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OPEN FILE REPORT

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Marine Magnetometer Measurements

Gulf of Almeria

by

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Gulf Of Almeria
ADARO-USGS Project, 1974

Summary

Total field magnetic intensity measurements and concurrent seismic reflection profiles were collected in May 1974 aboard the B.H. Pollux, of the Instituto Hydrografico de la Marina, in the Gulf of Almeria, Spain, as a cooperative project between the U.S. Geological Survey and the Empresa Nacional ADARO de Investigaciones Mineras, S.A. (ENADIMSA). This report presents the magnetometer data in the form of a contoured map, and two sets of profiles.

The magnetometer data show that in general, the grain of the magnetic field trends southwest, conforming with the geologic structure as interpreted from seismic reflection profiles. A southwesterly trending set of anomalies marks the location of a fault zone (identified as Almeria fault zone A by J.C. Lucena and H.G. Greene, unpublished data, 1974) which extends onshore northwest of Cabo de Gata. Anomalies greater than 200 gammas in amplitude which occur south and southwest of the Cabo de Gata and greater than 150 gammas southwest of the Campo de Dalias probably result from underlying volcanic rocks.

Magnetic storms during the period of ship operations decreased the possible precision of the magnetometer data. Attempts to correct for temporal variation by comparing the marine magnetometer data with station magnetometer data from the Observatorio Geofisico de Almeria were not entirely successful. We have been unable to contour most of the area at

less than a 50 gamma contour interval.

Collection and Processing of the Magnetometer Data

The survey was made aboard the B.H. Pollux in the Gulf of Almeria during the period of 4 to 20 May, 1974. Marine proton precession magnetometer readings to one gamma accuracy were recorded at 6 second intervals in analog form on a paper strip chart and digitally on magnetic tape. Processing was done by computer from the data on magnetic tape. The magnetometer data were merged with navigation data (15 minute Raydist fixes) to provide geographic coordinates for each measurement so that the International Geomagnetic Reference Field could be removed. A constant 175 gammas had to be subtracted to bring the general residual level closer to zero. A "gradient" filter was used to attempt to eliminate periodic sequences of noise that had been introduced by simultaneous operation of the magnetomer with a 30 kj sparker. This filter rejected points which would create a magnetic gradient greater than 2000 gammas/km in high gradient areas, and 600 gammas/km elsewhere. These values exceed reasonable maximum gradients for the data. This procedure reduced the number of bad points, but a few data intervals had to be deleted altogether. Data resulting from this processing step are shown as "Shipboard Data" on the profiles of magnetic data which accompany this report (Figure 2). Plots of these data show a mean error of 18 gammas at track crossings. Inspection of records from the Observatorio Geofisico de Almeria at Lma. de la Molineta for May, 1974, revealed large magnetic storm disturbances. These station magnetometer records, in analog form, were manually digitized at irregular intervals between 2 and 30 minutes, as closely as practicable considering the scale of the available records. Total magnetic intensity calculated from the station

magnetometer records are shown on the profiles of Figure 2 as "Temporal Variation". Deviations from the mean of these station data were then used to correct the shipboard data to a common datum. The resulting corrected profiles are labeled "Corrected Data" in Figure 2.

Visual comparison of the temporal variation and corrected data suggests that the temporal variation has not been entirely removed from the shipboard data. The mean track crossing error of the corrected data is 10 gammas, with a standard deviation of 16 gammas about the mean. The greatest temporal variation seems to have occurred during the survey of the northwestern part of the area. The data from that area proved to be the most difficult to contour, although they lie closest to the land magnetometer station where the correction procedure should be most effective.

Results

The data we presented by means of a contour map and two sets of profiles (Fig. 1, 2, 3).

The contour map (Fig. 1) shows a NNE regional trend of magnetic anomalies. The anomalies are generally less than 50 gammas in amplitude; however, areas of higher amplitude anomalies are found southwest of the Cabo de Gata (greater than 200 gammas) and southwest of the Campo de Dalias(greater than 150 gammas). Sets of linear anomalies, which lie along fault zones identified in seismic profiles by J.C. Lucena and H.G. Greene (unpublished work, 1974) are difficult to see on the contour map because of the wide contour interval, but are more apparent in the magnetic profiles (cf. Fig. 3, lines 6A, 8A, 12, 13, 14).

Profiles of all the magnetic data acquired are shown in Figure 2. Judgements of data quality on any particular line may be made by comparing

the corrected data with the shipboard data and temporal variation.

Because the ship moved at varying speeds, profiles of magnetic intensity vs. time (Fig. 2) may not show gradients which are relatively comparable. Figure 3 shows profiles of corrected magnetic data vs. distance along several lines for which their are seismic profiles interpreted by Lucena and Greene, and for which the temporal variation during collection was minimal.

We thank Alan Cooper for his helpful review of this report.

The magnetic data presented in this report (Fig. 2) will be available, after June, 1976, at cost of reproduction, on magnetic tape from the National Geophysical and Solar Terrestrial Data Center, Boulder, Colorado, U.S.A.

Accompanying Figures

Fig. 1 Map of Residual Magnetic Anomaly. Contour Interval 50 gammas. Contours dashed where uncertain. Fix points shown at 15 minute intervals along track lines of B.H. Pollux, May, 1974. Dashed tracklines indicate absence of magnetometer data. Fixes are annotated in ship time (Ship time minus 2 hr. equals GMT). Numbers and letters along tracklines are line designations. Line designations in large print show lines of magnetic profiles presented in Fig. 3.

Fig. 2 Profiles of Magnetic Intensity Data vs. Time. The six segments correspond with six consecutive periods of survey operations. Time in hours is annotated both in ship time (-2) and in GMT (z) so that the data may be compared with station magnetometer data (z) and with other shipboard data. Temporal Variation shows total magnetic intensity recorded at the Observatorio Geofisico de Almeria, relative to an arbitrary mean datum (42673 gammas). Shipboard Data shows magnetic intensity recorded on the

B.H. Pollux, with the International Geomagnetic Reference Field and a constant 175 gammas removed. Corrected Data shows shipboard data as corrected for Temporal Variation; see text.

Fig. 3 Profiles of Corrected Magnetic Intensity Data vs. Distance (km) for lines 3A, 4, 4A, 6A, 8A, 12, 13, 14. Location of these lines is shown on Figure 1. Horizontal scale is the same as Figure 1. Fix times are annotated in ship time (zone - 2) to correspond with Figure 1.

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Bruce Grant
MGGB Building
Cofe D621, NOAA
Environmental data Service
Boulder, Colorado

11 August 1976

Dear Bruce,

I am sending, under separate cover, 3 magnetics tapes per request of the U.S. Geological Survey (J. Robb and W. Dillon). The cruises covered are the Pollux Almeira and the Pollux Alboran; the data type is magnetics. The standard DDL data history form has been enclosed, so you'll know exactly how the data was worked up -- as well as a relevant program, subroutine, "Open File Report", format key, tape file log, and a summary of how the diurnal correction was applied.

What I'm sending is different from what you usually get from us. Tape #1 contains the diurnal correction data for both Pollux Almeira and Alboran -- it is not blocked. Tape #2 is pre-diurnal Pollux Almeira magnetics, blocked as follows: 1 logical record = 76 characters; 1 physical record = 25 logical records. Tape #3 is a standard DDLS blocked tape containing 6 files of diurnally corrected Pollux Almeira data, and 1 file of Pollux Alboran data without the diurnal correction.

Tape #3 is in our standard library tape (DDLS) format; and tape #2 can be read as CALCM format, it's not exactly CALCM but close enough. Tape #1 -- well, you'll have to refer to the sheet entitled "Supplimental Data Processing Notes..." to decipher that one.

We will be sending you some WHOI navigation data next week: it will definitely be less complicated than this latest batch.

Keep smiling,

Jane Kroll
Digital Data Library
Dept. of Geology & Geophysics

enclosures
cc: J. Robb

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G & G DATA LIBRARY

DATA HISTORY FOR DIGITAL AND ANALOGUE DATA

DATA TYPE Magnetics

CRUISE Pollux Almeria/Alboran LEG All CHIEF SCIENTIST J. Robb and W. Dill

DATES 4/5/74-24/5/74

DATE RECEIVED IN PRELIMINARY FORM: J. Robb and W. Dillon, U.S.G.S., July 1974

DATA CONDITION, EXPLANATION OF GAPS, DATA PROCESSORS, ETC.

The data processing of the magnetics and navigation data from the Pollux Almeria and Pollux Alboran cruises was very extensive. The data processors were R. Groman and S. Gegg from the DDL and others from U.S.G.S.

Navigation: The navigation data was digitized and verified using a computer program. Plots of the digital data were compared with original plots. All discrepencies were corrected.

Magnetics: The magnetics data were acquired automatically onto 7-track magnetic tape. The sampling interval was initially every three seconds but later lengthened to every 6 seconds. These 7-track tapes were reformatted to the WHOI AQUI format preserving only the 6 second data. This time series magnetics data were merged with navigation (program CALCMMOD) at which time a regional field value was calculated and subtracted from the measured field value to yield a total magnetic anomaly for each data point. New computer software was written (the DDLEDIT routines) to convert the data from local time to GMT; to delete bad sections of data; and to check for jump in field value, the

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cc: DATE FORMS FORWARDED TO BELOW

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magnetics group
gravity group
NGSDC
OIP

*SEE DDL FOR DISTRIBUTIONS SUBSEQUENT TO THIS DATE

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DATA HISTORY FOR DIGITAL AND ANALOGUE DATA

DATA TYPE Magnetics

CRUISE Pollux Almeria/Alboran LEG All CHIEF SCIENTIST

DATES

DATE RECEIVED IN PRELIMINARY FORM:

DATA CONDITION, EXPLANATION OF GAPS, DATA PROCESSORS, ETC.

gradient check - as

$$\frac{\text{current anomaly value - previous anomaly value}}{\text{current distance - previous distance}}$$

Because different sections of the data had different acceptable gradient values, J. Robb checked the profiles of the data and chose appropriate values for the maximum allowable gradient check value. The dates and corresponding gradient check value (gammas/kilometer) are shown below. All data dates not explicitly stated were checked against 400 gammas/km.

DATES (local time)	Gradient Check
0605740515-0605740645	2000
0905741330-0905741430	2000
0905742330-1005740445	1000
1105740900-1105740930	2000
1105741430-1105741545	2000
1105742300-1205740230	2000

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DATA HISTORY FOR DIGITAL AND ANALOGUE DATA

DATA TYPE Magnetics

CRUISE Pollux Almeria/ Alboran LEG All CHIEF SCIENTIST _____

DATES _____

DATE RECEIVED IN PRELIMINARY FORM: _____

DATA CONDITION, EXPLANATION OF GAPS, DATA PROCESSORS, ETC. _____

DATES (local time)	Gradient Check
1205740415-1205740430	1000
1205740430-1205740530	2000
1205740530-1205740645	1000

The data deleted were between 0405742000 to 0405742140 and 1405741021 to 1405741040. The time zone connection was made as follows:

local time = GMT + 2

The Pollux Almeria data were corrected for diurnal correction using the computer. Although diurnal correction data do exist for Pollux Alboran data, the corrections were not applied. The DDLS library tapes contain the diurnally corrected Pollux Almeria data (in 6 parts) and the diurnally uncorrected Pollux Alboran data (in 1 part). The diurnally uncorrected Pollux Almeria data will be sent to NGSDC so they may have it on file. It is in a modified CALCM format but can be read with the standard CALCM format specification. Also, the diurnal correction station data will be sent to NGSDC for their records.

Mean value used in the diurnal correction was 42672.5 gammas.

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DATA HISTORY FOR DIGITAL AND ANALOGUE DATA

DATA TYPE Magnetics

CRUISE Pollux Almeria/Alboran LEG All. CHIEF SCIENTIST _____

DATES _____

DATE RECEIVED IN PRELIMINARY FORM: _____

DATA CONDITION, EXPLANATION OF GAPS, DATA PROCESSORS, ETC. _____

Included in the documentation is a listing for subroutine GETX which reads the station data format. Included also is the listing for program MAGGOT used to calculate the total magnetic intensity for the land based station magnetometers from the raw component values.

An 'Open File Report' by J. Robb et. al., June 1976 entitled "Marine Magnetometer Measurements Gulf of Almeria" has been written.

Signed: Robert C. Groman, 20 July 1976

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SUPPLEMENTAL DATA PROCESSING NOTES FOR

POLLUX ALBORAN - POLLUX ALMERIA

CALCULATION OF THE DIURNAL CORRECTION VALUE

Program MAGGOT calculated the total magnetic intensity at a land based station magnetometer from the component values TMEAS, HMEAS, and ZMEAS. The formula used is as follows:

```
HCAL = (26584.0 - (4.62*HMEAS)) + ((TMEAS - 20.0)*18.4)

ZCAL = (33292.0 + (3.82*ZMEAS))

TMAGINT = SQRT((HCAL**2) + (ZCAL**2))
```

The results were output with the following FORTRAN write statement:

```
      WRITE(KTAPE,1010) JDA,JMO,JYR,JTIME,ITZ,TMAGINT,HCAL,
     &   ZCAL,TMEAS,HMEAS,ZMEAS

 1010 FORMAT(3I2,I4,1X,I3,1X,F7.1,1X,F7.1,1X,F7.1,19X,F5.1,
     &   1X,F4.1,1X,F4.1)
```

where JDA, JMO, JYR, JTIME and ITZ are the day, month, year, time in GMT and time zone respectively.

The component values TMEAS, HMEAS, and ZMEAS were digitized by USGS personnel at approximately 15 minute intervals. Values in between these values were linearly interpolated and applied to the magnetic anomaly data at each point.

The final revision date of program MAGGOT is 31 March 1975. The programmer was Steve Gegg.

Robert C. Groman
9 August 1976