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REVIEW

THE SECOND CONFERENCE ON THE LUNAR HIGHLANDS CRUST AND NEW DIRECTIONS

Origin of the lunar highlands Mg-suite: An integrated petrology, geochemistry, chronology, and remote sensing perspective‡

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ABSTRACT

The Mg-suite represents an enigmatic episode of lunar highlands magmatism that presumably represents the first stage of crustal building following primordial differentiation. This review examines the mineralogy, geochemistry, petrology, chronology, and the planetary-scale distribution of this suite of highlands plutonic rocks, presents models for their origin, examines petrogenetic relationships to other highlands rocks, and explores the link between this style of magmatism and early stages of lunar differentiation. Of the models considered for the origin of the parent magmas for the Mg-suite, the data best fit a process in which hot (solidus temperature at ≥2 GPa = 1600 to 1800 °C) and less dense (ρ ~3100 kg/m^3) early lunar magma ocean cumulates rise to the base of the crust during cumulate pile overturn. Some decompressional melting would occur, but placing a hot cumulate horizon adjacent to the plagioclase-rich primordial crust and KREEP-rich lithologies (at temperatures of <1300 °C) would result in the hybridization of these divergent primordial lithologies, producing Mg-suite parent magmas. As urKREEP (primeval KREEP) is not the "petrologic driver" of this style of magmatism, outside of the Procellarum KREEP Terrane (PKT), Mg-suite magmas are not required to have a KREEP signature. Evaluation of the chronology of this episode of highlands evolution indicates that Mg-suite magmatism was initiated soon after primordial differentiation (<10 m.y.). Alternatively, the thermal event associated with the mantle overturn may have disrupted the chronometers utilized to date the primordial crust. Petrogenetic relationships between the Mg-suite and other highlands suites (e.g., alkali-suite and magnesian anorthositic granulites) are consistent with both fractional crystallization processes and melting of distinctly different hybrid sources.

Keywords: Moon, lunar highlands, chronology, Mg-suite plutonic rocks, planetary crust, planetary differentiation, Review