Geophysical Research Abstracts
Vol. 12, EGU2010-14842, 2010
EGU General Assembly 2010

Magnetic Signatures of Nectarian-Aged Lunar Basin-Forming Impacts: Probable Evidence for a Former Core Dynamo

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Previous analyses of Lunar Prospector magnetometer (MAG) and electron reflectometer (ER) data have shown that impact processes played an important role in producing the observed crustal magnetization. In particular, the largest areas of strong anomalies occur antipodal to the youngest large basins and correlative studies indicate that basin ejecta materials are important anomaly sources. Models suggest that transient fields generated by the expansion of impact vapor-melt clouds in the presence of an initial solar wind magnetic field are sufficient to explain the antipodal anomalies (Hood and Artemieva, Icarus, v. 193, p. 485, 2008). However, analyses of ER data have also shown that some anomalies are present within Nectarian-aged basins including Moscoviense, Mendel-Rydberg, and Crisium (Halekas et al., Meteorit. Planet. Sci., v. 38, p. 565, 2003). These latter anomalies could be due either to thermoremanence (TRM) in impact melt or to shock remanence in the central uplift. The former interpretation would require a long-lived, steady magnetizing field, consistent with a core dynamo, while the latter interpretation could in principle be explained by an impact-generated field. Here, LP MAG data are applied to produce more detailed regional maps of magnetic anomalies within selected Nectarian basins. Anomalies within the Crisium basin, in particular, are located inside the inner rim edges and are clearly genetically associated with the basin (rather than being due to ejecta from younger basins superposed on Crisium). An analysis of the vector field components shows that the directions of magnetization of the two main sources are close to parallel within the errors of the modeling. These anomalies are therefore most probably due to TRM of impact melt that cooled in a steady, large-scale field. In addition, the paleomagnetic pole position calculated for the strongest and most isolated anomaly lies close to the present rotational pole. Assuming no true polar wander since the Crisium impact and that the lunar dynamo behaved similarly to presently existing terrestrial planet dynamos, they are therefore consistent with the existence of a lunar dynamo field.