Lateral heterogeneous structure influences on lunar heat flow value

Yasuyuki Saito[1]; Shinsuke Yoshida[2]; Satoshi Tanaka[2]; Hitoshi Mizutani[2]

[1] Earth and Planetary Sci., Tokyo Univ.; [2] ISAS

The lunar heat flow measurements were made at Apollo 15 and 17 landing sites.

These measurements provide a direct method to estimate bulk abundance of refractory elements such as U and Th that are heat producing radioactive elements. Langseth et al. (1976) estimated the bulk moon U abundance to be 46 ppb, which is three times higher than U abundance (about 16 ppb) of the CI chondrites. Mizutani and Osako (1974) pointed out that both the Apollo 15 and 17 heat flow measurements were made near the boundary of maria and highlands. Conel and Morton (1975) first analyzed the heat flow focusing effect that is thought to be caused at the boundary of mare and highland. Warren and Rasmussen (1987) also examined the heat-flow focusing effect and estimated the global average heat flow to be 12 mW/m2 and global U abundance as 17 ppb which is close to the CI value. Saito et al. (2003) made a detailed analysis of the focusing effect taking into account of topographic variations. They showed that the topography affects the heat flow measurements in the order of 10%, and as such, should not be neglected. In the present study, we expand the work of Saito et al. (2003).

In the new models, we introduce the temperature dependence of the thermal conductivity in the lunar crust and mantle and lateral and vertical distribution of radioactive elements. The vertical distribution of the radioactive elements in the crust is assumed to decrease exponentially with depth, while the surface abundance of those elements are represented by the Prospector's data. Since the heat-flow focusing effect is controlled by many factors, we examined how large area must be incorporated in numerical calculations to obtain a reasonable result of heat flow values at a point. With a reasonable range of topography and surface abundance of radioactive elements distribution on the moon, we find that the calculation type must include the range of 50 km from a point where we would like to estimate the focusing effect within 1 % accuracy. This result also suggests that it is necessary to know the topography and megaregolith thickness within +/- 100 m accuracy if we want to estimate the intrinsic heat flow value with 0.1 mW/m2 (approximately 1 %) accuracy.