ORIGIN OF LUNAR TROCTOLITE: IMPLICATION FOR COMPOSITION AND CRYSTALLIZATION OF MAGMA OCEAN.

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Introduction: Lunar troctolites have been sampled by Apollo missions and by lunar meteorites (Dhofar 489 group). Both of them include Mg-rich olivine (Fo_{80-90}). The former is generally enriched in REE, and likely represents REE-rich, magnesian magma intruded into the anorthositic crust during the post-magma ocean magmatism [e.g. 1, 2, 3], which is probably confined to the Procellarum KREEP Terrane (PKT) of the nearside. In contrast, the latter is depleted in REE, and co-exists with magnesian anorthosite [4], thus may be generated from a primordial magma ocean. Based on Clementine ultraviolet-visible multispectral data, troctolites have been reported at some central peaks of impact craters [5, 6] and in the farside highland [7], indicating that olivine is an important mineral within the feldspathic crust.

Origin of troctolite: As a result of low-pressure crystallization experiment [8] with a hypothetical bulk-Moon composition [9], which is nearly equal to the terrestrial mantle composition, the magma ocean (~300 km deep) first crystallizes olivine, subsequently olivine and orthopyroxene co-crystallize, and then olivine, orthopyroxene, and clinopyroxene crystallize. Finally, anorthite begins to crystallize. On the other hand, the crystallization sequence to produce troctolite should be given by olivine → plagioclase → low Ca pyroxene → high Ca pyroxene, unlike the experimental result. This infers the bulk-Moon composition should be more Al_2O_3-rich to generate troctolite than the previous assumption.

Future studies: In order to further constrain the composition and crystallization path of the magma ocean, rock types of the global feldspathic crust should be essential. Multiband images (415, 750, 900, 950, 1000 nm for visible with spatial resolution of 20 m, and 1000, 1050, 1250, 1550 nm for near infrared with spatial resolution of 62 m) provided by Multiband Imager (MI), and visible to near infrared (500-2600 nm) continuous reflectance spectra with high spectral resolution (6-8 nm) and spatial resolution of 500 m, provided by Spectral Profiler (SP) will be utilized to investigate geologic setting and distribution of troctolites and other rock types within the feldspathic crust.

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