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 \( \pm 2 \) GPa = 1600 to 1800 \( ^\circ \)C) 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 \(<1300 \) \( ^\circ \)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

### INTRODUCTION

The lunar highlands crust is dominated by numerous “pristine” magmatic lithologies. These “pristine” igneous rocks include the ferroan anorthosites (FANs) and Mg-rich rocks (Warren 1993; Papike et al. 1998). Dowty et al. (1974a, 1974b) recognized that FANs typically have \( >90 \) vol\% plagioclase, very calcic plagioclase (\( >\text{An}_{90} \)), and pyroxene and olivine compositions that are relatively iron-rich (\( \text{Mg}^{2+} < 70, \) where \( \text{Mg}^{2+} \) = molar [\( \text{Mg} / (\text{Mg} + \text{Fe}) \) ] \( \times 100 \)). Recent studies (Norman et al. 2003; Borg et al. 2011; Shearer et al. 2013) identified FAN rocks with similar mineral compositions but with higher abundances of mafic minerals (10–20 vol\%). The compositional range for the Mg-rich rocks, however, is not well defined and they are a lithologically very diverse group (e.g., Norman and Ryder 1980; James 1980; James and Flohr; 1983; Warren 1986; Papike et al. 1998; Shearer and Papike 2005; Shearer et al. 2006). Papike et al. (1998) subdivided the Mg-rich highlands rocks into the magnesian plutonic rocks [also known as (aka) Mg-suite, highlands magnesian suite], alkali rocks (aka the alkali-suite), and KREEP [lunar component high in potassium (K), Rare Earth Elements (REE), and phosphorus (P)] basalts (see their Table 10). Unlike Heiken et al. (1991), Papike et al. (1998) grouped these compositionally diverse rocks together because recent interpretations had petrogenetically linked some of these rocks to each other and to the Mg-suite (Snyder et al. 1995). The Mg-suite rocks are distinguished from all other Mg-rich rocks based on their lower alkali element content (e.g., \( \text{K}_2\text{O} \) generally \(<0.1 \) wt\%, plagioclase \( >\text{An}_{90} \)) and more magnesian mafic silicates (\( \text{Mg}^{2+} \) generally \( >78 \); Fig. 1). The Mg-suite rocks in the Apollo collection have the paradoxical chemical characteristics of very