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THE SECOND CONFERENCE ON THE LUNAR HIGHLANDS CRUST AND NEW DIRECTIONS

A large spectral survey of small lunar craters: Implications for the composition of the lunar mantle†

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Abstract

A global spectral survey of 4506 immature craters with diameters <1 km was carried out using near-IR data from the Kaguya Spectral Profiler to characterize the composition of the lunar megaregolith. On the basis of band minima and radiative transfer mixing models, small crater spectra fall into three groups: (1) mare basalts with strong absorptions at relatively long wavelengths indicating high ratios of high- to low-Ca pyroxene; (2) norites containing about 50% plagioclase and with pyroxene assemblages dominated by low-Ca pyroxene that occur within the South Pole-Aitken Basin (SPA), near Apollo 14 and other locations near Imbrium Basin, and three major cryptomaria deposits; and (3) noritic anorthosites occurring within the Feldspathic Highlands Terrane containing about 20 wt% pyroxene with a pyroxene assemblage containing exclusively very low-Ca pyroxene. Very few pure anorthosites are present in this survey and there are no occurrences of pyroxene-poor olivine-rich assemblages. Models of the composition of basin ejecta incorporate large amounts of mantle material and the spectral results require that that the sampled mantle is orthopyroxenite. Basin depth-diameter ratios used in the models required to match the measured composition are consistent with prior estimates for the largest basins. The composition found in the SPA and Imbrium regions are consistent with mafic impact melt breccias or basaltic impact melts of basin origin. For SPA we model this composition and find it requires an extremely low impact angle. While this is consistent with prior work on an oblique impact for the SPA event, a more robust solution invokes the production of norite in impact melt seas.

Keywords: Remote sensing, Moon, multi-ringed basins, megaregolith