

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

DESCRIPTION OF DIGITAL AEROMAGNETIC DATA, U.S. ATLANTIC
CONTINENTAL MARGIN, SURVEY OF 1974-76

by

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Open-File Report 82-189

1982

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Digital data from U.S. Atlantic Continental Margin

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INTRODUCTION

A closely spaced, high-sensitivity, aeromagnetic survey of the U.S. Atlantic continental margin provided data for detailed mapping of magnetic anomalies over a nearly 850,000 sq km area, extending from Cape Cod to Cape Canaveral and from the shoreline eastward to the 4,000 m isobath. The data have been used to compile magnetic anomaly maps (Klitgord and Behrendt, 1977; Behrendt and Klitgord, 1979a through 1979g; 1980a through 1980r). They have also been used in calculations determining depth to magnetic basement along the entire U.S. Atlantic continental margin (Klitgord and Behrendt, 1979; Behrendt and Klitgord, 1980b). All of these compilations and calculations have provided information about the basin and platform structure of this passive continental margin and the nature of the East Coast Magnetic Anomaly.

This report describes the aeromagnetic survey, initial data reduction, and corrections that were made to the data tapes and the data, and presents a total magnetic intensity map. The format of the data tapes is described in an appendix.

AEROMAGNETIC SURVEY

From November 1974 to February 1976, the United States Geological Survey collected high resolution aeromagnetic data along 185,000 km of flight lines over the United States Atlantic continental margin (fig. 1). The survey was flown and compiled by LKB Resources, Inc. They incorporated into the data set a small block of aeromagnetic data obtained by Aero Service east of Cape Cod in 1966.

Flightlines were NW-SE in direction and varied in spacing. Between the coastline and the 2,000 m isobath they were as closely spaced as 2.5 km, whereas, over deeper water they were as widely spaced as 32.5 km. Details on flightline spacing and headings are presented in figure 2.

An integrated navigation system consisting of LORAN C, VLF (very low frequency) and doppler-radar was used for the 1974-76 survey. Position accuracy is estimated to be better than one kilometer. The nominal altitude was 450 m. LORAN A provided the navigation for the 1966 survey which was flown at approximately 300 m.

LKB used a high sensitivity (± 0.1 nT) (1 nT = 1 gamma) optical absorption helium vapor magnetometer. A rubidium vapor magnetometer was used by Aero Service in 1966. A base station was established to monitor diurnal field variations. Noisy lines were reflighted. Magnetic data, navigation, and altitude were all digitally recorded. Analog records were made of total magnetic field and radar altimeter readings. Additional information on equipment and data acquisition are given in figures 2 and 3.

Figure 2.--Detailed information on areas, dates, monitoring ground stations, navigation, and data sampling for U.S. Atlantic margin.

	DATES	BLOCKS INCLUDED	BASE STATION LOCATION	LINE SPACING AND HEADING	ALTITUDE	DIGITAL DATA
AREA 1	Nov. 3, 1974 to Jun. 4, 1975	1,2,5,6	McArthur Airport Islip, NY	Shoreline to 2,000 m isobath Flight lines - 3.2 km NW/SE (145° & 325°) Tie lines - 32.5 km NE/SW (55° & 325°) 2,000 to 4,000 m isobaths Flight lines - 32.5 km NW/SE (145° & 325°) Tie lines - 64.5 km NE/SW (55° & 235°)		Sample rate: observed total field radar altimeter barometric altimeter Loran 1 second
AREA 2	Dec. 27, 1974 to Oct. 7, 1975	3,4,7,8, 9	N. Philadelphia Airport Philadelphia, PA Newport News, VA	Shoreline to 2,000 m isobath Flight lines - 4.8 km NW/SE (145° & 325°) (Tie lines - 32.5 km NE/SW) (55° & 235°) 2,000 to 4,000 m isobaths Flight lines - 9.7 km NW/SE (145° & 325°) Tie lines - 32.5 km NE/SW (55° & 235°)	450 m	Units observed total field 0.1 nT radar altimeter 10 ft barometric altimeter 0.5 ft (above and below 1,500 ft)
AREA 3	Jul. 25, 1975 to Feb. 11, 1976	10,11, 12,13, 14,15, 16,17	Brunswick, GA	Flight lines - 3.2 km NW/SE (145° & 325°) Tie lines - 32.5 km NE/SW (55° & 235°)		
CAPE COD BLOCK	Jun. 1966 to Aug. 1966	CC-1, CC-2, CC-3	[not known]	Flight lines - 2.4 km NW/SE variable tie line spacing & direction	300 m	Sample rate: 1.2 seconds

Figure 3.--Equipment used by LKB Resources, Inc. during 1974-1976 U.S. Atlantic margin aeromagnetic survey.

Aircraft	Altimeters	Navigation System	Digital System	Analog Recorders
AeroCommander NI006S (sensor in tail cone attached to aircraft)	<p>Minneapolis Honeywell Radar Altimeter model RT 840.APN-171</p> <p>Rosemount Barometric Altimeter model 840F</p>	<p>Communications Components Ontrac II VLF navigation system. EDO Commercial Corp., EDO 1200 Dual L O K Trak Loran coupled to the digital acquisition system for online and post plotting information.</p>	<p>S.D.I. digital acquisition system coupled with a Kennedy incremental tape recorder.</p>	<p>Hewlett Packard- Moseley 7100B dual channel</p>
Douglas DC-3 N75T (sensor in tail cone attached to aircraft)		<p>Bendix Doppler System Model DRA-12, Teledyne Corp. Loran system model TDC 601 coupled to the digital acquisition system for on line and post plotting information.</p>		

DATA COMPILATION BY LKB

Because of the size of the survey the area was broken into blocks the limits of which are indicated in figure 1.

LORAN navigation data were checked for quality and used to compute flight line locations. Eastings and northings (X, Y coordinates relative to the central meridians and base latitude) of positions along the flight lines were generated and plotted. Position coordinates were then merged with the magnetic data. Adjustments were made to the magnetic field values to minimize errors caused by diurnal variations and positioning errors. A modified control-line leveling system was used. At each intersection plotting accuracy, diurnal variations, ground positions, and level were evaluated and used to make adjustments to the total magnetic field values. After these adjustments the IGRF was removed using the 1965 tables (IAGA, 1969) updated to mid-1975.

The data obtained from Aero Service were recompiled by LKB Resources. Flight lines were plotted using the navigation data. Magnetic field values were adjusted using their modified tie-line leveling system. Then the IGRF was removed using the 1965 tables updated to 1966.

After the IGRF was removed a datum of 52,000 nT was added to the 1974-76 data and a datum of 43,850 nT was added to the 1966 data. These are the values contained in the "adjusted total field" data records on the data tapes.

Areas I, II, and III (figs. 1 and 2) were compiled individually. Data were gridded prior to computer contouring. Grids were rotated to the flight line direction. For area I the grid interval was .7 km in the "x" direction, and .4 km in the "y" direction, for areas II and III it was 1 km by 1 km.

CORRECTIONS TO THE DATA

The tape containing data from Block 3 could not be read because of the presence of many illegal characters on the tape. To facilitate reading of the tape all or portions of 14 lines were deleted. Figure 4a is a list of deleted records. The deleted lines have been removed from the flight line map (fig. 1). To make certain the removal of these lines had not distorted the total intensity contour map, Block 3 was contoured and compared with the map compiled by LKB Resources. No inconsistencies were found between the original LKB map and the one compiled from the abridged data set. One line from Block 2 (line #174) and also one line from Block 15 (line #491) contain illegal characters.

It was necessary to make some other corrections to the data. A constant of 719,476,735 meters had to be removed from all eastings with values in excess of 10,000,000 meters. These incorrect eastings remain on the tapes and occur in Blocks 8,9,10,11,12,13,14,15,16, and 17.

There were also a small number of obviously bad magnetic values within the data from Block 2. These bad values were deleted before we gridded the data; however, they remain on the magnetic data tapes. A list of the northings and eastings, sampled every 10th data point, for these bad values is given in figure 4b.

Figure 4a.--Records deleted from data tape---
Block 3.

<u>Line Number</u>	<u>Recorder Number</u>
1207	54-61
1208	77-95
1215	126-147
1203	163-170
1211	224-231
228 & 224	318-385
230	537-577
221 & 222	795-838
224	861-882
220	905-923
216	924-942
234	1160-1178
212	1217-1235

Figure 4b. Northings and eastings of bad magnetics values in block 2
(sampled every 10th data point).

	Eastings (km) CM = 74 ⁰		Northings (km) Basalt = 0	
	Eastings (km) CM = 74 ⁰	Northings (km) Basalt = 0	Eastings (km) CM = 74 ⁰	Northings (km) Basalt = 0
	97.648	4272.281	80.808	4295.305
	97.163	4272.929	80.336	4295.994
	96.679	4273.576	79.865	4296.682
	96.195	4274.224	79.393	4297.371
	95.710	4274.871	78.921	4298.060
	95.226	4275.519	78.450	4298.748
	94.742	4276.167	77.978	4299.437
	94.258	4276.814	77.507	4300.125
	93.773	4277.462	77.035	4300.814
	93.289	4278.110	76.563	4301.503
	92.805	4278.757	76.092	4302.191
	92.320	4279.405	75.620	4302.880
	91.836	4280.053	75.149	4303.568
	91.352	4280.700	74.677	4304.257
	90.868	4281.348	74.205	4304.946
	90.383	4281.996	73.734	4305.634
	89.899	4282.643	73.262	4306.323
	89.415	4283.291	72.791	4307.011
	88.930	4283.939	72.319	4307.700
	88.446	4284.586	72.847	4308.389
	87.962	4285.234	71.376	4309.077
	87.477	4285.882	70.904	4309.766
	86.993	4286.529	70.433	4310.454
	86.509	4287.177	69.961	4311.143
	86.025	4287.825	69.489	4311.832
	85.540	4288.472	69.018	4312.520
	85.056	4289.120	68.546	4313.209
	84.581	4289.767	68.075	4313.897
	84.109	4290.415	67.606	4314.577
	83.637	4291.062	67.148	4315.223
	83.166	4291.709	66.691	4315.869
	82.694	4292.356	66.233	4316.514
	82.223	4293.003	65.776	4317.160
	81.751	4293.650	65.318	4317.806
	81.279	4294.297	64.861	4318.452
			64.403	4319.097

TOTAL INTENSITY MAP COMPILATION

We gridded the data on a north-south, east-west grid with a 4 km grid spacing using an iterative minimum curvature program which minimizes the sum of the second horizontal derivatives to obtain the values at the grid points (Webring, 1981). A 4 km grid spacing was chosen because it was compatible with most of the flight line spacing. Although there may be some aliasing in those areas where basement is shallow most of the survey was flown where basement was sufficiently deep to prevent aliasing. Figure 5 is a sample of a machine contoured map made from the gridded data. The map is on a Universal Transverse Mercator projection with a central meridian of 74° and a base latitude of 0° . Where the flight line spacing was large we have left gaps in the contour map so that the accuracy of the contours is not misrepresented in those areas. A tape containing the data, unprojected and gridded at a $.036^{\circ}$ interval (approximately a 4 km spacing), is available from the National Geophysical and Solar-Terrestrial Data Center (N.O.A.A., Boulder, CO 80303). The format for this tape is described in Appendix B.

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APPENDIX A

Digital Magnetic Tapes

LKB provided us with 20 tapes, one tape for each of the 18 blocks (containing data for all lines and tie-lines included in the block) as well as 2 tapes containing only tie-line data. Copies of these tapes are available from the National Geophysical and Solar-Terrestrial Data Center (address: Solid Earth Geophysics Division, Code D62, EDIS/NGSDC, N.O.A.A., 325 Broadway, Boulder, CO 80303).

The tapes are 9-track, EBCDIC, with a density of 800 BPI. The data are formatted as follows:

1. Tape Header (first record on tape)
(block length: 72 characters)
12 words (6 characters/word)
 - 1 - job number
 - 2 - reel number
 - 3 - 12 - alphameric label

2. Line Header
(block length: 234 characters)
39 words (6 characters/word)
 - 1 - Julian day
 - 2 - line number
 - 3 - line azimuth (degrees)
 - 4 - time of first sample (tenths of seconds)
 - 5 - time of last sample (tenths of seconds)
 - 6 - number of samples
 - 7 - total number of records containing data
 - 8 - sample rate (tenths of seconds)
 - 9 - 20 - not applicable
 - 21 - record number giving location within the several data records that follow of the record containing observed total field data
 - 22 - record number for radar altimeter data
 - 23 - record number for barometric altimeter data
 - 24-25 - not applicable
 - 26 - record number for ground station total magnetic field data
 - 27 - record number for adjusted total field data
 - 28 - record number for UTM eastings (inches)*
 - 29 - record number for UTM northings (inches)*
 - 30-39 - not applicable

* Note: LKB compiled their contour maps using the standard central meridians for areas I, II, and III, however, when they combined the entire data set they recalculated all eastings and northings using 74°W as the central meridian. The standard central meridian, 69°W, was retained for the Cape Cod block. The base latitude for all blocks was 0°.

3. Data Records
(block length: 7200 EBCDIC characters)
9 characters/word
"9"s are used as pads where no data have been recorded

APPENDIX B

The gridded data are contained on one tape. Copies are available from the National Geophysical and Solar-Terrestrial Data Center (address: Solid Earth Geophysics Division, Code D62, EDIS/NGSDC, NOAA, 325 Broadway, Boulder, CO 80303).

Tape description:

tracks:	9 track
density:	800 BPI
recording mode:	ASCII
logical record length:	3584 bytes
blocked record length:	3584 bytes
number of records:	409
label:	unlabeled

Format:

Header Record:	(contains 9 items)	(A56, A8, 3I8, 4E16.7)
1	name of gridded file	MAGTOT.036DG
2	program that created file	MIN-CURV
3	number of columns of data	448
4	number of rows of data	408
5	number of 36-bit binary words/data element	1
6	position of first column of data (lon)	-0.8147E+02
7	column spacing	0.360E-1
8	position of first row of data (lat)	0.2750E+02
9	row spacing	0.360E-1

Data records: (448F8.0)

Each record contains one row of gridded data. Missing data are indicated by 9999999.