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Mineralogical investigation of evolved lithologies in the lunar silicic construct Lassell massif

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Lassell Massif is a lunar red spot and an established silicic construct on the northeastern quadrant of Mare Nubium on the lunar surface. In other words, it is a prospective host to granitic or granodioritic lithologies on the Moon. Generation of evolved lunar silicic constructs have been explained by previous workers using three possible mechanisms- silica-liquid immiscibility, crustal melting and in situ magmatic differentiation. However, such evolved silicic constructs are very rare on the lunar surface. The few other evolved constructs detected on the lunar surface that have been analysed for their mafic mineral distribution show very little abundance of any major lunar mafic mineral. In this work, we have conducted a detailed analysis of mafic mineral distribution on the evolved lunar silicic construct Lassell massif using high-resolution hyperspectral datasets from the Moon Mineralogy Mapper instrument onboard Chandrayaan-1 mission, operating in the VNIR range (450 – 3000 nm). Our analyses show that exposures bearing signatures of mafic minerals like low-calcium pyroxene (LCP), high-calcium pyroxene (HCP) and Mg-spinel are found on the surface of the Lassell massif complex. These exposures occur within the volcanic calderas in the Lassell massif complex (referred to as craters Lassell G and K), as well as on the upper and lower massif units described by Ashley et al. (2016) [1]. The Mg-spinel and pyroxene exposures often occur in close association with each other. Assuming that the Mg-spinel exposures are not impact generated, then the formation of Mg-spinel in the lunar crust can be explained by assimilation reactions between a high-Mg basaltic magma (e.g., Mg-suite parental liquid - MSPL) and a feldspathic crust. During such assimilation reactions, silicic magma may be generated by either crustal melting due to the heat from the stalled pluton or by in situ fractionation within the pluton. The silicic magma thus produced, during its ascent to the surface, may entrain the Mg-spinel formed in the vicinity (due to assimilation reaction) up to the surface. This may be a possible mechanism to explain the Mg-spinel exposures within evolved silicic constructs.

References:

[1] Ashley et al. (2016), Icarus, vol. 273, pp. 248–261.