PETROLOGY OF MARE BASALT AND HIGHLAND CLASTS FROM BRECCIA 15498
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Lunar breccia 15498 was collected on the south rim of Dune Crater, approximately one kilometer north of the Apennine Front and near boulder samples 15485, 15486, and 15499. Sample 15498 is a coherent glassy matrix regolith breccia and one of the largest breccias returned by the Apollo 15 mission (2.34 kg). The breccia consists of about 16% clasts (mostly mare basalts) in a matrix of glass and finely comminuted minerals. We selected 28 clasts for extraction from existing chips and from a new slab (141). The clasts include 25 mare basalts, 2 felsic breccias, and one highland glass. Here we present preliminary results of our petrographic and mineral chemistry investigation; whole rock geochemical studies are in progress.

HIGHLAND CLASTS
The only highland clast for which we have chemical data at this time is a pale green glass. It contains no phenocrysts and has a composition typical of KREEPy highland melt rocks: Mg# = 74, CaO/Al2O3 = 0.60, Na2O = 0.73%, and K2O = 0.52%. This is almost identical to the average IKFM basalt glass in the Apollo 15 soils (1). The two felsic breccia clasts consist of small relict feldspar grains in a matrix of very finely crushed feldspar, low-Ca pyroxene, and opaques, and glass. They are much lighter in color than the surrounding breccia matrix.

MARE BASALTS -- PETROGRAPHY
The mare clasts include both olivine-phyric and pyroxene-phyric basalts, consistent with previous studies showing the bimodal nature of Apollo 15 mare basalts (2-6). The olivine-phyric suite is divided into slowly-cooled olivine-pyroxene cumulates and more rapidly cooled olivine basalts. The olivine-pyroxene cumulates contain large primocrysts of olivine, pigeonite, and augite with sparse post-cumulus plagioclase and opaques. Olivine is commonly enclosed by post-cumulus overgrowths of pyroxene. The olivine basalts exhibit a range of textures from vitrophyric with sparse olivine phenocrysts to medium or coarse grained subophitic with both olivine and pigeonite phenocrysts. Pyroxene-phyric basalts are characterized by pigeonite phenocrysts in a fine to medium grained groundmass of plagioclase, pyroxene, pyroxferroite, ilmenite, Ti-Cr spinel, glass, and in the coarser samples, cristobalite. Textures range from variolitic to subophitic, with sheaf-like intergrowths of pyroxene and plagioclase common in the coarser samples.

MINERAL CHEMISTRY
Minerals in the olivine-pyroxene cumulates show limited compositions: Fo65-Fo71 olivine, An90 plagioclase, and high-Mg pigeonite and augite (Fig. 1). The occurrence of Mg-rich augite as an early liquidus phase in mare basalts is unusual. The augite is zoned outward to subcalcic augite that approaches the magnesian pigeonite in composition (Fig. 1). The olivine basalts show a larger range of mineral compositions than the cumulates. Olivine phenocrysts are zoned with cores Fo69-Fo73 and rims Fo48-Fo57. Pigeonite phenocrysts (present only in one coarse grained olivine basalt) are similar to pigeonites in the olivine-pyroxene cumulates (Fig. 2). Groundmass pyroxene is more calcic and more Fe-rich (Fig. 2), while plagioclase ranges from An89 to An93.

In contrast, the pyroxene-phyric basalts are characterized by wide variations in pyroxene composition (Fig. 3). Pyroxene phenocrysts are zoned from magnesian pigeonite cores to augite or subcalcic augite rims. Groundmass pyroxenes vary from subcalcic ferroaugite to ferrohedenbergite and pyrox-
ferroite and plot in the forbidden zone of the pyroxene quadrilateral. Plagioclase is slightly more calcic than in the olivine-phyric basalts (An90-An95.5) and lower in K2O. These compositions are typical of the pyroxene-phyric basalts described by Dowty et al. [2].

DISCUSSION

Previous studies have shown that the Apollo 15 mare suites olivine-phyric and pyroxene-phyric mare basalts are not related by simple near surface crystal fractionation processes or by variable melting of a single source [2-6]. Our data support this division, but also suggest that distinct magma types may be present within each suite. Modal analyses of the olivine-pyroxene cumulates are consistent with two early liquidus trends: (1) olivine + pigeonite (most common), and (2) olivine + augite. The occurrence of augite as an early liquidus phase requires a parent magma that is either higher in normative diopside or lower in silica activity than the olivine-pigeonite parent magma.

The olivine basalts display a range of textures that indicate large variations in cooling rate. The vitrophyric and fine-grained subophitic samples are saturated with olivine only; coarser grained samples may be saturated with both olivine + pigeonite. This excludes a parent-daughter relationship with the olivine + augite cumulate. A relationship with the olivine + pigeonite cumulates is possible.

The pyroxene-phyric basalts generally contain pigeonite as the only phenocryst phase; augite phenocrysts are rare but do occur in one sample as large, euhedral crystals with high Mg#. This sample may be derived from the pigeonite-phyric basalts by fractional crystallization, or may represent a distinct magma type. Further geochemical data are necessary to test these hypotheses.