

THE MYTH OF THE MAGNESIAN SUITE OF LUNAR “HIGHLANDS” ROCKS

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Introduction: On the basis of Apollo samples, igneous and plutonic rocks of the lunar crust have long been divided into two main petrogenetic groups, the ferroan-anorthositic (“ferroan anorthosite”) suite and the magnesian (“Mg-rich,” “magnesium”) suite [1,2]. The latter consists mainly of mafic plutonic rocks like norite, troctolite, dunite, and gabbro but also alkaline anorthosite and KREEP basalt [2]. Although early works conservatively designated such rocks only as “nonmare” [1], the magnesian suite is usually identified with the feldspathic highlands [e.g., 2–5]. New data suggest a different heritage.

Orbital Geochemistry and Mineralogy: Various studies have shown that the Apollo magnesian-suite rocks differentiated from KREEP (Th-rich) magmas. Lunar Prospector demonstrated that KREEP is almost entirely restricted to the PKT (Procellarum KREEP Terrane), a unique geochemical province [6]. There is no evidence in the LP data that KREEP is globally distributed beneath the FHT (Feldspathic Highlands Terrane) [7]. There is no evidence in the Clementine data for intrusions of truly mafic plutons (norite, troctolite, gabbro) into the feldspathic crust [8].

Lunar Meteorites: Feldspathic lunar meteorites, all of which are polymict breccias, derive from numerous places in the FHT. Mafic magnesian-suite rocks such as those of the Apollo missions are absent as clasts in the meteorites; they are only common at Apollo sites in or near the PKT [9].

Conclusions: Magnesian-suite rocks are not rocks of the lunar highlands, and it can (and has) only lead to obfuscation to regard them as such. They are products of the Procellarum KREEP Terrane, a topographically low region that is distinct from the feldspathic highlands [6,10,11]. The misconception arises from preconception, historical accident, coincidence, and non-ideal order of discovery [12]: (1) The Moon has long been viewed as simply bimodal in geology, mare or highlands; (2) The last basin-forming bolide to strike the lunar nearside happened to impact the PKT, redistributing Th-rich material about the surface [13]; (3) All six Apollo landings occurred in or near the PKT; (4) The Apollo samples (unlike as for Mars) were acquired, studied, and interpreted long before global constraints imposed by orbital missions and lunar meteorites were obtained.

Magnesian (high-Mg/Fe) feldspathic lithologies exist in the highlands, but there is no evidence that such lithologies are related to the magnesian suite of the PKT and nearly all such samples are brecciated [9].

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