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U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Environmental Research Laboratories

Caribbean Atlantic Geotraverse, NOAA-IDOE 1971, Report No. 3, Gravity

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BOULDER, COLO.
AUGUST 1973

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator
ENVIRONMENTAL RESEARCH LABORATORIES
Wilmot N. Hess, Director

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CARIBBEAN ATLANTIC GEOTRAVERSE, NOAA-IDOE 1971, REPORT NO. 3, GRAVITY

LeRoy M. Dorman,[1] B. G. Bassinger,[1] E. Bernard,[2] S. A. Bush,[1] O. E. DeWald,[1] L. A. Lapine,[2] R. K. Lattimore,[1] and G. Peter[1]

This report describes the collection and reduction of about 30,000 km of gravity data that were acquired during 1971 by the NOAA ship *Researcher* as part of the NOAA-IDOE program. Data are presented as a free-air anomaly map and as profiles of free-air anomaly, accompanied by a track chart. The data, in processed and original form, are available through the NOAA National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo., under NGSDC file number 00102.

INTRODUCTION

As part of a 2-year program funded in part by the Office for the International Decade of Ocean Exploration of the National Science Foundation, the NOAA ship *Researcher* collected gravity, magnetic, and bathymetric data along tracklines shown in figure 1. The collection and reduction of the gravity data are described in this report.

INSTRUMENTATION AND DATA ACQUISITION

The gravimeter used was the La Coste and Romberg gyrostabilized sea gravimeter serial number S-52. The calibration table used was dated 1/12/70. Observations were made every minute and recorded on digital magnetic tape (the raw-data tape). The parameters measured were the

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[1] NOAA Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.

[2] NOAA Corps, NOAA Ship *Researcher* (OSS-03).

corrected gravity, spring tension, total correction, averaged-beam position, and cross-coupling correction. The beam position may have been recorded improperly because it was not recoverable from the tape.

DATA REDUCTION

The data reduction process divides naturally into two parts: (1) correction for ship motion, and (2) removal of the earth's main field as represented by the international gravity formula of 1930.

The first correction (the Eötvös correction) is by far the most difficult and, at present, is the factor limiting the accuracy of the data. This Eötvös effect represents the vertical component of the centripetal acceleration resulting from the east-west (E-W) component of the ship velocity. The magnitude of this effect requires knowledge of the E-W velocity to about 0.1 kt to achieve an accuracy of 1 mgal. The navigation control during this field season consisted of the SRN-9 satellite navigation system (Guier, 1966; Talwani et al., 1966) and the Loran C. Fixes from satellites were available, on the average, about every 2 hours. Because most of the survey area is at such a distance from the Loran station on the east coast of the United States, the accuracy of the Loran fixes is questionable; therefore, the Loran was used principally to validate the dead-reckoning (DR) interpolation which was used to generate the track between satellite fixes. The DR track between fixes was generated by integrating the velocity and heading and by adding a correction velocity vector (a constant for each fix pair) to make the DR track coincide with the position of the second fix of each pair (Talwani, 1970; Bowin et al., 1972).

The frequency standard used in the satellite navigation receiver failed on Julian Day (JD) 295 and was replaced on JD 302. The gravimeter failed on JD 300 at 0611 and was repaired at JD 301 at 0000.

One of the navigation files covering the period from JD 292/0700 to JD 294/0805 was lost so that data could not be processed in the same manner as the remainder. The basic data are available, however, so that these data can be recovered.

The shipboard data-acquisition system provides real-time correction of gravity data using DR from the last available fix. These provisionally corrected data are written on another digital magnetic tape (the processed-data tape). The fundamental observable—the meter gravity—however, is not preserved on this tape nor on the printout of the results of the real-time reduction so that the processing results are of evanescent value only.

At the first still reading at Barbados (JD 281), a zero meter gravity (ZMG) value, approximately 102 mgal too low, was obtained. This value was not repeated at the still reading upon departure on JD 285 nor were any data found to be in error by this value. It is probable that the reading resulted from a dial-reading error of 100 dial divisions.

ACCURACY

From the values of ZMG in table 1, we see that the meter drift over the experiment is less than 1 mgal and that the gravity values for the bases are consistent to within 1 mgal.

From 71 track crossings made, the root-mean-square crossing error is 3.7 mgal.

Table 1. Researcher base ties 1971

Location	Base gravity	Meter gravity	ZMG	JD
Miami	979045.55		972893.00	
Barbados	978294.19	5401.38	972892.81	285
Guadeloupe	978559.27	5666.25	972893.02	302
Miami	979045.55	6152.27	972892.28	327

The base stations used were:

Miami, Fla.; NOAA Ship Base

Barbados; Deep Water Pier
(Naval Oceanographic Office NO 0045.21)

Guadeloupe; Pointe-à-Pitre Airport
(Naval Oceanographic Office NO 0045.14).

DATA DISPLAY

Tracklines for which data have been reduced are shown in figure 1. Figure 2 shows the primary survey area and the profile number for each line segment. Table 2 tells the times of the beginnings and ends of each profile in the Appendix. The profiles themselves, designated by number, are also shown in the Appendix. The East-West profiles, beginning with the most northerly, are shown first and are approximately alined by longitude. The North-South profiles, beginning with the most westerly, follow next and are alined approximately by latitude. Finally, the remaining short profiles are shown in numerical order. The caption on each page lists the profile numbers, reading from left to right and then top to bottom.

Figures 3 and 4 are contour maps of the free-air anomaly for the region of densest coverage. The contours on these maps are derived from a grid representation of the data, with the grid interval set at about 17 km. Grid values were obtained from the data by taking a weighted average of values near the grid point. Gravity data from *Chain* cruise 75 (Bowin et al., 1969) are included in the data set from which the contour map was made.

Table 2. Profile start and stop times

RP-12-RE-71

Profile number	Start JD	Start Time	Stop JD	Stop Time
1	261	0800	262	0130
2	262	0405	263	1515
3	263	2330	264	1740
4	264	1835	265	1230
5	265	1420	266	0600
6	266	1010	266	1620
7	266	1625	267	0740
8	267	0745	267	1610
9	267	1615	268	2200

Table 2. Profile start and stop times RP-12-RE-71—continued.

Profile number	Start JD	Start Time	Stop JD	Stop Time
10	268	2205	269	1330
11	269	2125	270	1240
12	270	1245	271	0420
13	271	0425	271	1920
14	271	1925	272	0310
15	272	0315	272	1320
16	272	132[illegible]	274	1005
17	274	1010	274	1535
18	274	1540	274	2240
19	274	2245	275	1730
20	275	1835	276	2240
21	276	2245	277	0815
22	277	0820	277	1400
23	277	1405	279	1710
24	279	1725	279	2200
25	279	2205	280	1230
26	280	1505	280	1910
27	280	1915	281	0055
28	286	0100	286	0830
29	286	0905	290	2040
30	290	2300	294	1505
31	294	1717.5	299	0100
32	299	0240	302	0555
33	306	2115	309	2240
34	310	0015	312	1645
35	312	2230	315	1835
36	315	2005	318	1710
37	318	1715	320	1830
38	320	2000	322	1650

ACKNOWLEDGMENTS

We appreciate the cooperative spirit shown by CAPT Steven L. Hollis and the crew of the NOAA ship *Researcher*. We are especially grateful to LCDR T. Wyzewski for his zealous supervision of all phases of the navigation. This work was funded in part by NSF-IDOE Grant No. AG-253.

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Guier, W. H. (1966): Satellite navigation using integral Dopper data—the AN/SRN-9 equipment, *J. Geophys. Res. 71:* 5903-5910.

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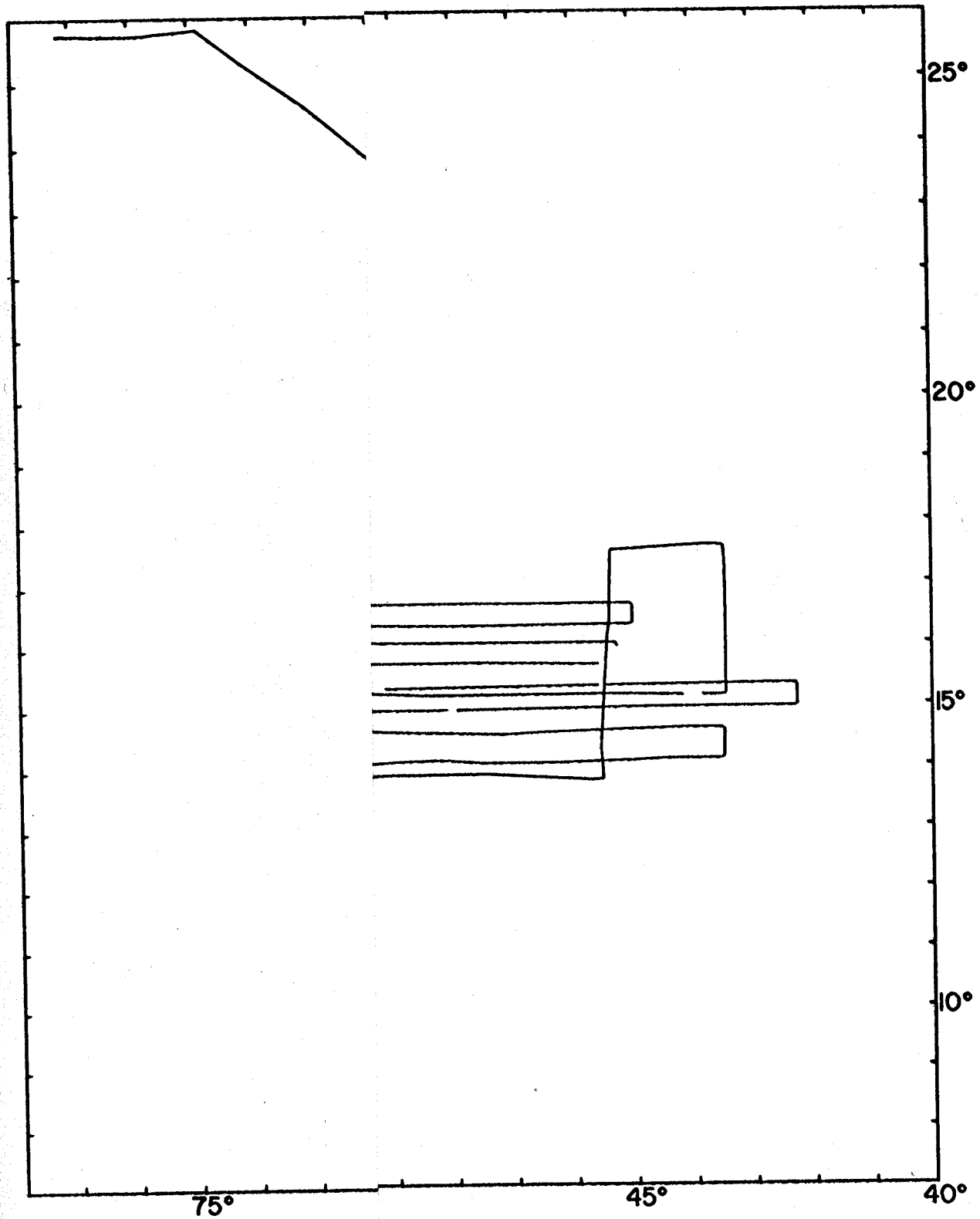
Talwani, M., J. Dorman, J. L. Worzel, and G. M. Bryan (1966): Navigation at sea by satellite, *J. Geophys. Res. 71:* 5891-5902.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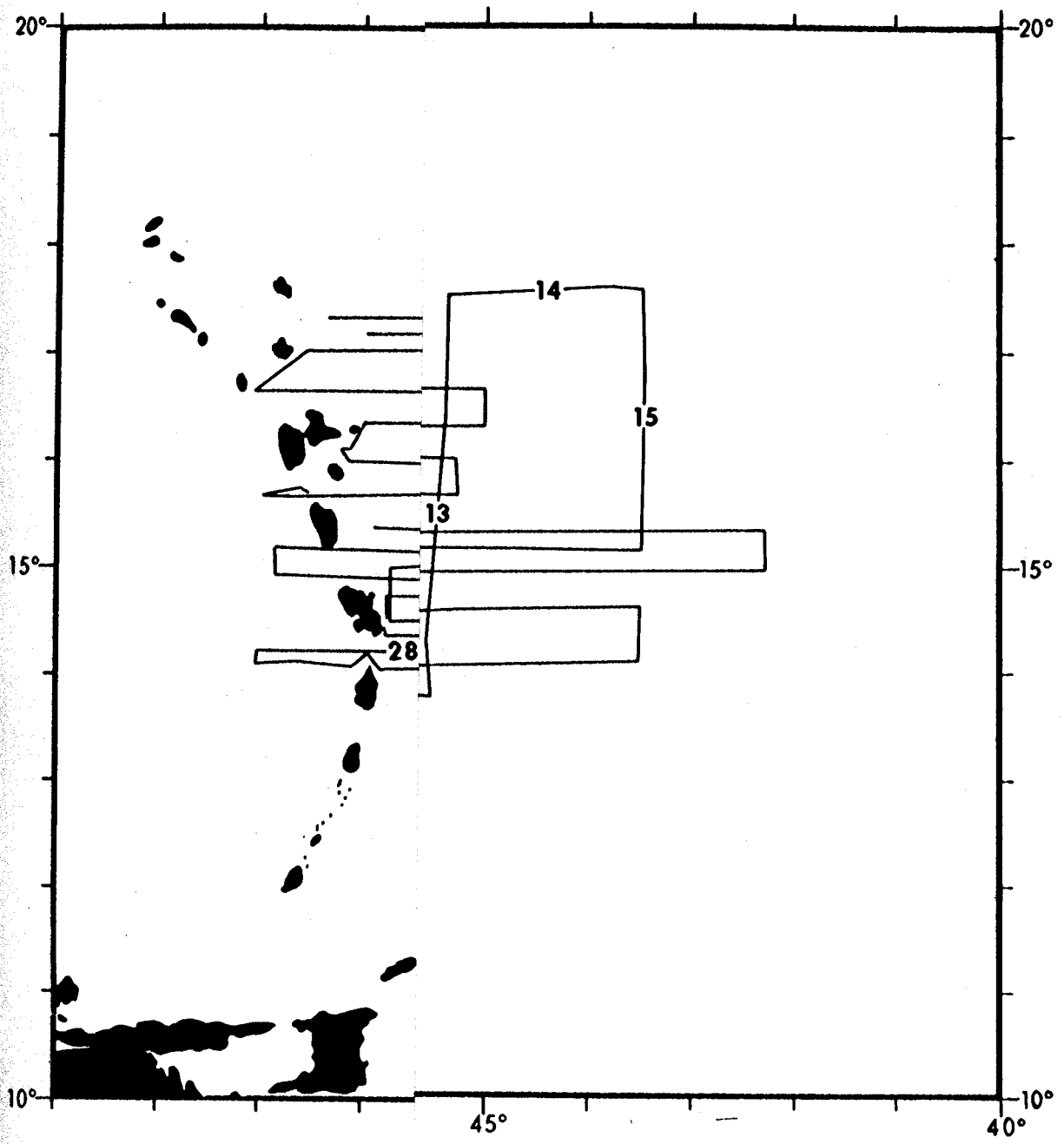
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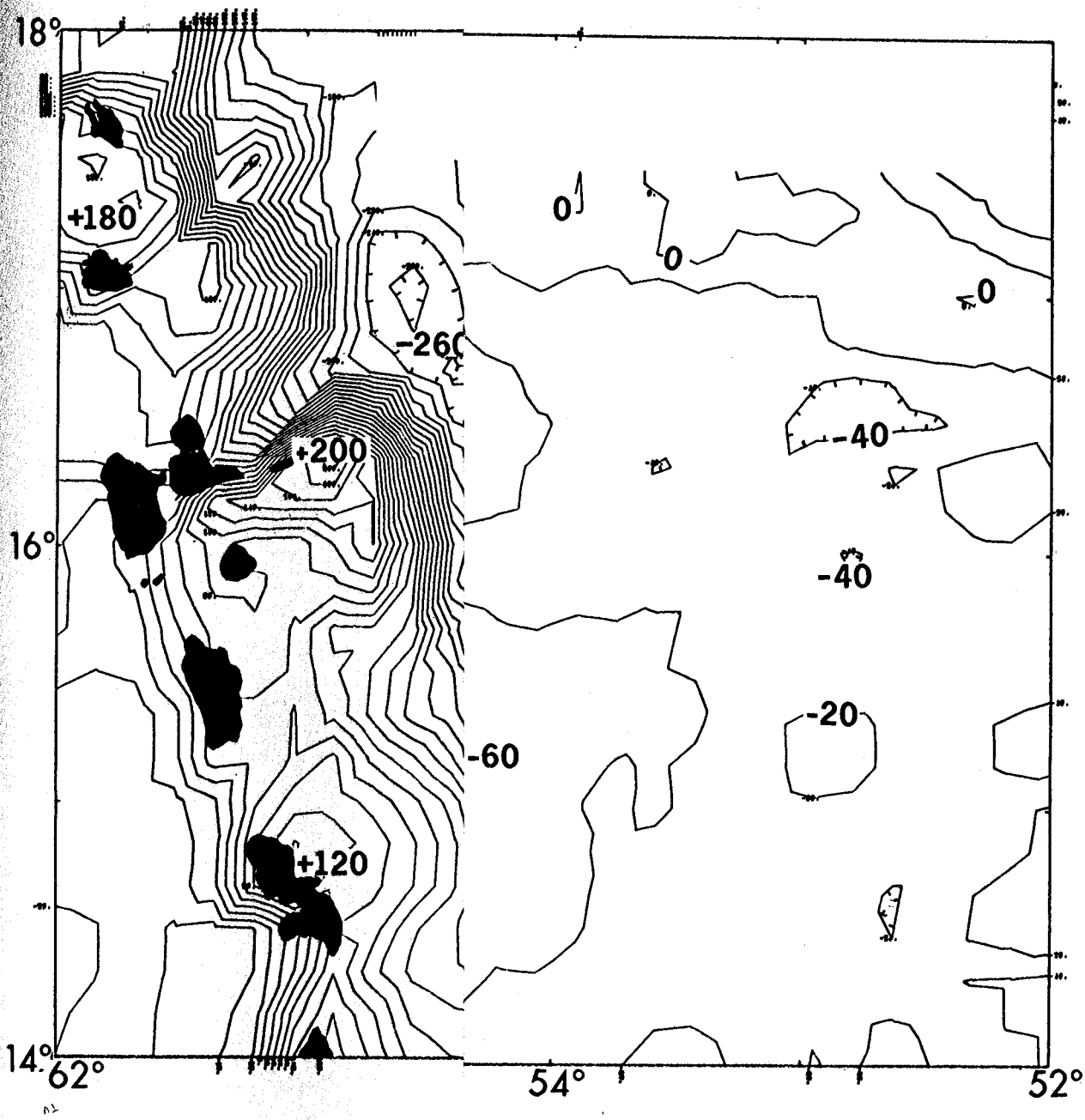
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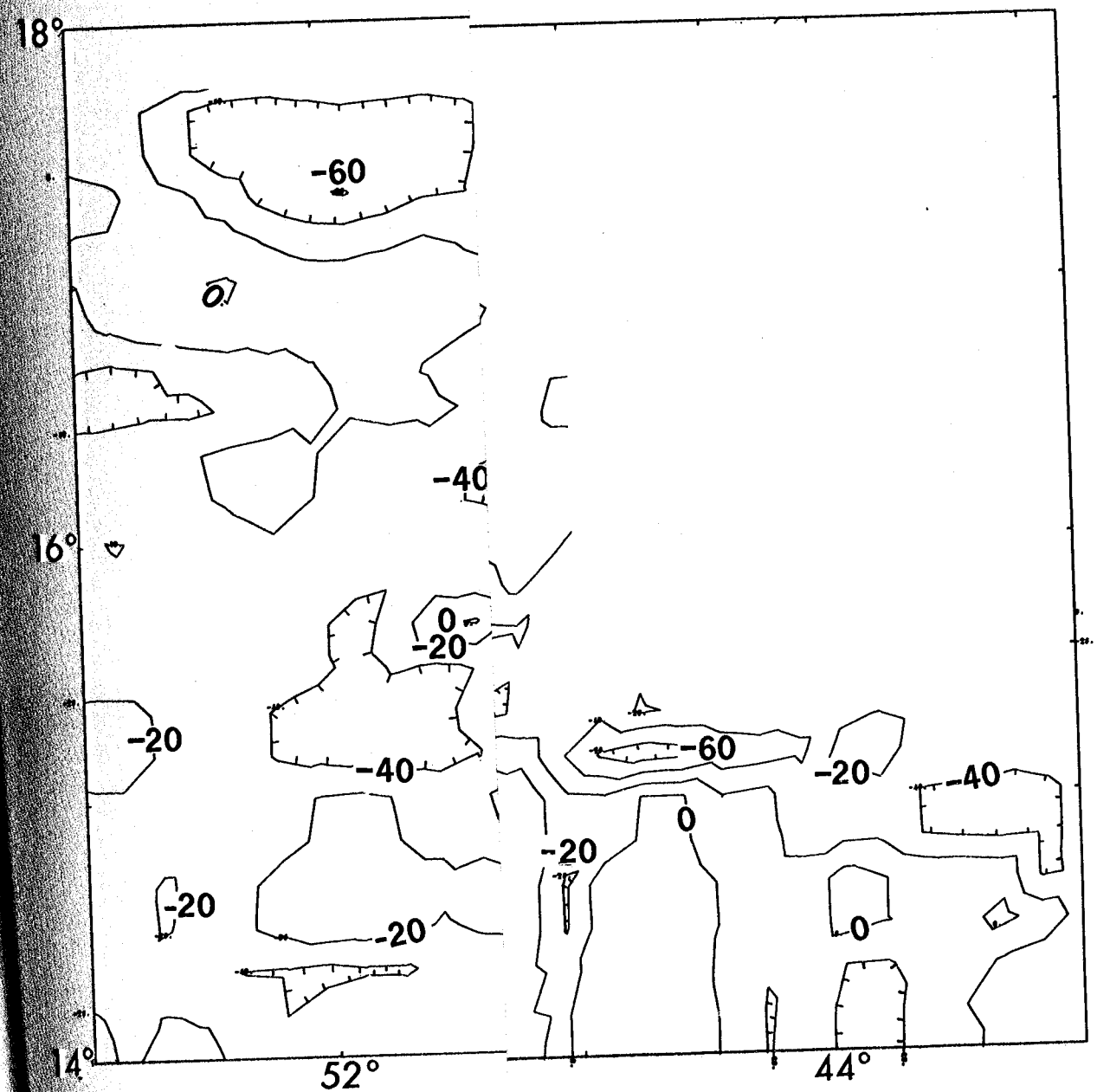
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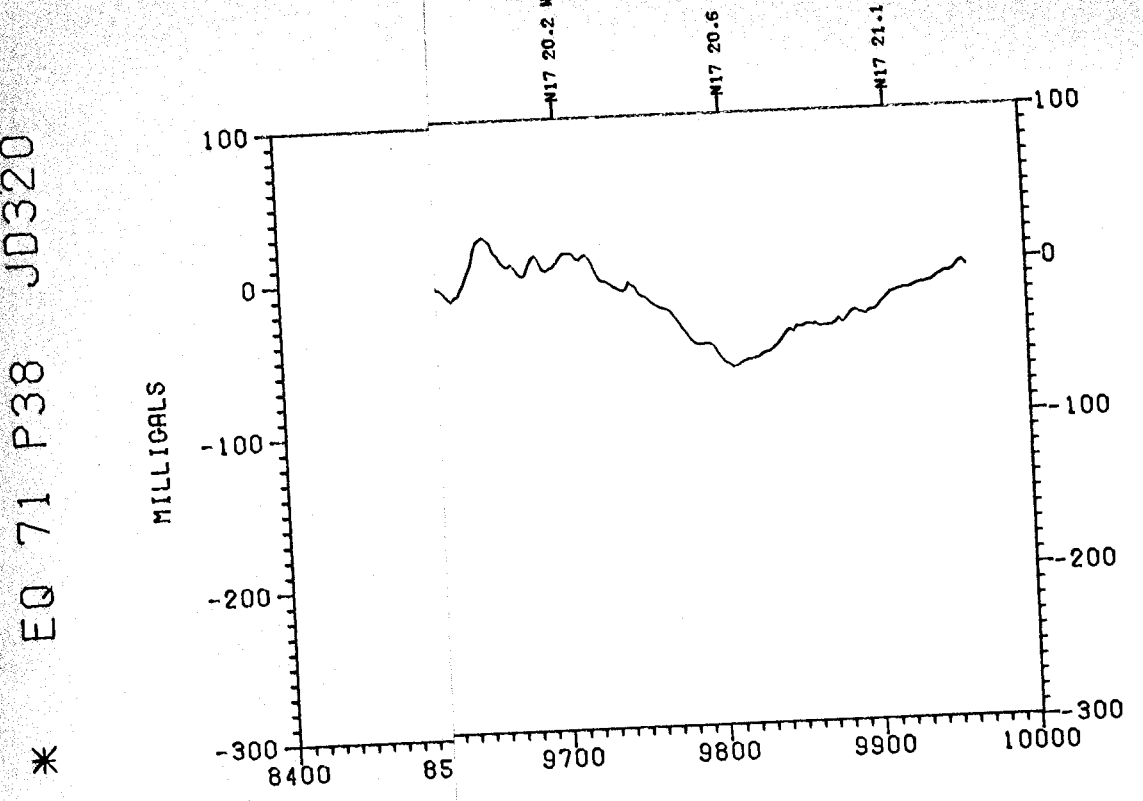
APPENDIX. PROFILES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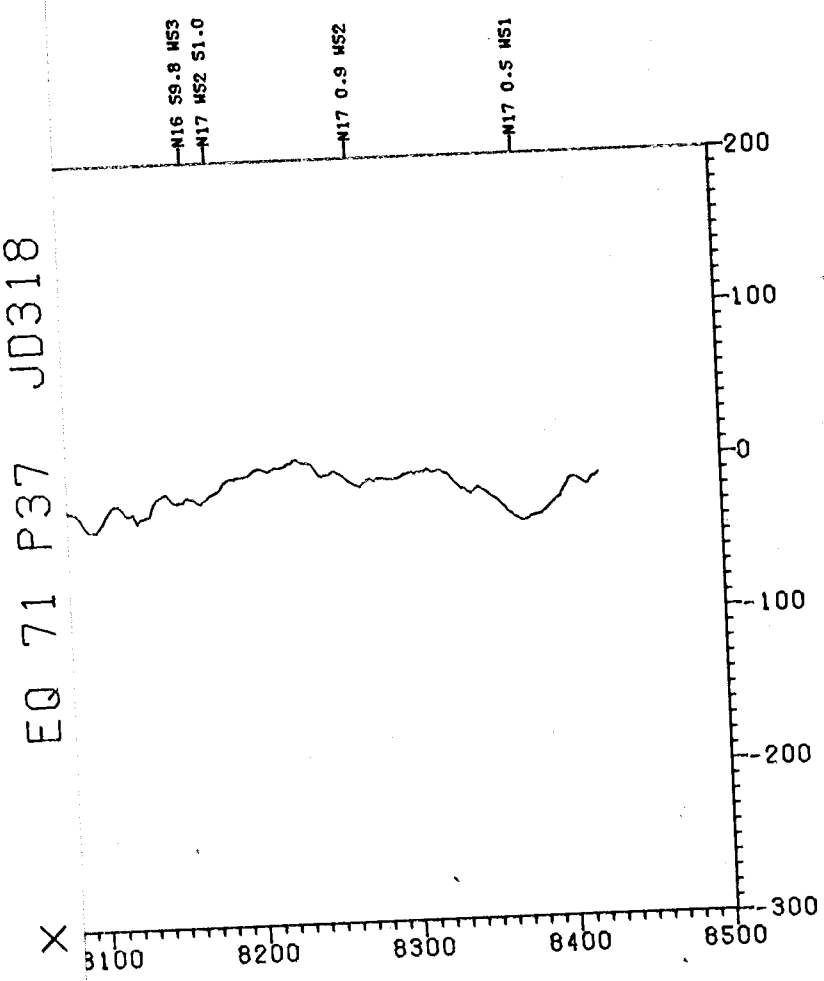
N17 21.1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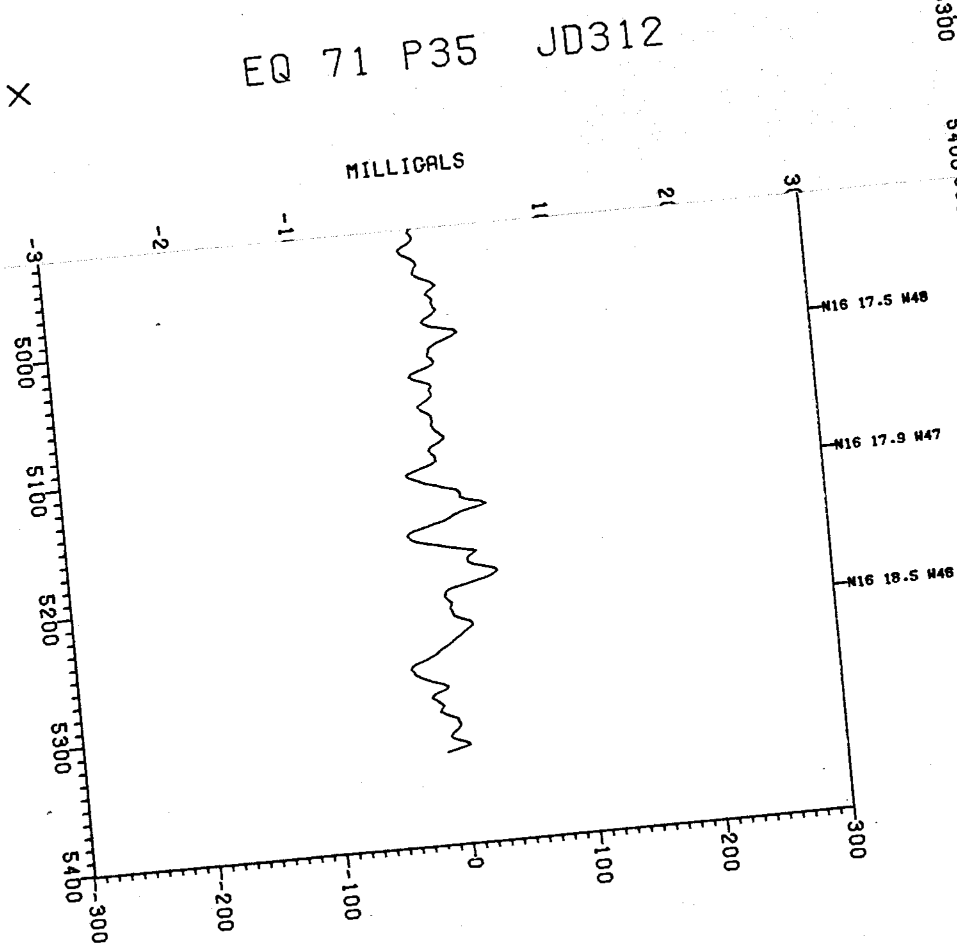
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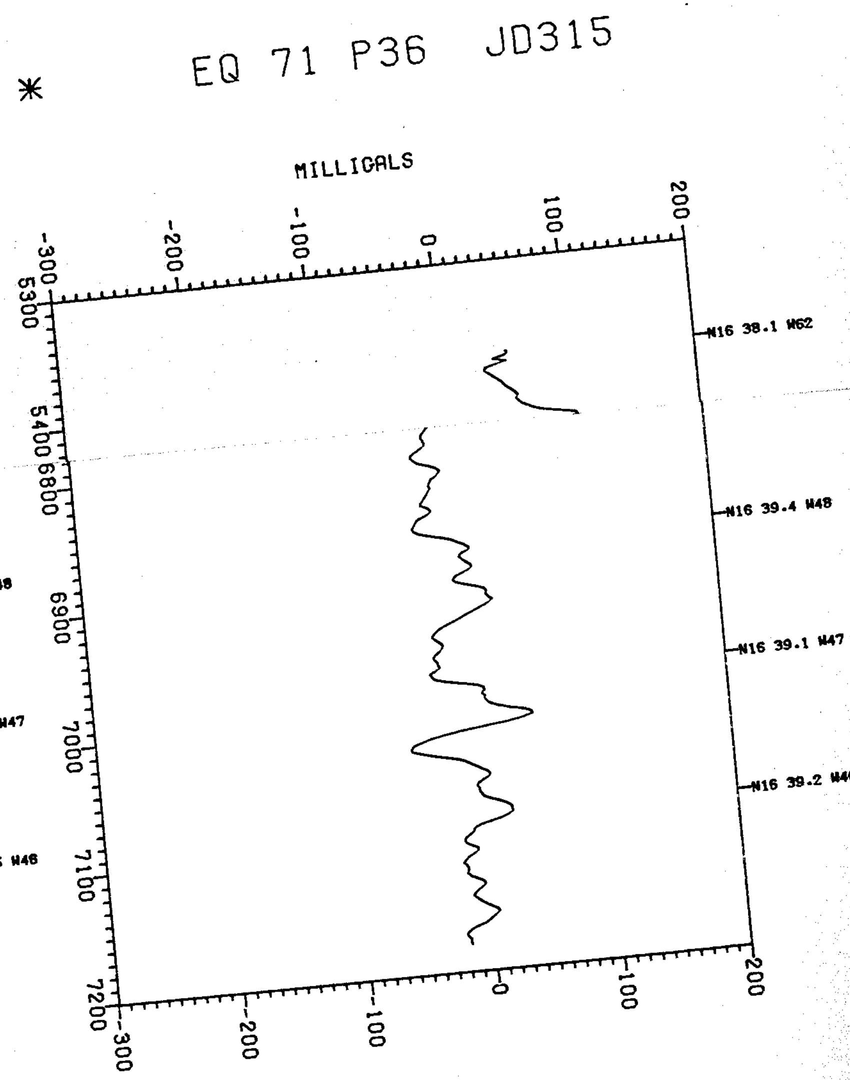
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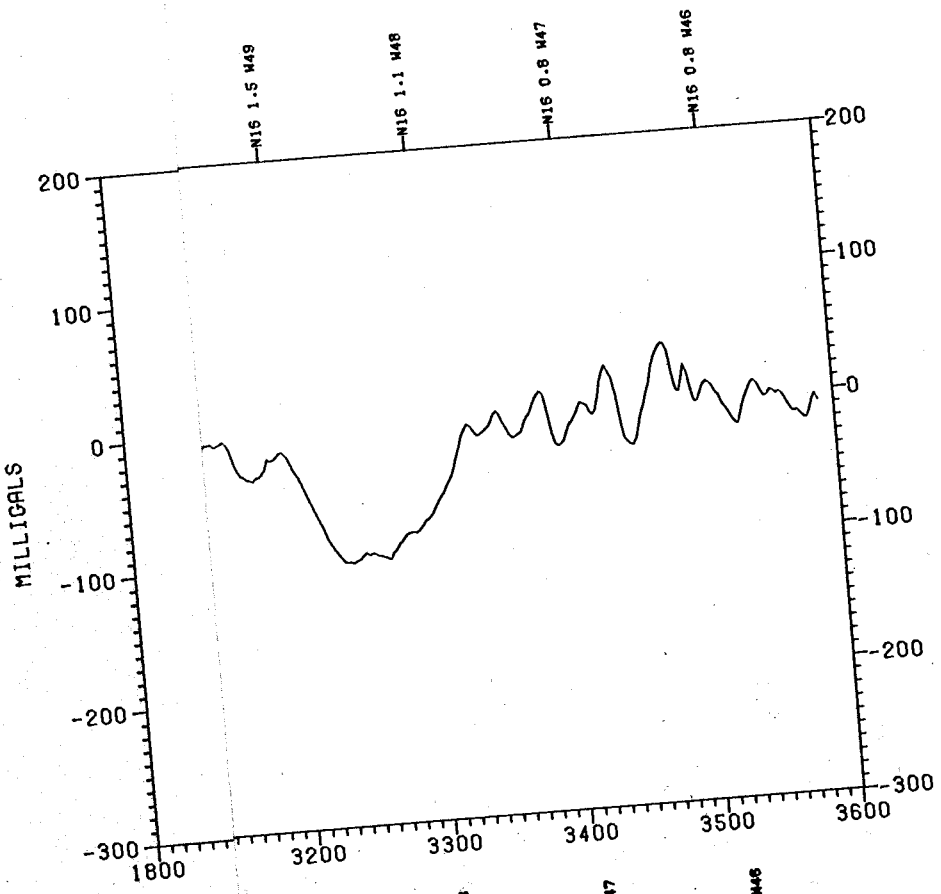

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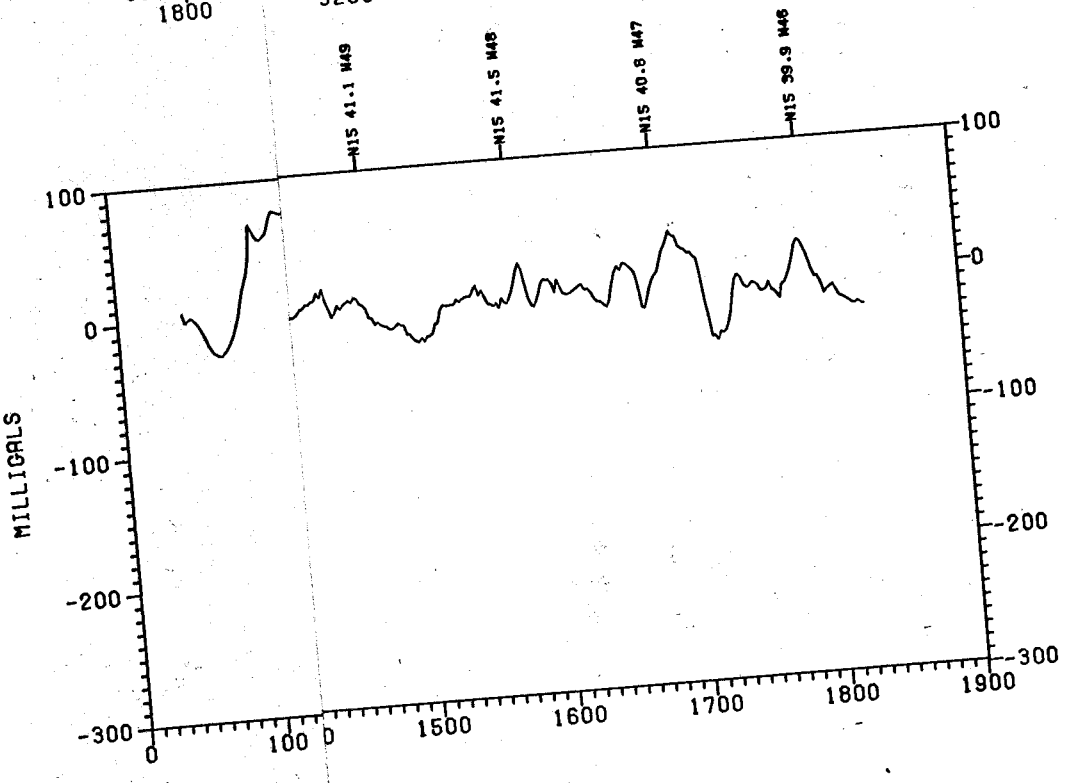

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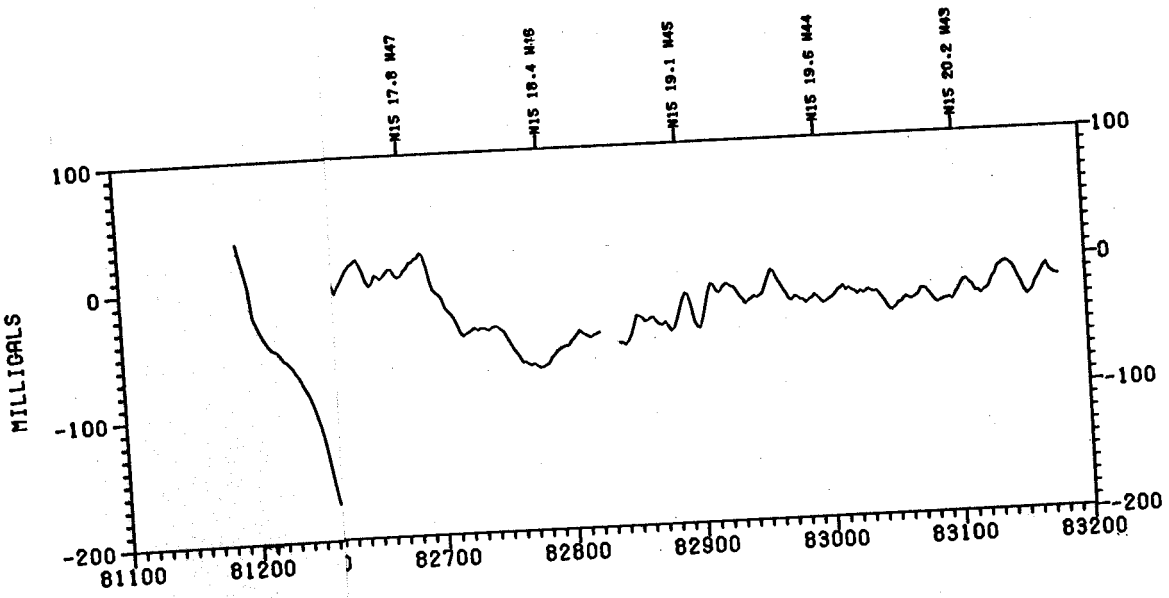

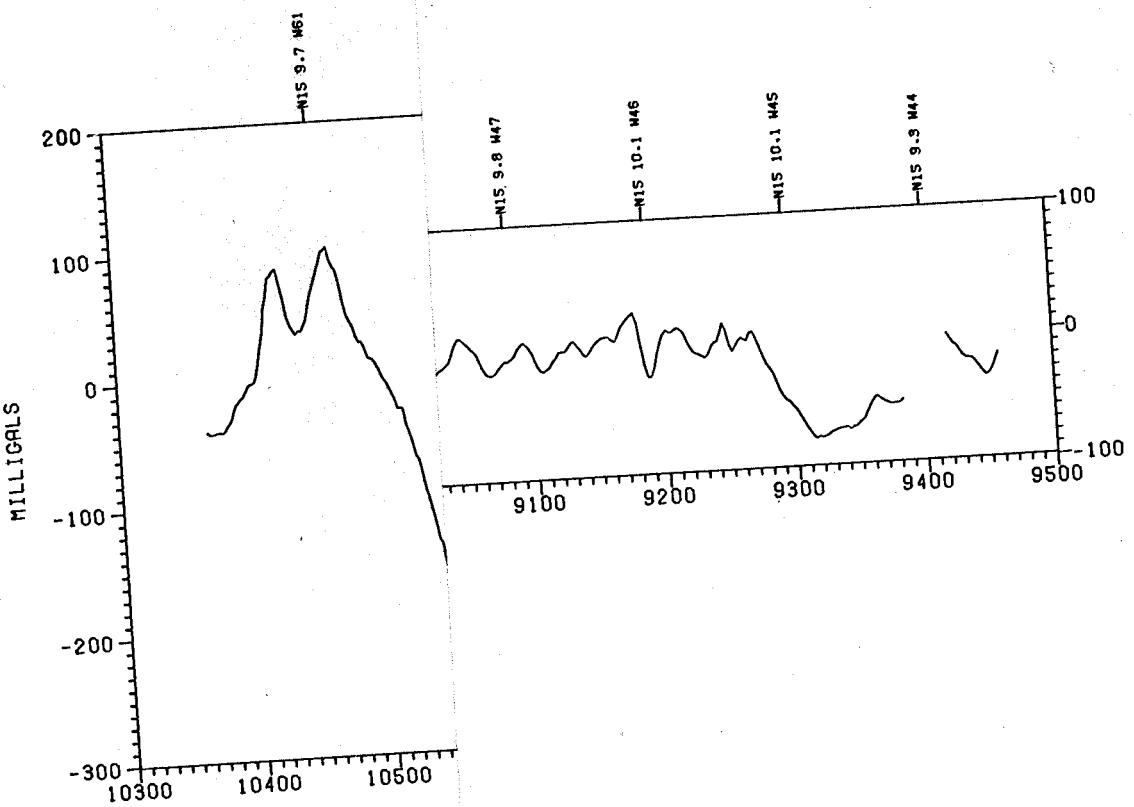

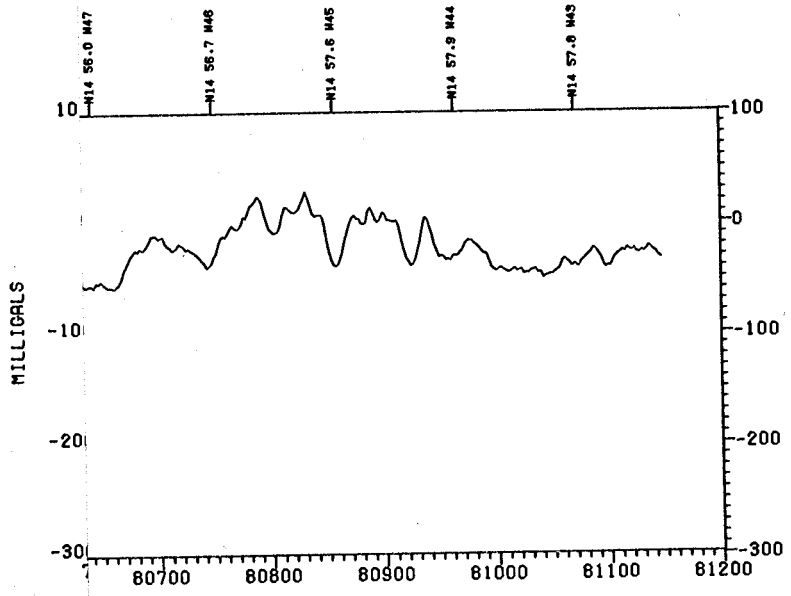
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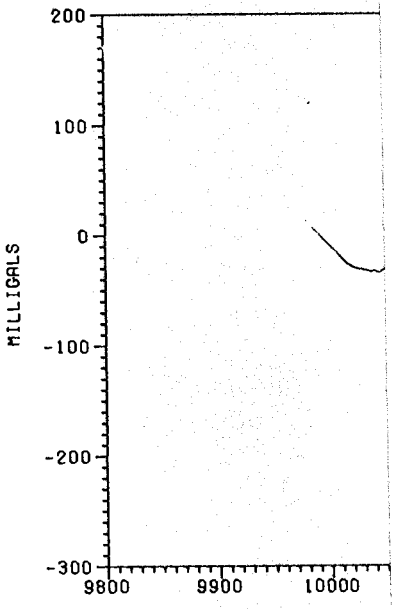
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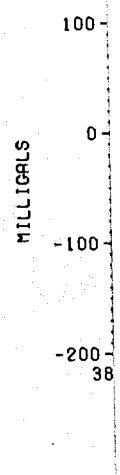
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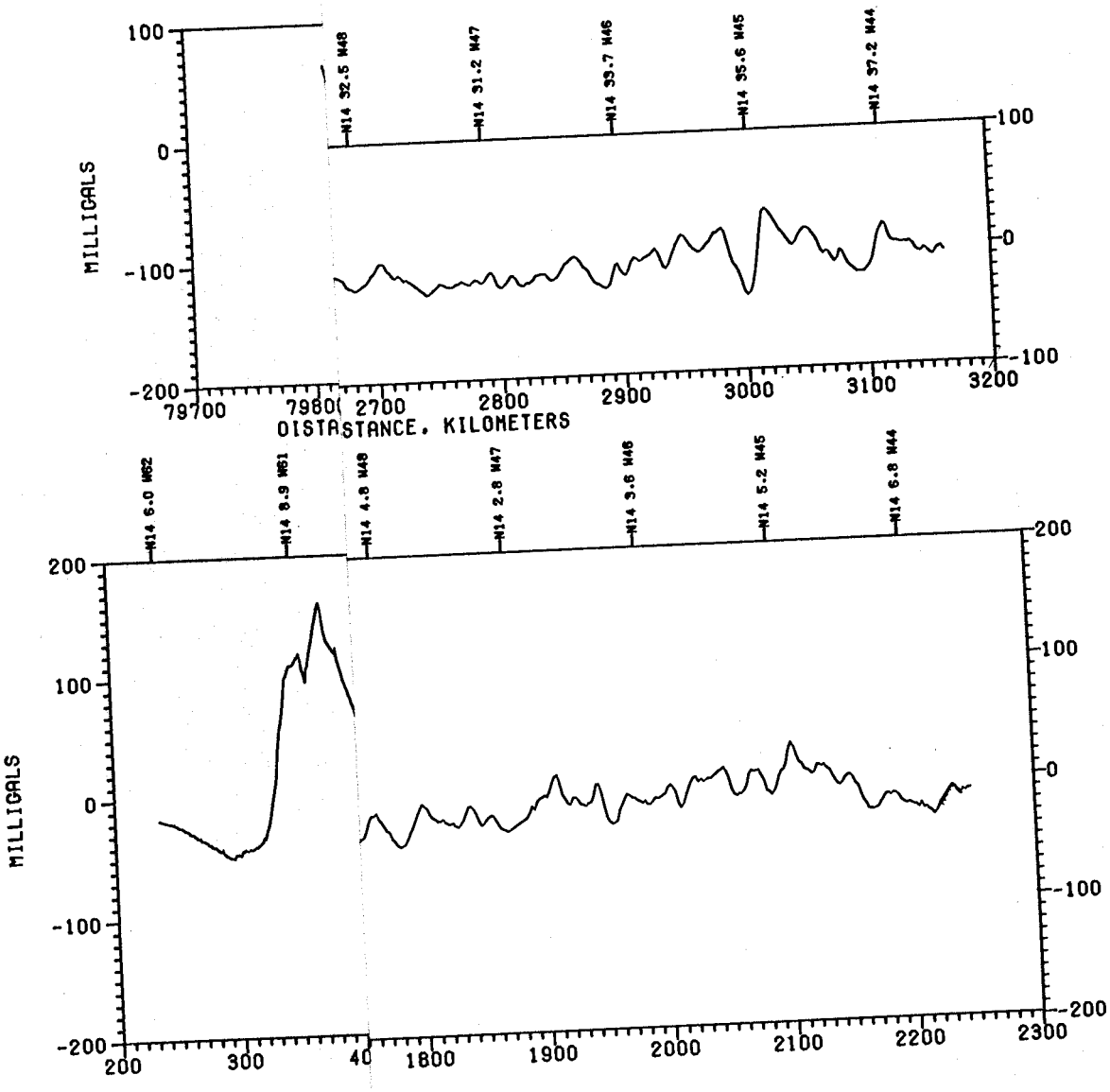

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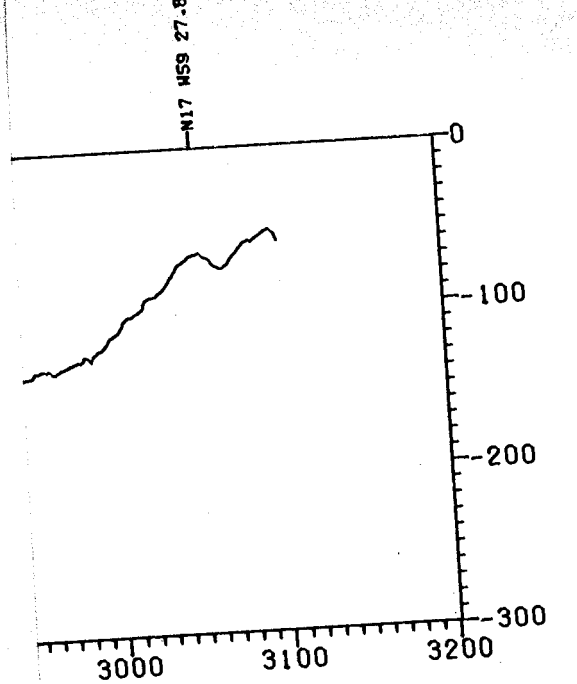
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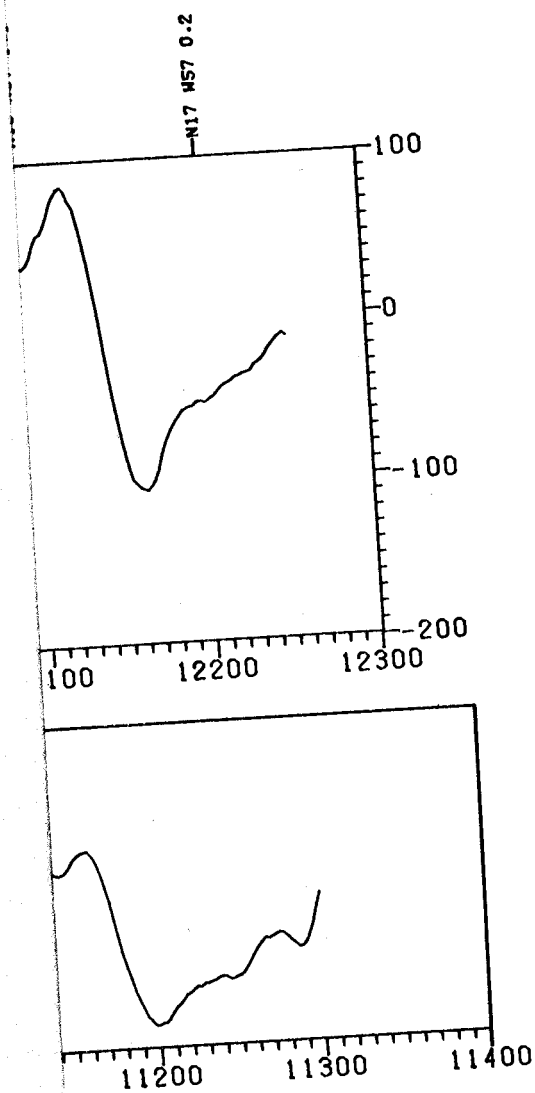
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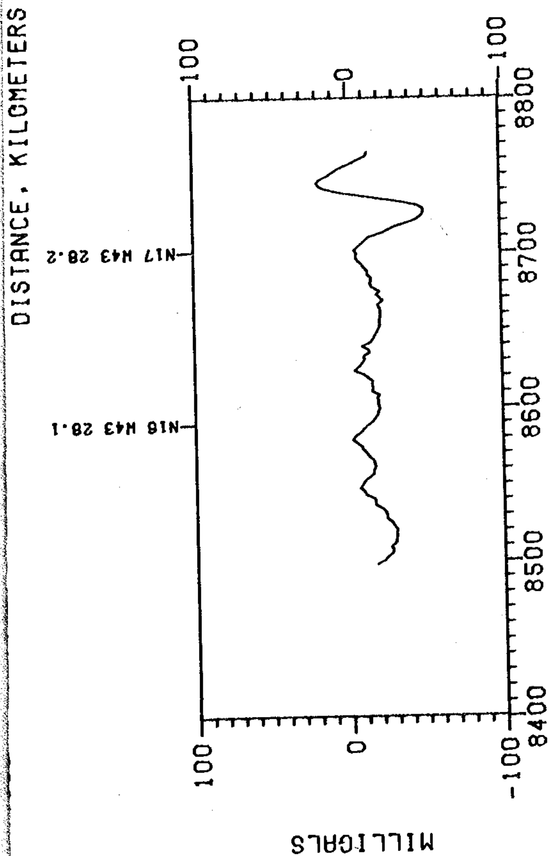
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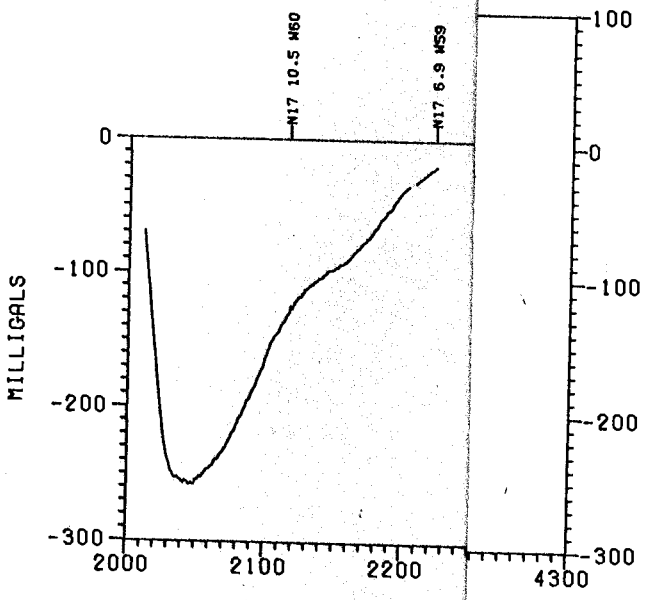
MILLIGALS

Profile 15

Profile 1



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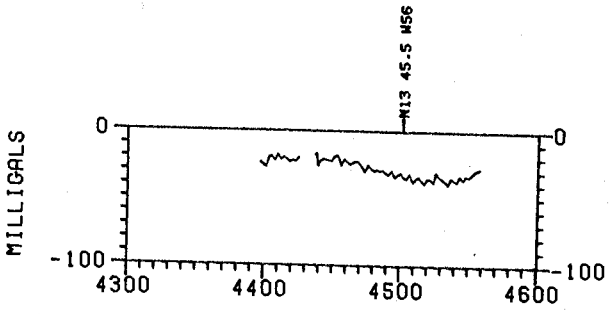

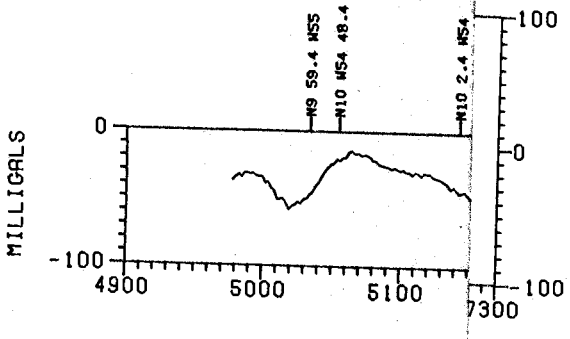

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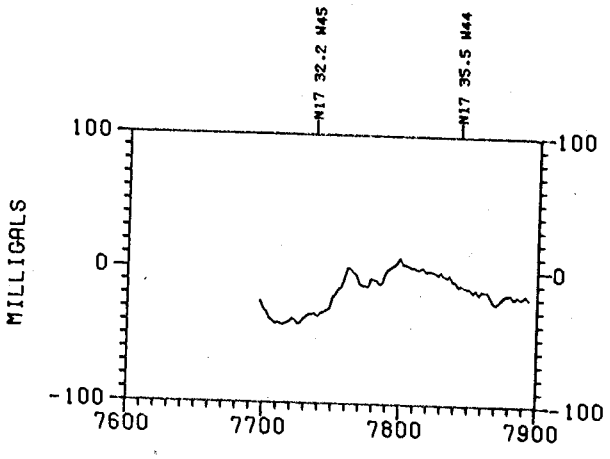

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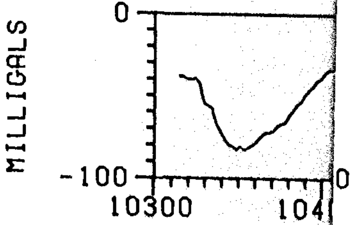

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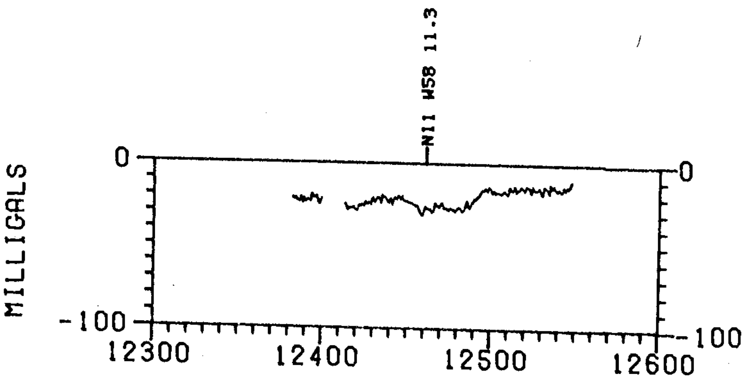

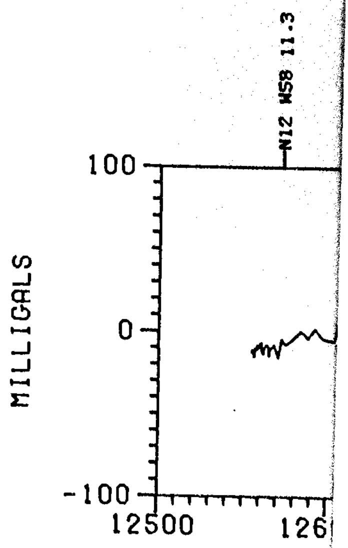

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