Mare Volcanism: Reinterpretation Based on Kaguya Lunar Radar Sounder Data

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The volumes of single geological units with different ages and compositions are essential for revealing characteristics of mare volcanisms and for constraining the thermal history of the Moon. Recently, the thicknesses of mare basalt units were indirectly estimated from Clementine multispectral data [1]. The results were derived for only limited areas and showed a wide variation, implying large uncertainty. At present, the geological structures under the lunar maria are directly investigated using sounder observations. The Lunar Radar Sounder (LRS) onboard Kaguya detected widespread horizontal reflectors under some nearside maria [2]. The LRS detects echoes from subsurface horizons with abrupt changes in dielectric constants [3] at the apparent depths smaller than about 1 km [4]. Oshigami et al. [5] concluded that the reflectors correspond to the interfaces between basalt units with different FeO contents. Therefore the LRS data allow us to discuss the volume of each basalt unit.

We correlated subsurface reflectors with the surface geologic units, the ages of which have been estimated by several researchers [e.g., 6], to evaluate the thicknesses and volumes of the units. The estimated thicknesses and volumes of the geologic units were the order of 10^1 to 10^2 m (Figure 1) and 10^3 to 10^4 km^3 (Figure 2), respectively, and showed positive correlations with unit ages within the same mare basin [7]. Previous studies indicated that the typical thicknesses of single basalt flows were about 10 m or less in most of the studied sites [8]. These estimations suggest that the geologic units are made up of dozens of lava flows. The long-term average eruption rates were estimated to be the order of 10^{-5} to 10^{-2} km^3/yr (Figure 3) [7].

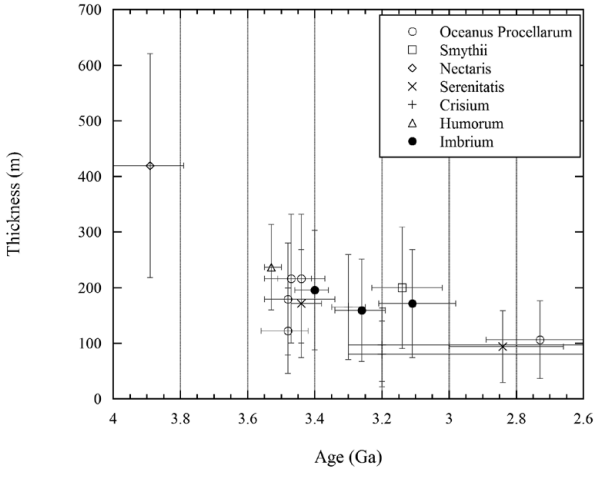

Figure 1: Estimated thicknesses of mare basalt units.

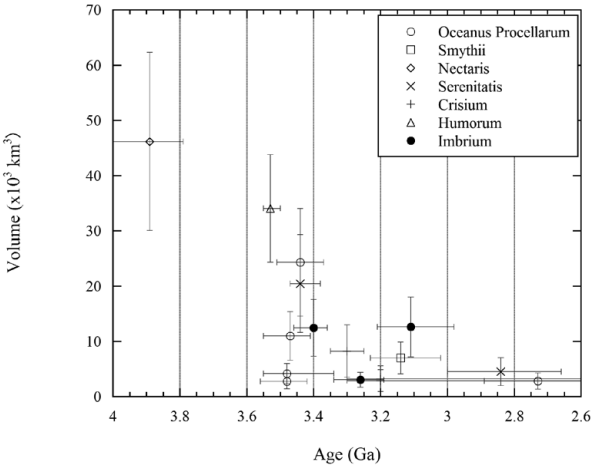

Figure 2: Estimated volumes of mare basalt units.

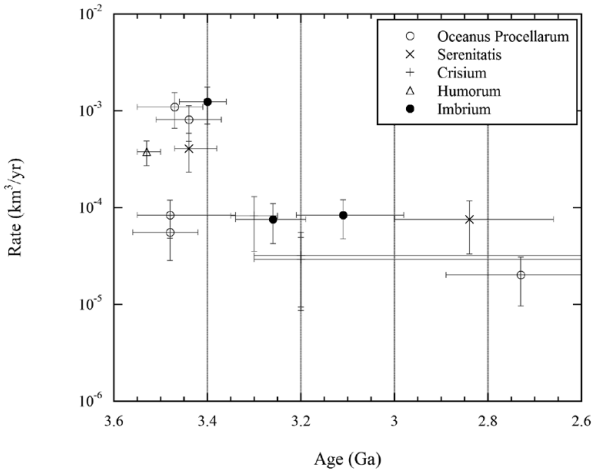

Figure 3: Estimated average eruption rate of mare basalt.

References

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