SOURCES OF NEAR SIDE LUNAR MAGNETIC ANOMALIES. Nicola C. Richmond, Lon L. Hood, *Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721-0092, USA, (nic@lpl.arizona.edu)*, J. S. Halekas, D. L. Mitchell, R. P. Lin, *Space Science Laboratory, University of California, Berkeley, California 94720, USA*, M. H. Acuña, *NASA Goddard Space Flight Center, Greenbelt, Maryland 20771, USA*, A. B. Binder, *Lunar Research Institute, Tucson, Arizona 85747, USA.*

Introduction. Preliminay mapping and interpretation of lunar crustal magnetic anomalies using Lunar Prospector magnetometer data was recently carried out by Hood et al. (1). That study considered the nearside anomalies at Reiner Gamma and Rima Sirsalis, and the magnetic anomaly groups antipodal to Imbrium and Crisium. Nearside anomalies have also been studied using Lunar Prospector Electron Reflectometer data (2). It was reported that moderate strength anomalies were associated with basin ejecta formations, and a previously unmapped anomaly located close to the Apollo 16 site was presented. Both studies indicated that the well known Reiner Gamma and Rima Sirsalis anomalies are associated with basin ejecta. In this paper, we report results obtained using the Lunar Prospector magnetometer for a number of strong, isolated nearside anomalies. With the exception of the anomaly close to the Apollo 16 landing site, the features discussed have not been identified previously.

Mapping Method. Data obtained by Lunar Prospector during 1999 have been used to produce magnetic anomaly field maps. Data from time intervals when the external field variations were minimised have been converted to a lunar radial, east and north coordinate system. All orbits were then examined for noise to remove any remaining external field disturbances. A moving boxcar algorithm was used to smooth the data to produce vector field maps along the curved surface defined by the spacecraft altitude. The maps were then continued to constant altitude to enable direct comparison of anomaly magnitudes at different locations. The continuation was carried out using a method which assumes that all fields fall off as the inverse of the altitude to the x power. Two Lunar Prospector maps were selected which provided coverage of the same area at two altitudes. The altitude continuation method was then applied to the low altitude data set and the value of x varied until the corrected data showed good agreement with the high altitude data. Values of x were determined for each area of interest and the resulting values were then used to continue the maps to any required altitude.

Near Side Anomalies. In addition to the well known Reiner Gamma and Rima Sirsalis anomalies, the Lunar Prospector magnetometer identified a number of other strong, isolated nearside anomalies.

A. 11°S, 16°E. A strong anomaly was identified at approximately 11°S, 16°E. This is close to the Apollo 16 landing site (8.97°S, 15.50°E) and has been identified by previous work (2). The anomaly appears to correlate with a region of Cayley and Descartes Formation, which has been interpreted as Imbrium primary/secondary basin ejecta (3).

B. 18°S, 3°E. Figure 1 presents an overlay plot of the magnetic field at this location (altitude = 27.5 km) and the geology. It can be seen that the anomaly appears to correlate

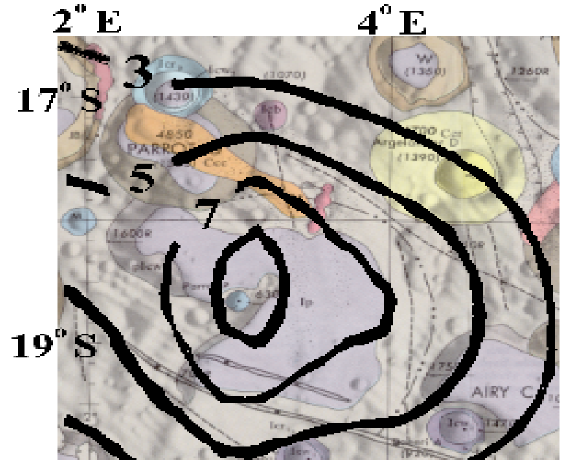

Figure 1: An overlay plot of the magnetic field and geology (reproduced from 4) of the area at 18°S, 3°E. Contour intervals are 2 nT.

with an Imbrium plains unit (mauve on the geological map). Holt (4) interprets this unit as impact ejecta (including Imbrium basin ejecta), with a possible minor volcanic component.

C. 15°S, 51.5°E. An anomaly has been identified on the edge of Mare Fecunditatis at 15°S, 51.5°E. Figure 2 presents the magnetic field plot for this area at an altitude of approximately 16 km. This area corresponds to a region of pre-Imbrium cratering and more recent Imbrium cratering as shown in Figure 3. The latter impacts have been interpreted as possible secondary impacts related to the formation of the Imbrium basin (6).

D. 32°S, 87°E. This anomaly occurs over a relatively complex geological region on the edge of Humboldt (7). This area includes mare materials and seconday impact craters, both of Imbrium age. There is no clear association between a particular geological feature and the magnetic anomaly.

E. 37°S, 5.5°E. This feature appears to overlay an area of Imbrium/pre-Imbrium terra, pre-Imbrium crater wall materials and Imbrium plains (8). There is no clear geological correlation.

F. 40°S, 3°E. As for the previous feature there is no clear correlation between any geological unit and this anomaly. The area includes Imbrium/pre-Imbrium terra and Copernican satellite crater materials (8).

Discussion. Anomaly A appears to correlate with an area of Cayley and Descartes Formation materials. Previous work on the Reiner Gamma and Rima Sirsalis anomalies (for example 1, 2 and references therein) have indicated that both of these features are associated with Imbrium basin ejecta. The

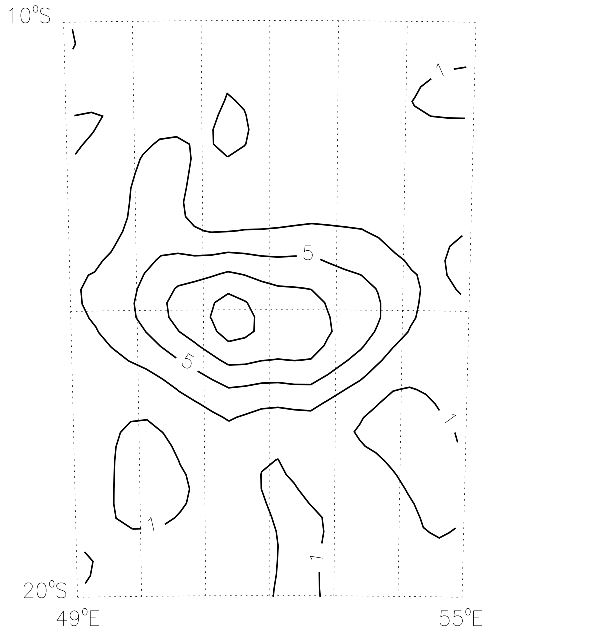

Figure 2: Magnetic anomaly plot of the area at 15°S, 51.5°E.

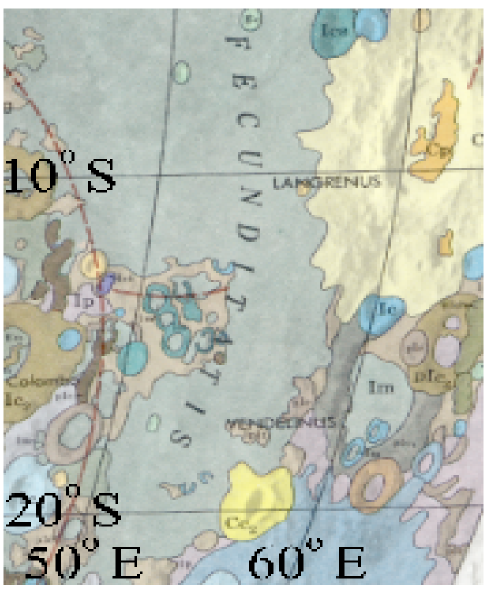

Figure 3: Geology of the area at 15°S, 51.5°E (reproduced from 5).

Cayley and Descartes Formations have been interpreted as primary/secondary Imbrium ejecta and the correlation between these units and a strong magnetic anomaly supports an impact ejecta origin to the nearside anomalies. This is further supported by Anomaly B which shows good correlation with a geological unit interpreted to be impact ejecta.

However, questions remain regarding these correlations. Particularly why some areas of impact ejecta are magnetized and others are not. While a mechanism has been proposed to explain anomaly groups antipodal to young basins there is no model which explains the isolated anomalies present on the Near Side. The antipodal anomalies have been proposed to have formed in the presence of a magnetic field which was concentrated antipodal to the basin by a plasma cloud generated during the impact (9). There are questions regarding this mechanism, and it is possible that it could be a turbulent process leading to localized field amplifications as the plasma cloud expands. It is possible that this could lead to the magnetization of small areas of impact ejecta as is seen on the Near Side.

Not all of the anomalies identified in this study correlate clearly with basin ejecta. In part this could be the result of difficulties caused by the complex geology in those areas. Certainly impact ejecta is present, but the anomalies cannot currently be shown to be associated with the ejecta. It has been shown that some older terranes exhibit moderate magnetization (2) which may explain what we are seeing in the magnetometer data. However, this seems unlikely given the strength of the anomalies and how isolated they are. Alternatively, it is possible that a thin layer of ejecta blankets the geology which is not shown on the geological maps, but could be the source of the magnetization.

Summary. Lunar Prospector magnetometer data has been used to identify a number of nearside magnetic anomalies. Some of the features identified appear to correlate with impact ejecta, supporting a basin ejecta origin to the nearside anomalies. In other cases the correlation between the magnetic anomalies and surface geology is less clear.

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