HIGHLAND CLASTS IN APENNINE FRONT BRECCIA 15295

Marilyn M. Lindstrom, NASA Johnson Space Center, Houston, TX,
Ursula B. Marvin, Harvard-Smithsonian Center for Astrophysics, Boston, MA,
and David W. Mittlefehldt, Lockheed EMSCO, Houston, TX

The highlands crust at the Apennine Front includes ancient highland rocks and products of major basin impacts which have been reworked by regolith processes and mixed with younger volcanic rocks [1]. As a continuation of our studies of Apollo 15 highland components [2] we have begun a detailed petrologic and geochemical study of clasts in 15295, a glassy regolith breccia collected at Station 6 at the base of the Apennine Front. We have mapped the clasts larger than 2 mm on the exterior and two newly-sawn surfaces of the breccia. Preliminary INA analyses of 10 clasts are reported here; studies of additional clasts are in progress. Clasts of mare basalt and green glass are found in 15295, however this report focuses on highland lithologies which are divided into three groups: Plutonic rocks, poikilitic noritic breccias, and KREEP-rich impact melts.

Plutonic Rocks. The largest clasts in 15295 are ferroan anorthosites. We have studied two cm-sized clasts. One (INAA 74/ PM 75) was extracted in this study. The other is a clast in TS 19 which is the same clast analyzed by [3]. Anorthosites also occur as small clasts scattered throughout the breccia. One such clast (62/63) was included in this study. The clast in TS 19 is a typical cataclastic anorthosite consisting of 97% plagioclase (An_{97}) and 3% augite ($En_{41}Wo_{37}$). Its original coarse grain size is seen in regions of plagioclase up to 4 mm and augite to 0.2 mm which are interspersed among finer crushed zones having the same mineral compositions. Bulk analyses show the anorthosites to be nearly pure plagioclase with very low transition metal and incompatible element concentrations. REE patterns (Fig 1) are typical of ferroan anorthosites such as 15415.

Mafic plutonic rocks are also found in the breccia. Coarse-grained norite 66/67 consists of 1-3 mm crystals of plagioclase (An_{93}) and 0.3 mm grains of pigeonite ($En_{73}Wo_{3}$), and has a small clot of rutile, whitlockite, troilite and silica. The bulk composition is that of a norite rich in FeO and trace transition metals, and poor in incompatible elements. The REE pattern (Fig 1) reflects HREE enrichment due to pyroxene. This norite is intermediate in composition between 15445-15455 Mg-norites and 15459 Fe-norites [2].

Poikilitic Noritic Breccias. Recrystallized noritic rocks are common clasts in 15295, four of which are included in this study (64/121, 68/69, 70/71, 81/82). Textures of the clasts show some variation, but all appear to be recrystallized clastic rocks. Clast 70/71 has the best developed poikilitic texture. Blocky plagioclase ranging from 30 to 385 um and primary pyroxene up to 320 um are enclosed in patches of poikilitic pyroxene optically continuous to 225 um. Small olivines (Fo_{70}) and Mg-ilmenites are scattered throughout the clast. The polymict nature of the precursor is seen in the unequilibrated mineral compositions. Plagioclase is bimodal (An_{93} and $An_{69}Or_{5}$) and pyroxene includes both pigeonite ($En_{72}WO_{3}$) and augite ($En_{47}Wo_{43}$). Other clasts are finer grained and more variable in texture. These clasts are similar to the recrystallized norites in 15465 [4] and poikilitic anorthositic norites in 15459 [5]. Bulk compositions are noritic with 8% FeO, 12% CaO (19% Al_2O_3) and moderate transition metal concentrations. Incompatible element concentrations are moderately low (REE 15-30 x ch in Fig 1) with little or no Eu anomaly. These clasts appear to represent a subdivision of the KREEP-poor group E impact melts, a prominant member of which is the 2 x 3 cm white clast in 15459 [2]. Figure 2 is a Sc-Sm plot for Apollo 15 samples [2] in which these noritic breccias occupy the area below the group D impact melts and Apennine Front soils. These noritic breccias may represent an important KREEP-poor component of the Apennine

Front which is infrequently seen as pristine rocks. Its precursors are most likely dominated by a magnesian norite similar to clast 66/67 described above.

KREEP-Rich Impact Melts. Two clasts (72, 80) in 15295 are impact melts with KREEP-rich compositions. Both clasts are very fine-grained aphanatic rocks which have noritic bulk compositions and REE concentrations (Fig 1) between those of group A and B impact melts defined by [6] and identified in other recent Apollo 15 studies [2, 7, 8]. Whether these impact melts originate as melts of local KREEP basalts or as major basin ejecta awaits further study.

REFERENCES. [1] Spudis and Ryder (1985) EOS 66, 721-726. [2] Lindstrom et al (1988) PLPSC18, in press. [3] Warren and Wasson (1978) PLPSC9, 185-217. [4] Cameron and Delano (1973) PLSC4 461-466. [5] Ridley (1977) Phil Trans Roy Soc Lond A 285, 105-114. [6] Ryder and Spudis (1987) PLPSC17 E432-E446. [7] Simon et al (1988) PLPSC18, in press. [8] Ryder et al (1988) PLPSC18, in press.

Fig. 1 REE patterns in clasts from 15295.
○ KREEP-rich impact melts;
□ poik. noritic breccias;
△ plutonic rocks.

Fig. 2 Sm-Sc variations in Apennine Front samples. Fields of AF soils are outlined. AnFNT plutonic rocks; KBG volcanic rocks; abcde impact melts; + 15295 melts; * 15295 plutonic rocks.