THE APOLLO 17 DRILL CORE: CHEMISTRY AND STRATIGRAPHY OF MONOMINERALIC FRAGMENTS AND THE DISCOVERY OF A NEW VERY LOW Ti (VLT) MARE BASALT; D. T. Vaniman and J. J. Papike, Dept. of Earth and Space Sciences, State Univ. of New York, Stony Brook, N. Y. 11794

INTRODUCTION. This report has two objectives: first, to characterize the monomineralic component in the upper three sections of the Apollo 17 drill core; second, to describe a new very low Ti (VLT) mare basalt from the drill core and suggest implications of a VLT component among the very high Ti (VHT) Taurus-Littrow mare basalts. Samples for this study are 35 polished thin sections; modal analyses of these specimens are discussed by Papike et al. [1] and chemistry and stratigraphy of the glass component is described by Vaniman and Papike [2].

Mineral fragment categories of pyroxene, olivine, plagioclase and opaque were used for modal analysis [1]. Microprobe analyses were collected for four areas (each ~ 10 mm²) from four thin sections at depth intervals of ~ 35 cm. Within each area all feldspar and olivine grains and a minimum of 50 pyroxene grains were analyzed. At least 3 spots were analyzed on each pyroxene grain to account for chemical zonation. These analyses are summarized in Figs. la and 2a, which depict data from 117 feldspars, 30 olivines, and 873 spots in 235 pyroxenes.

STRATIGRAPHY OF MINERAL FRAGMENTS. LSPET [3] (b) and Duke and Nagle [4] recognize a coarse-grained unit (x-radiograph unit "59") at a depth of 17.5-79 cm in the Apollo 17 core; a coarse-grained unit in our modal stratigraphy [1] corresponds with this interval. Of the four 10 mm² areas in which mineral fragments were analyzed (Figs. 1a, 2a), 70009,288 is above, 70008,354 and 70007,312 are within, and 70007,332 is below the coarse-grained unit.

A major change in the monomineralic component occurs below the coarse-grained unit. There is a decrease in Na-rich (> Ab10) plagioclase and Fe-rich pyroxene, and an increase in Mg-rich olivine (P.T.S. 70007,332; Figs. 1a and 2a). Comparison with the range of mineral compositions in lithic types (Figs. 1b and 2b) shows that these changes reflect an increased highland/mare ratio in the provenance of mineral fragments below the coarse layer. Moreover, a change within the mineral component from mare basalts also occurs in this transition. Within the Apollo 17 basalts Papike et al. [5] have identified two pyroxene trends with distinct Ti/Al ratios. Figure 3 shows that pyroxenes from olivine porphyritic basalts [5] (Ti/Al < 0.5) are present below the coarse-grained unit (e.g., 70007,332) but not within it (e.g., 70008,354).

A NEW VERY LOW Ti (VLT) MARE BASALT. Two lithic fragments of a unique mare type were found in P.T.S. 70008,356 and 70008,370. These rocks are plagioclase, ophtic pigeonite basalt (0.4 mm pyroxene) with euhedral Cr-Fe-Mg-Al spinel (0.03 mm), rounded olivine phenocrysts (~ Fo67; 0.3 mm) and late anhedral plagioclase (Fig. 4). The pigeonites are zoned to Fe-rich rims (Fig. 2b) P.T.S. 70009,288; 70008,354; 70007,312 and 70007,332.
Apollo 17 Drill Core: Monomineralic Fragments and VLT Basalt

Vaniman, D. T., et al.

Fig. 2a  MONOMINERALIC PYROXENE AND OLIVINE

Fig. 2b  LITHIC PYROXENE AND OLIVINE

TABLE 1

<table>
<thead>
<tr>
<th></th>
<th>VLT Basalt Values</th>
<th>Lunar Base Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Mg</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Si</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Al</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Ti</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Ca</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Na</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Fig. 3

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System
Apollo 17 Drill Core: Monomineralic Fragments and VLT Basalt

Vaniman, D. T., et al.

and the mesostasis may contain SiO₂, metallic iron, ilmenite and glass. Modal analyses of both fragments are listed in Table 1. The paucity of ilmenite (< 1%) and low concentration of TiO₂ in pyroxene (0.2-2.0 wt.%), indicate that these are very low Ti basalts (< 1.5 wt.% TiO₂).

VLT basalt is a distinctive type with less ilmenite than other mare basalts [6]. Although VLT basalt is rare in the Apollo 17 core, it is not stratigraphically restricted. The phaneritic varieties were found only in core segment 70008, but vitrophyres with skeletal intermediate-Ca or low-Ca pyroxene (Fig. 2b), skeletal olivine (Fo74) and euhedral spinel are found in P.T.S. 70009,288 (intermediate-Ca pyroxene) and P.T.S. 70007,328 (low-Ca pyroxene). The vitrophyre fragments extend the VLT component throughout the three segments of the upper drill core.

Where did the VLT basalt come from? Distant sources are possible; the telescopic reflectance data of Pieters and McCord [7,8] show that low Ti basalts (< 1.5% TiO₂) occur in the Imbrium, Frigoris and Crisium Basins. However, the presence of vitrophyres as well as phaneritic varieties of VLT in the Apollo 17 core indicates thorough sampling of a complex source; this is most likely if that source were nearby. Spectral measurements [7] on the light-colored central soils of Serenitatis indicate a TiO₂ content of 2-3%, much lower than spectral TiO₂ determinations for the Taurus-Littrow Valley. These low-Ti soils extend to within 100 km of the Apollo 17 site [3], and are another possible source of VLT basalt.

REFERENCES