Mapping of lunar magnetic field using linear inversion

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JAXA is going to launch a lunar-orbiting satellite, SELENE, in 2007. SELENE will measure the lunar crustal magnetic field, going around the moon at altitudes of about 100 km. Therefore, the procedure for the processing magnetometer data obtained in this measurement has to be prepared. Here we report an objective scheme for restoring the spatial distribution of the lunar magnetic field from the orbital measurement data.

In this study, the magnetic field is restored by solving an inverse-problem that many sources distributed on the lunar surface are determined to satisfy the observational data. The source can be any shape, because the magnetic field is divergent free potential field. We use magnetic charges (magnetic monopoles) as the sources for ease of calculation. These charges are arranged in the mapping region on a uniform mesh, and their interval is short enough to avoid the instability of the magnetic field will not appear in the map. The total number of charges exceed the number of observation points, and thus the value of charges can not be determined (under-determination). To solve this problem, we introduce a dumping constraint that the juxtaposed charges are not much different. The parameter controlling the strength of dumping is set so that the residual is comparable to the measurement error.

We use Lunar Prospector (LP) magnetometer data obtained at lower altitudes in 1999, and provide magnetic field map in the region centered at Reiner Gamma anomaly which is classified as the strongest anomaly group on the moon. This region is the most intensively studied and has been mapped by previous studies. Hood et al.(2001) provided anomaly map by a two-dimensional averaging and Kurata et al.(2005) restored the magnetic field by a nonlinear inverse-problem.

This study improves the restoration of 3-d magnetic field distribution solving a linear inverse-problem. Because of the linearlity, we do not have to shepherd the calculation, and thus can process a lot of data being provided by SELENE. We will show the magnetic field maps at three different altitudes (10 km, 20 km, 30 km). Comparing to the previous studies, our maps reproduce observation more accurately.