Lunar petrology of silicate melt inclusions,

Apollo 11 and 12, and terrestrial equivalents

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(Tentative abstract)

Early melt inclusions, in lunar olivine, have formed daughter minerals on cooling: ilmenite, plagioclase, and pyroxene. Heating such olivine grains in vacuum, melting the daughter minerals, and quenching, established a sequence of phase disappearance for these olivine-saturated magmas: solidus <1065°C; plagioclase out, 1105°; pyroxene out, 1130°; ilmenite liquidus, 1210°. The ilmenite and plagioclase daughter crystals occur as flat plates, "epitaxially" oriented parallel to (100) of the enclosing olivine. This was thought to be unique until identical epitaxial daughter minerals were found in inclusions in olivine from Hawaii. Experiments on such inclusions also provide rough estimates of lunar and terrestrial cooling rates. After homogenization, these inclusions provide excellent samples for probe analyses of the original magma.

Late melt inclusions in lunar rocks show that when these magmas were 90-98% solid, the residual liquid split into two immiscible melts, which in part quenched to glasses of grossly different color, index, and composition. Probe analyses show compositions equivalent to ferropyroxenite and potassic granite. The latter differs from granite formed by crystal fractionation, e.g., in distribution of phosphorous. Quenching results on similar synthetic melts verified the immiscibility. This was also thought to be unique until identical immiscibility was found in

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Hawaiian, Modoc, Keweenawan, and Disko basalts. In these quenched rocks the immiscible liquids are retained as isolated globules. Under conditions of slower cooling, as in the early history of the earth or moon, significant liquid separation might have occurred.

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