THE APOLLO 16 MARE COMPONENT (NECTARIS); John W. Delano, Dept. of Earth and Space Sciences, State Univ. of New York, Stony Brook, N. Y. 11794

The Apollo 16 landing site is located approximately 250 Km from the western margin of Mare Nectaris and its associated Copernican-age crater, Theophilus. According to Milton and Hodges (1972), secondary craters from Theophilus occur within a few kilometers of the landing site. Therefore, Nectaris-derived rocks and glasses, which would allow the characterization of that mare, are likely to be present in the Apollo 16 sample collection.

The 1-2 mm and 2-4 mm soil fractions and 60639,1 from Apollo 16 have been examined. Three mare basalts and thirty mare-derived glasses have been identified and analyzed.

66043.2,17. This holocrystalline, high-TiO$_2$ mare basalt has an average grain size of 0.50-0.75 mm. The paragenetic sequence was olivine followed by ilmenite followed by pyroxene.

The plagioclases have cores of An$_5$ with Fe/(Fe+Mg) = 0.38 which zone continuously to rims of An$_2$ with Fe/(Fe+Mg) = 0.66. The pyroxenes are titaniferous (4% TiO$_2$) and display a limited iron enrichment trend. The (Al/Si) ratio in the pyroxenes varies from 0.17 to 0.03 with increasing (Fe/Mg) ratio, which suggests that plagioclase and pyroxene coprecipitated. Olivines have nearly constant composition Fo$_{72-73}$. Ilmenites are zoned from Fe/(Fe+Mg) = 0.75-0.90.

The mineralogy, crystal chemical trends, and paragenetic sequence of this basalt resemble those reported by Papike et al. (1974) in the Apollo 17 plagioclase-poitikilitic ilmenite basalts (e.g., 70035).

This fragment has also been dated by Schaeffer and Husain (1974) using the $^{40}$Ar/$^{39}$Ar method. An age of 3.79±0.05 G.Y. and a K abundance of 270 ppm were determined. These data are also consistent with this basalt being similar to the Apollo 17 high-TiO$_2$ basalts (i.e., 70215, 7035 chemical type).

SAO 630 (61501). This porphyritic, high-TiO$_2$ mare basalt has a grain size for the olivine and spinel phenocrysts of 0.10-1.00 mm. The paragenetic sequence is somewhat uncertain due to the limited size of the sample but appears to be spinel followed by olivine followed by ilmenite followed by (?) plagioclase followed by (?) pyroxene. The ilmenite occurs as mantles on the spinel phenocrysts and as thin blades in the groundmass. The titaniferous pyroxenes generally mantle the euhedral olivine phenocrysts. The pyroxenes are titaniferous (5.1% TiO$_2$) and also display limited iron enrichment. The (Al/Si) ratio in the pyroxenes varies from 0.21 to 0.06 with increasing (Fe/Mg) ratio which suggests that pyroxene and plagioclase coprecipitated. Olivines are zoned from Fo$_{66}$ to Fo$_{64}$.

Ilmenites have Fe/(Fe+Mg) ratios varying from 0.90 to 0.91. The mineral-zoning trends and paragenetic sequence observed in this high-TiO$_2$ mare basalt are similar to those observed by Papike et al. (1974) in the Apollo 17 olivine-porphyrion ilmenite basalts (e.g., 70215).

60639,1. This porphyritic, feldspathic mare basalt was first studied by Dowty et al. (1974). The paragenetic sequence was spinel followed by olivine followed by plagioclase: followed by ilmenite followed by pyroxene.

Plagioclase occurs as subhedral phenocrysts with core compositions of An$_{90-91}$, Fe/(Fe+Mg) = 0.5 and as splinitery laths and phenocryst rims ranging in composition from An$_9$, Fe/(Fe+Mg) = 0.5 to An$_{78}$, Fe/(Fe+Mg) = 0.8. The
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Pyroxenes have iron enrichment to pyroxferroite. The (Al/Si) ratio displays limited variation in the pyroxenes (0.10-0.03) with increasing (Fe/Mg) ratio, which suggests that plagioclase preceded pyroxene in the crystallization sequence (consistent with textural evidence). Olivines are zoned from Fo72 to Fo64. Ilmenites are zoned from Fe/(Fe+Mg) = 0.91-0.99.

Dowty et al. (1974) suggested that this basalt was similar to the Luna-16 samples. The mineralogy, mineral zoning trends, and paragenetic sequence are consistent with that interpretation.

Mare-Derived Glasses. Thirty mare-derived glass fragments have been analyzed and found to delineate seven compositional groups (Table 1). High (>7%) and low (<5%) TiO₂ glasses occur in about equal abundances.

Glass group A (Fig. 1) is similar to Apollo 17 orange glass (74220). Groups B and C, which may actually be a compositional continuum, are interpreted as being shock-melted regolith compositions. These B and C regoliths could be derived by contamination of a high-TiO₂ mare soil (%80% 70215, %20% 74220) by ~25% and ~45%, respectively, of a low-TiO₂ mare soil (%60% 12063, ~40% 73141 highlands). Group D may be a high-TiO₂ regolith composition which was contaminated by ~15% highlands (73141 soil). Group E is chemically similar to 12063 and may thus be a volcanic glass. Group G is similar (possibly related) to group E but has a higher (Fe/Mg) ratio. Group H is considered to be a shock-melted regolith composition derived through mixing ~10% high-TiO₂ regolith (%80% 70215, 20% 74220) with a low-TiO₂ regolith (%60% 12063, 40% 73141 highlands) similar to that of Apollo 12.

Conclusions. If Theophilus is the source of the Apollo 16 mare component, then the following conclusions seem plausible:

1. Mare Nectaris consists of both low and high-TiO₂ basaltic chemistries.
2. The high-TiO₂ component contains familiar chemistries: similar to Apollo 17 orange glass (74220) and Apollo 17 mare basalts (70035, 70215).
3. High-TiO₂ mare basalts were emplaced in Mare Nectaris, Mare Tranquililitatis (Apollo 11), and Mare Serenitatis (Apollo 17) during the same time period (3.8-3.7 G.Y.).
4. The low-TiO₂ component contains familiar chemistries: similar to 12063 and Luna-16. Ridley et al. (1974) reported glass compositions which indicate that Apollo 15 type chemistries are also present.

Those conclusions allow two additional ones to be made concerning other regions:

1. By analogy with Mare Nectaris, the high-albedo basalts filling the interior of Mare Serenitatis may contain Apollo 12, 15 and Luna-16 type chemistries.
2. The occurrence of similar basaltic chemistries over widely-separated areas of the Moon suggests that the lunar mantle is quite homogenous laterally.

References
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Table 1

<table>
<thead>
<tr>
<th>GLASS ANALYSES</th>
<th>APOLLO 15 MARINE-DERIVED GLASSES</th>
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<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>SiO₂</td>
<td>40.5 (2.3)</td>
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<td>TiO₂</td>
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<td>Al₂O₃</td>
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<tr>
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<tr>
<td>Fe₂O₃</td>
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Number of Samples: 3

(σ) = one standard deviation.

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