CHEMISTRY OF SOME ROCK TYPES AND SOILS FROM THE APOLLO 15, 16 AND 17 LUNAR SITES. David F. Nava, Planetology Branch, NASA/Goddard Space Flight Center, Greenbelt, MD 20771.

The major and minor element compositions of two Apollo 15 mare basalts (15065 and 15597), four Apollo 16 breccias (61016, 66095, 67559 and 68415), one soil (65500), three Apollo 17 soils (74121, 74220 and 74241), one mare basalt (70017), and one breccia (76055) have been determined by the combined semi-micro (50-mg sample aliquants) atomic absorption and colorimetric spectrophotometry procedure previously described (1, 2), except for K by isotope dilution - mass spectrometry (1). The analytical results are presented in Tables 1 and 2.

Both a whole-rock portion and a heavy liquid separation of the black matrix material of basalt 15597 were analyzed. Ti, Na, P and lithophile trace elements are seen to be higher in the matrix than in the whole rock. Material from two fragments (one-gram and five-gram portions), separated by some 10 cm in the original specimen, of basalt 15065 were studied and found to possess distinctly different bulk chemical compositions. Similar observations have been discussed by Cuttitta, et al. (3), and by Rhodes and Hubbard (4), who have classified Apollo 15 mare basalts into two distinct types, one quartz normative and the other olivine normative in a plot of $TiO_2$ versus MgO. The chemical composition (particularly Ti, Mg and Fe in Table 1) of these two fragments places 15065 in both of these mare basalt groups.

The data in Table 2 for coarse-grained anorthositic rock 61016 is from a hand-picked 100-mesh size separate of the purest white material. The composition of breccia 67559, from the southeast rim of North Ray Crater, is very similar to that of breccia 68415 from near the northeast rim of South Ray Crater. Analyses of two 68415 fragments gave virtually identical results. Unsieved soil fines 65500 has higher Si and Mg and lower Al and Ca contents than almost all Apollo 16 soils observed thus far.

The composition of sample 70017 shows it to be typical of the Apollo 17 subfloor basalts reported in the literature as being characterized by low $SiO_2$ and high $TiO_2$ concentrations. The composition of breccia 76055, except notably for higher Mg and lower Si, is generally similar to Apollo 14 KREEP-type rocks.

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CHEMISTRY OF SOME ROCK TYPES AND SOILS...

Nava, D.F.

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TABLE 1. Chemical Compositions of Two Apollo 15 Mare Basalts.

| CONSTITUENT | 15065,6 STN 1 | 15065,42 STN 1 | 15597,19 STN 9A MATRIX | 15597,19 STN 9A WHOLE ROCK |
|---|---|---|---|---|
| $SiO_2$ | 47.7 | 48.2 | 47.9 | 48.1 |
| $TiO_2$ | 2.86 | 1.44 | 2.30 | 1.87 |
| $Al_2O_3$ | 6.05 | 10.32 | 15.13 | 9.27 |
| MgO | 9.52 | 10.35 | 1.40 | 9.18 |
| CaO | 9.33 | 9.55 | 9.62 | 9.69 |
| $Na_2O$ | 0.27 | 0.33 | 0.66 | 0.32 |
| FeO | 23.77 | 18.46 | 22.24 | 20.17 |
| MnO | 0.307 | 0.234 | 0.224 | 0.254 |
| $P_2O_5$ | 0.119 | 0.104 | 0.151 | 0.107 |
| $Cr_2O_3$ | 0.54 | 0.47 | <0.005 | 0.49 |
| $K_2O$ | 0.081 | 0.041 | 0.111 | 0.056 |
| TOTAL | 100.55 | 99.50 | 99.74 | 99.51 |

TABLE 2. Chemical Compositions of Some Apollo 16 and 17 Soils and Rocks

| CONSTITUENT | 61016,184 STN 1 | 65500,5 STN 5 | 66095,50 STN 6 | 67559,3 STN 11 | 68415,79 STN 8 |
|---|---|---|---|---|---|
| $SiO_2$ | 45.0 | 46.2 | 44.9 | 45.3 | 45.9 |
| $TiO_2$ | 0.02 | 0.62 | 0.60 | 0.26 | 0.28 |
| $Al_2O_3$ | 34.85 | 25.17 | 23.00 | 27.42 | 28.19 |
| MgO | <0.03 | 6.91 | 9.66 | 4.47 | 4.41 |
| CaO | 19.58 | 14.25 | 13.48 | 16.40 | 16.39 |
| $Na_2O$ | 0.41 | 0.48 | 0.48 | 0.50 | 0.47 |
| FeO | <0.05 | 5.65 | 6.86 | 4.31 | 4.01 |
| MnO | <0.005 | 0.072 | 0.080 | 0.054 | 0.048 |
| $P_2O_5$ | 0.047 | 0.137 | 0.240 | 0.113 | 0.072 |
| $Cr_2O_3$ | <0.002 | 0.12 | 0.13 | 0.08 | 0.07 |
| $K_2O$ | 0.005 | 0.139 | 0.146 | 0.078 | 0.060 |
| TOTAL | 99.99 | 99.75 | 99.58 | 98.99 | 99.90 |

| CONSTITUENT | 74121,16 LRV 6 | 76055,3 STN 6 | 70017,23 LM | 74220,40 STN 4 | 74241,20 STN 4 |
|---|---|---|---|---|---|
| $SiO_2$ | 44.9 | 45.7 | 38.8 | 38.9 | 42.3 |
| $TiO_2$ | 2.47 | 1.38 | 12.44 | 8.96 | 7.33 |
| $Al_2O_3$ | 18.75 | 15.84 | 9.73 | 6.38 | 13.69 |
| MgO | 10.20 | 17.89 | 9.89 | 14.76 | 9.88 |
| CaO | 11.73 | 9.13 | 10.04 | 7.01 | 10.89 |
| $Na_2O$ | 0.44 | 0.55 | 0.43 | 0.43 | 0.48 |
| FeO | 10.43 | 9.27 | 17.60 | 22.34 | 14.66 |
| MnO | 0.128 | 0.122 | 0.232 | 0.255 | 0.202 |
| $P_2O_5$ | 0.120 | 0.220 | 0.048 | 0.097 | 0.124 |
| $Cr_2O_3$ | 0.23 | 0.19 | 0.45 | 0.68 | 0.38 |
| $K_2O$ | 0.136 | 0.223 | 0.036 | 0.076 | 0.123 |
| TOTAL | 99.53 | 100.52 | 99.70 | 99.89 | 100.06 |