

Early crustal evolution of the Moon and Vesta

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The parent body of HED (howardite, eucrite, diogenite) meteorites (i.e., asteroid 4Vesta) and Earth's moon share similar characteristics because they still preserve pristine igneous crust. The comparative study of these planets give us an opportunity to study the early crustal evolution of relatively small planets. Almost all lunar highland breccias and the HED meteorites experienced repeated shock metamorphism and brecciation in 4 Ga ago evidenced by textures, mineralogy, and isotopic ages. Mineralogical evidence suggests that some eucrites record excavation from deep interior by large impacts when the parent body was still hot, indicating that large cratering events occurred as early as 4.5 Ga before cooling of the parent bodies. This mineralogical evidence is consistent with the presence of large impact craters on Vesta, found by the recent telescopic observations. On the other hand, we found that one lunar highland breccia found in the hot desert contains a fragment of spinel troctolite derived from deep crust of the moon. The Ar-Ar age of the breccia gives 4.2-4.3 Ga. These facts suggest that large impact cratering events occurred before the Imbrium event, and probably related to the formation of SPA. These data suggest that both on the moon and Vesta, large impact cratering events play an important role in the evolution of the early crust.