Petrogenesis of Apollo 17 High-Titanium Basalts Using Crystal Stratigraphy

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Abstract. The final Apollo mission returned a suite of basalts intriguing for their mafic characteristics and high TiO2 (>9 wt%) content. Considered to be derivatives of the mafic cumulates that form at least the upper lunar mantle, the textures and crystal chemistry of these basalts give a unique perspective of lunar volcanism and source region composition.

We investigated the petrographic and geochemical nature in 16 A17 high-titanium basalts that include 5 chemical types (A, B1, B2, C, and D). Major and trace element analyses of major crystal phases are applied with crystal size distributions (CSDs) to evaluate petrogenetic models based on whole rock data. Magma composition is reflected in core-to-rim or crystal-to-crystal compositional variation of prolonged crystallizing phases (e.g., ilmenite). CSDs provide additional insights to magma kinetics.

We calculated equilibrium liquid compositions and modeled multiple crystallization paths of an evolving magma. Our findings support conclusions of previous studies that indicate fractional crystallization is the most important post-magma process of these titaniferous basalts.