

FORMATION OF LUNAR PINK SPINEL ANORTHOSITES AS TOLD BY THE METEORITE NWA 13191

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Introduction: NASA's Lunar spectrometer M³ has defined a new type of lunar rock called pink spinel anorthosite (PSA). Possible explanations for the petrogenesis of spinel lithologies range from low-pressure near-surface crystallization to a deep sources in the lower lunar crust or upper mantle^[1-4]. The exact chemical or physical property of the lithology remains in question due to lack of samples. Fifty-nine Mg-spinel-bearing lithic clasts in NWA 13191 meteorite are selected as the main objects of this study. Through systematic petrological and mineralogical studies, we aim to investigate its relationship to the remotely defined PSA. Furthermore, by analyzing the origin and chemical properties of the melt, spinel and olivine, the formation of PSA clasts in the NWA 13191 meteorite is unraveled.

Petrology and mineralogy: Lunar meteorite NWA 13191 is a polymict breccia. Clast types include lithic clasts, glass and minerals. Lithic clasts include PSA, PST (pink spinel troctolite), Mg-anorthosite, norite and fine-grained basalt. PSA clasts are composed of plagioclase (26.3 - 80.9 vol%, avg. 63.7 vol%), melt (14.7 - 70.7 vol%, avg. 33.1 vol%), Mg-spinel (0.2 - 2.8 vol%, avg. 1.1 vol%), pyroxene + olivine (avg. 2.0 vol%). Most Mg-spinels (avg. Mg[#]=90.6, Al[#]=97.5) are subhedral to euhedral, with a particle size of 1 μm to 15 μm.

Discussion and conclusion: The content of "olivine ± pyroxene" and spinel in PSA clasts is consistent with the characteristics defined by remote sensing^[5]. NWA 13191 records the highest known bulk Mg[#] (avg. 89.8), and the Mg-spinel records the highest Al[#] (max. 99.7) and Mg[#] (max. 93.6) of lunar samples. Detailed information of the PSA is obtained for the first time: in addition to plagioclase and newly formed spinel, a large amount of Mg - Al - rich melt are found. The average Mg[#] of the melt is 72.5, FeO + MgO = 23.9 wt%, Al₂O₃ = 19.9 wt%. The formation of PSA is elucidated: the Mg - Al - rich melt produced by impact melting of Mg-rich troctolites or magnesian anorthosites is rapidly cooled, the spinel is a metastable crystallization product along with plagioclase and vitric melt near the Moon's surface.

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