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An estimate of the shallow lunar electrical conductivity using SELENE magnetometer data

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The electrical conductivity of the moon can be determined by electromagnetic response. From the simultaneous Apollo and Explorer 35 magnetometer observation, the electrical conductivity structure of the lunar interior was estimated. However, it so far contains significant ambiguity larger than two orders of magnitude especially for the shallow part. The ambiguity principally comes from low sampling rate of Explorer 35, which is 6.14 sec. So we thought that it is possible to improve the estimate of the shallow lunar electrical conductivity by using SELENE magnetometer data, which is averaged every 1 sec.

Because we use only the magnetic field observation of SELENE as the output, we suppose that the external input is randomly oriented uniform field. Under the condition that the electrical conductivity is uniform inside the moon, we compute Pr/P, when Pr and P represent the power of the vertical component and sum of three components, respectively. Then, we obtain the apparent electrical conductivity by comparing $\mathrm{Pr/P}|_{theory}$ with $\mathrm{Pr/P}|_{obs}$.

At $6*10^{-3}$ Hz, the apparent electrical conductivity is $2*10^{-4}$ S/m (skin depth is 400 km), which is consistent with Hood et al.(1982). On the other hand, at high frequency data, it is no more than $3*10^{-6}$ S/m. This value is much smaller than that of the previous estimates. We could give constraints on the shallow lunar electrical conductivity to some extent.