NATURE OF THE HIGHLAND MASSIFS AT TAURUS LITTROW: AN ANALYSIS OF THE 2-4 mm SOIL FRACTION. A. E. Bence, J. W. Delano, and J. J. Papike, Dept. of Earth and Space Sciences, State Univ. of N. Y., Stony Brook, N. Y. 11790

A statistical analysis has been made of 254 2-4 mm soil fragments from nine sampling stations at the Apollo 17 landing site to determine the nature of the Highlands Massifs to the north and south of the landing sites. The samples studied are from Stations 1A (mare southeast of the LM), 2, 2A, and 3 (on landslide from South Massif), 4 (Shorty Crater), 5 (Camelot), 6 (North Massif), 8 (Sculptured Hills) and 9 (Van Serg). Our samples from five of these stations (2, 2A, 3, 6, 8) contain significant Highland components. A preliminary classification was made of each fragment into the following categories: glass (G), dark matrix (soil) breccias (DMB), recrystallized noritic breccias (RNB), poikilitic (or poikiloblastic) breccias (POIK), members of the anorthositic-noritic-troctolitic suite (ANT), and feldspathic basalt (FELD. B). The distribution of these fragments is shown in Figure 1. South Massif sample 72503,8 is composed largely of recrystallized noritic breccias whereas samples 72703,9 and 73263,1 contain lower abundances of RNB and much higher abundances of ANT and FELD B. (Fig. 1). Apparently, the landslide that swept South Massif clean is extremely heterogeneous and has experienced no significant gardening. This is consistent with it having a relatively young age. Both North Massif sample 76503,6 and Sculptured Hills sample 78503,7 contain higher concentrations of glass, soil breccias, and mare basalts and, consequently, classification of the fragments in this manner is not useful in determining the lithologies present at these sites.

To ascertain the lithologic nature of the rock types at both North and South Massifs, individual clasts within the breccias have been studied in detail and a number of lithologically distinct rock types have been recognized (Table 1). Classification and resultant statistical analysis of these clasts is difficult due to their very small size, and silicate phase chemical data were taken to assist in the classification. Pyroxenes appear to be chemically the most diagnostic phases; and although considerable overlap in pyroxene chemistry occurs, it is possible to define specific compositional fields for the various lithologies. Figure 2 shows the compositional fields identified for the pyroxenes and coexisting olivines where present. The fields are: 1. Annealed noritic rocks; 2. Gabbroic anorthosites (type large rock 77017); 3. Feldspathic basalts; 4. Poikiloblastic rocks in which the low Ca pyroxenes is pigeonite (type rock 77135); 5. Troctolitic breccias; 6. A variety of melt rocks with olivine + plagioclase ± clinopyroxene + glass which contain abundant plagioclase and lithic clasts; 7. Annealed troctolite 76535,27; 8. Crystalline KREEP fragment.

It is important to note the small range in pyroxene compositions obtained for recrystallized noritic breccias. Many of them have pyroxenes enveloping plagioclase laths and appear to have grown through solid state recrystallization. These pyroxenes contrast distinctly with those from other poikilitic rocks where they tend to be pigeonitic and exhibit significant inter- and intracrystalline compositional variation (1), (2). This distinction probably is a reflection of different growth rates for the two assemblages and may be diagnostic in distinguishing melt from solid-state crystallization. Several cataclastic coarse-grained spinel troctolites contain very low Ca orthopyroxene ($\sim Wo_1$) which is highly magnesian ($Fe/Fe+Mg = 0.09$) and which is extremely aluminous. These may represent samples of deep crustal material. Plagioclase major element chemistry is not as useful a diagnostic tool in distinguishing the lithologies of the clasts; however, distinct differences in An content are observed between the annealed ANT suite rocks and highland basalt cores of plagioclase (Fig. 3). Clasts in some of the melt rocks resemble those from the ANT rocks. The Fe/(Fe+Mg) ratio in the plagioclase is more diagnostic (3) and it is possible to distinguish a number of lithologic types on this basis (Fig. 4).

The compositional fields for the lithologic types, when tied into the textural data, permits classification of clasts in the breccias. Data for Stations 2A, 3 and 6 are given in Table 2. From these data, it is apparent that the dominant rock types at all three sites are annealed noritic breccias and melt rocks containing the assemblage olivine + feldspar ± pyroxenes + glass. Differences between North (Sta. 6) and South Massifs (2A, 3) include a greater abundance of anorthosites and fewer spinel troctolites at Station 6. Melt rocks, Highland Basalt and $O\ell + P\ell \pm Px + G$ are significantly more abundant at Station 3 than at either 2A or 6. These $O\ell + P\ell \pm Px + G$ melt rocks are mineralogically and chemically similar to the "type A FIIR" (4) found at the Apollo 16 site and to 62295. The proximity of their compositions to the olivine-spinel-plagioclase peritectic (5) suggests that they could be derived by partial melting of a spinel troctolite parent and, consequently, may represent internally generated liquids rather than shock melts. The abundant plagioclase and lithic clasts which make these melts extremely "dirty" could be samples of the powdered regolith through which these liquids passed on their way to the surface.

References

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TABLE 1. Highlands Petrographic Rock Types.

- Feldspathic Basalts--Vitrophyres to Intersertal
- Gabbros--Coarse-grained, cataclasite
- Norites
  - Igneous (Diabasic)
  - Annealed Breccias
- Spinel Troctolite
  - Fine-grained Igneous
  - Coarse-grained, cataclasite
- Troctolite
- Olivine + Plagioclase ± Pyroxene + Glass Melt Rocks
- Gabbroic Anorthosite
- Anorthosites
- Others (including Crystalline KREEP)

TABLE 2. Clast Populations.

Station	Feldspathic Basalt	Gabbro	Norite Igneous	Norite Annealed	Spinel Troctolite
3	9	4	4	25	11
6	3	2	6	18	1
2A	3	1	11	18	5

$O\ell+P\ell\pm Px+G$	Troctolite	Gabbroic Anorthosites	Anorthosites	Other
26	3	9	6	3
10	4	3	14	
15	5	3	6	5

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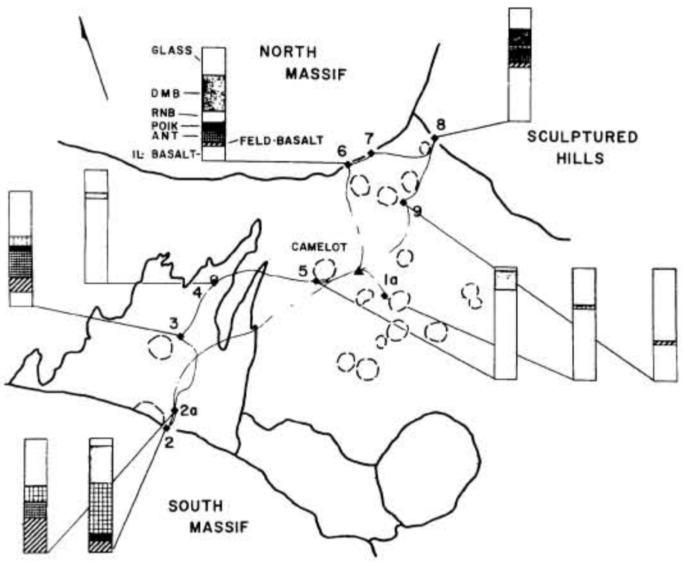

Fig. 1

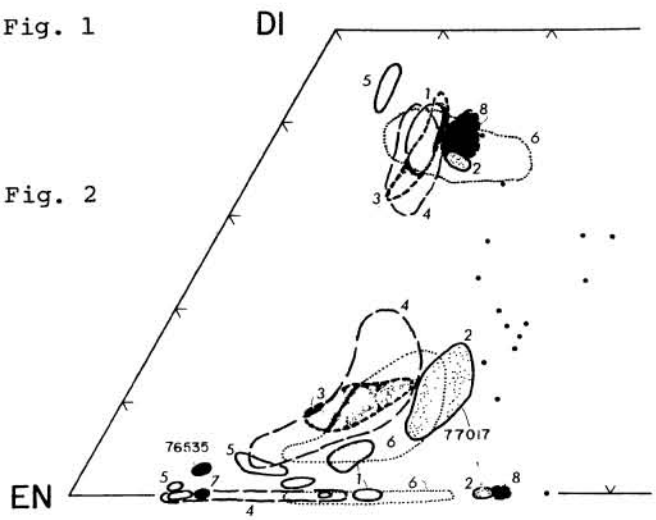

Fig. 2

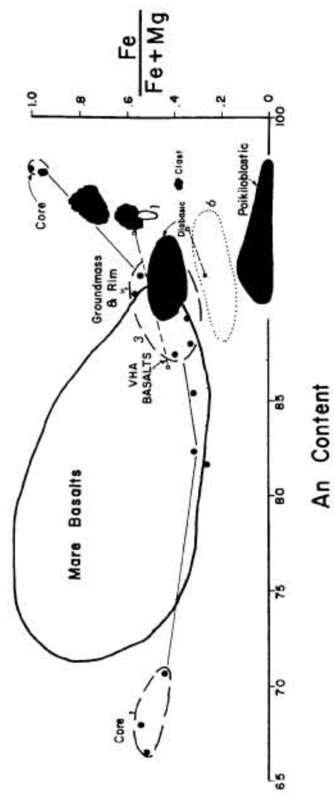

Fig. 4

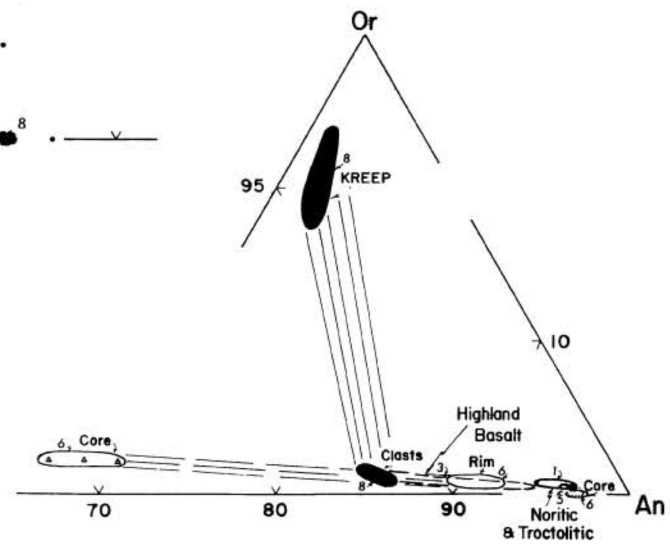

Fig. 3