A NEW ANALYSIS OF THE LUNAR PROSPECTOR MAGNETOMETER DATA: APPLICATION TO THE STUDY OF REINER GAMMA-TYPE SWIRLS. Nicola C. Richmond[1,2], Lon L. Hood[1] and David T. Blewett[3], [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, Az, 85721, USA (nic@lpl.arizona.edu, lon@lpl.arizona.edu), [2]Planetary Science Institute, 1700 E. Ft Lowell Suite 106, Tucson, Az, 85719, USA, [3]NovaSol, Honolulu, Hawaii, USA.

Introduction: We present new mapping results using the low altitude (~18-35 km) Lunar Prospector magnetometer (LP-MAG) measurements obtained in 1999. Previous work using this data has yielded coverage of only ~40% of the lunar surface [1, 2]. Studies using that data have investigated magnetic, geologic and albedo correlations at basin antipode locations, and attempted to identify source terranes for strong, isolated nearside crustal anomalies [1, 2, 3]. However, the limited coverage available has restricted the studies that could be carried out. Many questions remain unanswered regarding the age and origin of the magnetization and the relationship between crustal magnetization and albedo. For example, high albedo swirls of the Reiner Gamma-type have been mapped on regions of the Moon for which magnetometer coverage is not available [4]. In order to fully investigate the possible association between albedo and magnetization, improved data coverage is necessary.

New Mapping Results Using the LP-MAG Measurements: The method used to produce the new maps follows from [1, 2]. However, the approach used here differs in two key ways from those studies. First, no data were rejected based only on the location of the Moon relative to the magnetosphere or the location of the spacecraft relative to the Moon. Second, looser noise criteria were used for areas where we have no coverage. Passes with minor noise can still be useful for putting limits on the possible magnitude of crustal sources, even if crustal sources are not detectable over the noise.

Figure 1 compares the coverage obtained in earlier constant altitude studies using all low altitude passes [1, 2] with the coverage obtained from the new processing using 169 ascending passes from July 1999 only. Using just this subset of data, it is clear from Figure 1 that we have already obtained improved coverage over previous work. Large-scale maps, using other data from 1999, have been produced which fill some of the gaps in Figure 1B. These will be presented at the meeting.

Application of the New Mapping Results to the Study of High Albedo Lunar Swirls: Unusual high albedo swirls have been identified on the moon at a number of locations. Typically, these swirls are bright sinuous regions, exhibiting a variety of patterns with a scale ranging from meters to kilometers. The largest concentrations have been mapped antipodal to the similarly-aged Orientale (Figure 2), Imbrium and Crisium basins [e.g. 5, 6]. Other swirls have been identified at Reiner Gamma [7], near the crater Airy [4] and near Mare Moscoviense [4, 8].

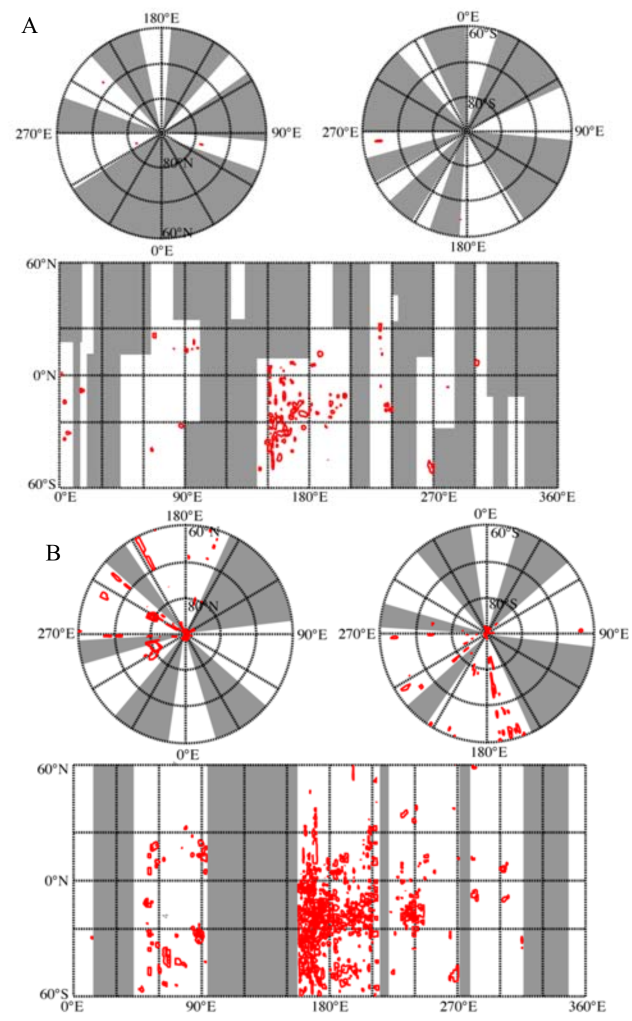

Figure 1. A: Coverage from the mapping of [1, 2]. B: Coverage obtained from the new processing, produced using reprocessed data from July 1999 only. Note the improved coverage, particularly over the northern far side. The red lines show the general distribution of magnetization. Differences between A and B are due to altitude differences in the data plotted. Maps of the crustal anomalies will be presented at the meeting.

Various explanations have been offered for the swirls, including surface scouring by a recent cometary impact [9, 10], meteoroid swarm impact [11] and magnetic shielding of the regolith by the crustal magnetization [12]. In all of these areas there is evidence of strong crustal magnetization, identified by the LP-MAG and/or the LP electron reflectometer experiment [1, 2, 3, 4, 13]. Currently only the cometary impact and magnetic shielding mechanisms of swirl formation are able to explain both the magnetization and albedo. However, the origin of the swirls remains poorly understood.

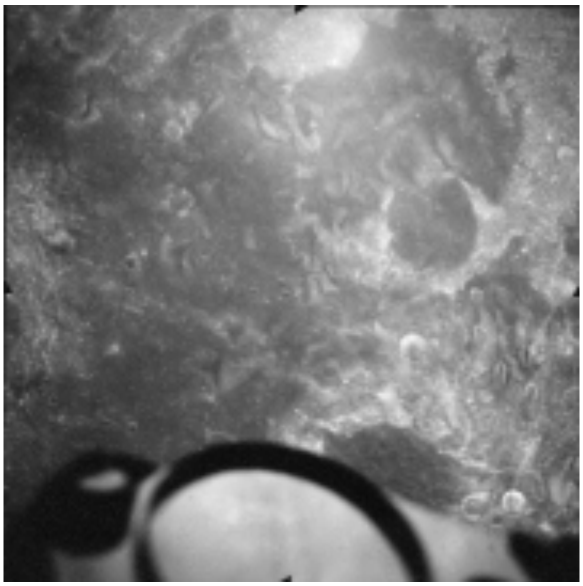

Figure 2. The Mare Marginis region antipodal to the Orientale basin. High albedo sinuous swirls can be seen throughout this area, overlaying both mare and highland terranes (Apollo 17 frame AS17-M-0264).

Analysis using earlier magnetometer mapping results has investigated the correlation between crustal magnetization and albedo in basin antipode areas and at the Descartes Mountains near the Apollo 16 landing site [2, 3]. However, those studies were limited due to the incomplete magnetometer coverage. For example, coverage was not available over the full distribution of swirls antipodal to Orientale [2, 5] and for other regions with swirl markings [4] there was no magnetometer coverage at all. Further, it has been shown [14] that it may be possible to determine the existence of mini-magnetospheres over the lunar anomalies by comparing maps obtained when the spacecraft is either in the solar wind or in the sheltered geomagnetic tail region. Previous mapping [1, 2] did not use measurements obtained when the spacecraft was in the solar wind.

The improved mapping reported here offers new insights into the association between high albedo swirls and crustal magnetization by (1) providing improved coverage over regions where high albedo swirls have been mapped; and, (2) providing maps over the same crustal anomalies at different solar wind conditions.

We will discuss (1) progress towards a global LP-MAG map; (2) improved correlation results between magnetization and albedo at the Orientale antipode; and, (3) a comparison between maps of crustal magnetic anomalies obtained at different external conditions (for example, when the spacecraft was in the solar wind or in the tail region). These results may further improve our understanding of the relationship between albedo and magnetization, and the way in which crustal magnetic anomalies on the Moon interact with the solar wind.

References: [1] Hood L. L. et al. (2001) *JGR, 106*, 27,825-27,839. [2] Richmond N. C. et al. (2005) *JGR, 110*. [3] Richmond N. C. et al. (2003) *GRL, 30,* 1395-1398. [4] Hughes, C. G. et al. (2006) *LPSC XXXVII*, Abstract #1230. [5] Wilhelms D. and El-Baz F. (1977) *U.S. Geol. Surv. Misc. Geol. Invest. Ser.* Map I-948. [6] Hood L. L. and Williams C. R. (1989) *Proc. Lunar Planet. Sci. Conf. 19th*, 99-113. [7] Hood L. L. (1980) *Proc. Lunar Planet. Sci. Conf. 11th*, 1879-1896. [8] Craddock R. A. et al. (1997), *LPSC XXVIII*, 265-266. [9] Gold T. and Soter S. (1976) *Planet. Space Sci., 24*, 45-54. [10] Schultz P. H. Srnka L. J. (1980) *Nature, 284*, 22-26. [11] Starukhina L. V. and Shkuratov Y. G. (2004) *Icarus, 167*, 136-147. [12] Hood L. L. and Schubert G. (1980) *Science, 208*, 49-51. [13] Halekas J. S. et al. (2003) *Meteoritics & Planet. Sci., 38*, 565-578. [14] Kurata M. et al. (2005) *Geophys. Res. Lett., 32*, L24205.