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Modeling of lunar magnetic anomaly and paleomagnetic pole: Lunar dynamo in the past?

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Since findings in the Apollo era, the origin of magnetic anomaly is one of the biggest problems of the Moon. Whether or not the anomalies are records of an ancient magnetic field of lunar core origin puts strong constraints on the thermal evolution, internal structure and origin of the Moon. Magnetic field observations around the Moon by lunar-orbiting spacecrafts such as Lunar Prospector and Kaguya provide us with data to examine if the Moon once had a dynamo-generated magnetic field. For this purpose, we have conducted a study of modeling the lunar magnetic anomaly. A small-scale, relatively isolated anomaly can be modeled using point dipole sources, while more thorough modeling efforts are required for magnetic anomalies with complex structure. In this study, we have modeled lunar magnetic anomalies, taking effects of magnetization source with finite spatial scale into account. A rectangular prism is distributed in a bin of variable size as a magnetization source body. Depth of the bottom plane of the prism is fixed, while height of the prism can vary. Thus, for each prism, the magnetization vector and the height of prism are unknowns to be solved. Here, we report a preliminary modeling result using vector magnetic field data by Kaguya and Lunar Prospector low altitude observation. This technique will be applied to somewhat complicated anomalies, which are difficult to be modeled using a dipole source, such as Crisium-Antipode, Hartwig, Keeler-Heaviside, Kolorev, Krasovsky, Mendel-Rydberg, Moscoviense and Rima-Sirsalis anomalies. After modeling them, the obtained magnetization directions are mapped into distribution of paleomagnetic poles to discuss the ancient lunar dynamo hypothesis.

Keywords: Moon, magnetic anomaly, dynamo, paleomagnetic pole