CRUSTAL MAGNETIC FIELDS AND A BRIGHT ALBEDO ANOMALY AT LEIBNITZ CRATER

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Introduction: From the Apollo era, spacecraft remote-sensing has discovered that localized portions of the crusts are strongly magnetized [1]. Some lunar crustal magnetic anomalies are correlated with bright markings and dark lanes, known as swirls, which exhibit no distinct topography on the surface [2]. These sinuous high albedo markings and dark lanes such as Reiner Gamma, Mare Ingenii and Mare Marginis might be related to the near surface magnetic field structure. These fields form a mini-magnetosphere to reflect solar wind [2], or possibly result from fine dust grains lofted by induced electric fields [3, 4]. South Pole-Aiken (SPA) basin is the one of the most complicated and the oldest regions at the far side of the Moon [5]. Leibnitz (38.3˚S, 179.2˚E) is a 245 km diameter crater in SPA. It contains distinct crustal magnetic anomalies and a number of small regions of high albedo marking with uncertain origins. Previous studies have not been reported the Leibnitz crater as a swirl and a thorough study has not been performed. We have examined how the magnetic source is associated with unusual albedo marking at Leibnitz crater.

Methods: We used Lunar Prospector (LP) three axis magnetometer (MAG) data [6] 26th of May 1999 from 1:43:10 to 1:45:35, and Electron Reflectometer (ER) data [7] to investigate the magnetic anomaly at Leibnitz crater. Strong magnetic anomalies surround Leibnitz crater, but, a detectible magnetic field exists inside Leibnitz. The data include 22 measurements at 20 km altitude for MAG and 7 measurements at each-latitude for ER [8]. Data were selected when the Moon was in a magnetically quite time, in the geomagnetic tail or lunar wake. For examining the albedo anomaly, we use Clementine Ultraviolet / Visible data [9]. The Optical Maturity (OMAT) parameter is an experiential method for measuring maturity and ferrous iron content [10, 11]. It is obtained from the linear plot of reflectance at 0.75 μm versus the ratio of the reflectance at 0.95/0.75 μm. OMAT has been shown to be a distinctive property of swirls [3, 12].

Results: We have investigated the magnetic fields and OMAT at Leibnitz crater. In the Figure 1-top, MAG and ER total magnetic fields are illustrated. Circles and squares represent each data point. The MAG peak measurement is 9.82 nT (38.6˚S, 178.8˚E) in Figure 2-left (red asterisk) and the ER peak measurement is 29.56 nT (39˚S, 178.5˚E) in Figure 2-left (blue asterisk), at the middle of Leibnitz crater. The strength of the magnetic fields from MAG and ER are similar. On the Figure 1-bottom, the MAG magnetic fields are shown Radial and North-South, East-West components. The radial peak measurement is -9.34 nT at the same region of total magnetic fields. From these components of the magnetic field at Leibnitz crater, the field structure is a dominantly vertical dipole shape from the surface of the Moon, with the direction of magnetization downward. In the Figure 2, the data are taken from the rectangles on the OMAT map in the middle of Leibnitz crater. On the OMAT plot, the black pixels are background maturity trends and the magenta pixels show dark lane maturity trends. The trends exhibit similar slopes. On the other hand, blue, yellow, and red are taken from high albedo anomaly regions. These trends higher exhibit 0.75 μm reflectance that is immature compared to the background trend. They are similar to the trend observed a other swirls.

Discussion: In this study, we have found some evidence for association of optical anomalies and magnetic anomalies at the Leibnitz crater. These associations can be explained by swirl processes. Baek et al. discuss the depth of magnetic field sources [13, 14]. The Leibnitz crater may have magnetic fields sources near the surface, similar to other mare swirls. However, many strong magnetic fields regions also exist near Leibnitz, such as Mare Ingenii, Van de Graaff crater and the Apollo basin. These strong magnetic fields be related to Leibnitz crater. Therefore we only consider the crustal magnetic field inside of Leibnitz crater. We plan to examine the detailed magnetic fields structure at Leibnitz crater correlate it with the details of the albedo anomaly.

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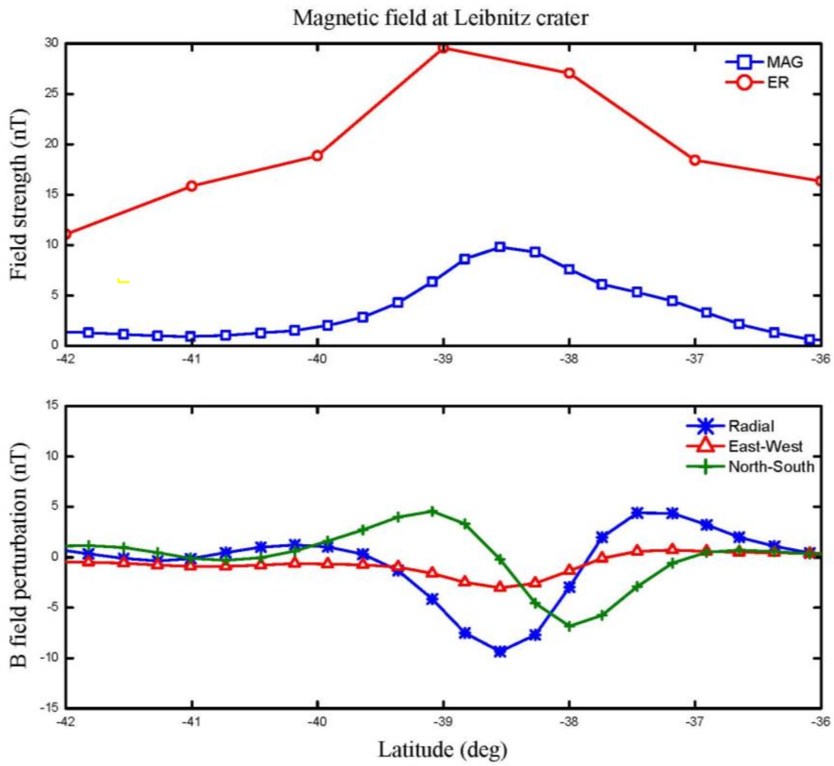

Figure 1. Magnetic fields at Leibnitz crater. MAG (Blue) and ER (red) field strengths are similar (top). Peak strength field of MAG and ER are in the middle of Leibnitz crater. Radial, North-South, East-West components of MAG data are shown. Asterisk, triangle and, cross are each data point on the latitude. (Bottom)

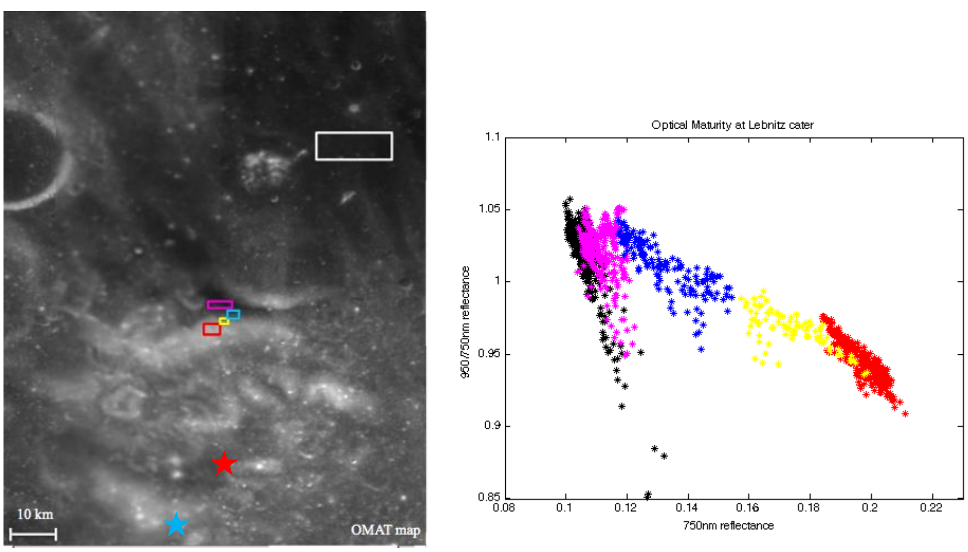

Figure 2. Spectral data at Leibnitz crater. Leibnitz crater study area. Red asterisk is MAG peak measurement and Blue asterisk is ER peak measurement (left). OMAT plot is illustrated with two trends (right): background trend (black and magnenta pixels) and a swirl feature trend (blue, yellow and red pixels).