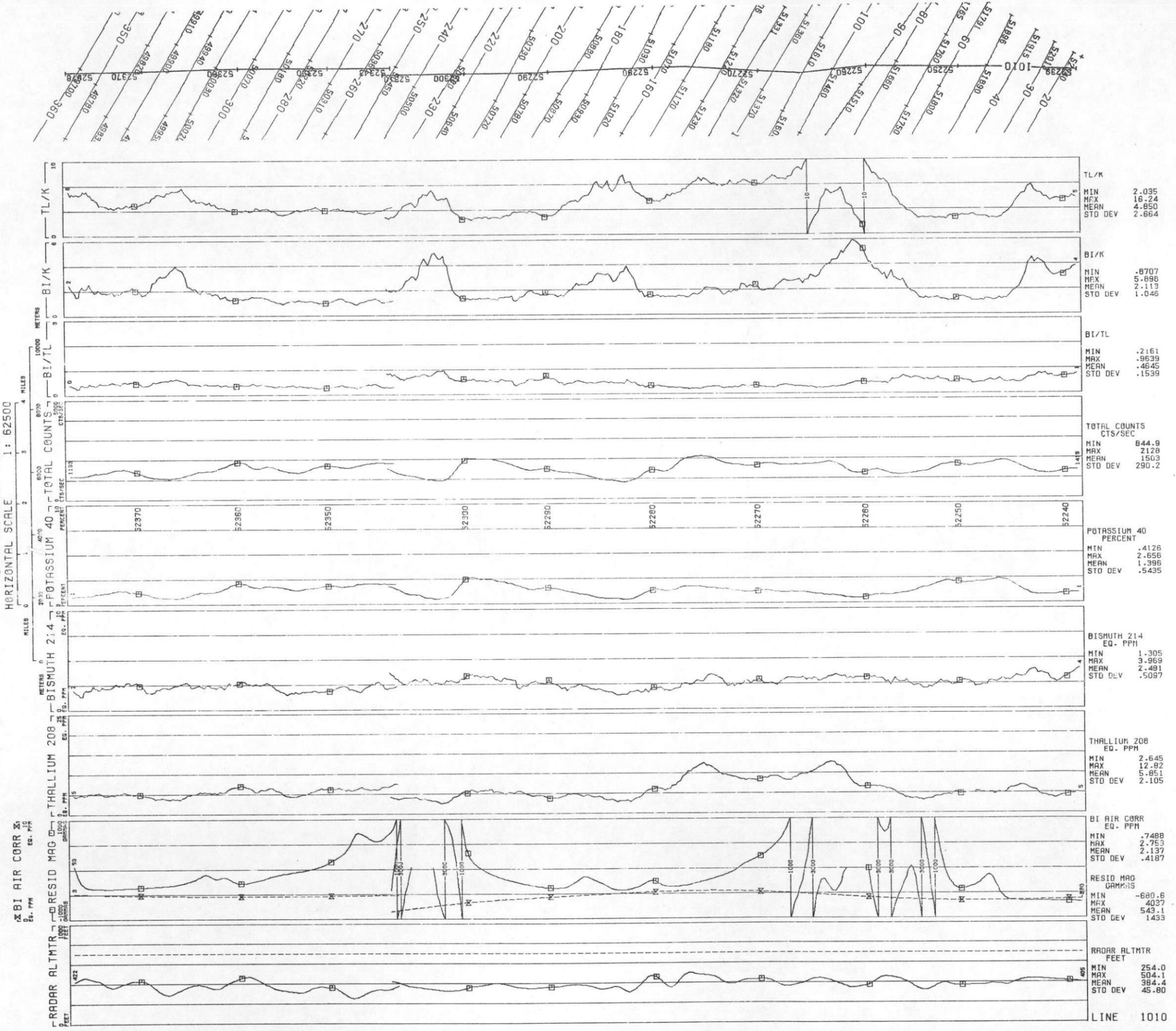
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

LINE 1010

NEMO DETAIL AREA - GEOMETRICS

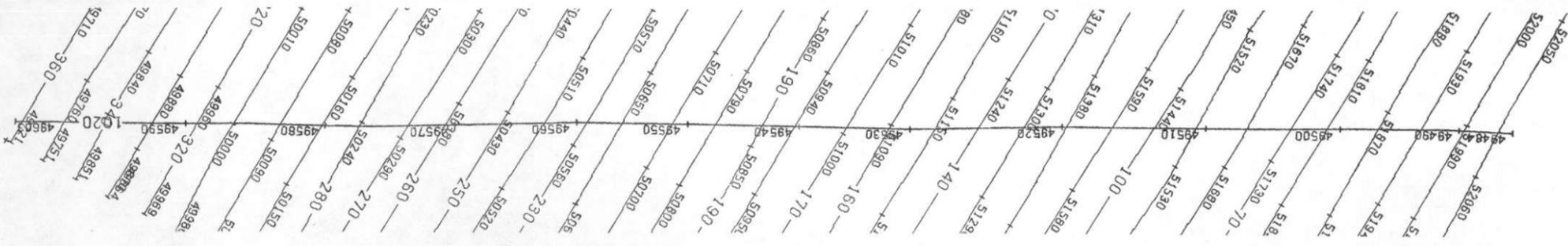
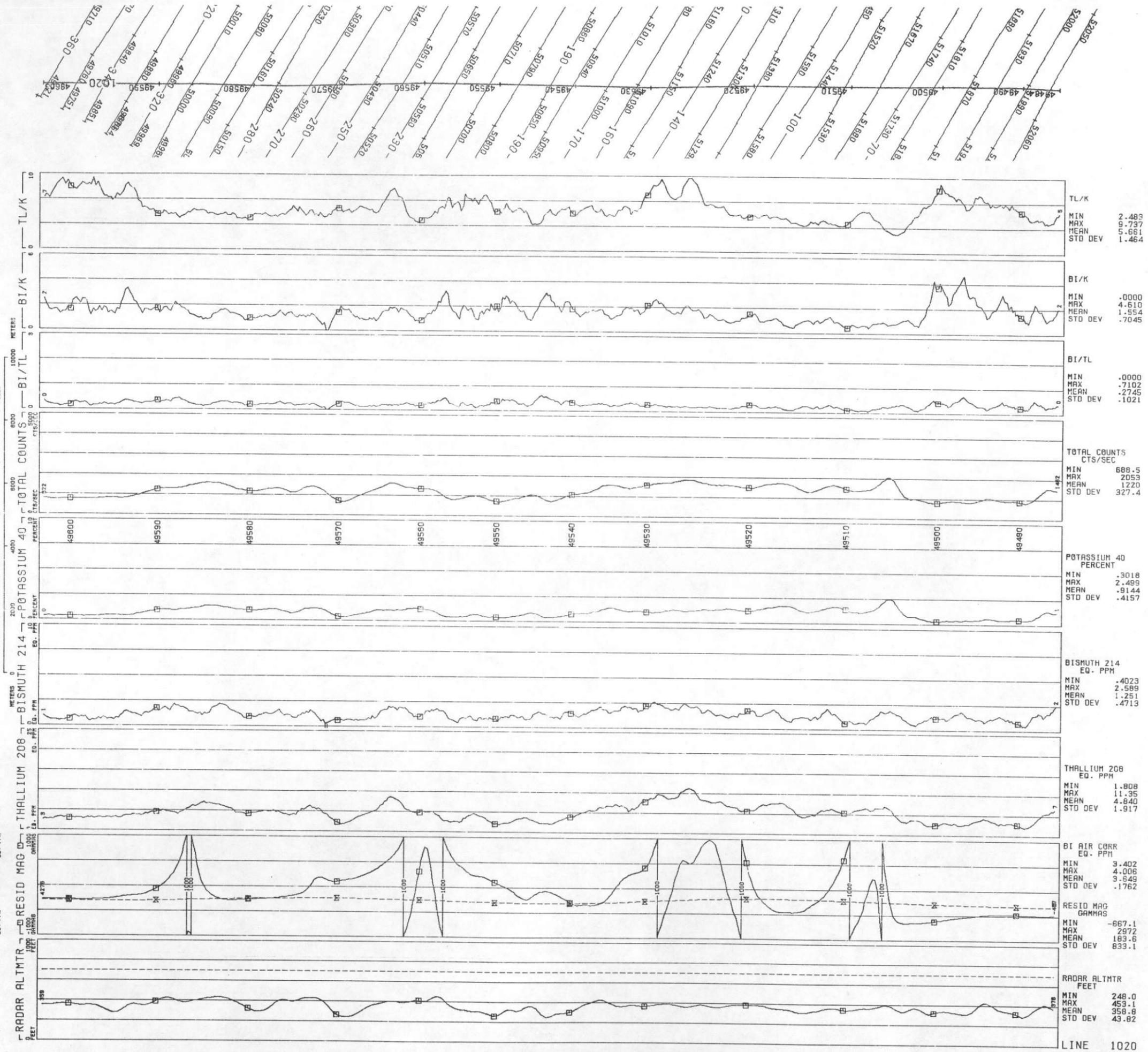
DATA ACQUIRED 79239

HORIZONTAL SCALE 1: 62500

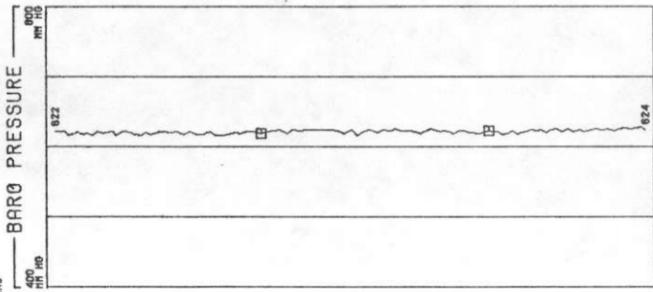
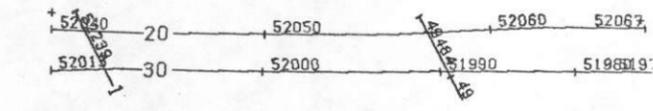


LINE 1020
IDAH0 SURVEY - NEMO DETAIL AREA - GEOMETRICS

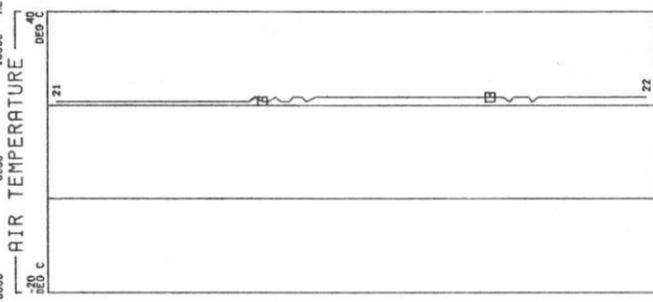
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



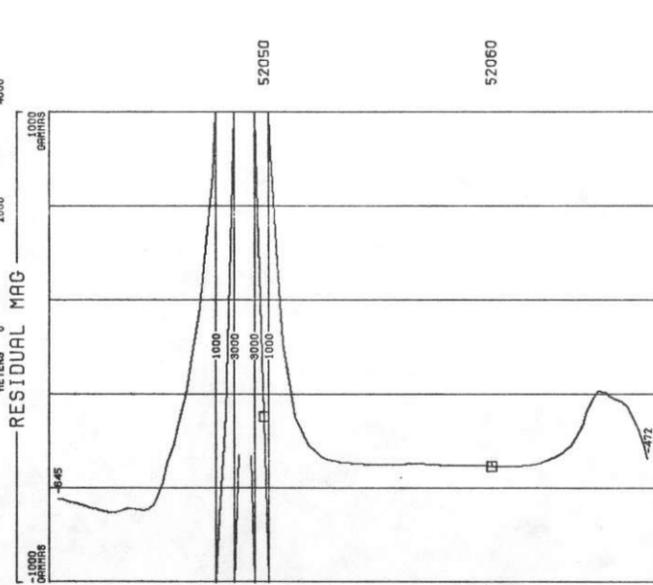
LINE 20
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



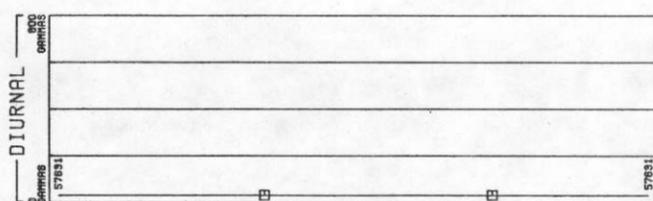
BARO PRESSURE
MM HG
MIN 616.2
MAX 628.9
MEAN 621.9
STD DEV 2.683



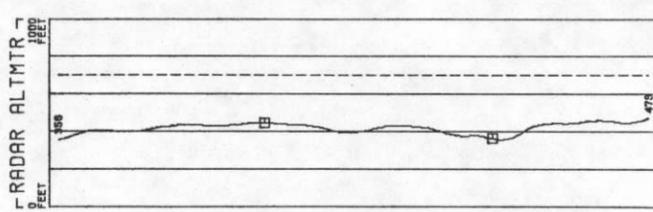
AIR TEMPERATURE
DEG C
MIN 21.00
MAX 22.00
MEAN 21.60
STD DEV .4906



RESIDUAL MAG
GAMMAS
MIN -703.0
MAX 3541
MEAN -214.2
STD DEV 852.4



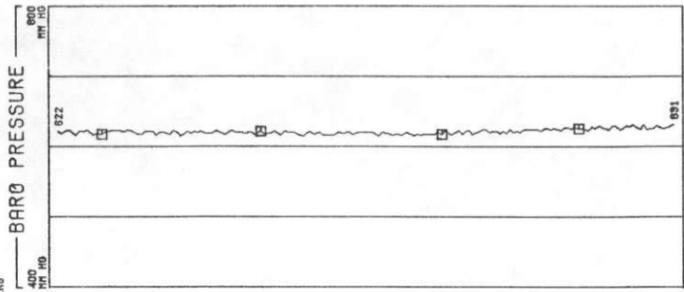
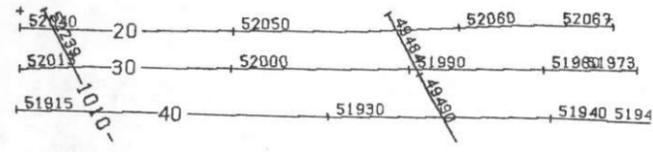
DIURNAL
GAMMAS
MIN 57630
MAX 57631
MEAN 57631
STD DEV .1904



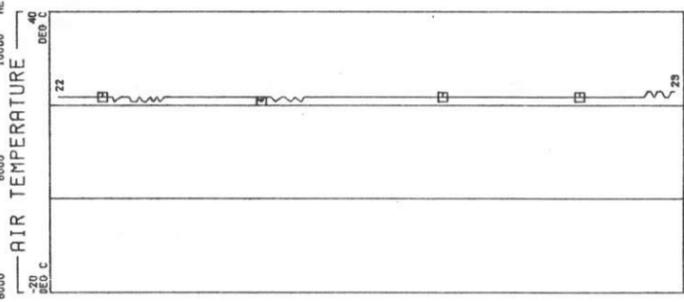
RADAR ALTMTR
FEET
MIN 356.4
MAX 472.8
MEAN 418.6
STD DEV 27.99

LINE 20

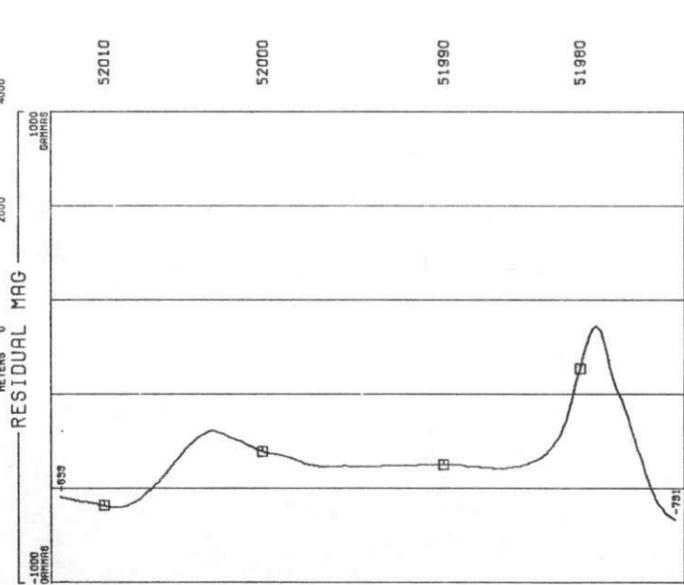
LINE 30
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



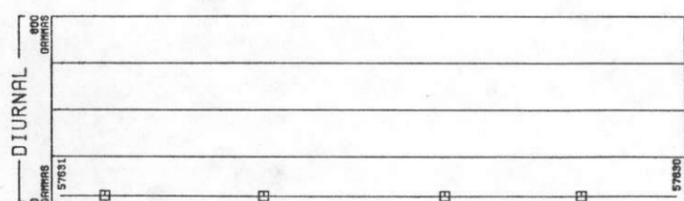
BARO PRESSURE
MM HG
MIN 615.0
MAX 631.0
MEAN 622.0
STD DEV 3.704



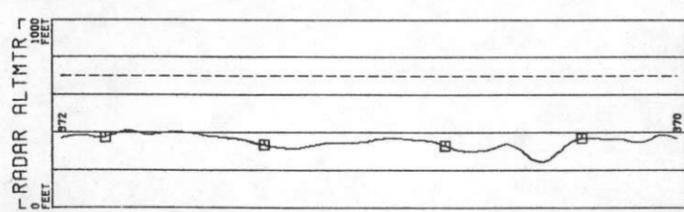
AIR TEMPERATURE
DEG C
MIN 21.00
MAX 23.00
MEAN 21.97
STD DEV .3255



RESIDUAL MAG
GAMMAS
MIN -730.8
MAX 88.47
MEAN -465.2
STD DEV 165.2



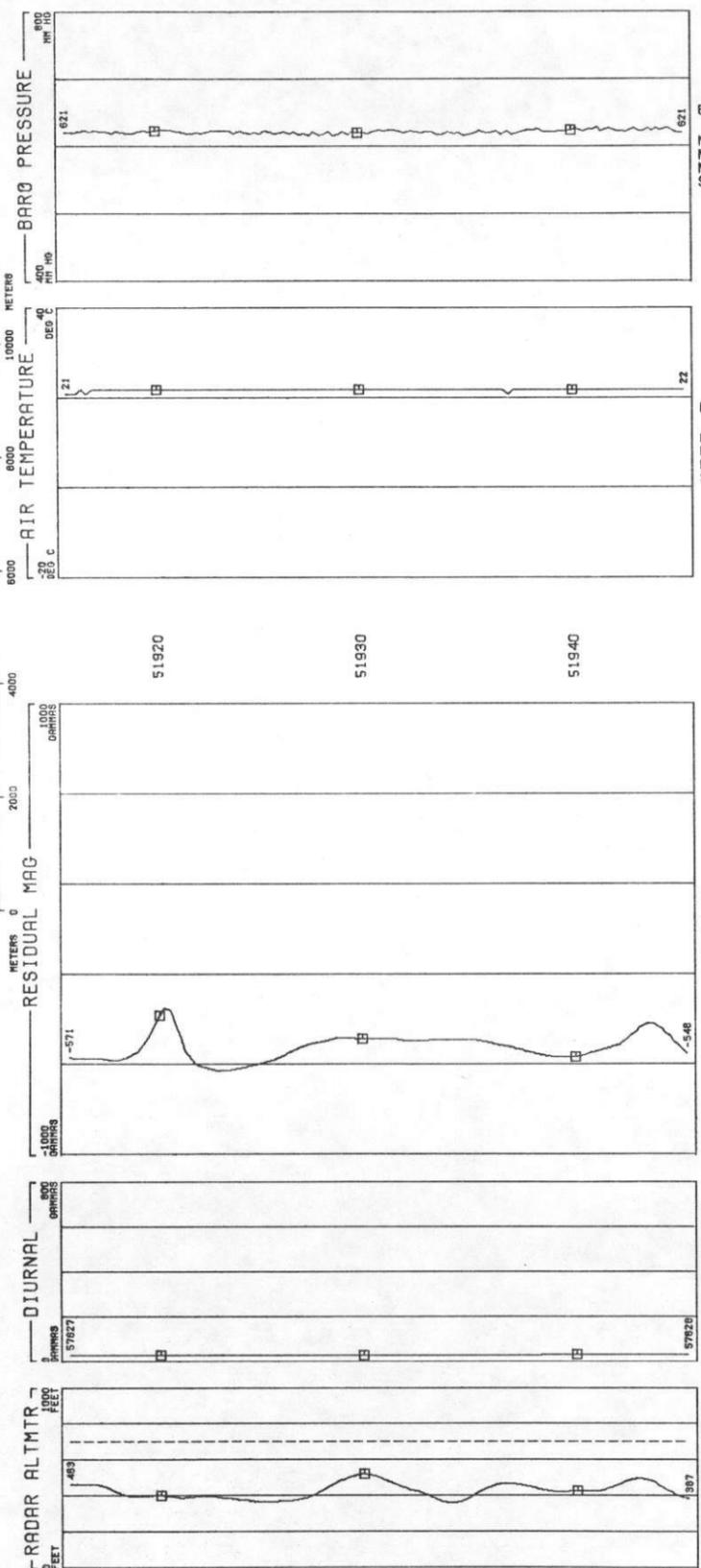
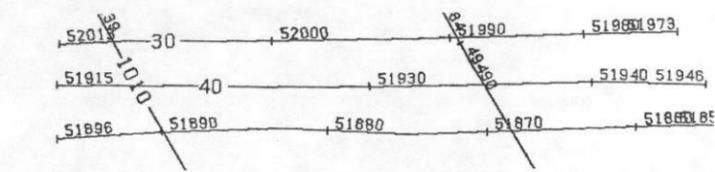
DIURNAL
GAMMAS
MIN 57630
MAX 57631
MEAN 57631
STD DEV .2971



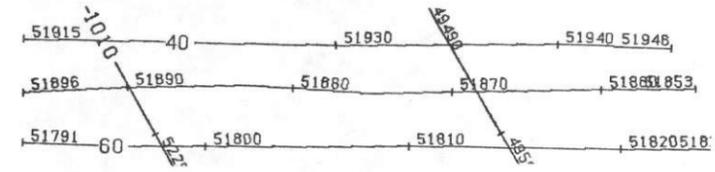
RADAR ALTMTR
FEET
MIN 246.2
MAX 411.2
MEAN 354.7
STD DEV 37.12

LINE 30

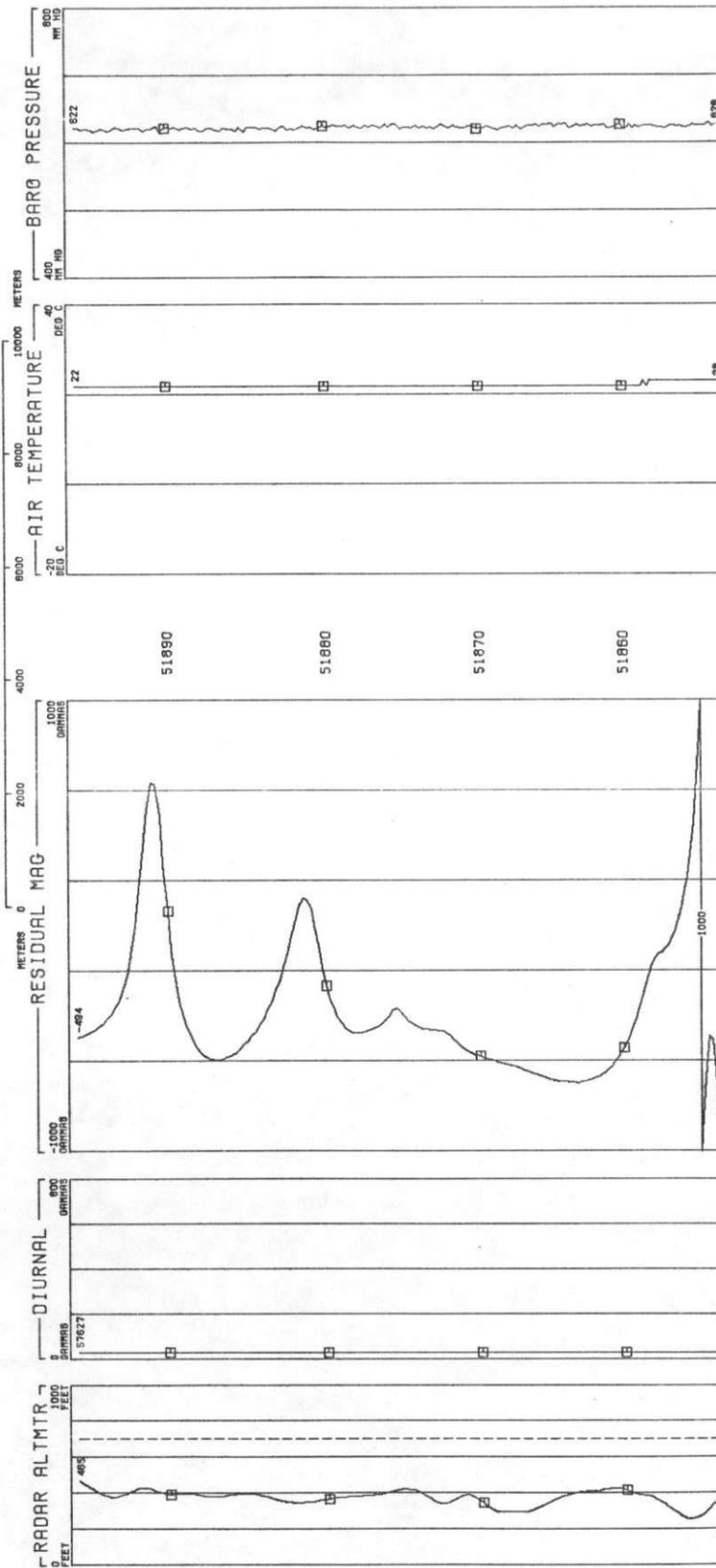
LINE 40
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



LINE 40

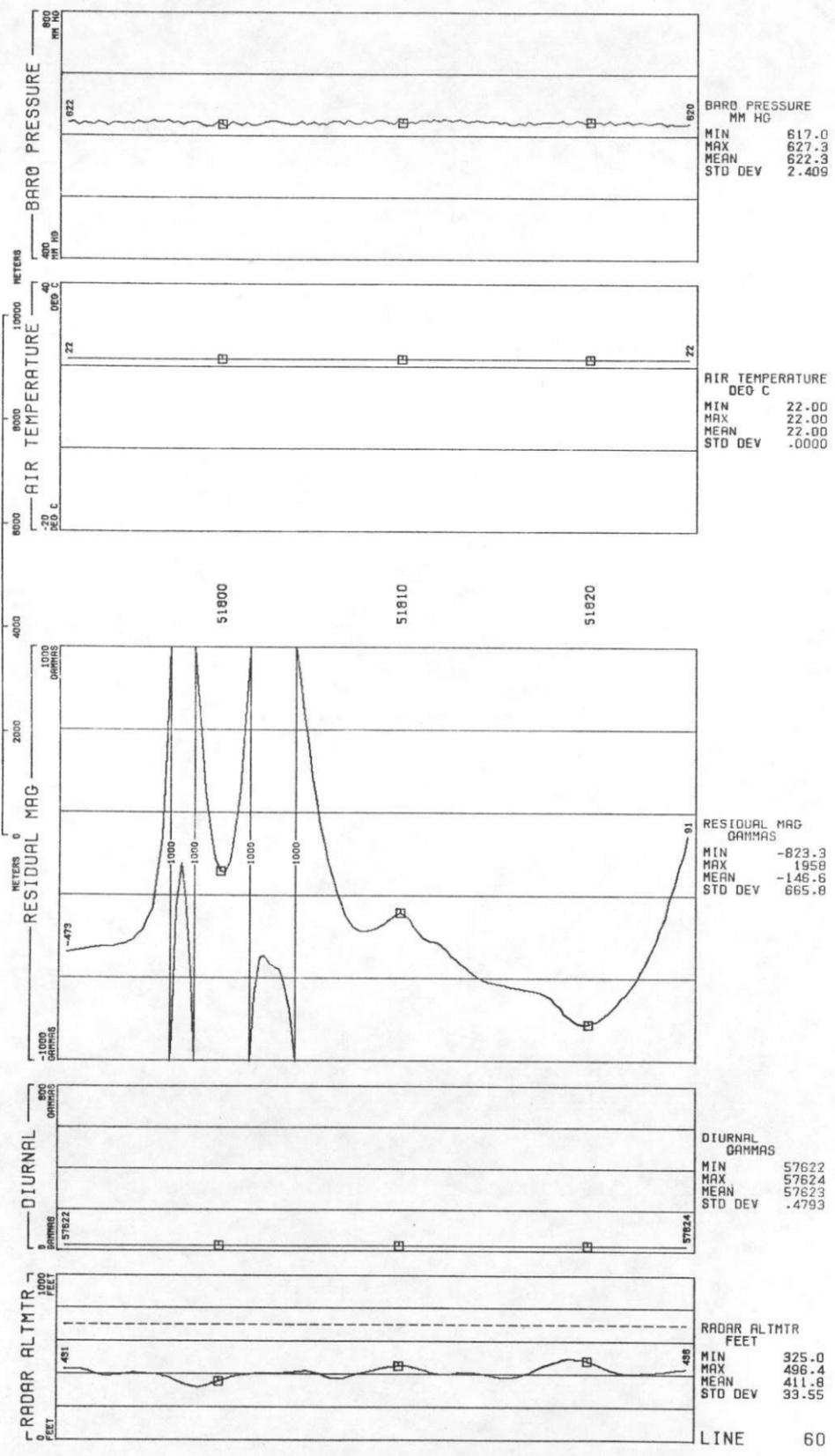
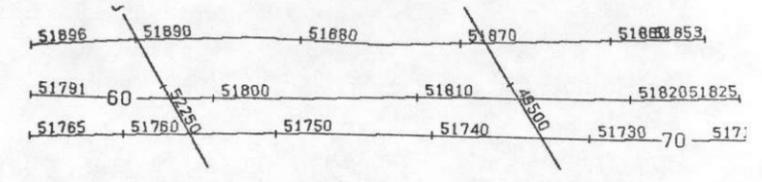


LINE 50
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500

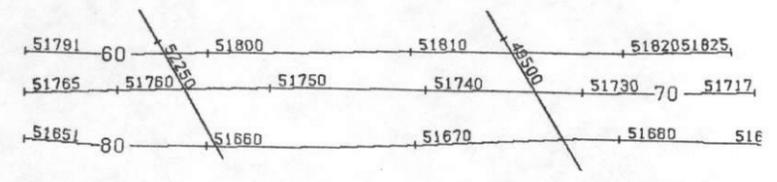


LINE 50

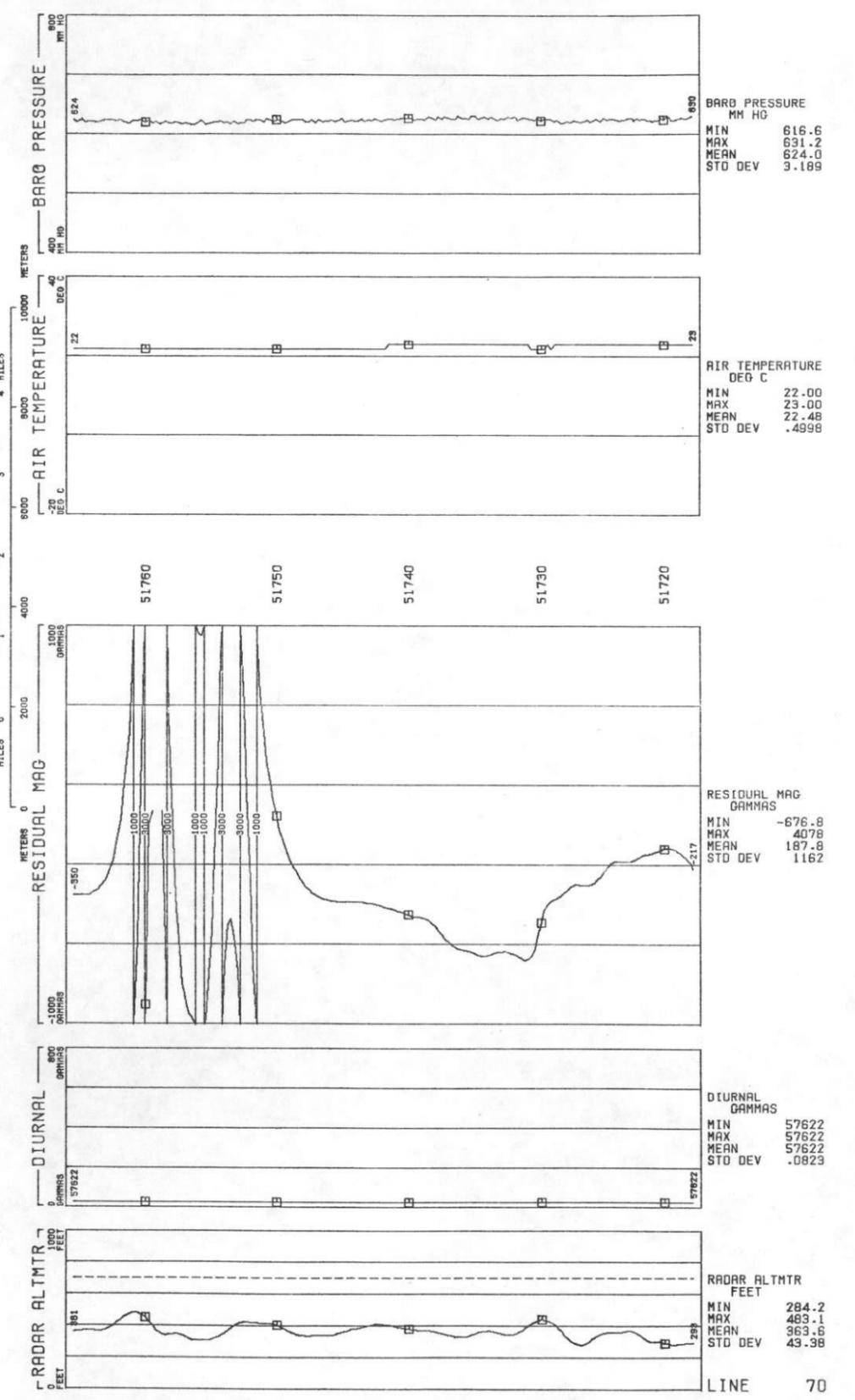
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 60
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



LINE 60

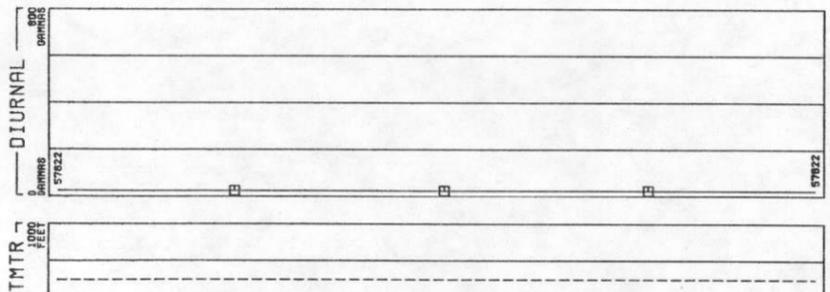
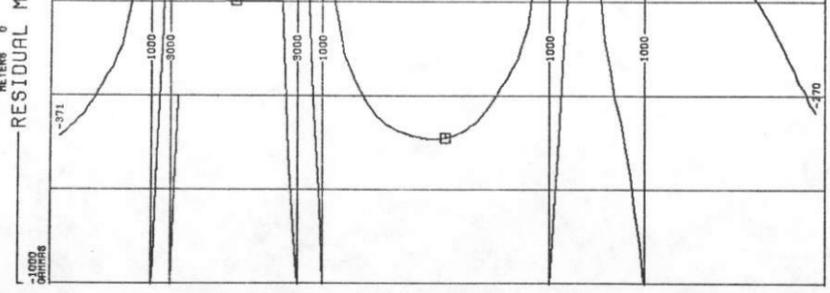
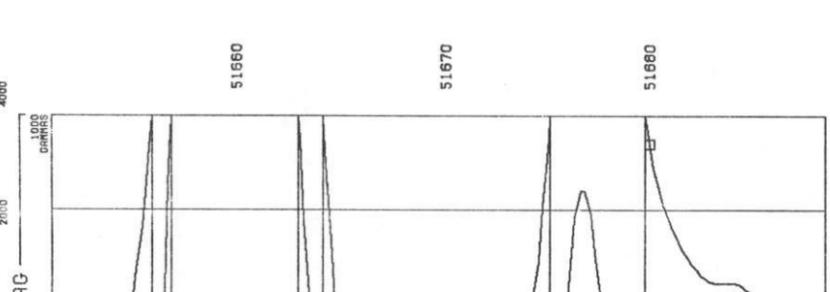
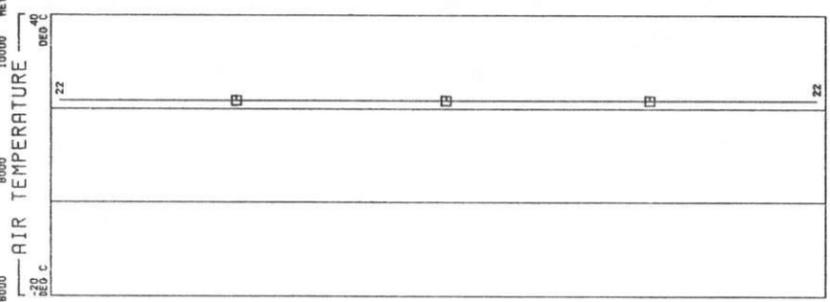
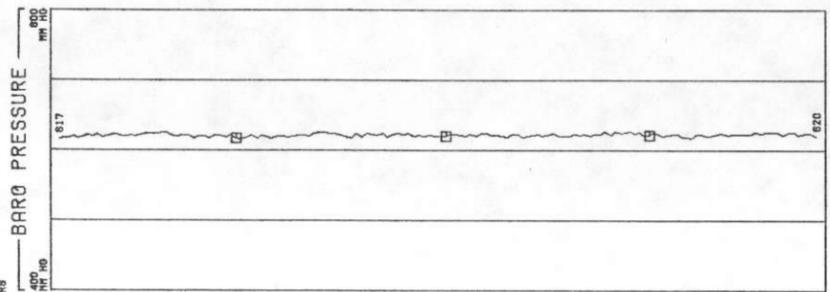
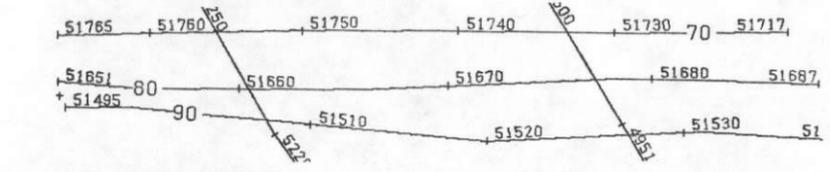


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 70
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



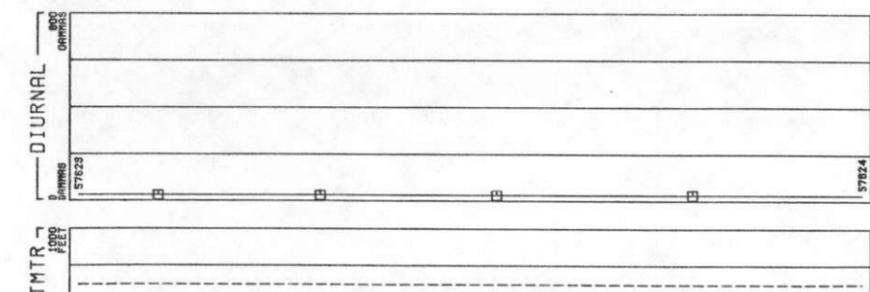
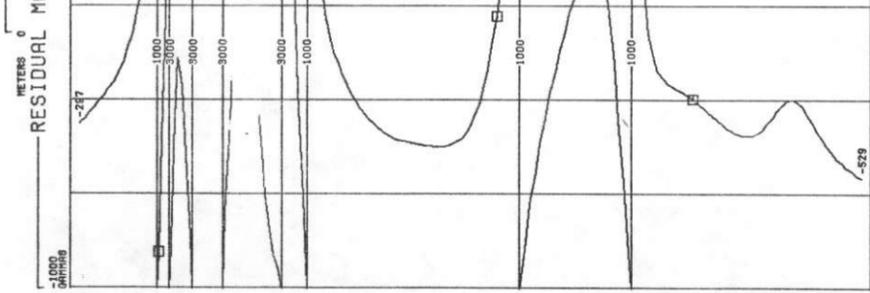
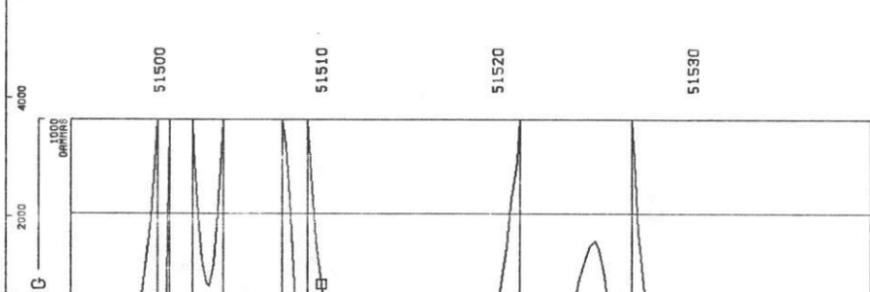
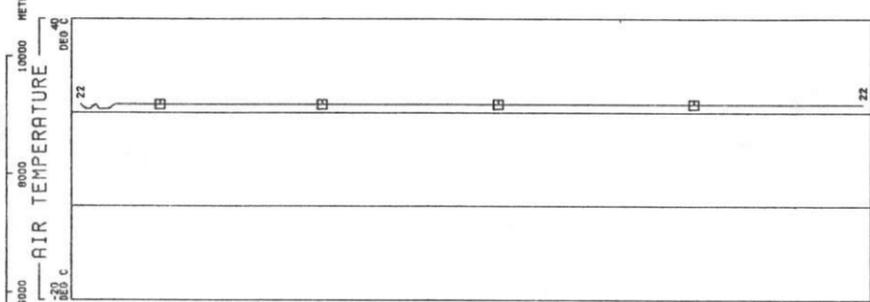
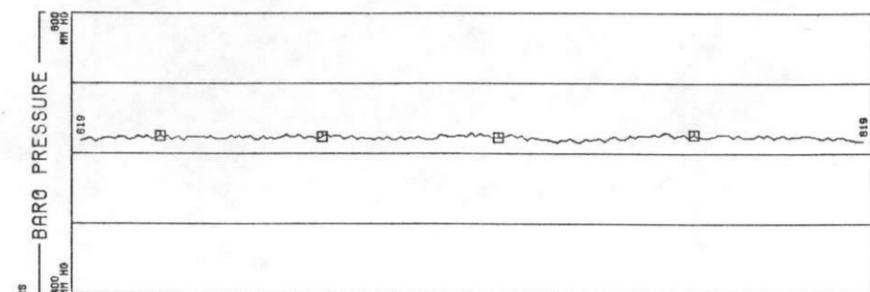
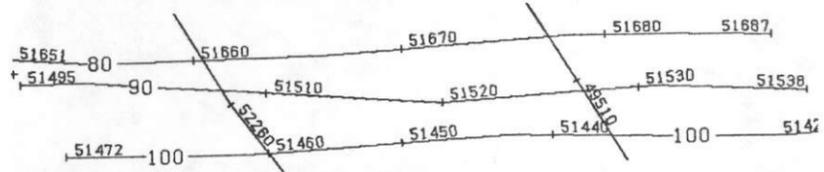
LINE 70

IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 80
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



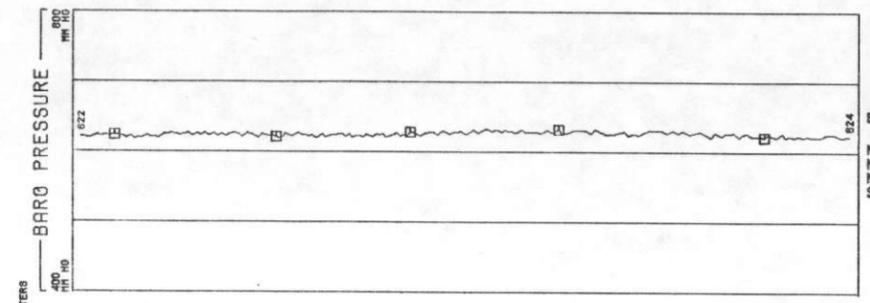
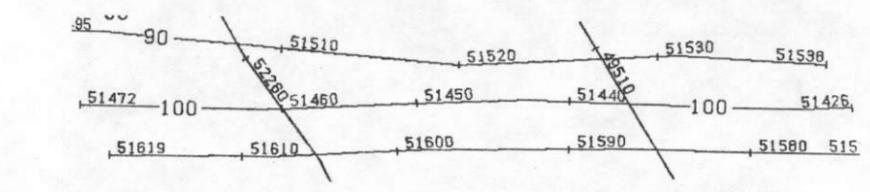
LINE 80

IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 90
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500

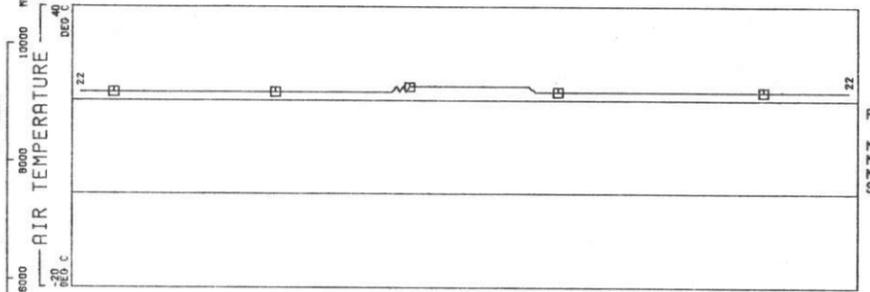


LINE 90

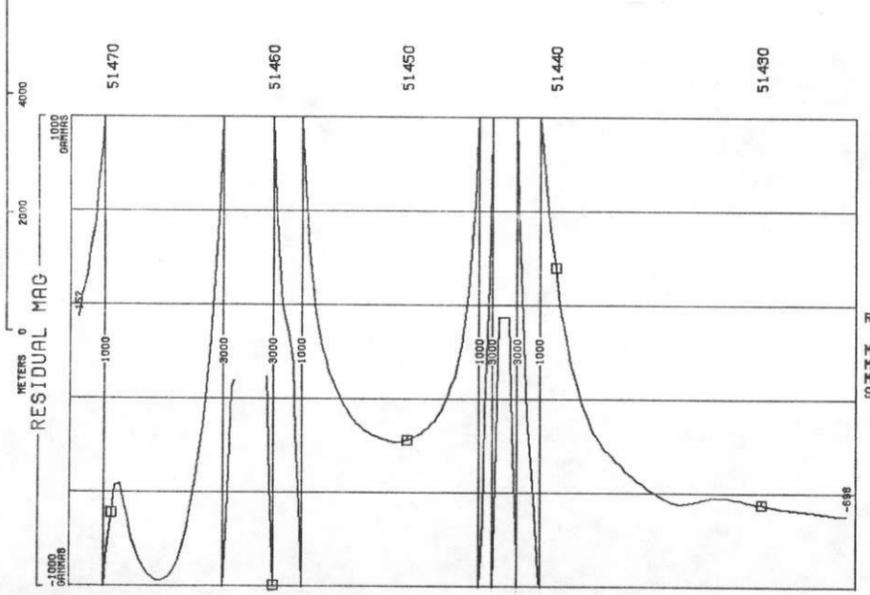
LINE 100
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



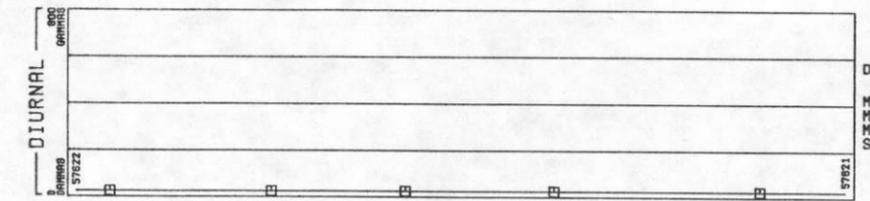
BARO PRESSURE
 MM HG
 MIN 619.8
 MAX 632.6
 MEAN 622.6
 STD DEV 3.210



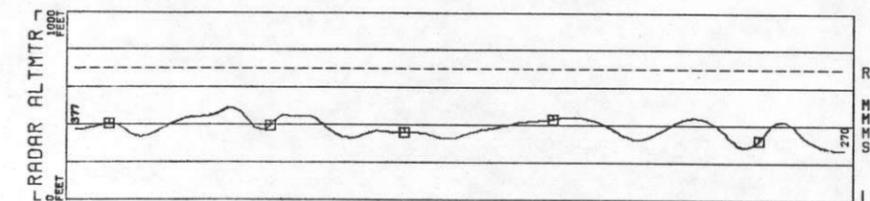
AIR TEMPERATURE
 DEG C
 MIN 22.00
 MAX 23.00
 MEAN 22.21
 STD DEV .4048



RESIDUAL MAG
 GAMMAS
 MIN -695.7
 MAX 4150
 MEAN 622.0
 STD DEV 1415



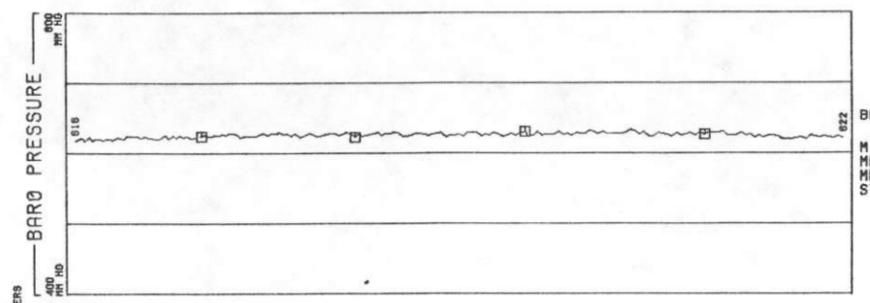
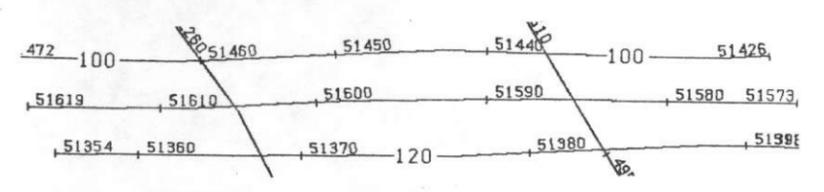
DIURNAL
 GAMMAS
 MIN 57621
 MAX 57622
 MEAN 57621
 STD DEV .3256



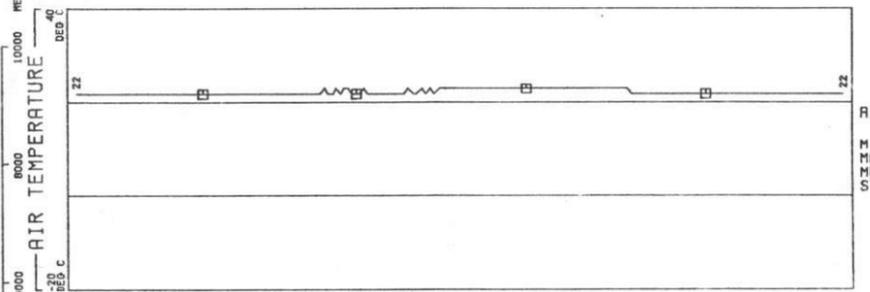
RADAR ALTMTR
 FEET
 MIN 270.4
 MAX 491.5
 MEAN 386.0
 STD DEV 46.57

LINE 100

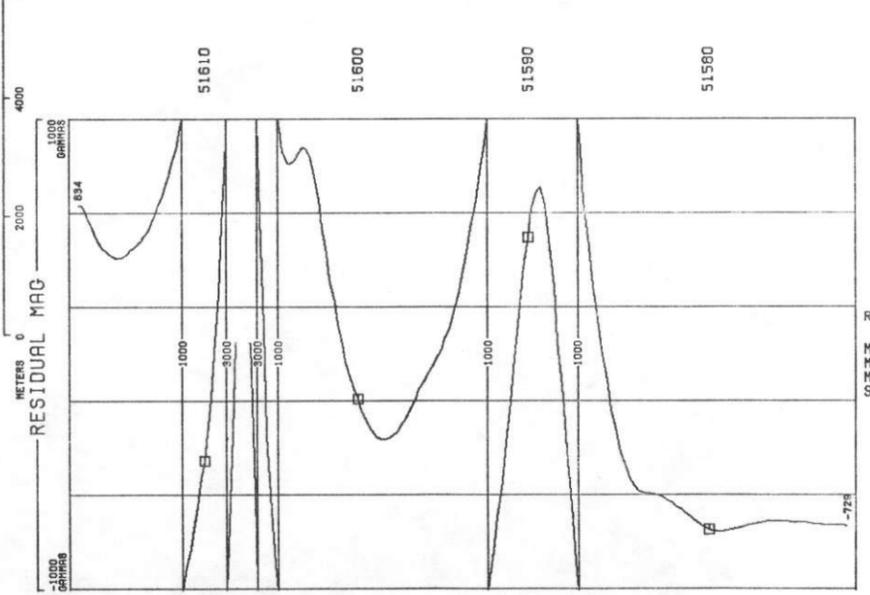
LINE 110
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



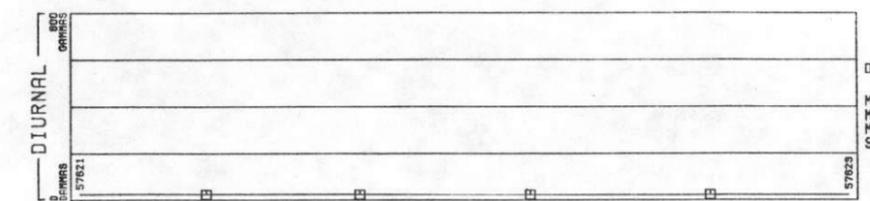
BARO PRESSURE
 MM HG
 MIN 617.7
 MAX 634.2
 MEAN 626.1
 STD DEV 3.269



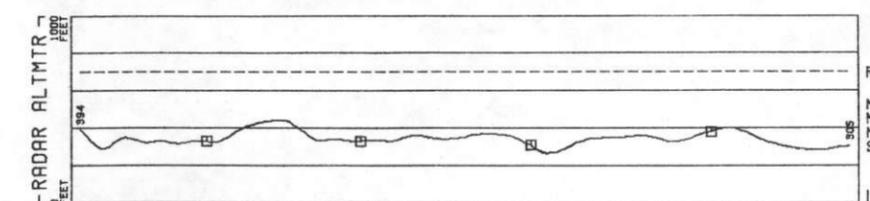
AIR TEMPERATURE
 DEG C
 MIN 22.00
 MAX 23.00
 MEAN 22.28
 STD DEV .4488



RESIDUAL MAG
 GAMMAS
 MIN -753.4
 MAX 4052
 MEAN 498.2
 STD DEV 1154



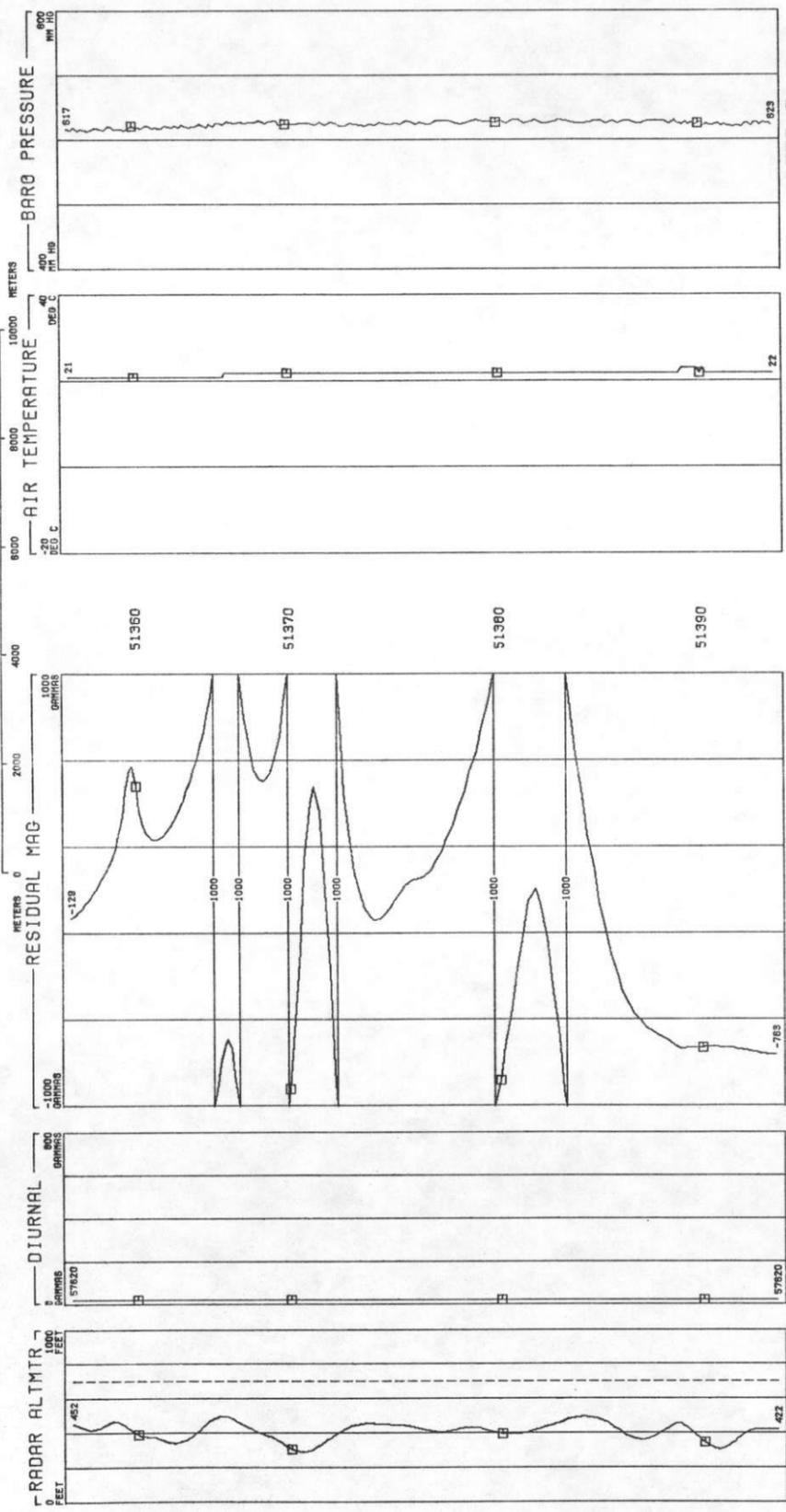
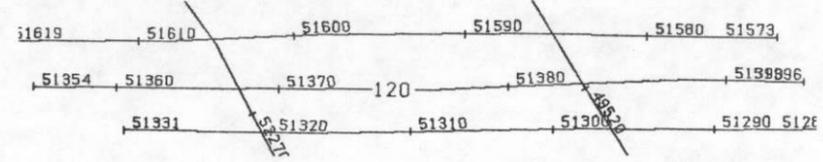
DIURNAL
 GAMMAS
 MIN 57621
 MAX 57623
 MEAN 57622
 STD DEV .3712



RADAR ALTMTR
 FEET
 MIN 269.8
 MAX 443.7
 MEAN 345.4
 STD DEV 96.21

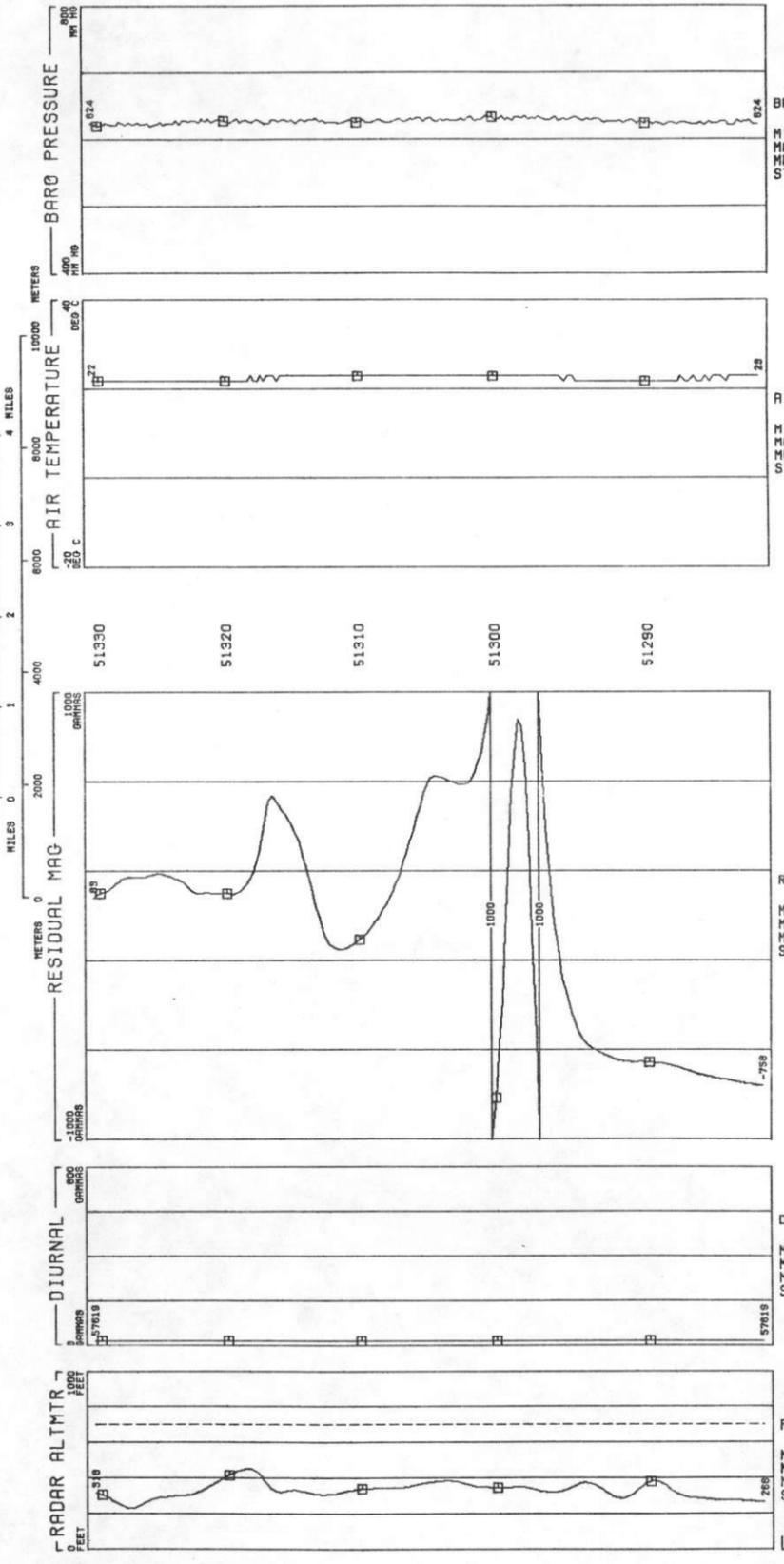
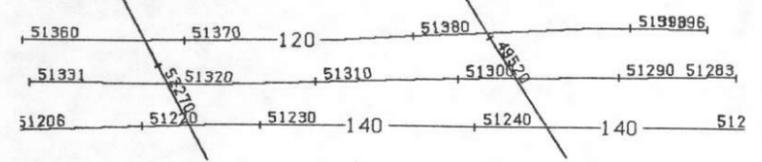
LINE 110

IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 120
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



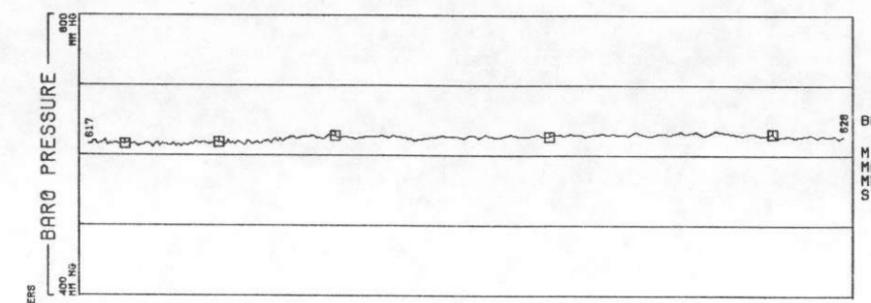
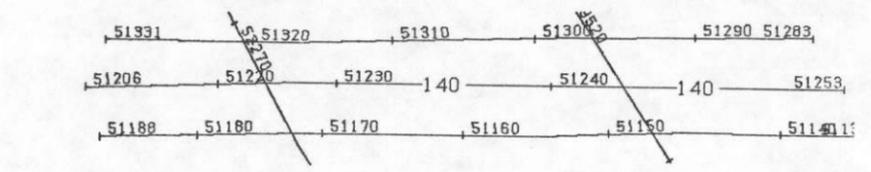
LINE 120

IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 130
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500

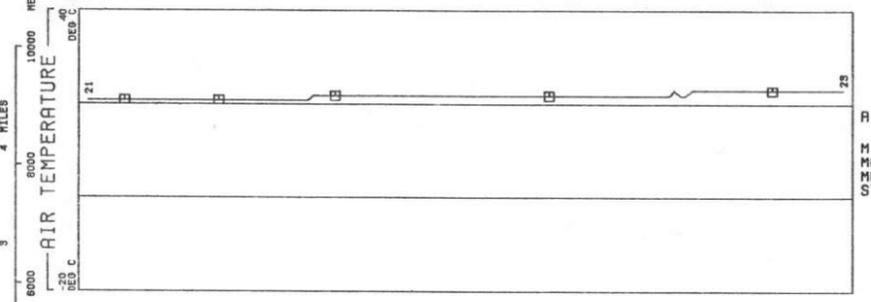


LINE 130

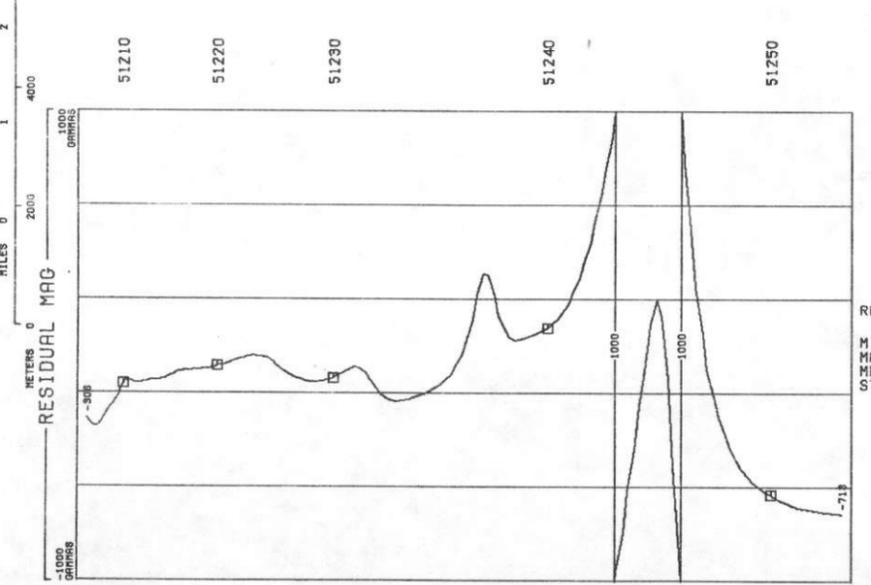
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 140
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



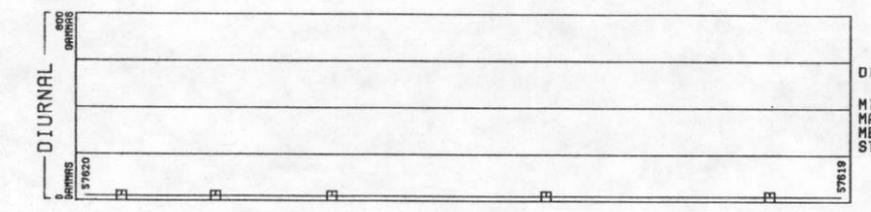
BARO PRESSURE
MM HG
MIN 613.2
MAX 634.7
MEAN 623.9
STD DEV 5.610



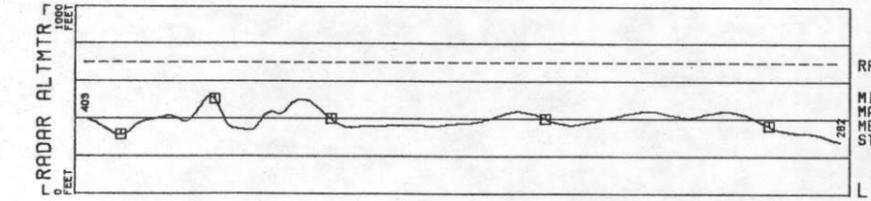
AIR TEMPERATURE
DEG C
MIN 21.00
MAX 23.00
MEAN 21.68
STD DEV .7306



RESIDUAL MAG
GAMMAS
MIN -712.6
MAX 2198
MEAN -19.27
STD DEV 515.6

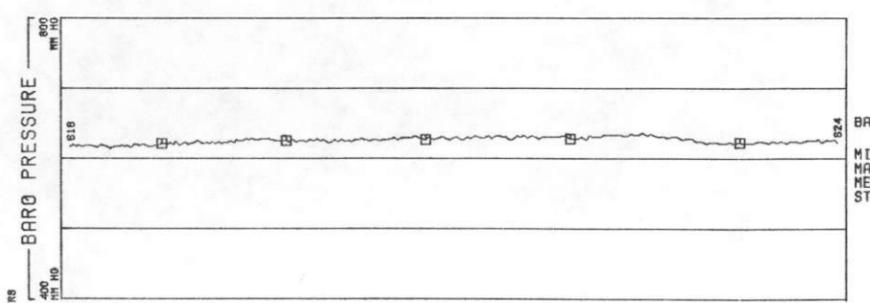
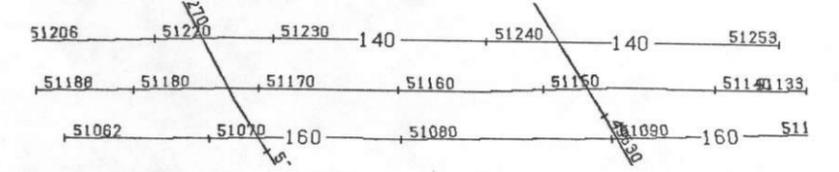


DIURNAL
GAMMAS
MIN 57619
MAX 57620
MEAN 57620
STD DEV .1903

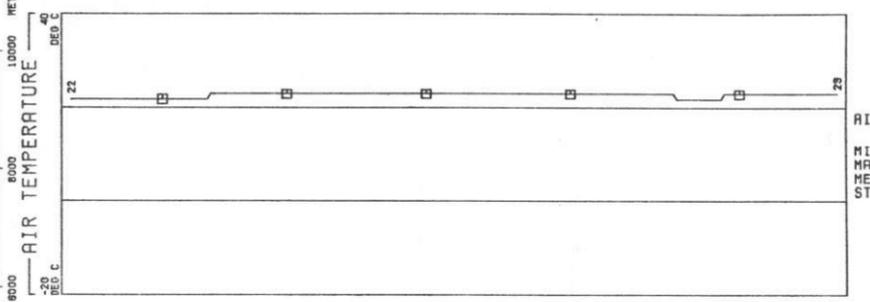


RADAR ALTMTR
FEET
MIN 281.5
MAX 521.3
MEAN 394.5
STD DEV 47.13

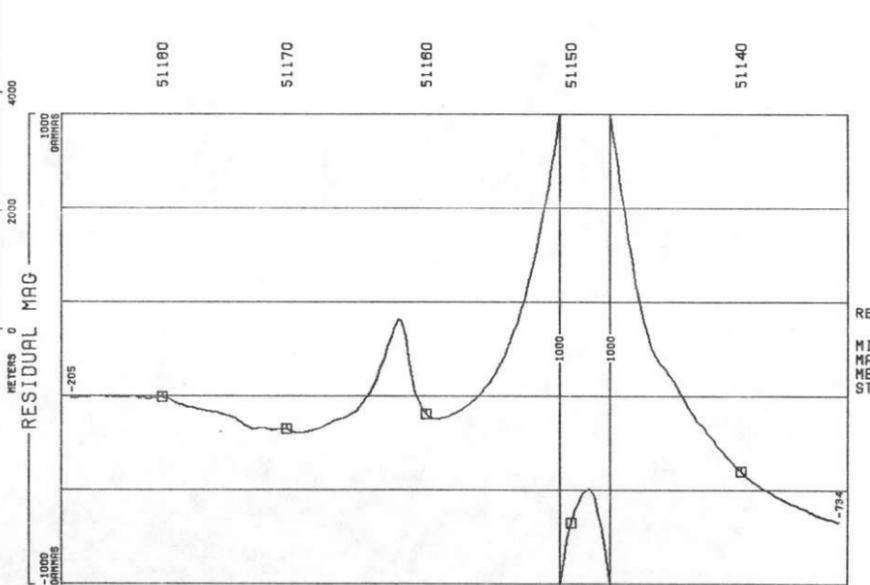
LINE 140



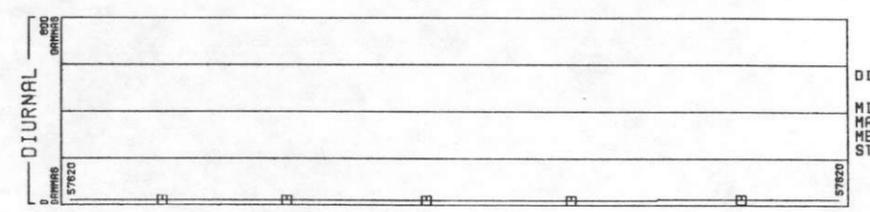
BARO PRESSURE
MM HG
MIN 615.9
MAX 636.8
MEAN 626.3
STD DEV 4.606



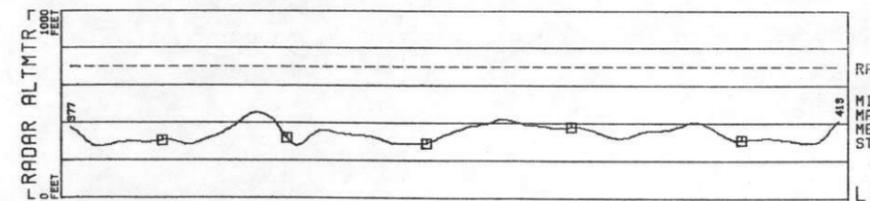
AIR TEMPERATURE
DEG C
MIN 22.00
MAX 23.00
MEAN 22.74
STD DEV .4376



RESIDUAL MAG
GAMMAS
MIN -734.0
MAX 1406
MEAN -121.1
STD DEV 462.6



DIURNAL
GAMMAS
MIN 57620
MAX 57620
MEAN 57620
STD DEV .1961



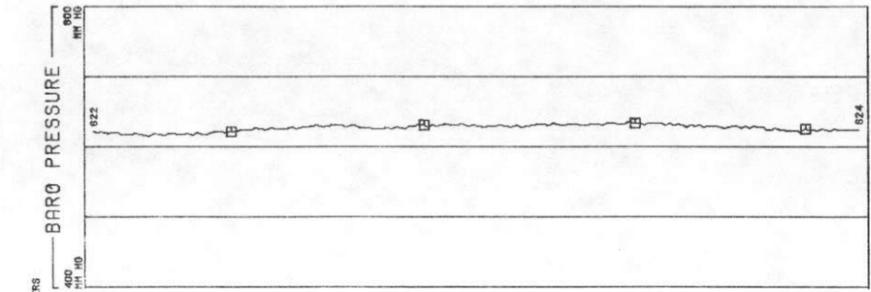
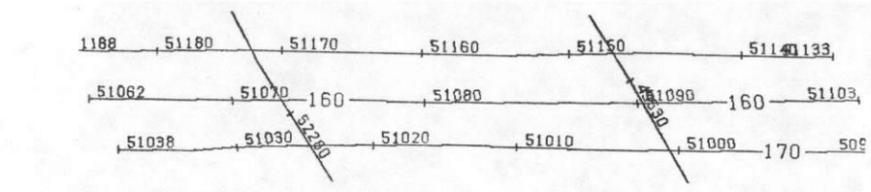
RADAR ALTMTR
FEET
MIN 275.2
MAX 458.0
MEAN 343.9
STD DEV 44.26

LINE 150

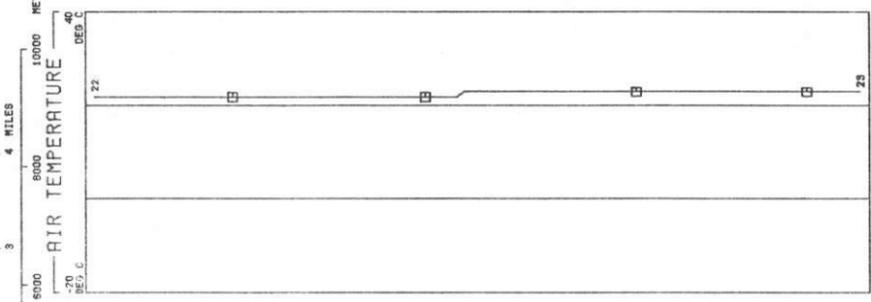
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 150
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500

LINE 160
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

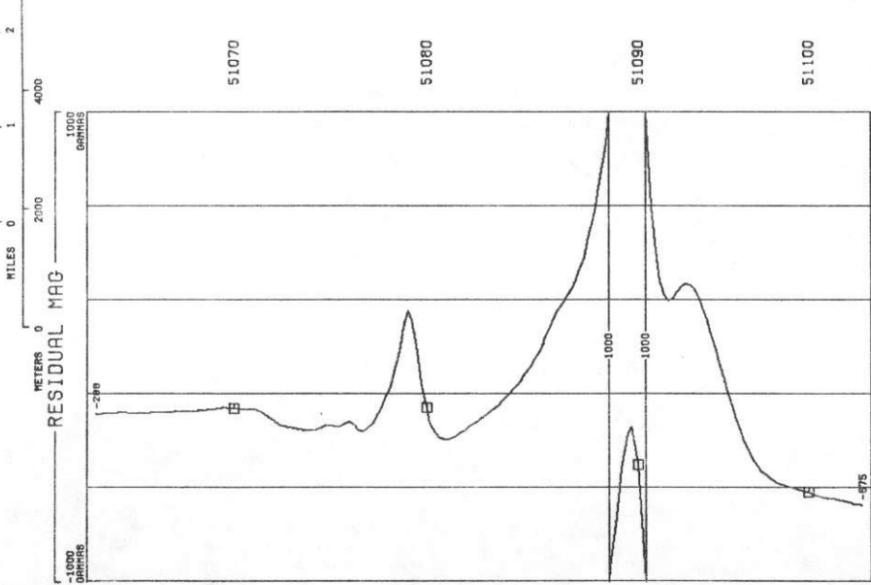
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



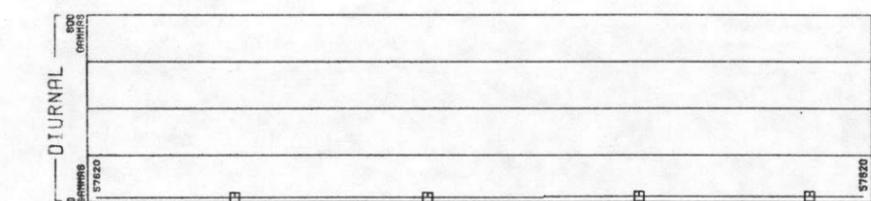
BARO PRESSURE
MM HG
MIN 615.9
MAX 635.1
MEAN 627.3
STD DEV 4.845



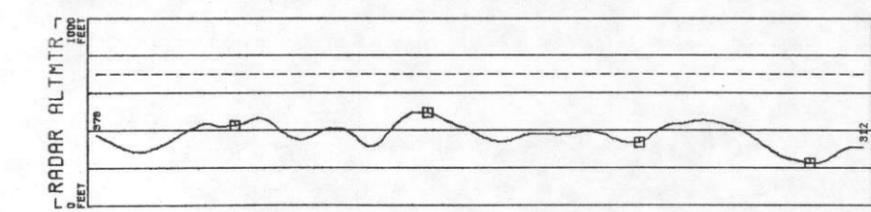
AIR TEMPERATURE
DEG C
MIN 22.00
MAX 23.00
MEAN 22.53
STD DEV .4992



RESIDUAL MAG
GAMMAS
MIN -674.7
MAX 1660
MEAN -148.3
STD DEV 448.5



DIURNAL
GAMMAS
MIN 57620
MAX 57820
MEAN 57620
STD DEV .2232

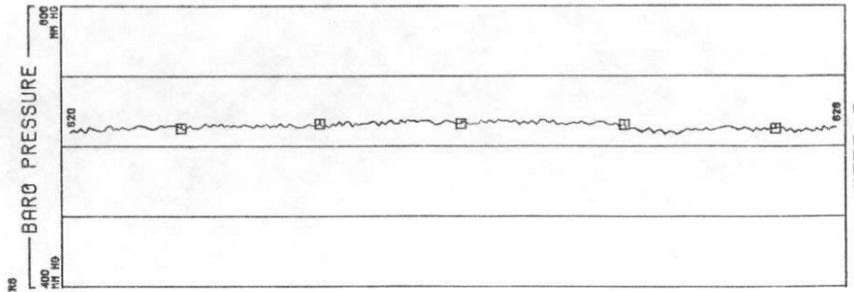
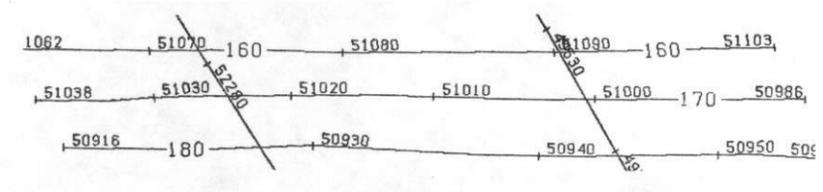


RADAR ALTMTR
FEET
MIN 226.9
MAX 499.2
MEAN 375.4
STD DEV 65.46

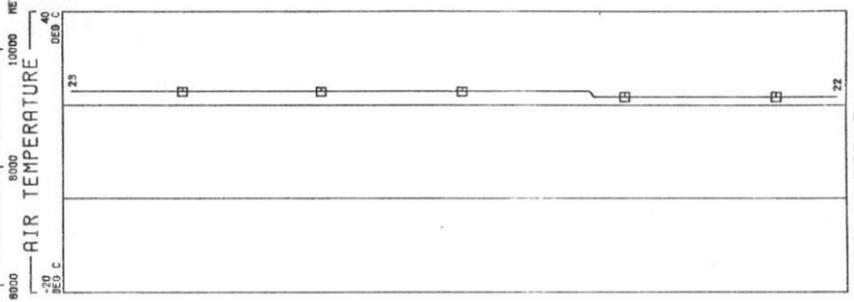
LINE 160

LINE 170
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS

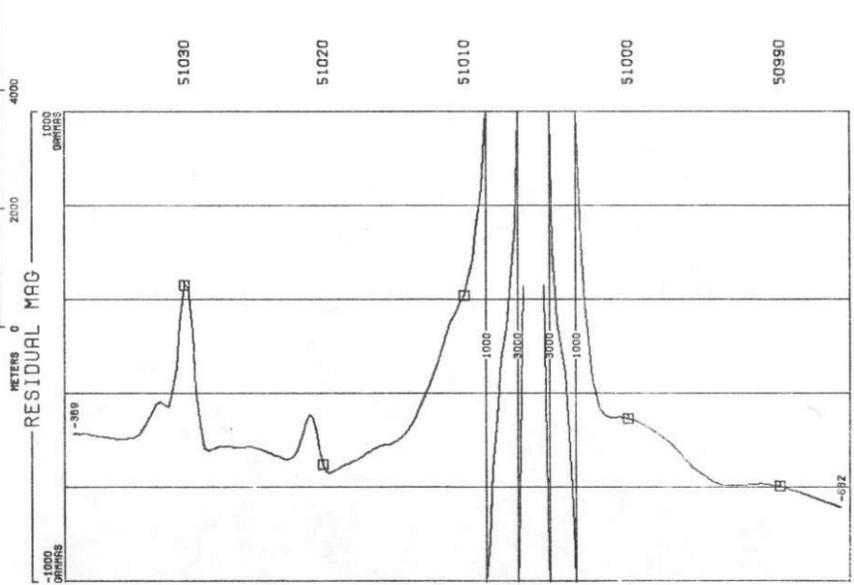
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



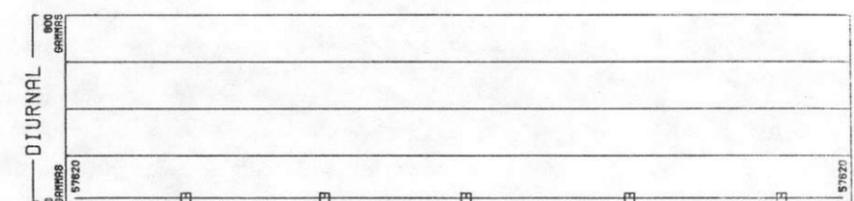
BARO PRESSURE
MM HG
MIN 618.4
MAX 637.7
MEAN 629.2
STD DEV 4.704



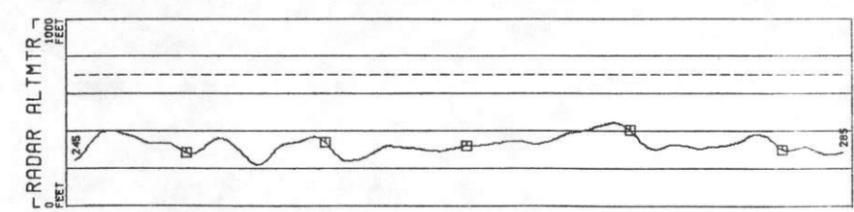
AIR TEMPERATURE
DEG C
MIN 22.00
MAX 23.00
MEAN 22.69
STD DEV .4623



RESIDUAL MAG
GAMMAS
MIN -681.7
MAX 4267
MEAN -56.05
STD DEV 1008



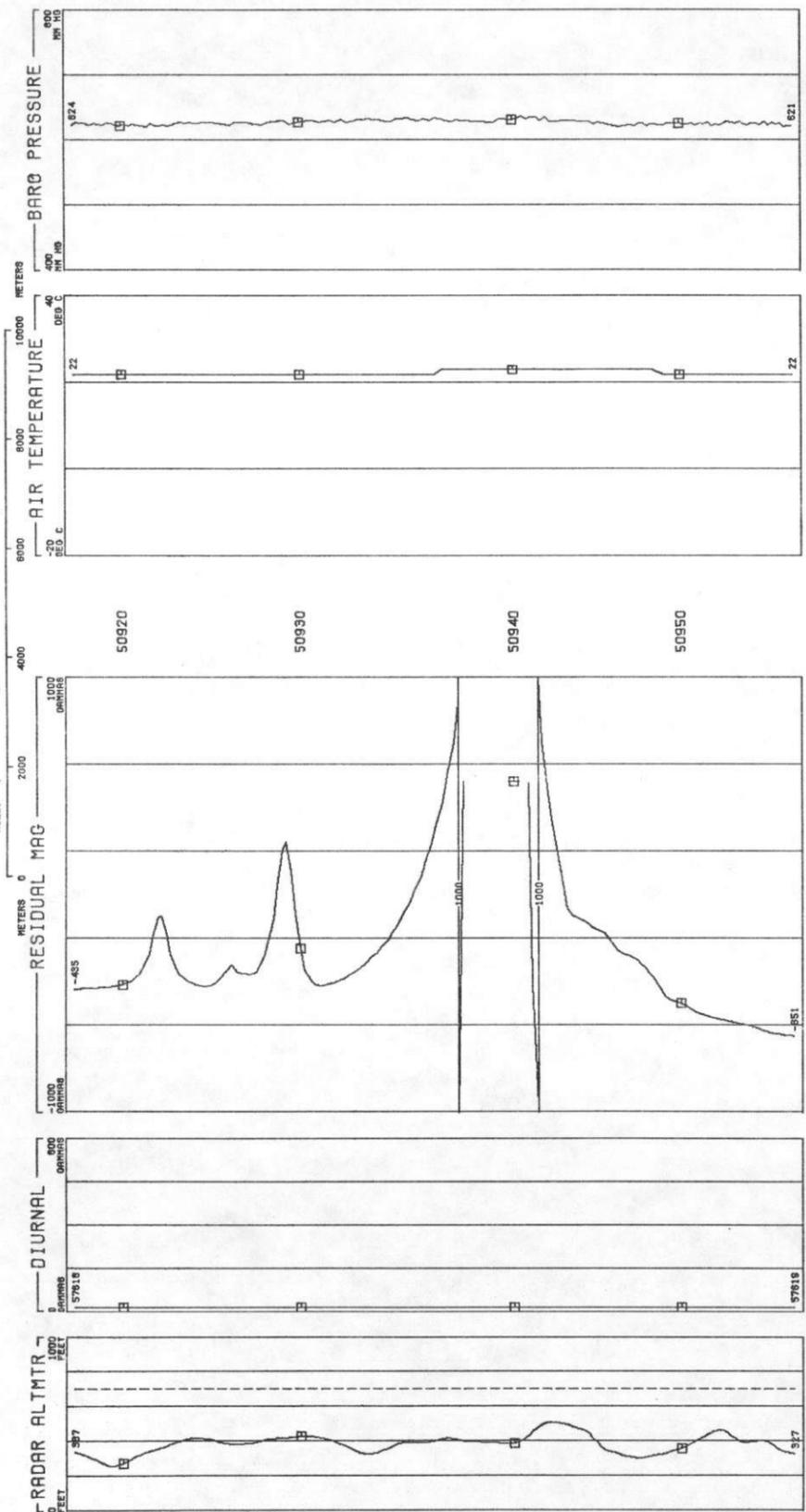
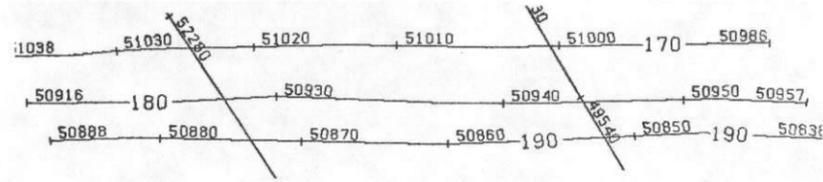
DIURNAL
GAMMAS
MIN 57619
MAX 57820
MEAN 57620
STD DEV .2190



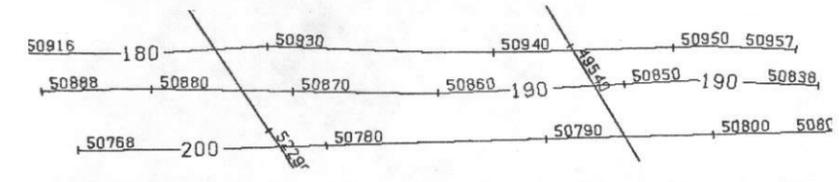
RADAR ALTMTR
FEET
MIN 221.5
MAX 445.8
MEAN 329.3
STD DEV 46.16

LINE 170

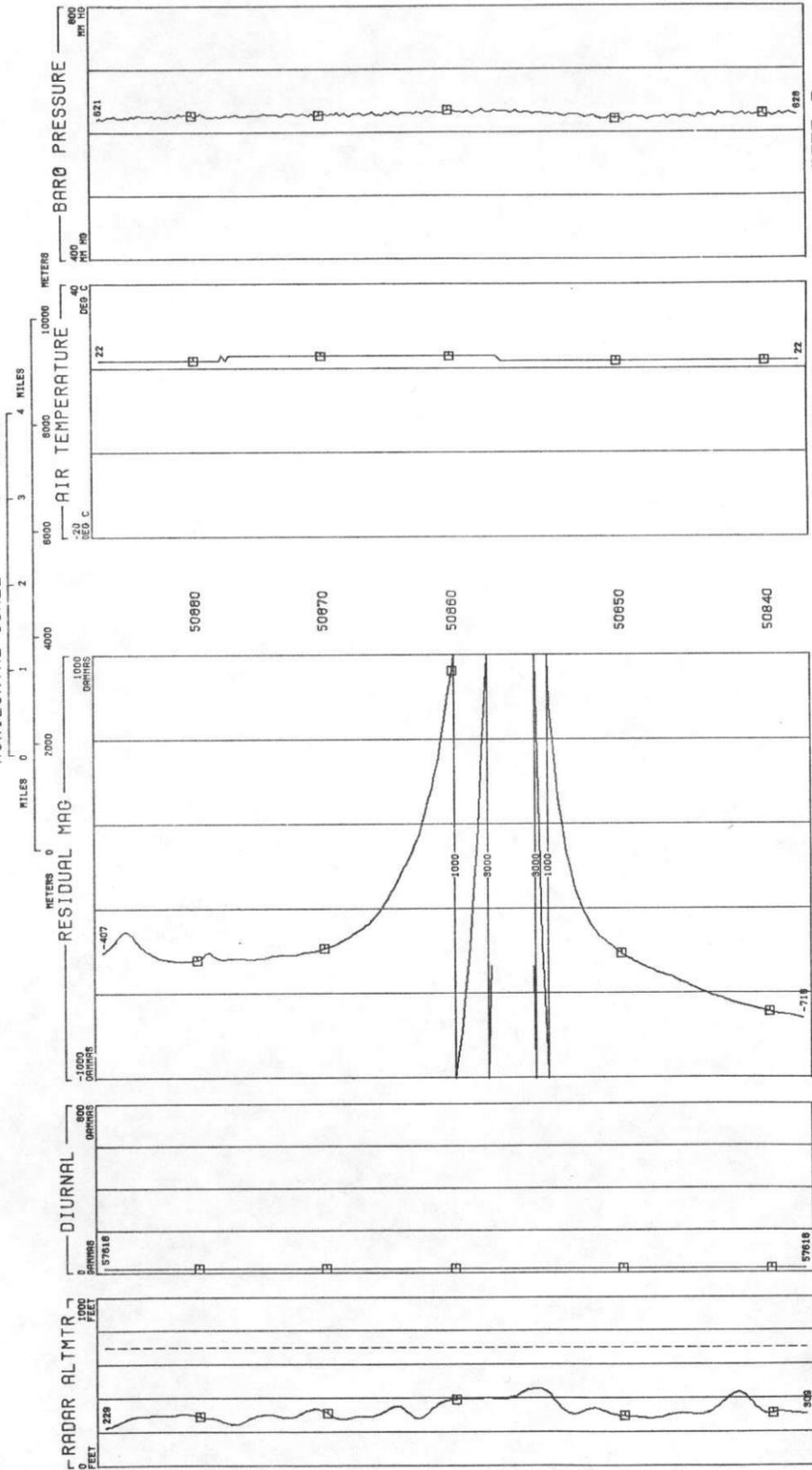
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 180
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



LINE 180

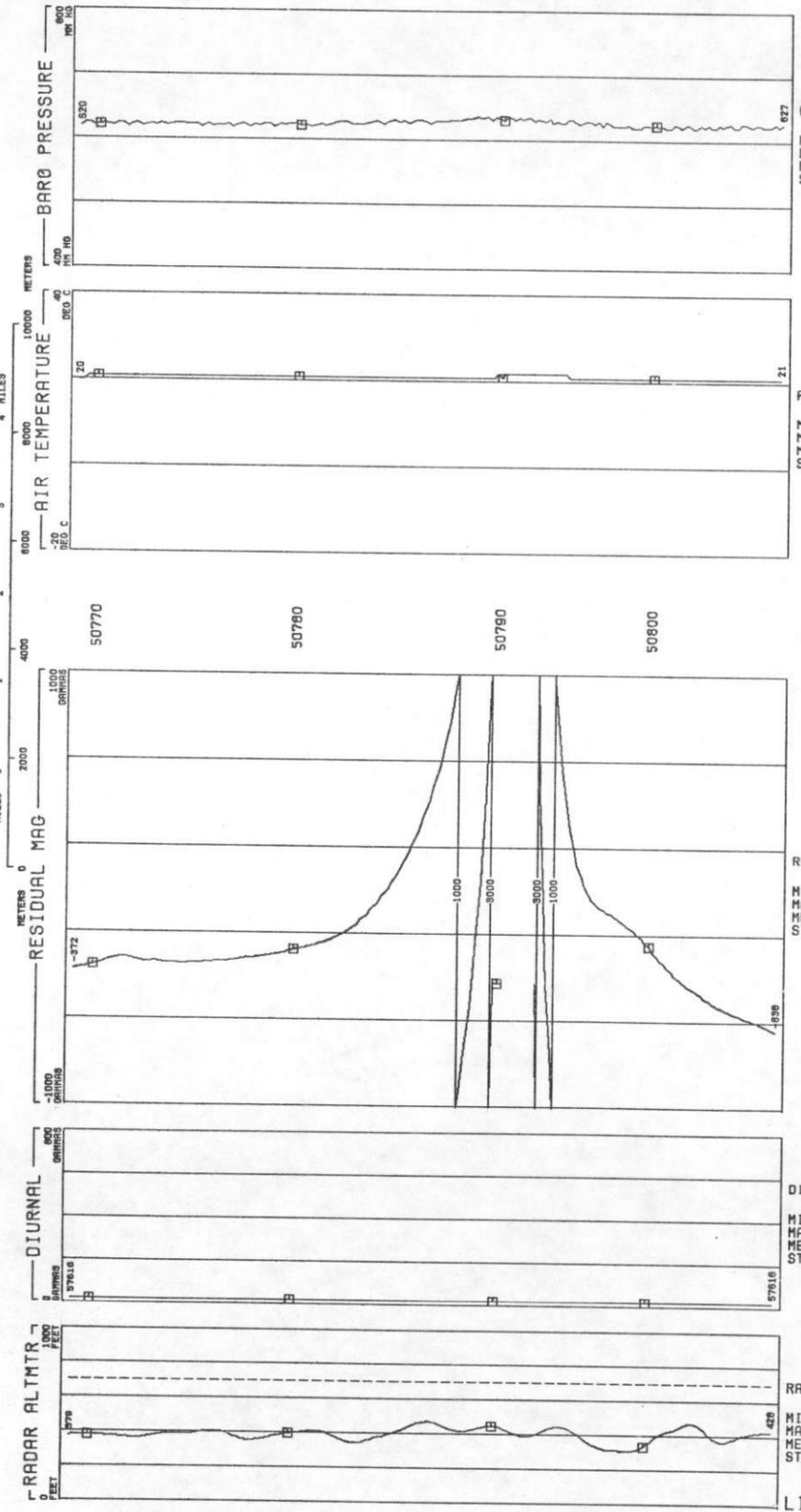
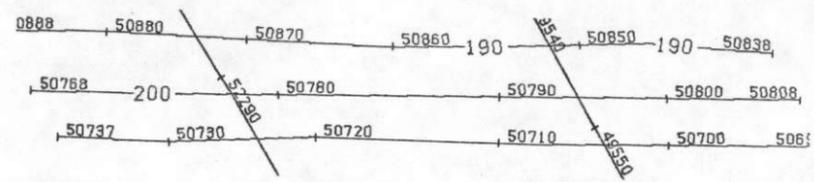


IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 LINE 190
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500

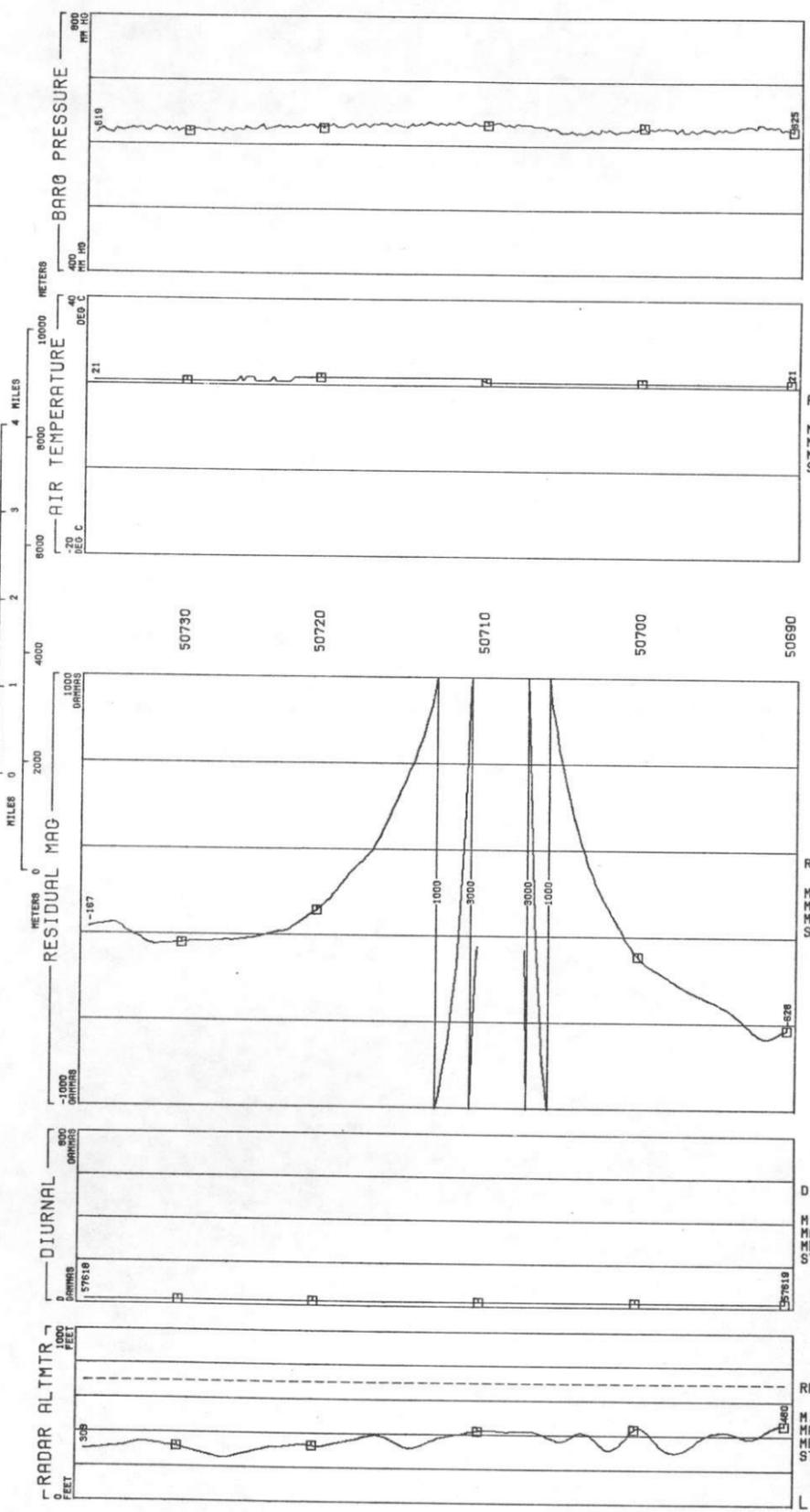
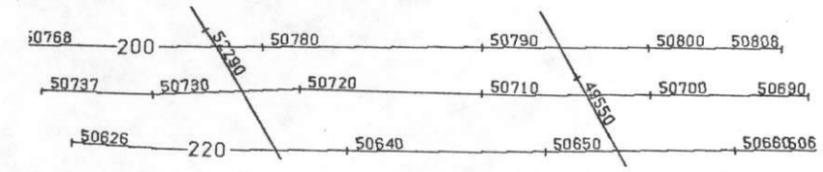


LINE 190

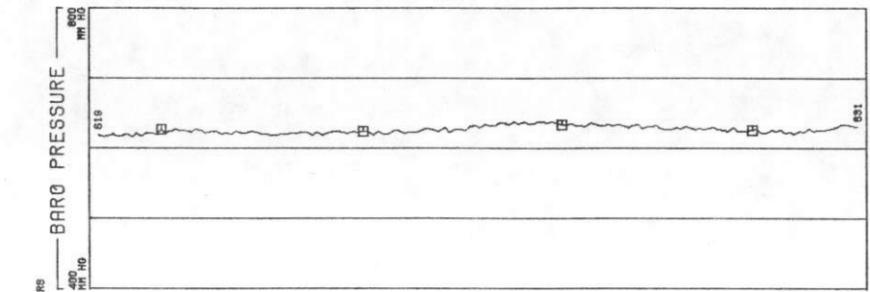
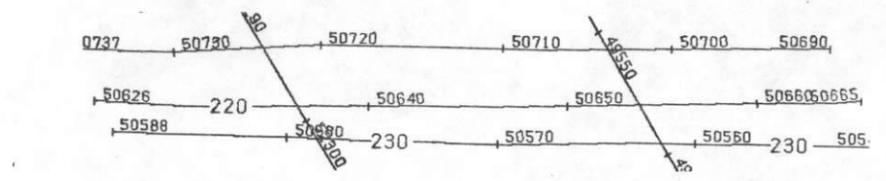
LINE 200
IDAH0 SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



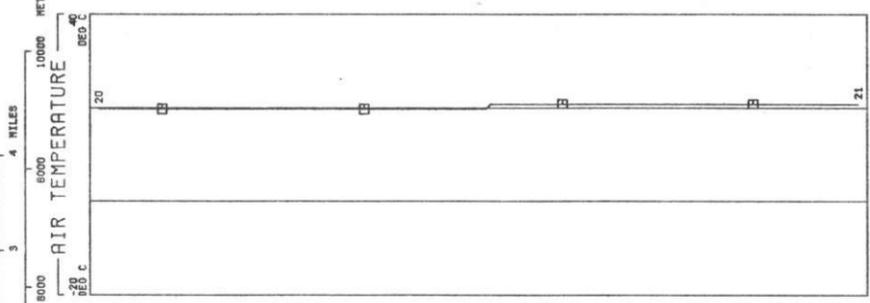
LINE 210
IDAH0 SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



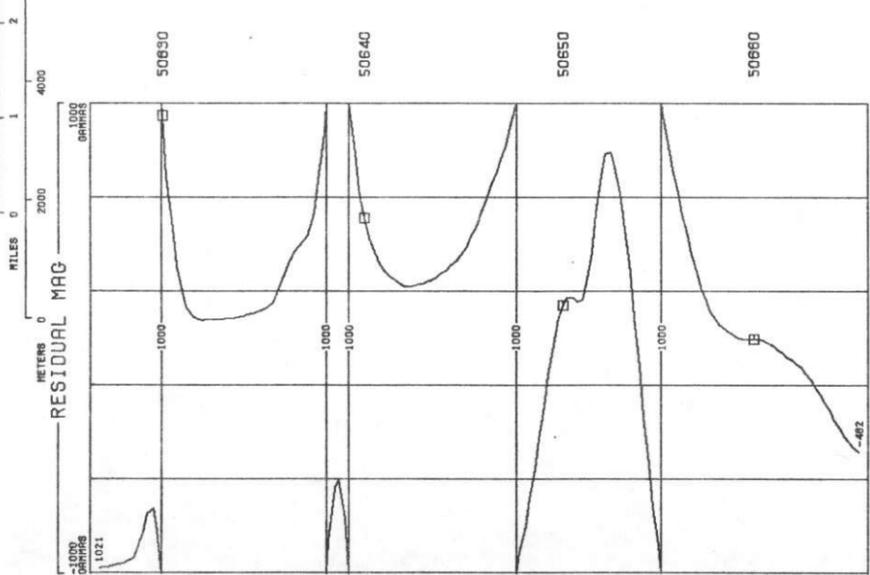
LINE 220
IDAH0 SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



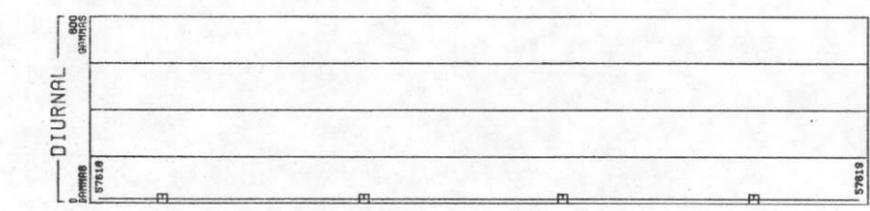
BARO PRESSURE
MM HG
MIN 617.0
MAX 638.8
MEAN 627.1
STD DEV 5.344



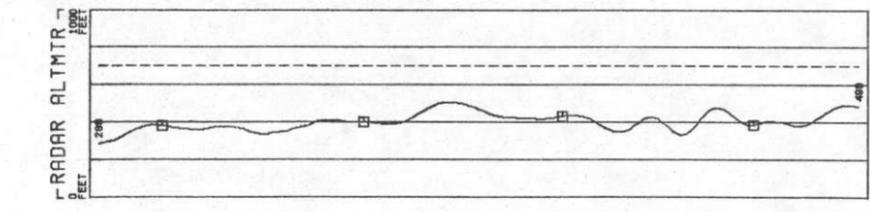
AIR TEMPERATURE
DEG C
MIN 20.00
MAX 21.00
MEAN 20.51
STD DEV .4998



RESIDUAL MAG
GAMMAS
MIN -481.6
MAX 2796.0
MEAN 682.4
STD DEV 800.6



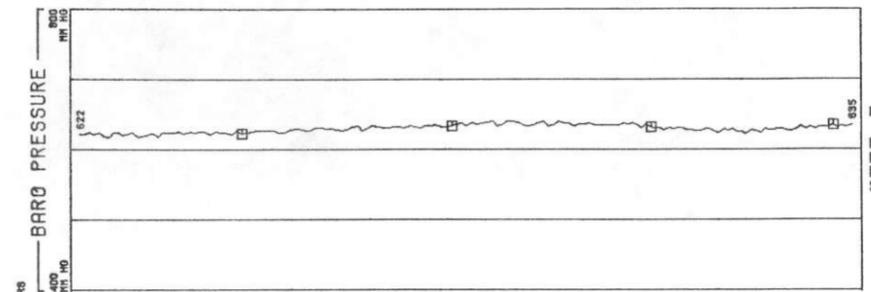
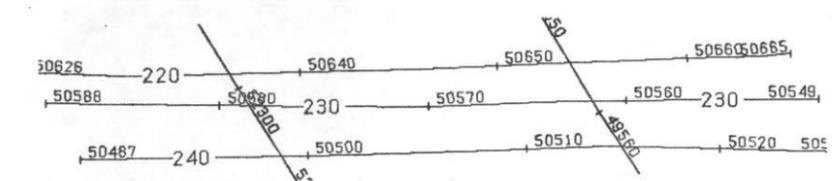
DIURNAL
GAMMAS
MIN 576.18
MAX 576.19
MEAN 576.18
STD DEV .3280



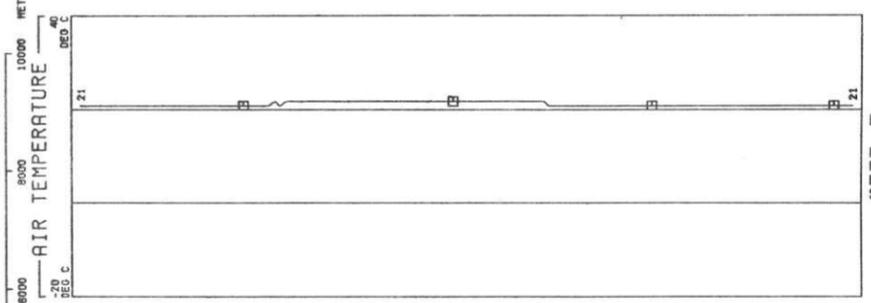
RADAR ALTMTR
FEET
MIN 288.2
MAX 508.1
MEAN 405.2
STD DEV 46.98

LINE 220

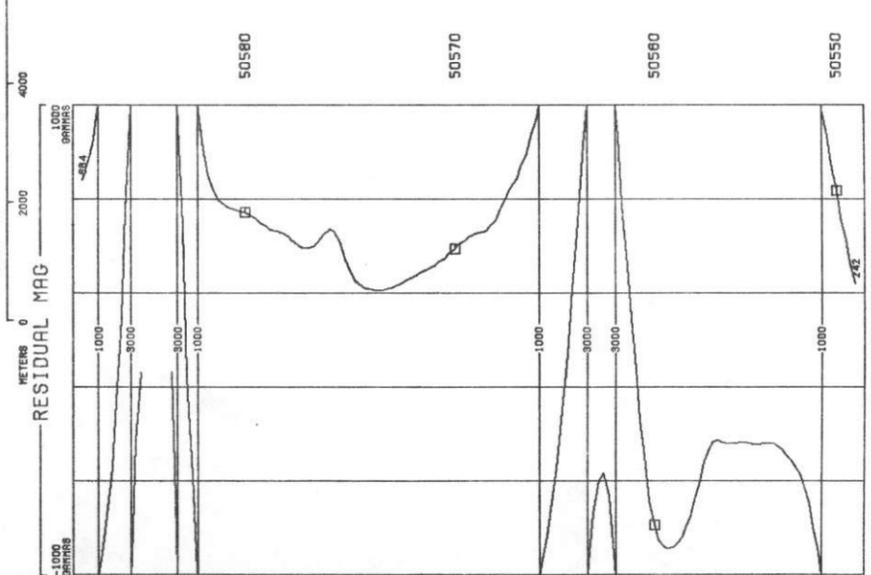
LINE 230
IDAH0 SURVEY - NEMO DETAIL AREA - GEOMETRICS
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



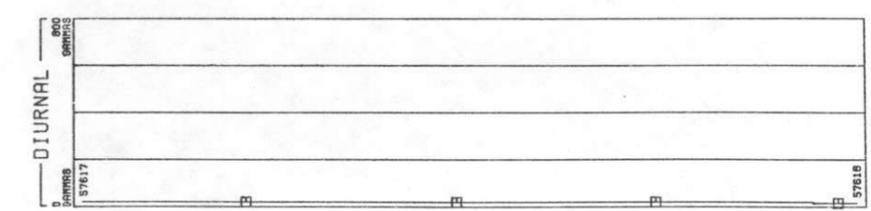
BARO PRESSURE
MM HG
MIN 618.4
MAX 641.2
MEAN 630.3
STD DEV 5.259



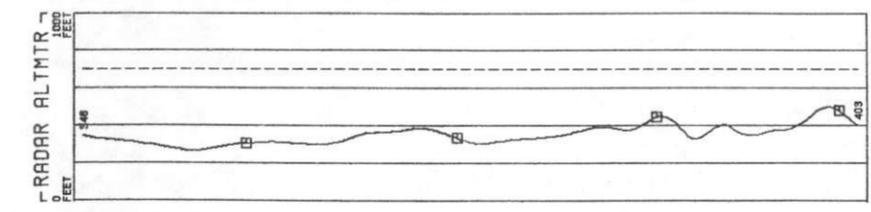
AIR TEMPERATURE
DEG C
MIN 21.00
MAX 22.00
MEAN 21.33
STD DEV .4706



RESIDUAL MAG
GAMMAS
MIN 215.6
MAX 3866
MEAN 1243
STD DEV 984.8



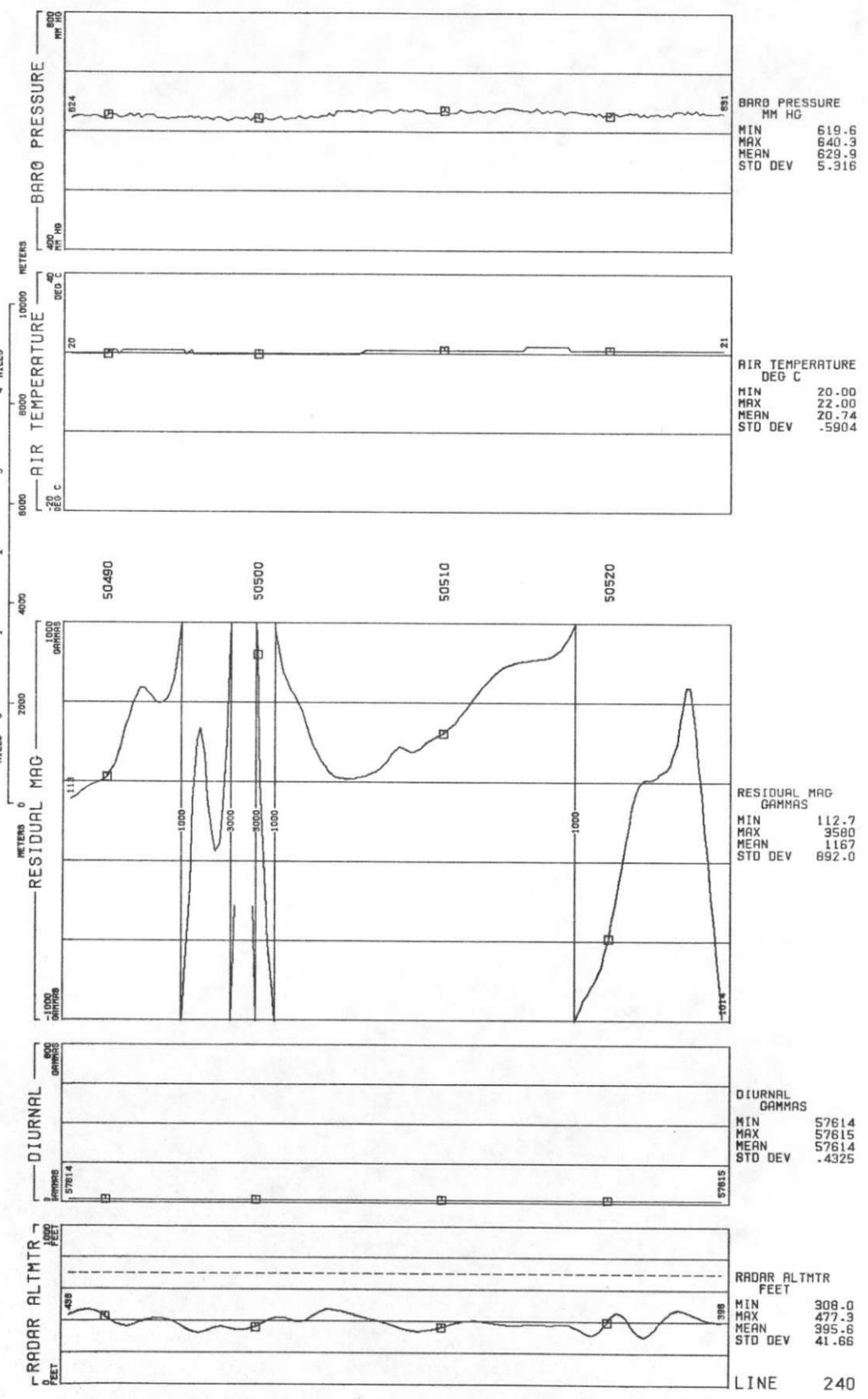
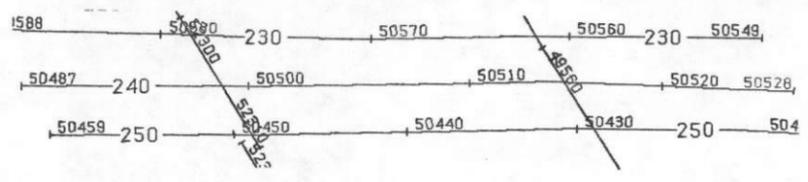
DIURNAL
GAMMAS
MIN 576.16
MAX 576.17
MEAN 576.17
STD DEV .4680



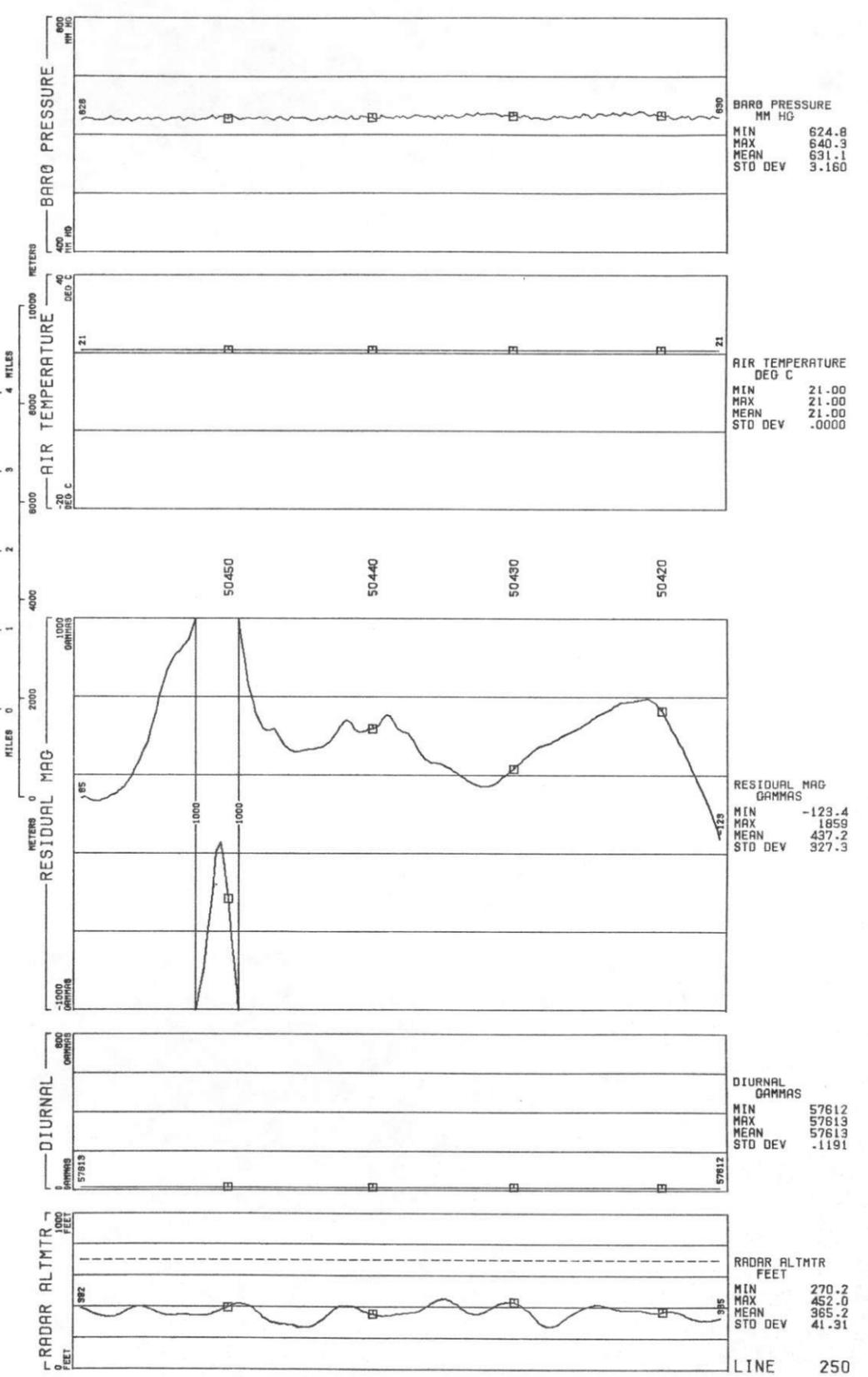
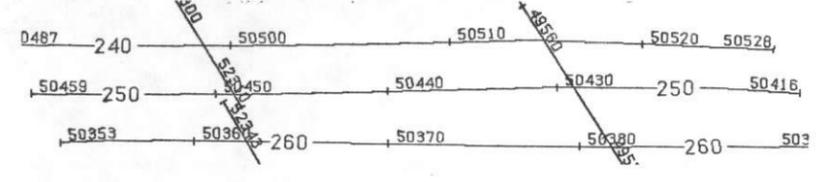
RADAR ALTMTR
FEET
MIN 287.4
MAX 603.0
MEAN 354.5
STD DEV 51.48

LINE 230

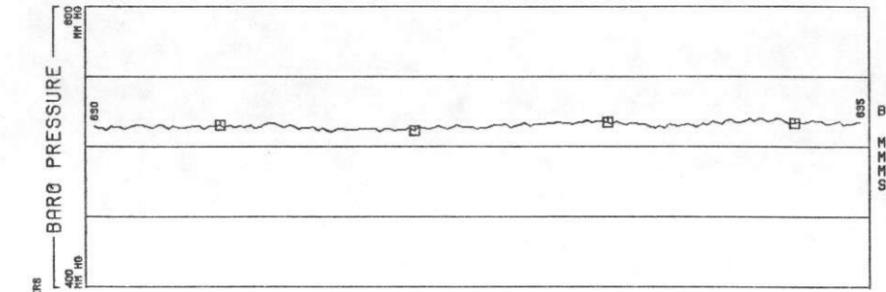
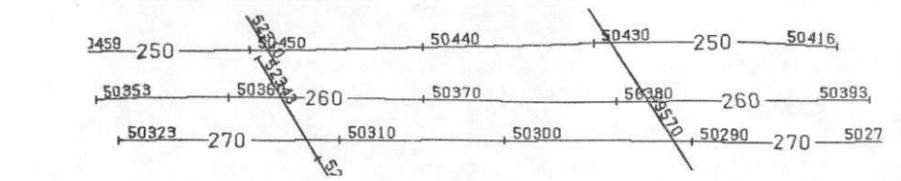
LINE 240
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



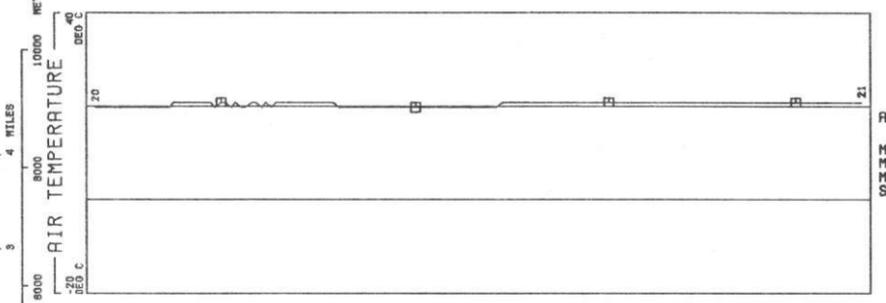
LINE 250
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



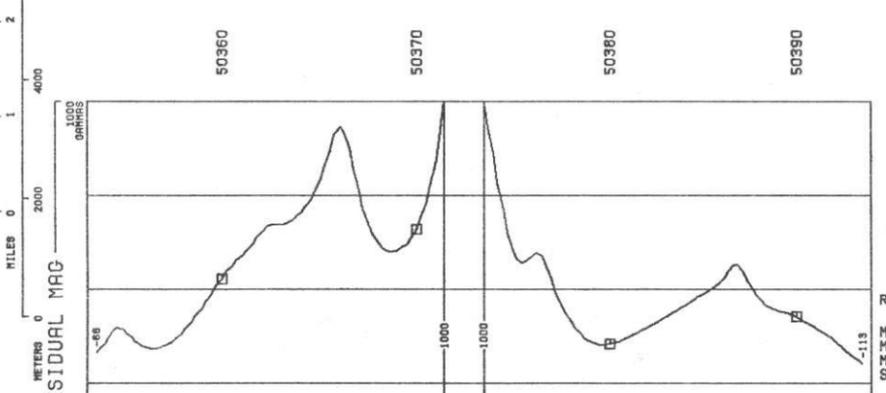
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 260
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



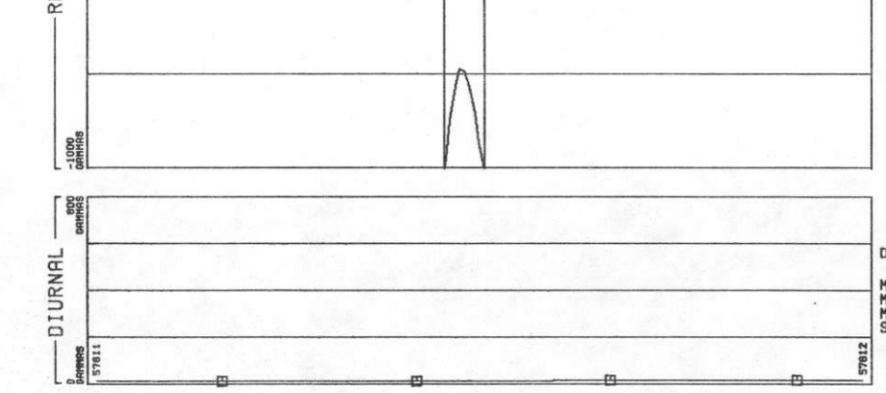
BARO PRESSURE
MM HG
MIN 621.6
MAX 640.5
MEAN 631.0
STD DEV 4.169



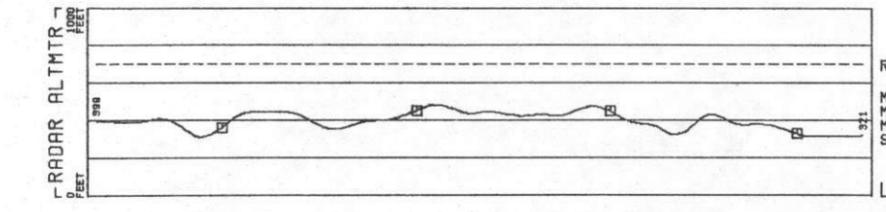
AIR TEMPERATURE
DEG C
MIN 20.00
MAX 21.00
MEAN 20.65
STD DEV .4775



RESIDUAL MAG
GAMMAS
MIN -113.1
MAX 1421
MEAN 292.1
STD DEV 339.2



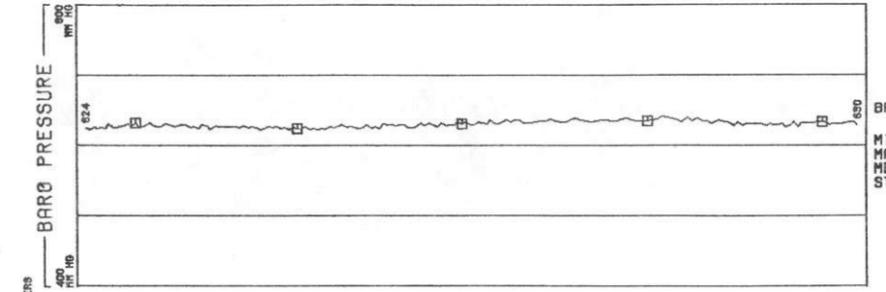
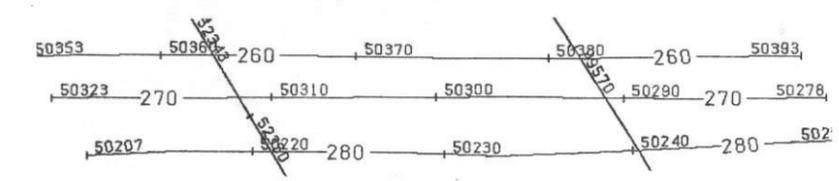
DIURNAL
GAMMAS
MIN 57611
MAX 57612
MEAN 57612
STD DEV .2456



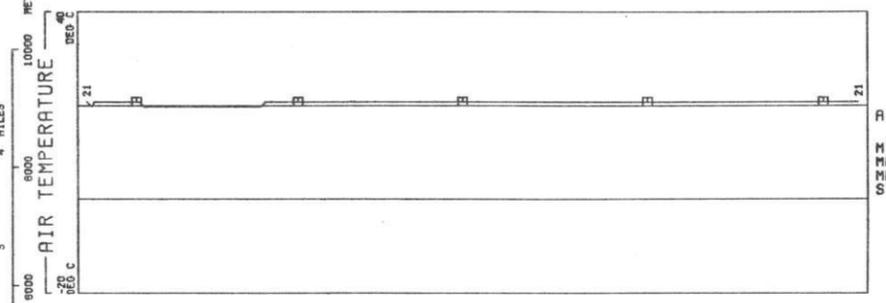
RADAR ALTMTR
FEET
MIN 312.7
MAX 484.2
MEAN 398.9
STD DEV 46.26

LINE 260

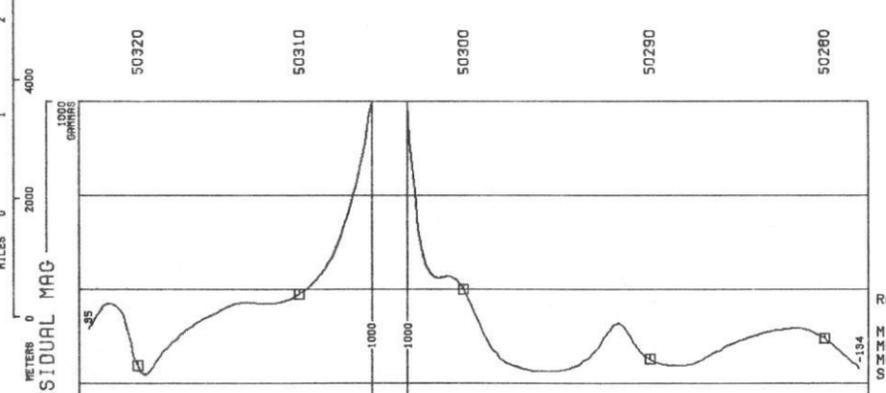
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 270
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



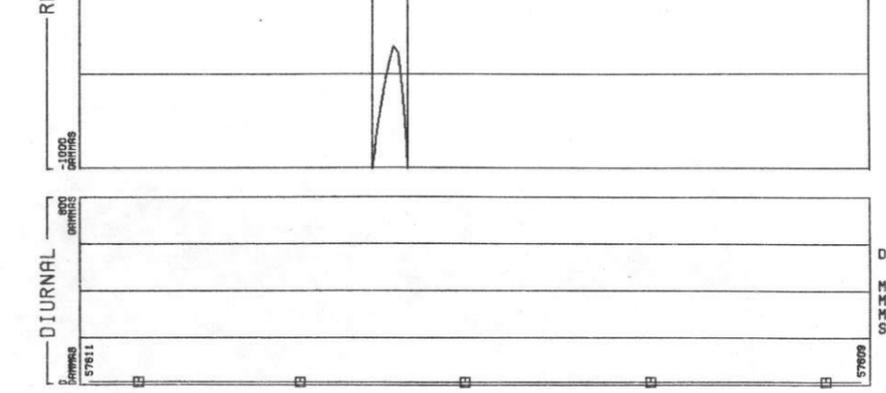
BARO PRESSURE
MM HG
MIN 622.7
MAX 641.4
MEAN 630.7
STD DEV 4.305



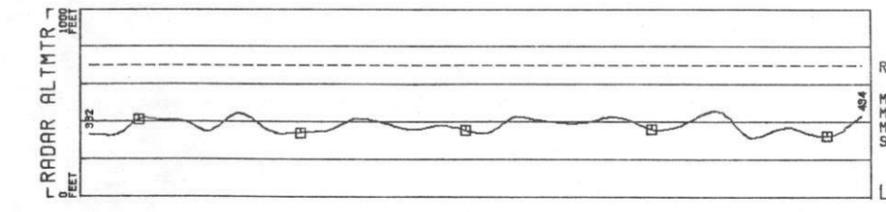
AIR TEMPERATURE
DEG C
MIN 20.00
MAX 21.00
MEAN 20.63
STD DEV .3751



RESIDUAL MAG
GAMMAS
MIN -160.7
MAX 1520
MEAN 127.5
STD DEV 333.9



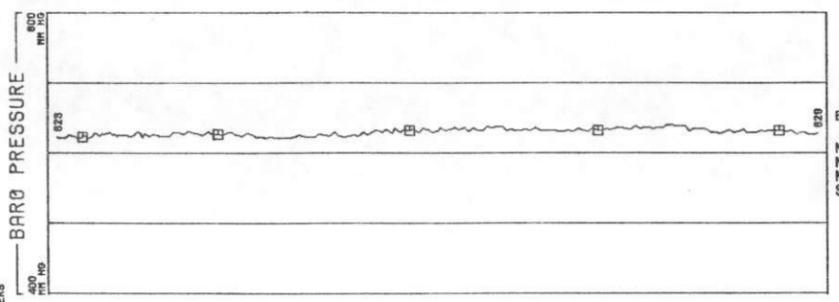
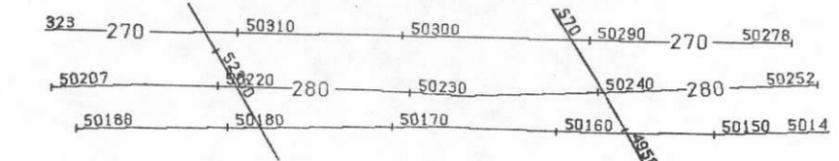
DIURNAL
GAMMAS
MIN 57609
MAX 57611
MEAN 57610
STD DEV .3872



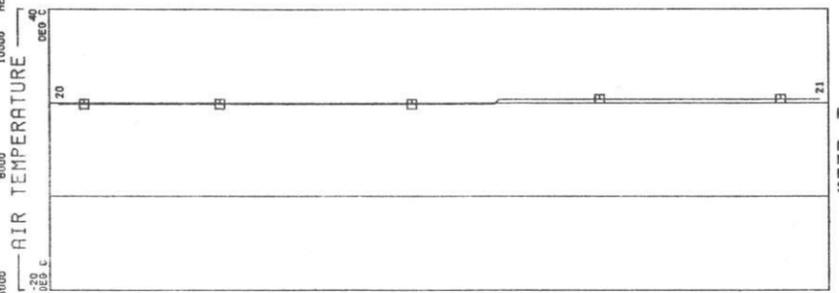
RADAR ALTMTR
FEET
MIN 316.0
MAX 457.5
MEAN 381.1
STD DEV 94.12

LINE 270

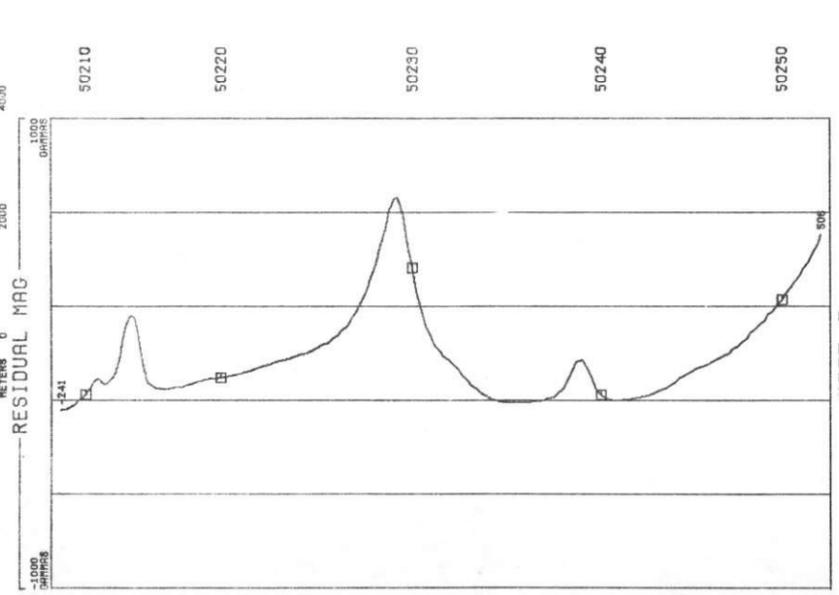
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 280
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



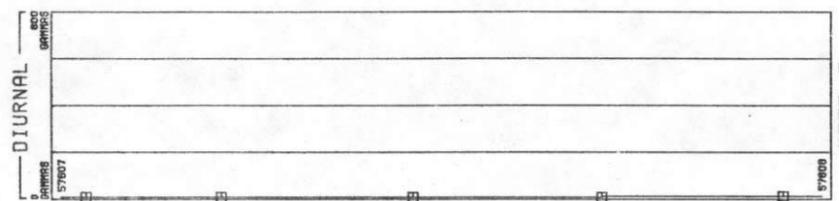
BARO PRESSURE
MM HG
MIN 621.8
MAX 640.7
MEAN 629.9
STD DEV 4.748



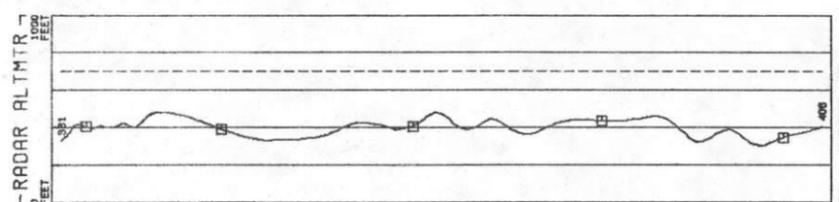
AIR TEMPERATURE
DEG C
MIN 20.00
MAX 21.00
MEAN 20.39
STD DEV .4887



RESIDUAL MAG
GAMMAS
MIN -241.0
MAX 665.6
MEAN -13.66
STD DEV 197.9



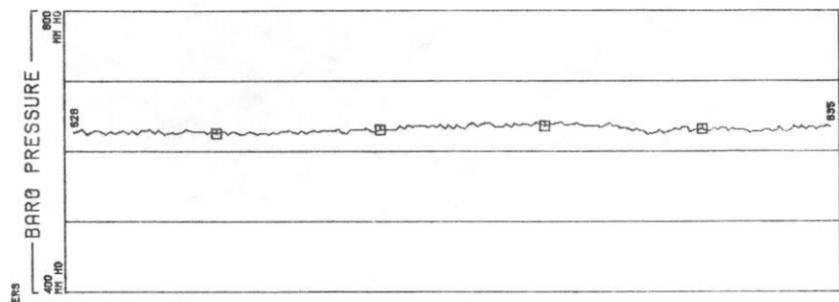
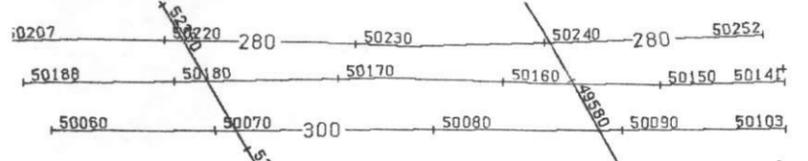
DIURNAL
GAMMAS
MIN 57807
MAX 57808
MEAN 57808
STD DEV .2832



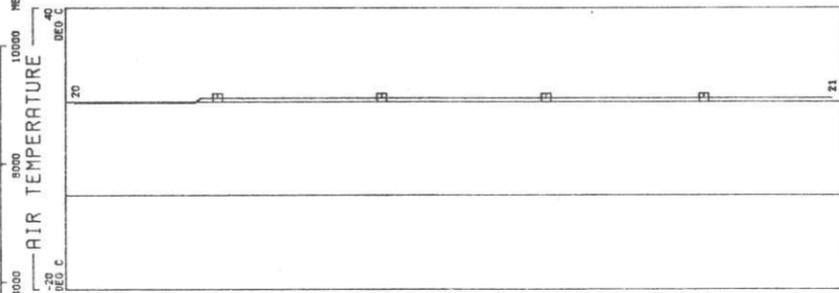
RADAR ALTMTR
FEET
MIN 307.4
MAX 484.2
MEAN 401.1
STD DEV 42.63

LINE 280

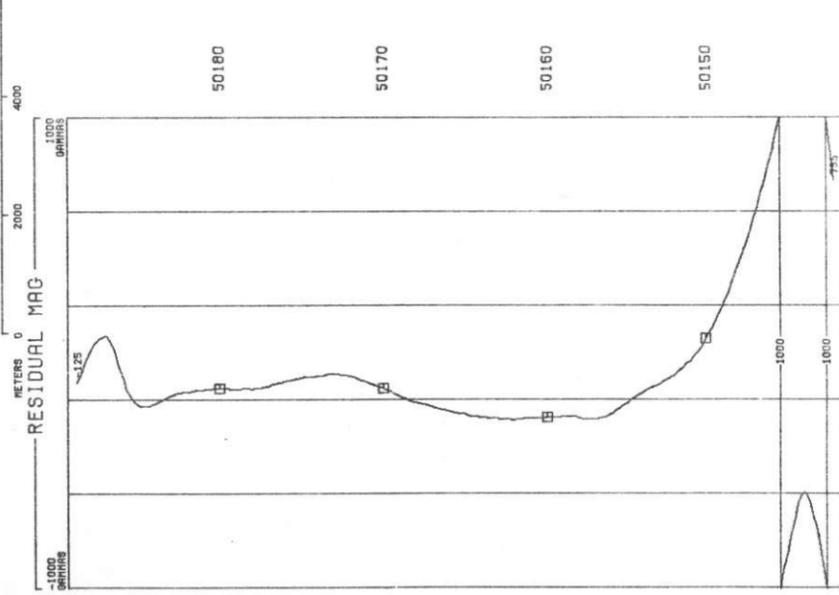
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 290
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



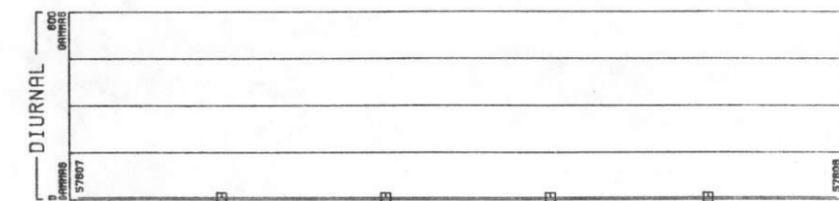
BARO PRESSURE
MM HG
MIN 624.1
MAX 642.3
MEAN 631.9
STD DEV 4.459



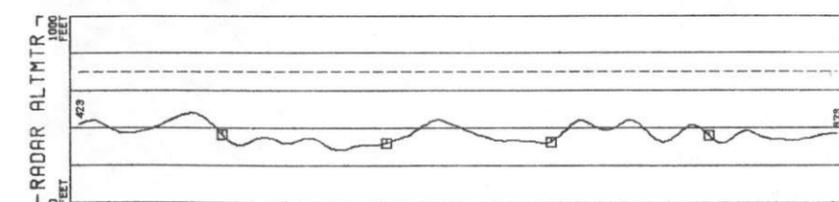
AIR TEMPERATURE
DEG C
MIN 20.00
MAX 21.00
MEAN 20.85
STD DEV .3604



RESIDUAL MAG
GAMMAS
MIN -284.6
MAX 1404
MEAN 6.258
STD DEV 418.2



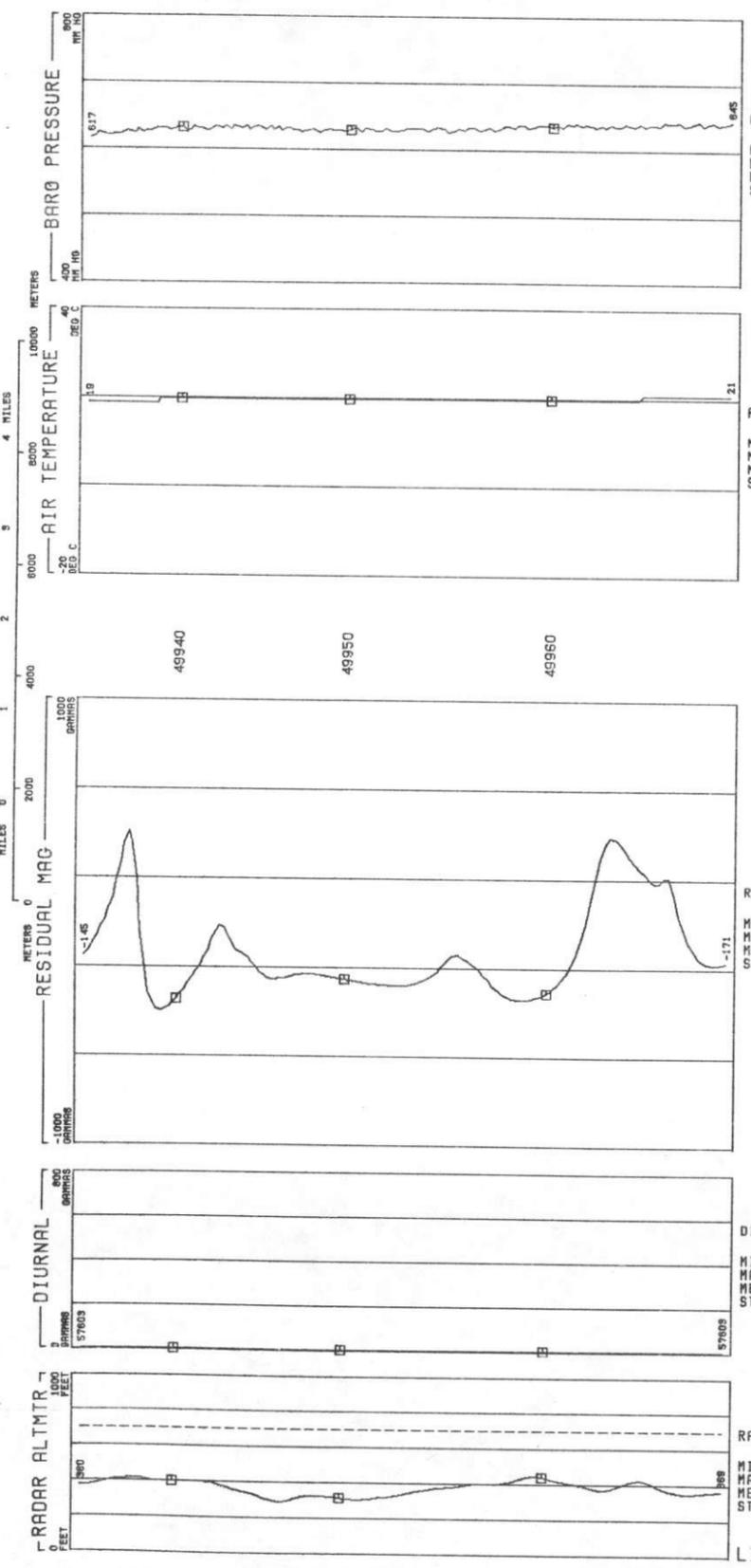
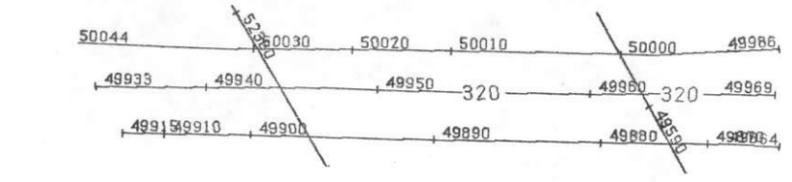
DIURNAL
GAMMAS
MIN 57807
MAX 57808
MEAN 57808
STD DEV .2930



RADAR ALTMTR
FEET
MIN 286.0
MAX 483.0
MEAN 371.6
STD DEV 45.50

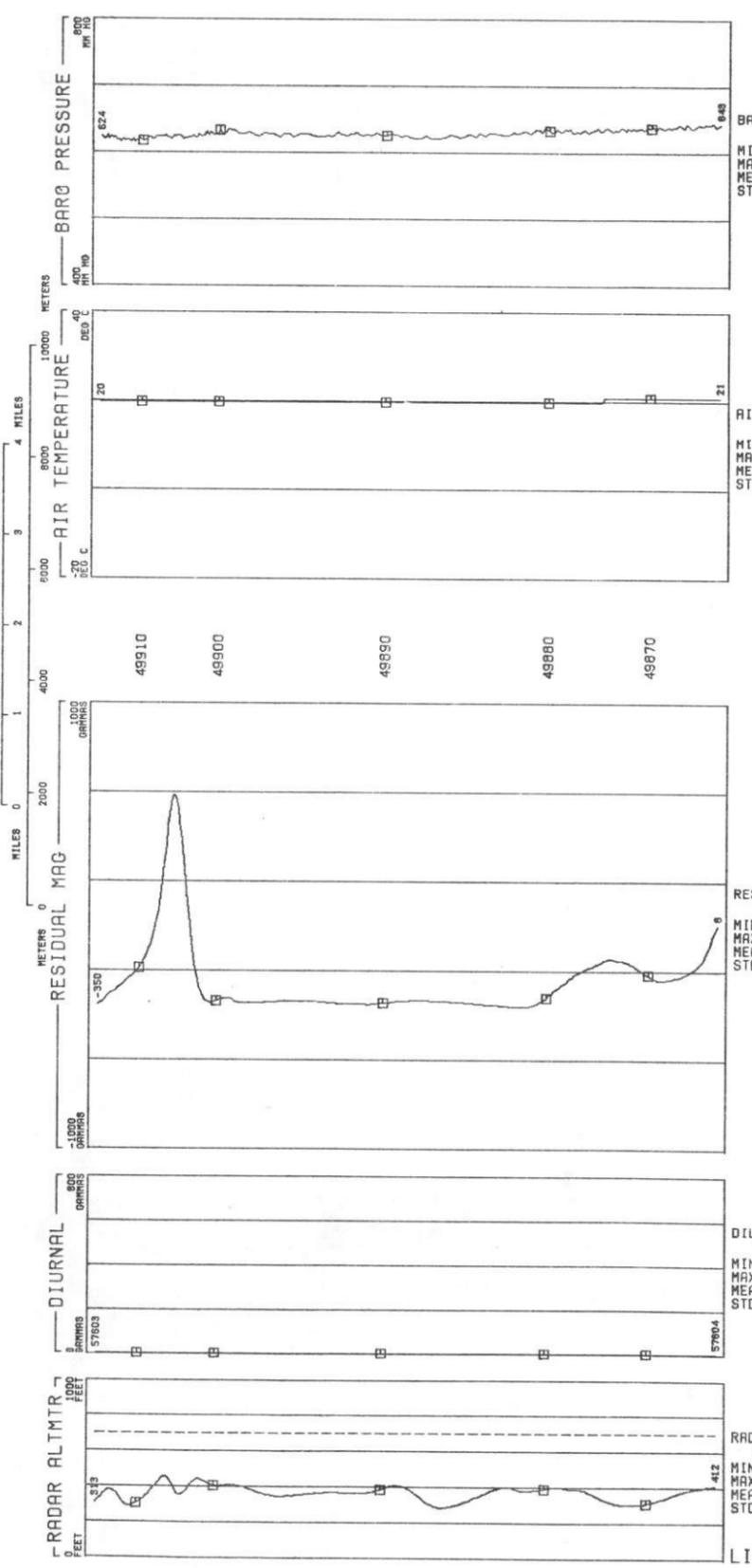
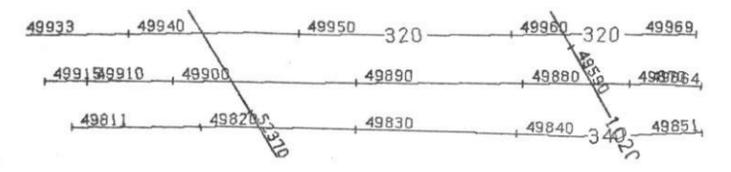
LINE 290

IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 320
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500

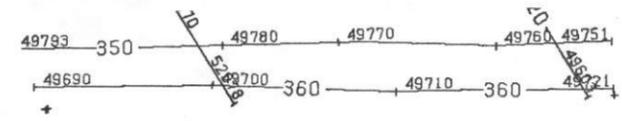


LINE 320

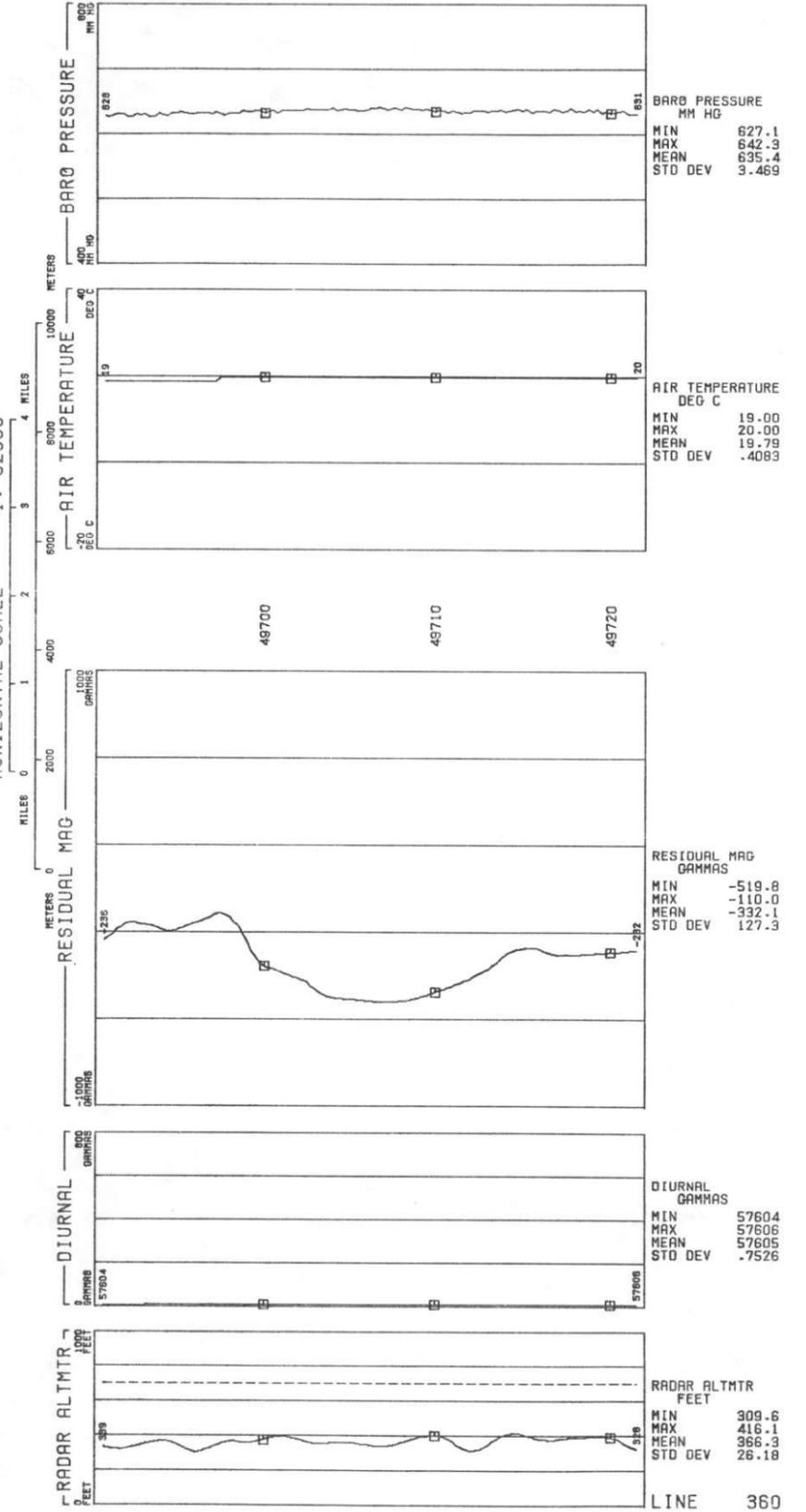
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 330
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



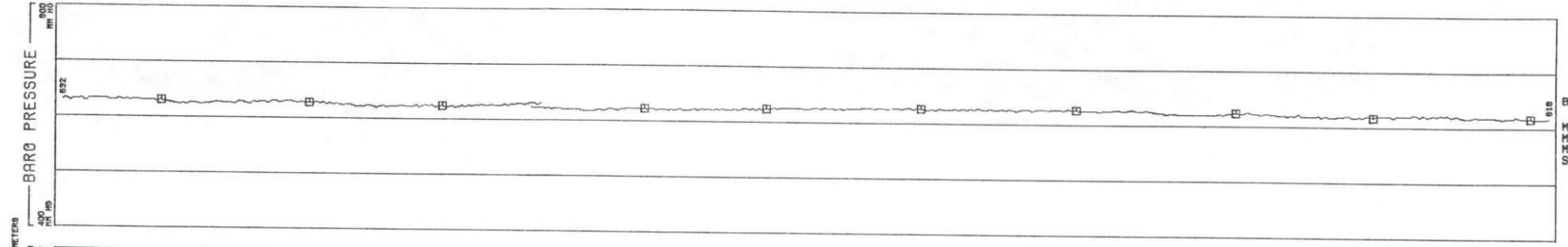
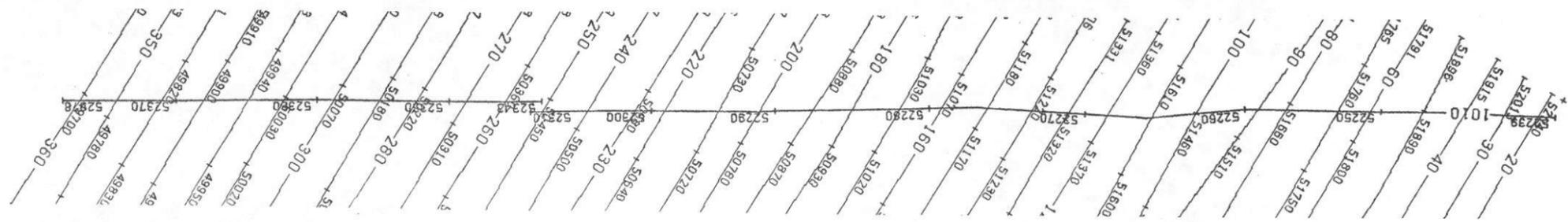
LINE 330



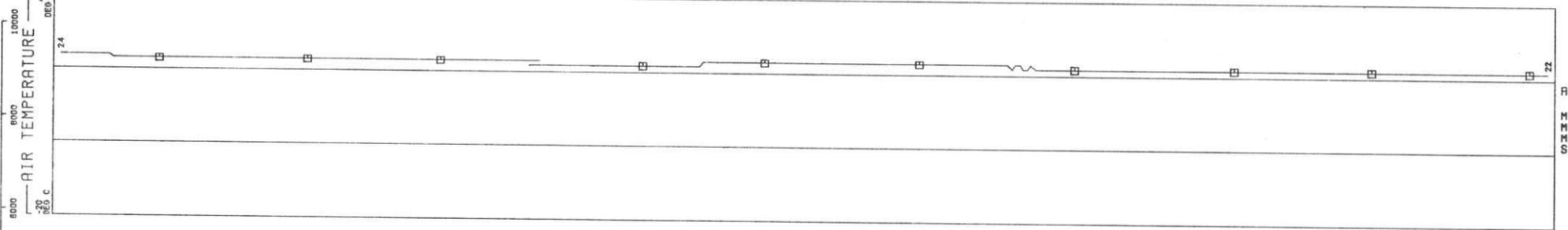
LINE 360
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



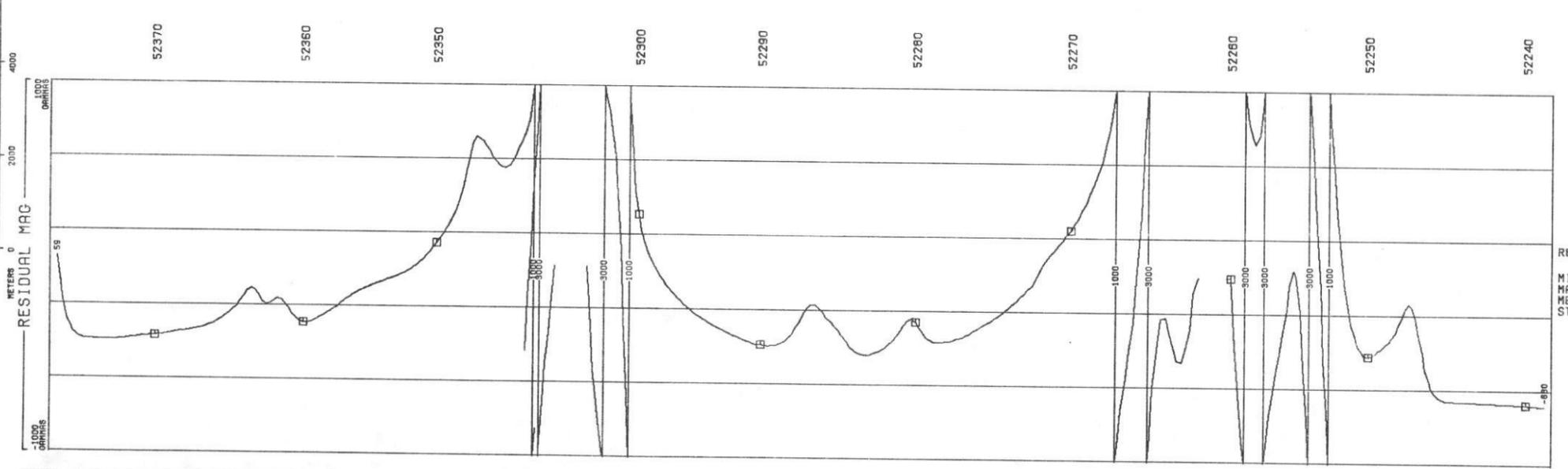
IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
LINE 1010
DATA ACQUIRED 79239
HORIZONTAL SCALE 1: 62500



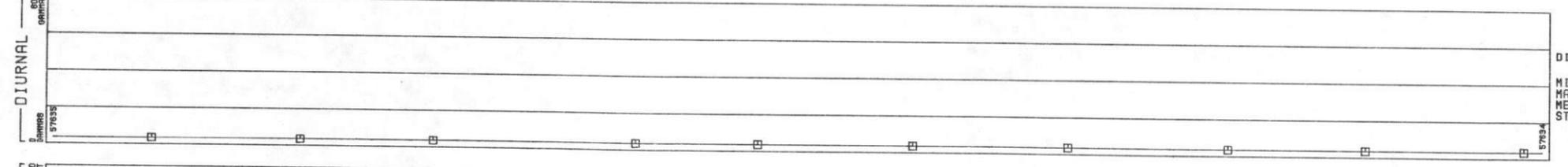
BARO PRESSURE
MM HG
MIN 616.8
MAX 634.2
MEAN 624.6
STD DEV 3.884



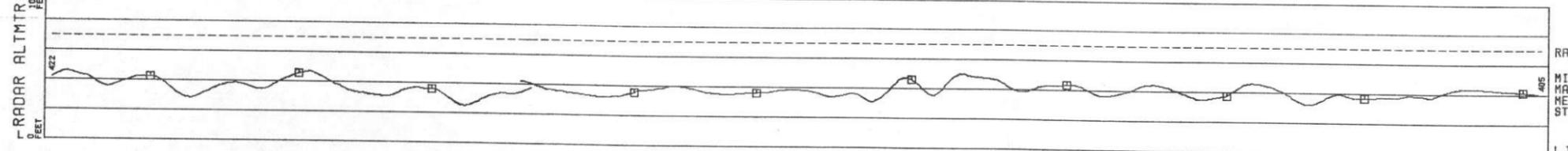
AIR TEMPERATURE
DEG C
MIN 22.00
MAX 24.00
MEAN 22.59
STD DEV .5765



RESIDUAL MAG
GAMMAS
MIN -680.6
MAX 4037
MEAN 543.1
STD DEV 1433

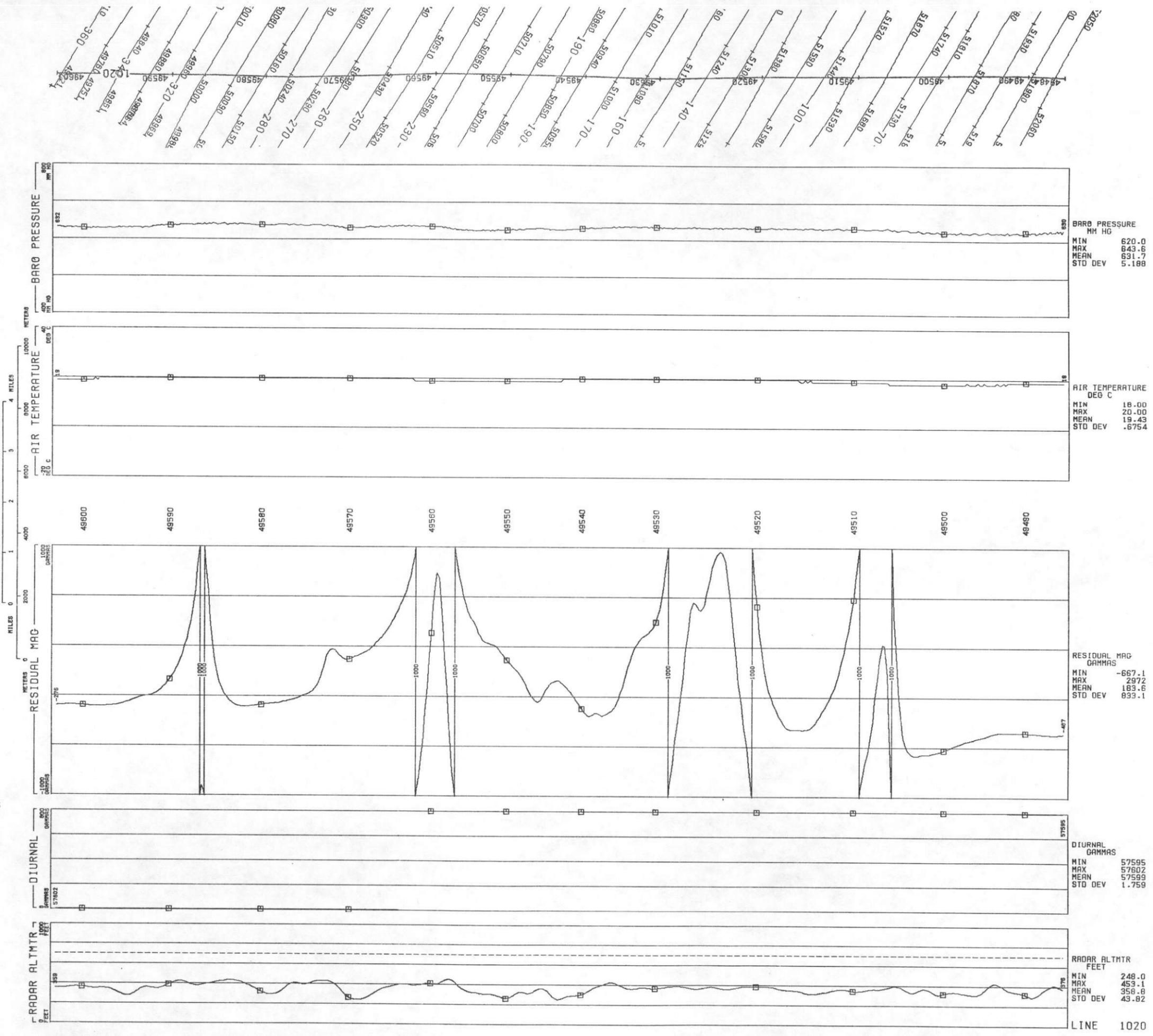


DIURNAL
GAMMAS
MIN 57634
MAX 57635
MEAN 57635
STD DEV .4792

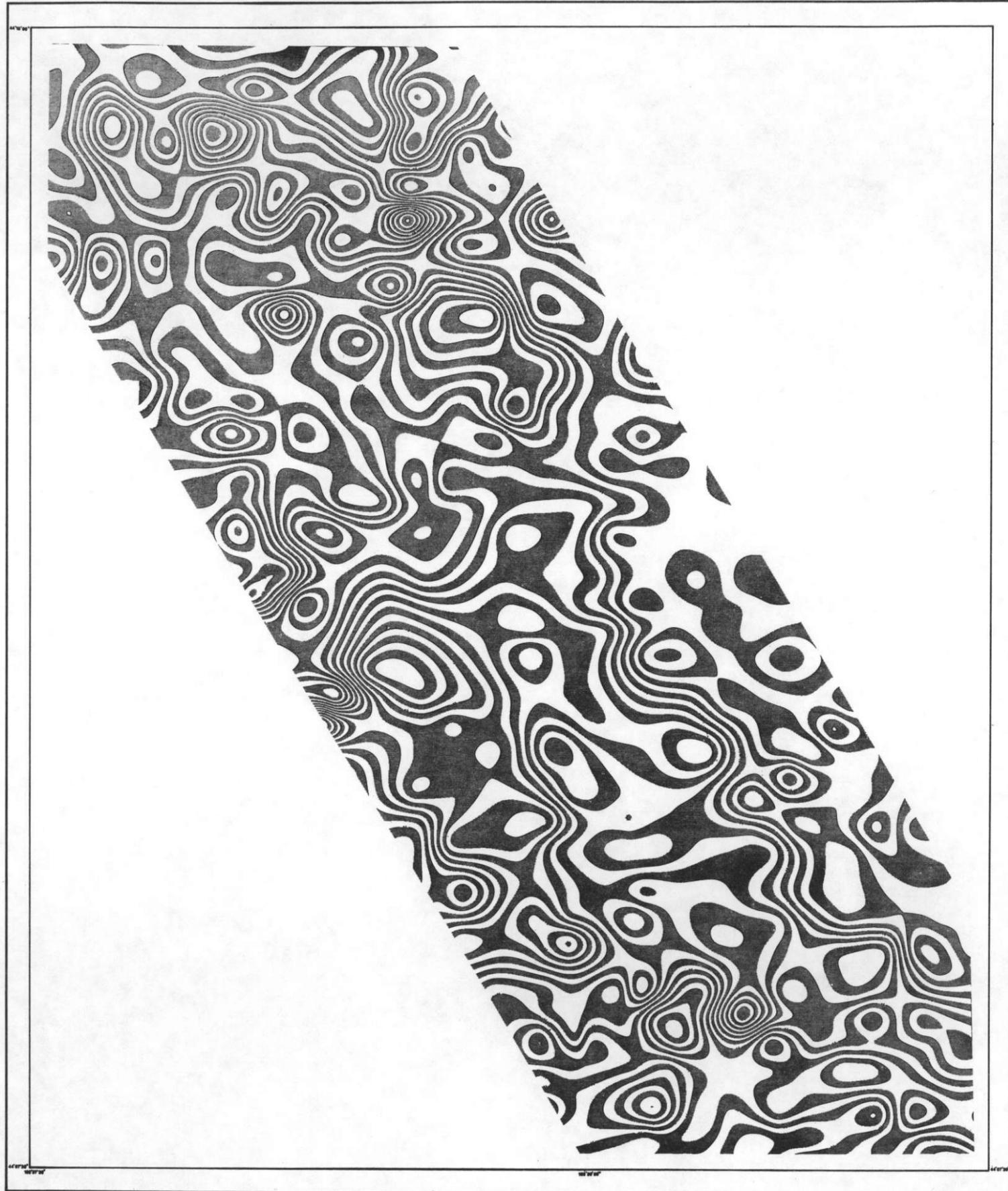


RADAR ALTMTR
FEET
MIN 254.0
MAX 504.1
MEAN 504.1
STD DEV 384.4

LINE 1020
 IDAHO SURVEY - NEMO DETAIL AREA - GEOMETRICS
 DATA ACQUIRED 79239
 HORIZONTAL SCALE 1: 62500



APPENDIX C - Contour Maps



POTASSIUM GAMMA RAY INTENSITY

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500

COMPON SCATTER AND ALTITUDE CORRECTED 0.2%
 CONTOUR INTERVAL 0.1%
 SHADING ON LOW SIDE 0.1%
 FLIGHT LINE SPACING 0.25 MILES
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT GR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY N49531



SURVEY AND
 COMPILED BY:




URANIUM GAMMA RAY INTENSITY

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

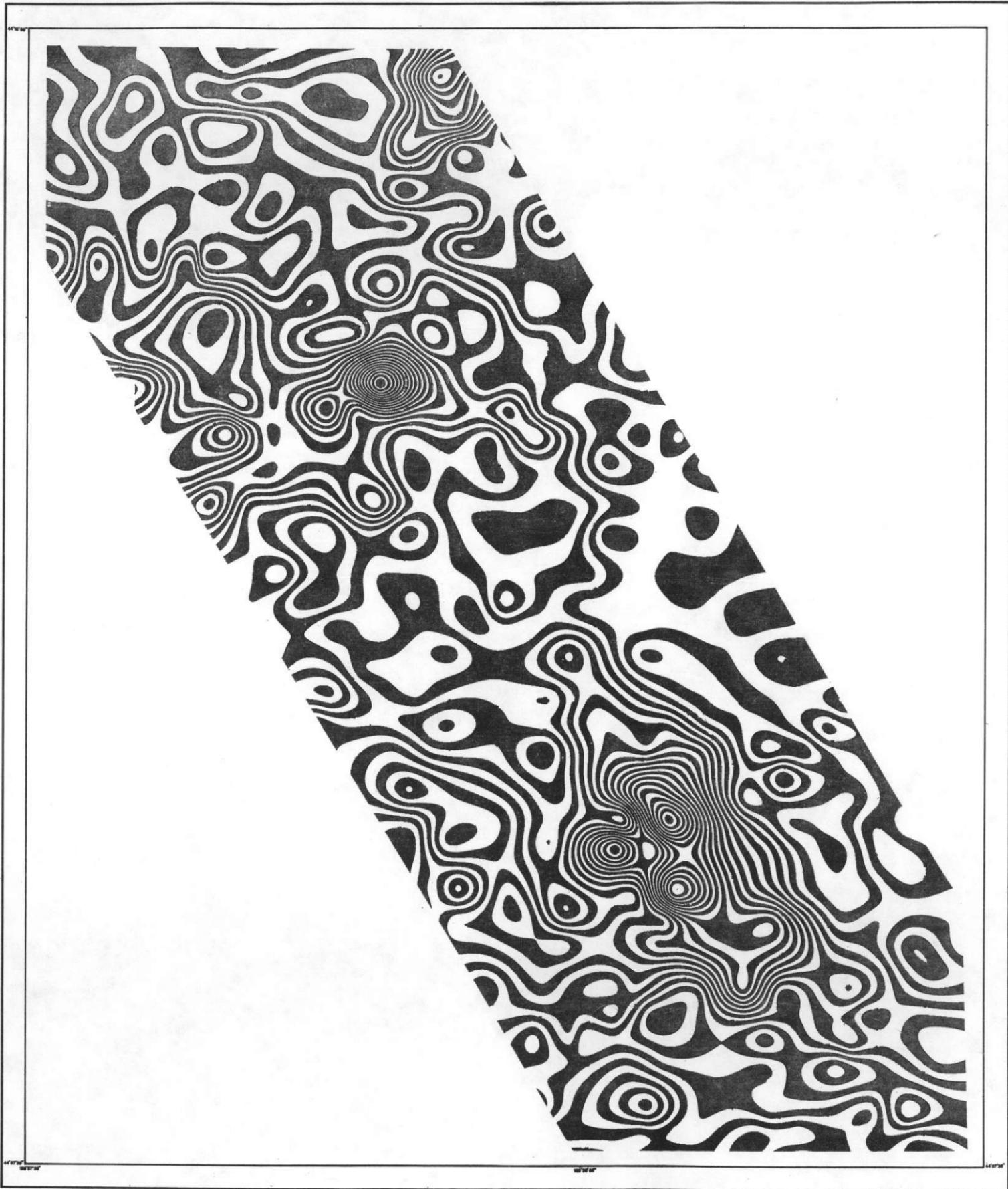
APPROXIMATE SCALE 1:82,500

COMPTON SCATTER AND ALTITUDE CORRECTED
 CONTOUR INTERVAL 0.2 PPM
 SHADING ON LOW SIDE 0.1 PPM
 FLIGHT LINE SPACING 0.25 MILES(S)
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT OR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY N48531



SURVEY AND COMPILED BY:

EG&G GEOMETRICS



THORIUM GAMMA RAY INTENSITY

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

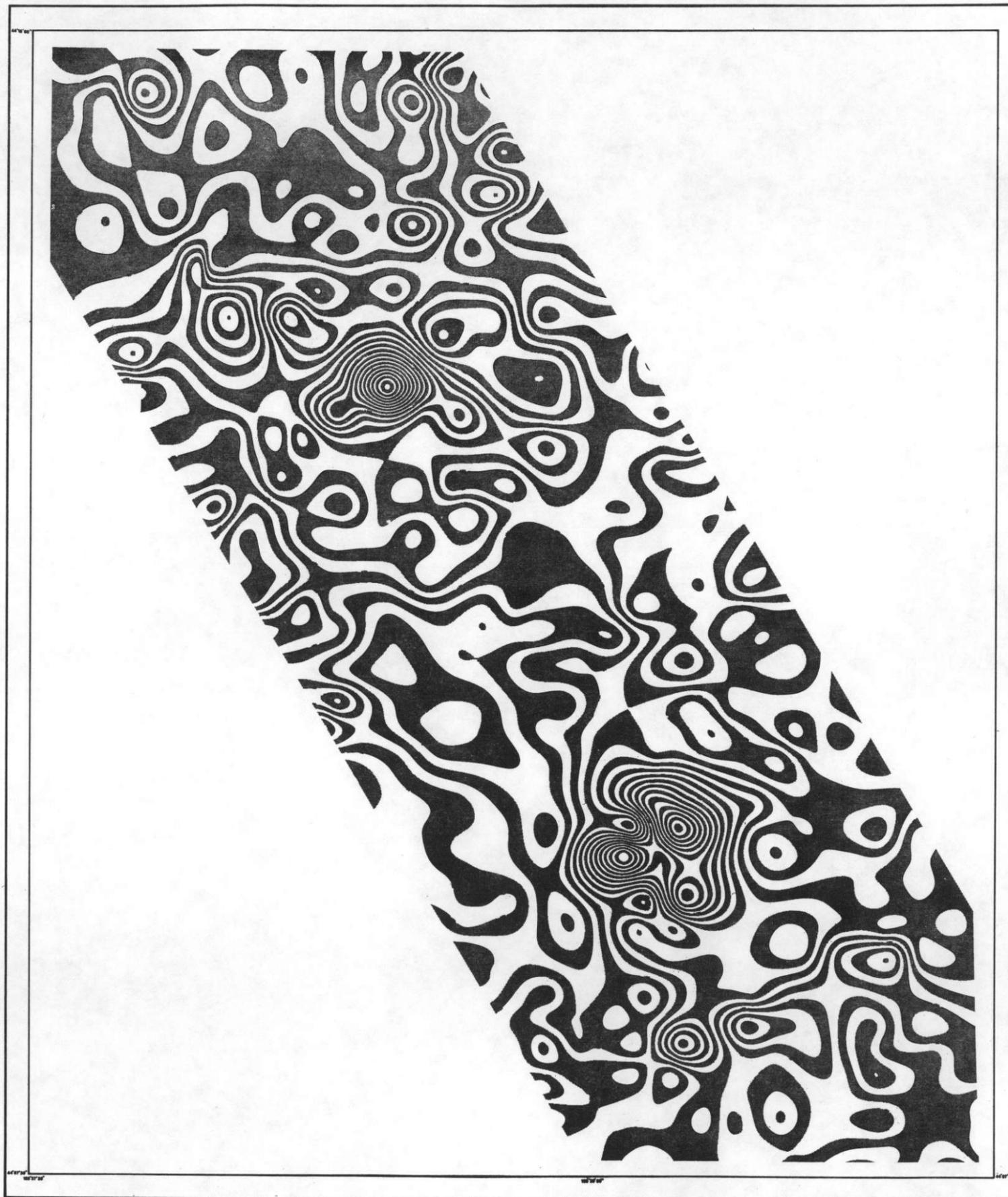
APPROXIMATE SCALE 1:62,500

COMPTON SCATTER AND ALTITUDE CORRECTED
 CONTOUR INTERVAL 1.0 PPM
 SHADING ON LOW SIDE 0.5 PPM
 DATUM 1975 IGRF UPDATED TO 1979
 FLIGHT LINE SPACING 0.25 MILES
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT GR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY N49531



SURVEY AND COMPILED BY:





THORIUM / POTASSIUM RATIO

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500

CONTOUR INTERVAL 10.0
 INCHES ON LOW SIDE 5.0
 ALL VALUES ON MAP MULTIPLIED BY 10 0.25 MILES(S)
 FLIGHT LINE SPACING 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT OR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY N49531



SURVEY AND
 COMPILED BY:
 EGB GEOMETRICS



URANIUM / POTASSIUM RATIO

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

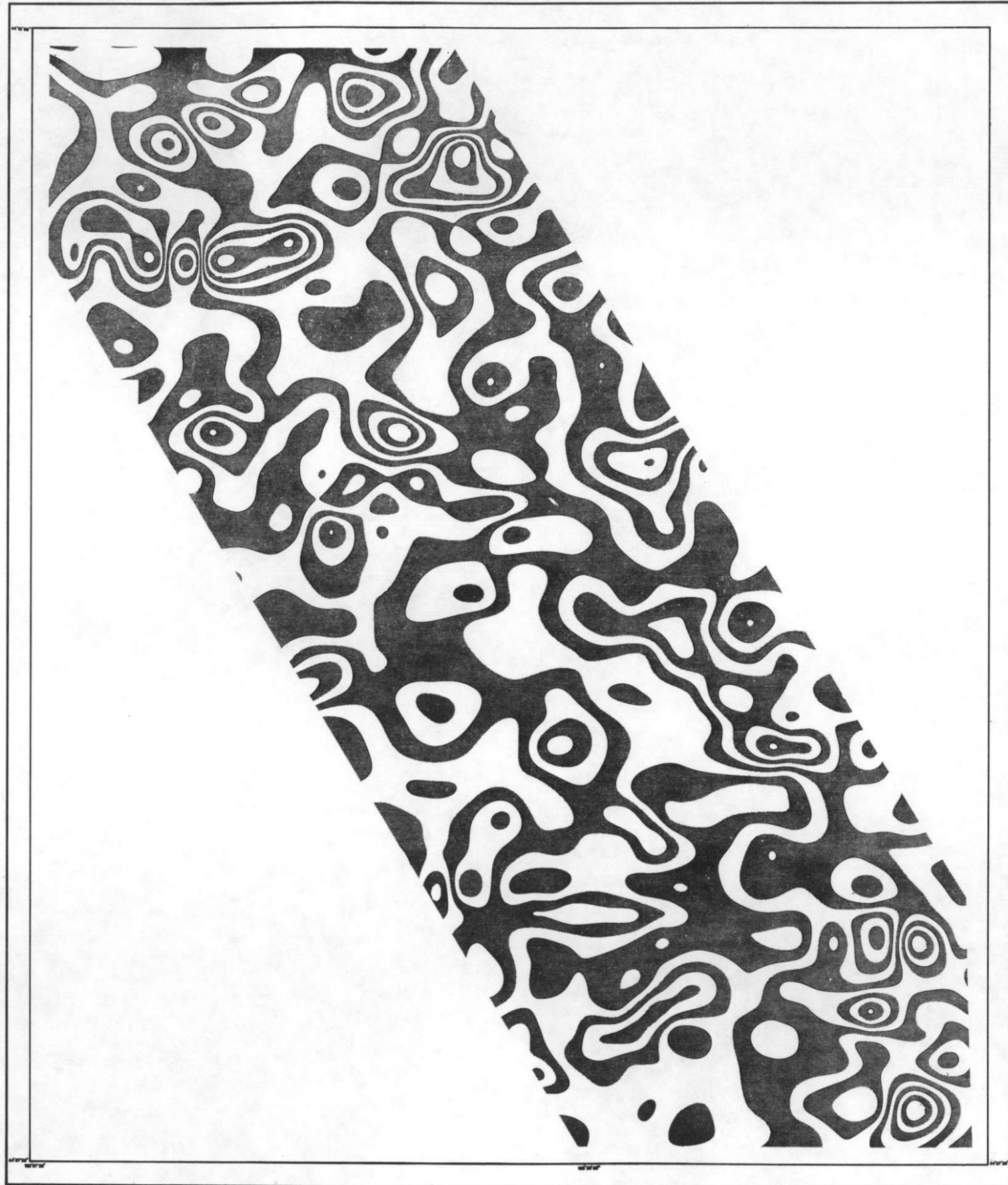
APPROXIMATE SCALE 1:62,500

CONTOUR INTERVAL 2.0
 SHADING ON LOW SIDE 1.0
 ALL VALUES ON MAP MULTIPLIED BY 10
 FLIGHT LINE SPACING 0.25 MILE(S)
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT GR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY W49531



SURVEY AND
COMPILED BY:

EB&B GEOMETRICS



URANIUM / THORIUM RATIO

NEMO DETAIL AREA

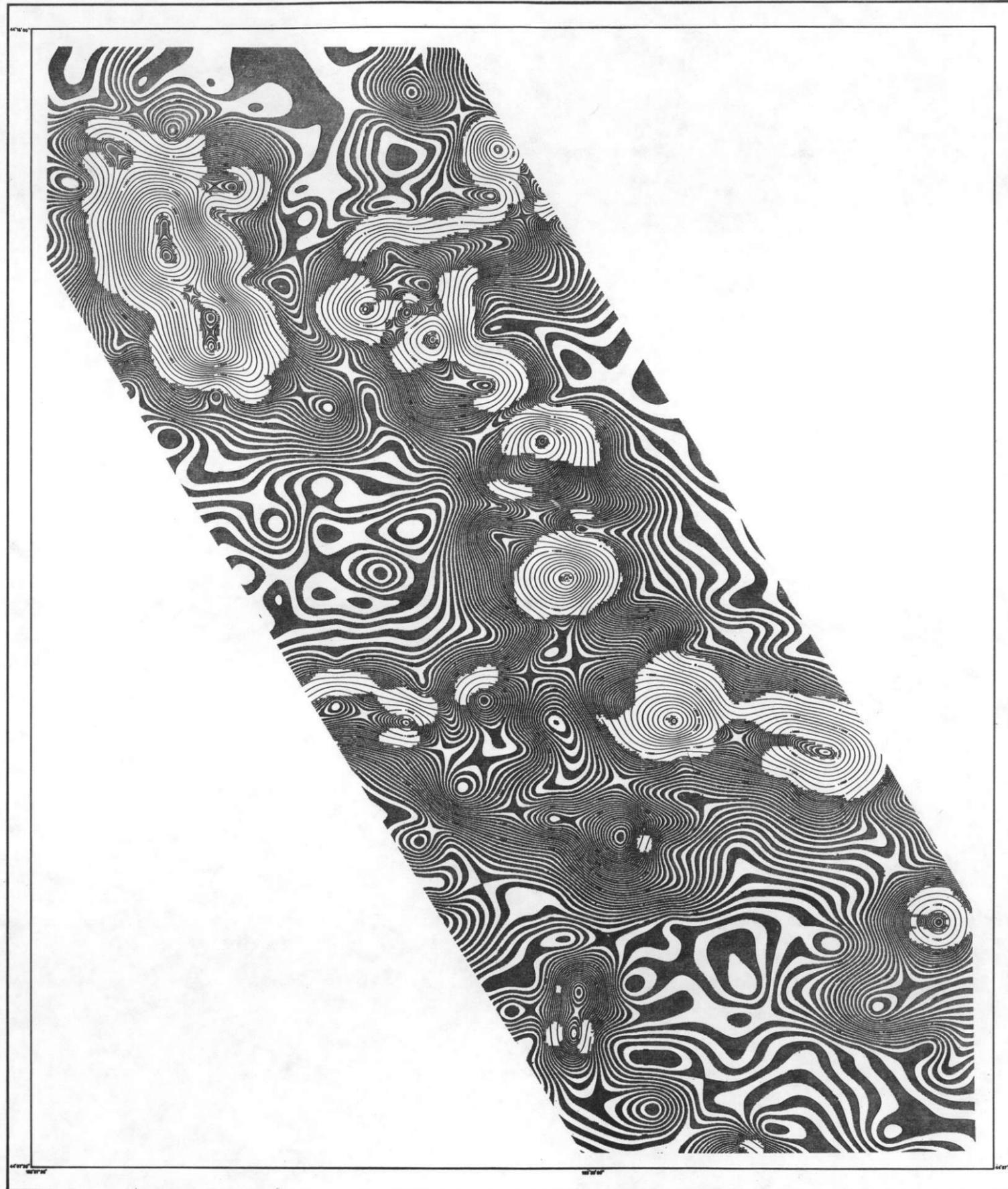
U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500

CONTOUR INTERVAL 1.0
 SHADING ON LOW SIDE 0.5
 ALL VALUES ON MAP MULTIPLIED BY 10
 FLIGHT LINE SPACING 0.25 MILES
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979/1980
 INSTRUMENT OR 800 2048 CUBIC INCHES DOWN
 256 CUBIC INCHES UP
 SURVEY FLOWN ROTARY WING BY N49531



SURVEY AND
 COMPILED BY:
 E&G GEOMETRICS



RESIDUAL MAGNETIC INTENSITY

NEMO DETAIL AREA

U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:62,500

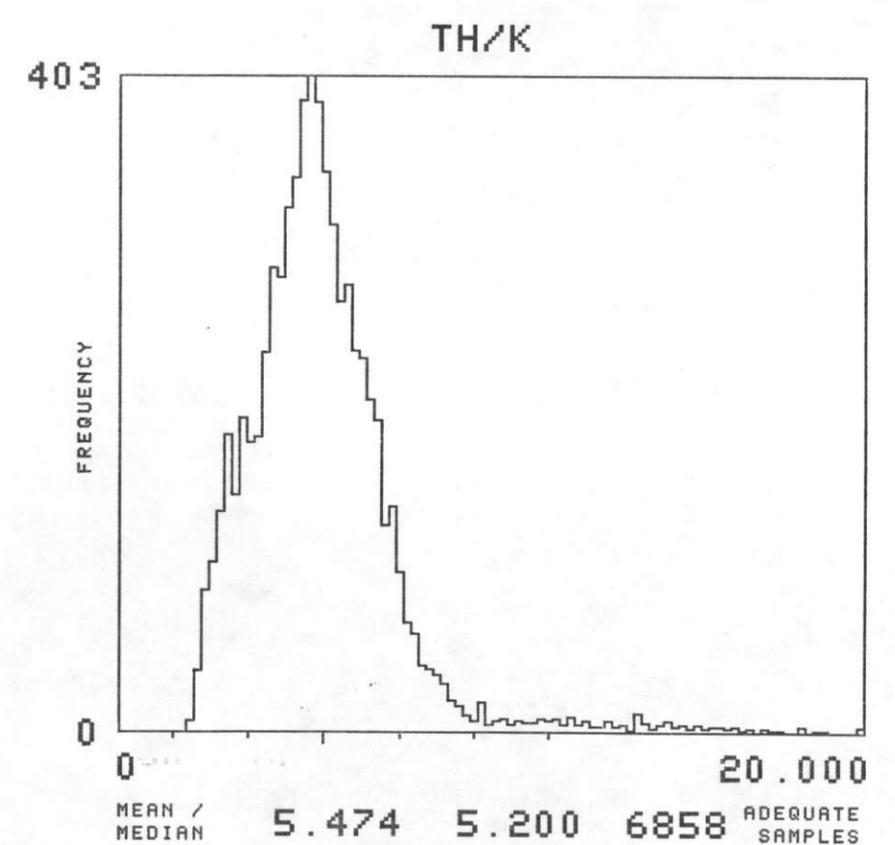
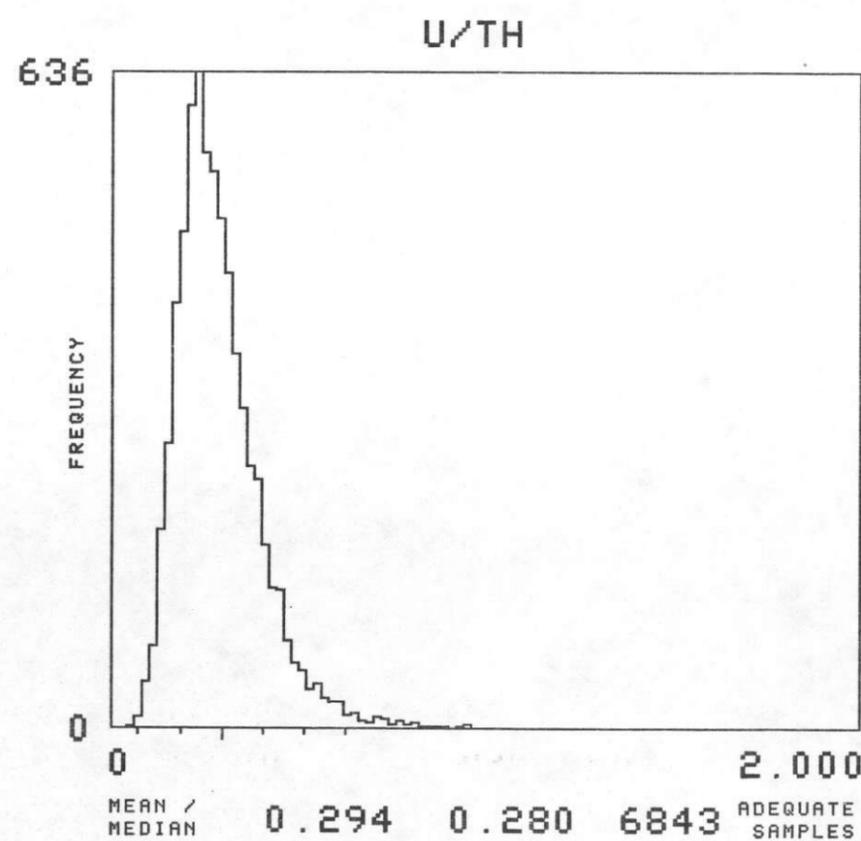
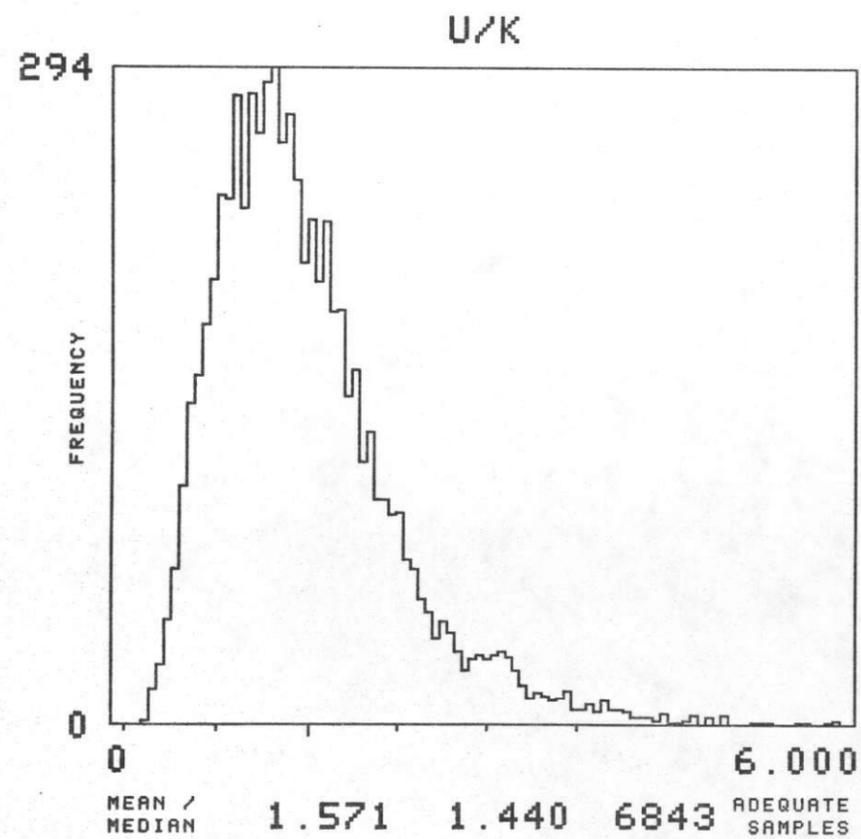
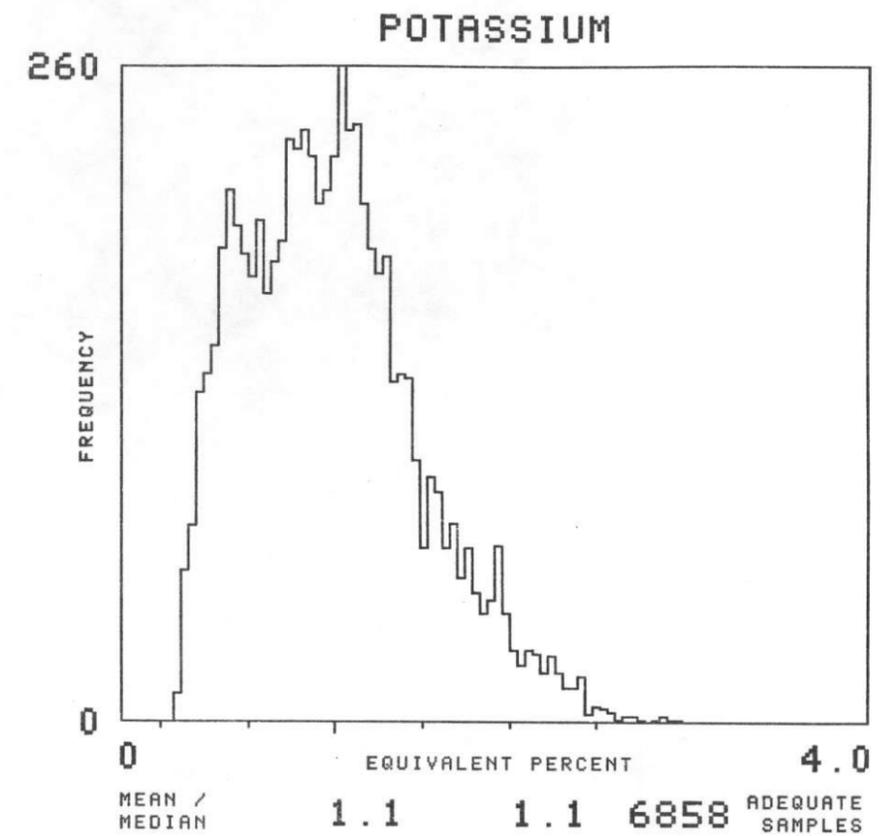
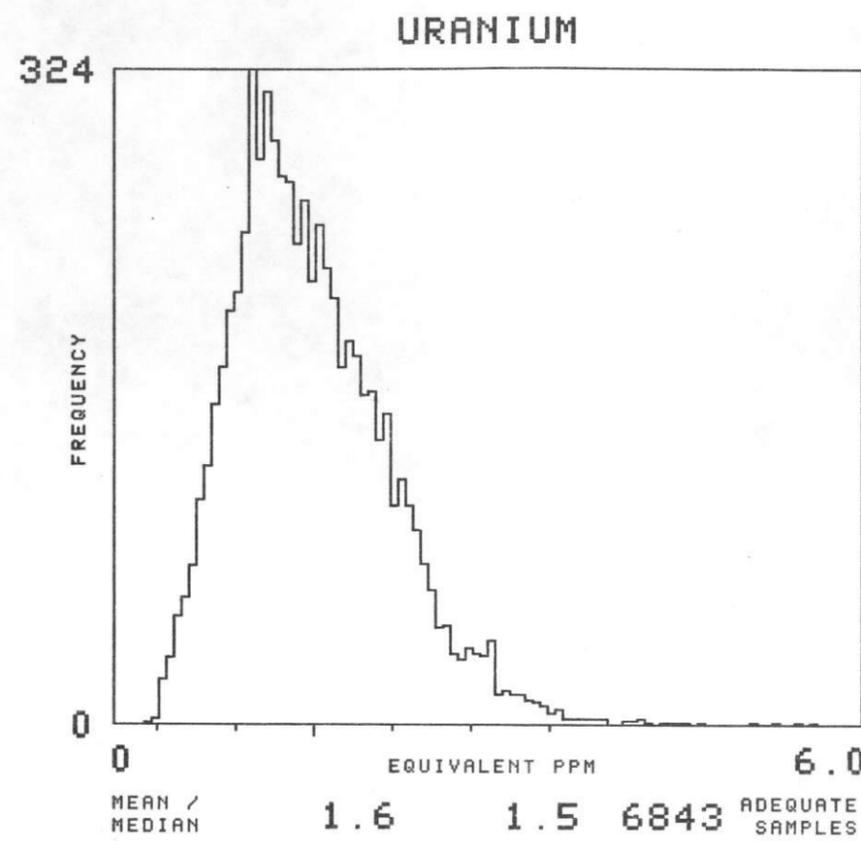
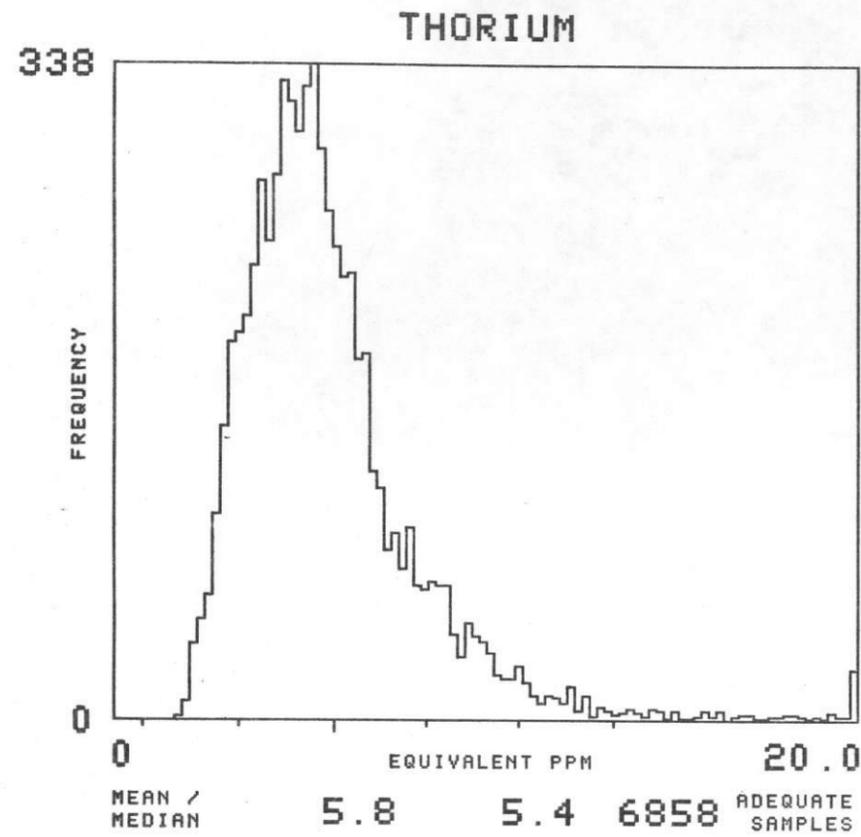
CONTOUR INTERVAL 40.0 GAMMAS
 SHADING ON LOW SIDE 20.0 GAMMAS
 DATUM 1975 IGRF, UPDATED TO 1979
 FLIGHT LINE SPACING 0.25 MILES
 FLIGHT ALTITUDE 400 FEET MTC
 FLOWN AND COMPILED 1979-1980
 INSTRUMENT GEOMETRICS G-803 PROTON MAGNETOMETER

SURVEY FLOWN ROTARY WING BY N49531



SURVEY AND
 COMPILED BY
EG&G GEOMETRICS

APPENDIX D - Histograms



APPENDIX E - Statistical Tables

NEMO

STATISTICAL SUMMARY TABLE

		-3	-2	-1	0	+1	+2	+3
K40	DIST NORMAL	-.2553	.2128	.4769	1.1430	1.6091	2.0752	2.5413
BI214	DIST NORMAL	-.2837	.3470	.9777	1.6084	2.2391	2.8698	3.5005
TL208	DIST NORMAL	-1.7582	.7725	3.3032	5.8339	8.3646	10.8953	13.4260
U/K	DIST NORMAL	-.6181	.1116	.8413	1.5710	2.3007	3.0304	3.7601
U/TH	DIST NORMAL	-.0398	.0714	.1826	.2938	.4050	.5162	.6274
TH/K	DIST NORMA	-.5564	1.4538	3.4640	5.4742	7.4844	9.4946	11.5048

ANOMALY SUMMARY TABLE

ANOMALY	FLIGHT	COMPUTER MAP UNIT AND NO. ANOMALOUS SAMPLES	PEAK CPS	NUMBER OF SAMPLES WITH A STANDARD DEVIATION OF							
				1	2	3	4	5	6	7	>7
1.	30, 40	9	2.9	5	4	0	0	0	0	0	0
2.	20,80,90,100,110,1010	87	4.0	56	26	3	2	0	0	0	0
3.	80	5	2.9	2	3	0	0	0	0	0	0
4.	130,140	13	3.1	5	8	0	0	0	0	0	0
5.	1010	40	3.7	18	16	6	0	0	0	0	0
6.	270	2	3.4	0	0	2	0	0	0	0	0
7.	1010	25	2.8	19	6	0	0	0	0	0	0

VARIABLES FOR MULTIVARIATE ANALYSIS

VARIABLE NUMBER	RADIOMETRIC WINDOW	CLOSED INTERVALS IN STANDARD DEVIATIONS	NUMBER OF SAMPLES IN SURVEY
1	K ₄₀	$-\infty < x < -1.0$	1234
2	K ₄₀	$-1.0 < x < 1.0$	4563
3	K ₄₀	$1.0 < x < \infty$	1046
4	Bi ₂₁₄	$-\infty < x < -3.0$	0
5	Bi ₂₁₄	$-3.0 < x < -1.0$	993
6	Bi ₂₁₄	$-1.0 < x < 1.0$	4790
7	Bi ₂₁₄	$1.0 < x < 3.0$	1007
8	Bi ₂₁₄	$3.0 < x < \infty$	53
9	Tl ₂₀₈	$-\infty < x < 1.0$	624
10	Tl ₂₀₈	$-1.0 < x < 1.0$	5388
11	Tl ₂₀₈	$1.0 < x < \infty$	831

PRINCIPLE COMPONENT RESULTS

COMPONENT	EIGENVALUE	PERCENT TOTAL VARIANCE
1	.843	28.087
2	.533	17.759
3	.501	16.673
4	.292	9.725
5	.252	8.384
6	.218	7.247
7	.133	4.421
8	.123	4.113
9	.073	2.439
10	.035	1.153
11	.000	.000

COVARIANCE MATRIX

	1	2	3	4	5	6	7	8	9	10	11
1.	.3102290										
2.	.0000000	.1942032									
3.	.0000000	.0000000	.4967289								
4.	.0000000	.0000000	.0000000	.0000000							
5.	.1250713	.0227410	-.0131648	.0000000	.2584130						
6.	.0631623	.0290214	.0030473	.0000000	.0000000	.2171891					
7.	-.0082801	.0071680	.0969193	.0000000	.0000000	.0000000	.4096320				
8.	.0000000	.0017367	.0006401	.0000000	.0000000	.0000000	.0000000	.1146167			
9.	.1369001	.0081958	.0000000	.0000000	.0616175	.0290910	-.0021257	.0000000	.1267788		
10.	.0893583	.0772029	.0354390	.0000000	.0645441	.0570643	.0021689	-.0005286	.0000000	.2097872	
11.	-.0009340	.0626251	.0428109	.0000000	-.0006297	.0370428	.2263399	.1295272	.0000000	.0000000	.6646017

MATRIX OF EIGENVECTORS

EIGENVECTOR

VARIABLE	1	2	3	4	5	6	7	8	9	10	11
1.	-.00451	.67865	.00645	.15992	-.24106	.24283	-.31698	-.25745	.07994	.47285	-.00000
2.	-.09145	.13726	.04921	-.34282	.48866	-.30020	-.52325	.42702	-.13164	.22465	-.00000
3.	-.24074	.01159	-.91810	-.22076	-.20465	-.03954	.00620	.07648	.01259	.02793	.00000
4.	-.00000	-.00000	-.00000	-.00000	-.00001	-.00000	-.00000	-.00000	-.00000	-.00000	-1.00000
5.	-.00208	.47609	.03747	.20182	-.09900	-.57365	.52535	.33958	-.00799	.03042	-.00000
6.	-.05751	.24057	.02428	-.27851	.28444	.67260	.45307	.33741	-.07699	.04807	.00000
7.	-.48386	-.06150	-.14854	.71065	.43140	.09415	-.01650	-.01944	-.19651	.02845	.00000
8.	-.14633	-.00558	.11061	-.18923	-.22734	-.05661	.07617	-.20093	-.90744	.07736	.00000
9.	-.00299	.32113	.01235	.13261	-.22205	.16305	-.35349	.29163	-.14098	-.75721	.00000
10.	-.03218	.35867	-.08508	-.25827	.47301	-.16584	.11437	-.62455	.05440	-.37286	-.00000
11.	-.82084	-.01846	.33308	-.25447	-.24428	-.04146	.01809	-.02239	.29193	-.05245	-.00000

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