Section 7: Magnetics

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7.1: Overview--Near Equator Magnetic

In order to understand the magnetic data we collected over the study area, it is useful to review some basic principles of geomagnetism at low latitudes. The magnitude of the geomagnetic field is near its minimum value for the earth, ~30,000nT, due to the low density of flux lines at the equator compared with the poles. The magnetic field at the equator is all in the horizontal component, compared with the poles where it is in the vertical. Anomalies over high magnetisation bodies are negative at the equator because of a 180° phase transition from the poles to the equator (i.e. same feature at the poles would have a positive anomaly).

Surveys of a N-S trending feature are more difficult at the equator than at higher latitudes because the magnetic flux lines are parallel to the sides of the magnetic body. Therefore, along a body such as the EPR (which we can assume as infinite in the N-S direction at the study area), we do not get any edge effects, and consequently no anomaly, that would normally result from the intersection of the flux lines and the north and south poles of the body. We do see an anomaly from profiles in an E-W direction, but it is of very small amplitude due to weak edge effects along the sides of the body. However, an E-W trending feature (such as the Incipient Rift) has strong edge effects and a large anomaly along profiles in a N-S direction because we see the intersection of the flux lines all along the north and south poles of the body.

7.2: Survey Specifications

Magnetometer: Proton Precession Magnetometer (x2, old and new), measures total magnetic field
Sampling Frequency: 4sec
Raw data files sampling frequency: 60sec
Expected accuracy:1nT
Using Maurice Tivey's matlab program magfd.m:
Lat:2° 40'N
Long:101° 55'N
Inclination:20.62
Declination:8.09
IGRF field: 32,495nT
 x-component: 30,109nT
 y-component: 4284nT
 z-component: 11,446nT

7.3: Daily Log

Thursday, August 8th(220)

New magnetometer deployed for a test run after a successful short test run in the harbor. This magnetometer had already been sent back to the manufacturer twice after bad data recorded on previous cruises, but no problems could be found.
Test Information
Lat: 28° 33.6'N
Long 115° 47.7'W
Inclination: 52.8
Declination: 11.8
IGRF field: 44,925nT
The new magnetometer was on for three hours and collected good data, Total magnetic field values were as expected from IGRF value above.

Friday, August 9th(221)

Seabeam survey begins. Magnetometer in the water at 1530GMT, and collected good data for ~half an hour then began to give bad data values consistently around 19,000nT. Bad data points became more frequent than good after some time. Seth had left instructions about manually tuning the scale, which we tried. At 1800GMT decided to bring in the new magnetometer and put out the old one. Old magnetometer out at 2000GMT. Collected good data for ~three and a half hours then the same bad data points appeared again. Seemed to improve when we set the manual tuning but the signal strength was hardly over 200. Bad data points seemed to correlate with low signal strength.

Saturday, August 10th(222)
Decided to switch off the magnetometer at 0130GMT. Switched on again at 0230GMT and collected good data for 15mins. Bad data again dominated after a while and it was switched off again at 0315GMT.
The electronics box was replaced as we suspected an overheating problem. The magnetometer was switched on again at 1430GMT and worked well from then onwards. Signal values high (>200) and tuning value appeared on the display (before it had been 0). Software seems happy in automatic tuning mode.
Magnetometer was run continuously for the rest of the Seabeam survey, until ~1700GMT on Wednesday, August 14th.

Wednesday, August 28th(240)
Seabeam and magnetics survey begun at ~0020GMT, new survey lines to fill in areas to the north-east.

Thursday, August 29th(241)
Discovered what may be a new spreading centre to the north east of the survey area. Continued the seabeam survey to include a perpendicular profile (N-S) across the feature to try and limit the boundaries of the feature . Survey stopped at 1807GMT

7.4: Data Processing
Using magfd.m the IGRF value for each data point were calculated and subtracted from the raw data to produce a plot of residual magnetic field (Figure 6.1). This was the only correction made to the data, a diurnal correction can be calculated if the data are requested from an observatory near the survey area. Range in bathymetric depth over the area is ~500m, therefore a terrain correction is probably not necessary.

7.5: Residual Magnetic Field (grid spacing 2min) Plot

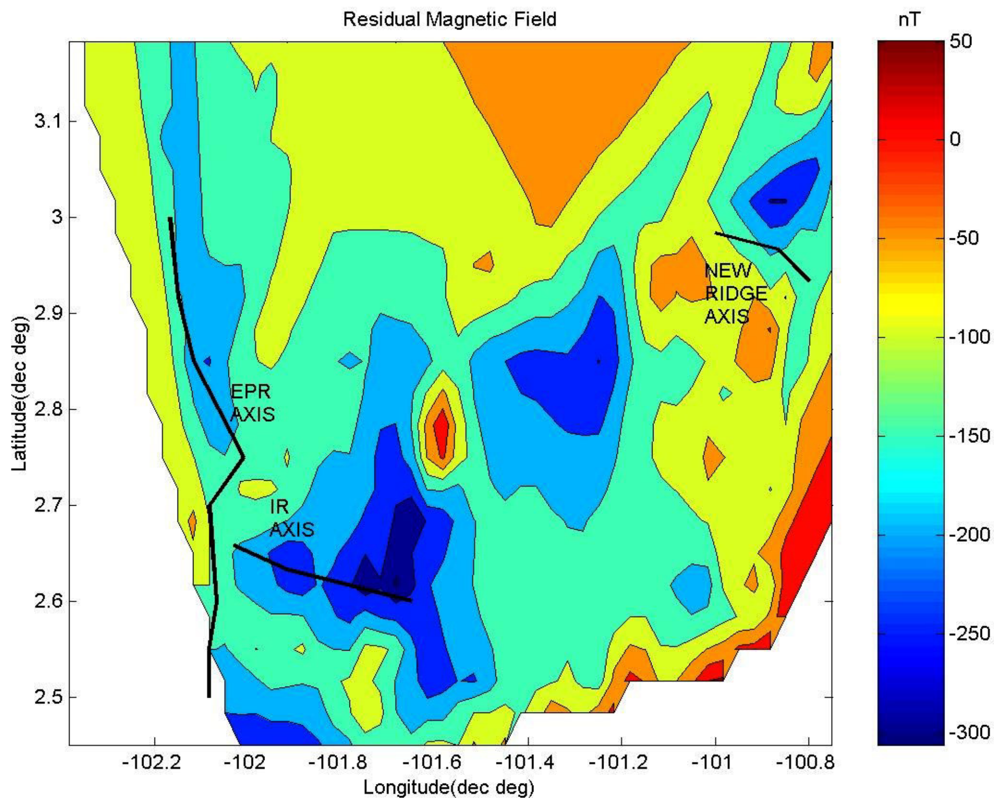

Figure illustrates several large amplitude negative anomalies we would expect for high magnetisation rocks along the axis of the Incipient Rift, East Pacific Rise and Pre-Incipient Rift (axes marked by black line). The maximum amplitude of the negative anomaly is ~350nT at the western end of the Incipient Rift. We can see that this negative anomaly is wedge shaped, mirroring the wedge shape of the feature we see in the bathymetry. The intrusive, (50nT) positive peak at 2.8N, -101.8W is located over the boundary between linear abyssal hills from the EPR and smooth bathymetry of the IR. The orientation of these abyssal hills is slightly different from those closer to the EPR axis, suggesting some change in spreading orientation or an overlapping spreading center. Due to the decay of magnetisation with time, from oxidization of the magnetic minerals, this positive anomaly may be caused by an old piece of EPR with low magnetisation compared with the younger IR crust surrounding it. Or it may be the remnants of a magnetic reversal strip. Based on half spreading rate of the EPR at 67km/Myrs this could be the Brunhes/Matuyama boundary(0.78Mya).

The increasing amplitude of the negative anomaly at the Incipient Rift suggests that there could be an increase in intrusive dykes or extrusive lava flows from west to east but these data need to be combined with the geochemistry and data from the camera pictures.

Section 8: Dredging and Wax Cores

8.1: Overview

During the cruise we occupied 53 dredge stations and 5 wax core stations. Of these, all but 5 dredges recovered samples suitable for chemical analysis. Additional glass samples were recovered by wax balls dropped during camera tows (see Figs. 9.1-9.13). The locations of all sampling sites are shown on the maps in Figs. 5.1 and 5.2. In addition, dredge and wax core locations are presented in the Appendix 1, and wax ball locations in Appendix 3. Lastly, a description of each sampling site, and the samples labeled for chemical analysis are presented in Appendix 2.

Using the four geographic and tectonic provinces discussed earlier, the sampling sites are as follows (moving from west to east):

A. East Pacific Rise
B. Linking Ridge (following Lonsdale's demarcation, from EPR to 101°59'W
C. The Magmatic Gore (transitional between the Linking Ridge and the Faulted Gore region to the east); from 101°59'W to 101°53'W.
D. The Faulted Gore; from 101°53' to the N-S EPR-parallel abyssal hills at 101°26'W.

8.2: Sampling (See Appendices 1 and 2 and Figs 5.1 and 5.2)

East Pacific Rise Sampling

Eight sampling sites were occupied along the East Pacific Rise within ~15 km of its intersection with the Incipient Rift. These include Dredges 1- 4 and 6, and Wax Cores 1-3. All sampling sites recovered fresh basaltic glass +/- whole rock lavas or sheet flows.

Linking Ridge Sampling

Ten sampling sites were occupied along the Linking Ridge. These include Dredges 5, 7-11, 15 and 16; and Wax Cores 4 and 5. All sampling sites recovered fresh basaltic glass +/- whole rock lavas or sheet flows. D16 recovered both older and younger looking rocks.

The Magmatic Gore

Seven sampling sites were occupied along the Magmatic Gore. These include Dredges 12-14, 17 and 19-21. All sampling sites recovered basaltic glass +/- whole rock lavas, sheet flows or massive rock. Compared to lavas from the EPR and Linking Ridge, the quality of glass and freshness of whole rock was generally somewhat lower within the Magmatic Gore.

The Faulted Gore

Thirty-three sampling sites were occupied along the Faulted Gore. These include Dredges 18, 19, 21-52. Some time was spent through both dredging and camera tows searching for the locus of magmatism within the Faulted Gore. It was discovered that the locus of magmatism is constrained to a narrow zone which runs along the south of the Gore, just north of the faulting that defines the southern limit of the gore. The presence and freshness of basaltic glass and freshness of whole rock samples generally decreased eastward, although our easternmost dredge (D52; ~66 km from the EPR) within the Gore nevertheless recovered thin but largely palagonitized glass. Five dredges were empty.

Stein Seamount

One sampling site (Dredge 53) was occupied on the Stein Seamount, located at approximately 2°45.5'N 101° 30'W. No igneous sample was recovered in this dredge.