Retrieving paleopoles using newly mapped lunar magnetic anomalies within basins

Joana S. Oliveira$^{1,2}$ and Lon L. Hood$^3$

$^1$ESTEC - European Space Agency, SCI-S, Noordwijk, Netherlands (joana.oliveira@esa.int)
$^2$CITEUC, Geophysical and Astronomical Observatory, University of Coimbra, Portugal
$^3$Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA

Orbital spacecraft magnetic field observations show that several isolated magnetic anomalies are found to be heterogeneously distributed over the lunar surface. The magnetic anomalies origin is still debated; however, it is largely accepted that an ambient core magnetic field was present during their formation. Contrary to previous studies, here we focus only on anomalies that are related to basins/craters, which correspond to the best possibility to hold ancient core field information. In particular, the basin rocks become thermoremanently magnetized as the melt sheet cools down slowly recording the ambient magnetic field that was present when the crater was formed.

We build regional magnetic field maps using data from quiet orbits of Lunar Prospector and Kaguya spacecraft. When comparing these regional maps to existing global models, several differences and details are discovered. Further investigation is required to understand why small scales are missing from global models. For each mapped crater, we perform inversions for the magnetization direction to estimate the corresponding paleopole position (defined as the north magnetic pole when the anomaly formed). In detail, a grid of dipoles is placed over the basin inner depression, where the melt sheet is believed to be. All dipoles have the same common direction, nonetheless different dipole moments.

Preliminary results show that paleopole positions of regionally mapped anomalies associated with craters are not in absolute agreement with previous paleopole studies. Also of significance is the distribution of dipoles obtained, which seem to be consistent with inferred impactor trajectories. We conclude that paleopole position results are highly dependent on the technique and choices we make to construct the magnetic field maps. Further studies of several other craters will be performed, but we expect large differences when using regionally mapped anomalies. Our results will help to better constrain the lunar ancient core field morphology.
