NECTARIAN PALEOMAGNETIC POLE INFERRED FROM KAGUYA SATELLITE MAGNETIC OBSERVATIONS OF THE CENTRAL LEIBNITZ BASIN.

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Introduction: The Nectarian age (3.8 – 4.2 Gyr) Leibnitz impact basin (center ~ [38˚S, 179˚E], diameter ~ 245 km) is located within the giant South Pole-Aitken basin. Careful screening for Kaguya orbital magnetic observations of the SELENE mission with minimal external field effects (e.g., [1]-[5]) revealed a prominent crustal magnetic anomaly across the central Leibnitz basin (Figure 1). Comparable central basin magnetic anomalies observed for several other Nectarian basins (e.g., Mendel-Rydberg, Nectaris, Bailly, Moscoviense, Crisium, Humboltianum) have been attributed to thermoremanent magnetization, and thus may provide important contraints on the Nectarian properties of the of the lunar core dynamo [5]-[8].

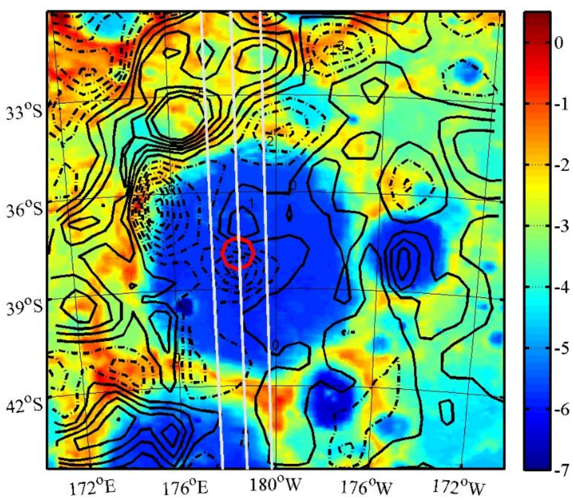

Figure 1: LOLA-inferred topography (color bar in km) of the Leibnitz basin with superimposed contours of gridded Kaguya vertical component magnetic anomalies (contour interval = 1 nT, solid contours are positive; dashed are negative). Three orbital tracks (white lines) strongly constrain the crustal affinity of the central basin anomaly, which was modeled for its magnetization attitude using the crustal disk outlined by the red contour.

Accordingly, the three-component central Leibnitz basin magnetic anomaly was modeled in selenographic coordinates for its possible magnetization attributes. Specifically, the central basin anomaly components were related to a 2-km thick, 30-km dimeter basin-centered disk with 2-A/m magnetization intensity. The resulting magnetization orientation implies a Nectarian north paleomagnetic pole (dynamo field lines radially outward) at roughly (41°S, 5°W). This paleopole falls within the midlatitude pole position cluster centered at (44°S, 8°E) for the Lunar Prospector anomalies and (35°S, 12°W) for the Kaguya anomalies that Takahashi et al. [9] obtained.

Analysis: The Kaguya data for this study were extracted from the later phase of the SELENE mission when the passes in the southern hemisphere at lower altitudes (~ 30 km) were subjected to quieter solar activity conditions. Using the lunar magnetic data screening and reduction procedures of [1], Kaguya tracks with maximum crustal effects across the central Leibnitz basin were extracted as shown in Figure 1.

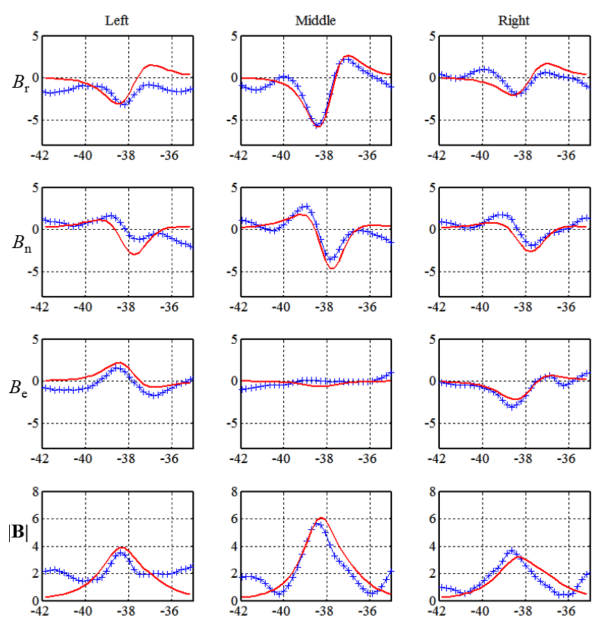

Figure 2: Comparison of the Kaguya-observed component anomalies (blue) for the left, middle, and right tracks in Figure 1 and the disk-modeled effects (red) over the central Leibnitz basin.

Iterative inversion related the radial B_r-, north B_n-, east B_e-, and total |B|-components of the central Leibnitz basin magnetic anomaly to the magnetic effects of the central disk modeled in selenoidal coordinates by Gauss-Legendre quadrature integration. As shown in

Figure 2, the analysis obtained a best-fit local magnetization inclination of +20˚ (downward) and declination of 5˚E. The analysis was conducted using the coordinate system with positive upward, northward, and eastward components.

Future works: Additional analysis of the Lunar Prospector and Kaguya magnetic data is needed to establish the presence and attributes of central basin magnetic anomalies of other Nectarian and Pre-Nectarian impact basins and large craters. These efforts also should be extended to Imbrian basins and large craters to help constrain the behavior of the core dynamo until ~ 3.6 Gyr.

Also, the geological context of the central basin magnetic anomalies needs to be further established because the geology controls the sign of magnetization's intensity contrast, and thus the signs of the magnetization's inclination and declination and related paleomagnetic pole.

References: [1] Richmond, N. C. and Hood, L. L. (2008) *JGR*, E02010. [2] Hood et al. (1981) *JGR*, 86, 1055-1069. [3] Tsunakawa et al. (2010), *Space Sci. Rev*. 154, 219-251. [4] Hemingway, D. and Garrick-Bethell, I. (2012), *JGR*, 117, E10012. [5] Hood, L. L. (2011) *Icarus*, 211, 1109-1128. [6] Halekas, J. S. et al. (2003) *Meteoritics & Planet. Sci., 38*, 565-578. [7] Mohit, P. et al. (2009) *Eos Trans. AGU 90 (22)*, Abstract CG22A-05. [8] Wiezorek, M. A. and Weiss, B. P. (2010) *LPS XLI*, Abstract #1625. [9] Takahashi et al. (2014), *Nature Geosci*., 7, 409-412.