METEORITE ALHA 81005 : A LUNAR HIGHLAND BRECCIA. Gero Kurat and Franz Brandstätter, Naturhistorisches Museum, Postfach 417, A-1014 Vienna, Austria.

Thin-section ALHA 81005,8 has been allocated to us for a restricted study period of four weeks starting February 10, 1983. This report necessarily has to be a preliminary one. Here we concentrate on our results on lithic and mineral components in ALHA 81005. Results on investigations of various glasses are included in the report by Fudali et al. (1).

Results : ALHA 81005 is a lunar regolith breccia. Figure 1 shows one of the possible chemical evidences for a lunar origin, the FeO/MnO ratio in olivines. ALHA 81005 is a compacted immature lunar highland soil consisting of a variety of lithic fragments, glass fragments, glass beads, chondrules, and mineral fragments suspended into a glass-rich fine-grained matrix which has been shock-melted in places, probably during compaction. The most common lithic fragments are granulitic metabreccias, followed by "basaltic" clasts, shocked anorthosites, chondrules, and complex microbreccias.

Igneous lithology : Most igneous rocks present (regardless wether they are real igneous rocks or melt rocks) are metamorphosed and partially equilibrated. Only one fragment (basalt A) of a felspathic basalt composition (low-K Fra Mauro basalt) is apparently not metamorphosed and displays a crystallization sequence of plag, plag+ol, and plag+px. The compositional variation of olivines and pyroxenes are shown in Fig.2 and typical analyses are given in Table 1. The meta-igneous rocks clearly can be devided into two groups : The Mg-suite (Fig.2) consists exclusively of fine-grained ophitic rocks which are all olivine bearing and which could be melt rocks. The Fe-suite is coarse to very coarse-grained and apparently of a deeper seated origin. "Metabasalt" H actually is only a large pyroxene fragment with some silica attached to it and we can only infer that it belongs to the basalt suite. The Fe-suite tends to be of noritic composition.

Anorthosites : Two large shocked anorthosite fragments have been encountered. Both belong to the ferroan rock suite (2-4), have different pyroxenes (Fig.3, Table 2) and are metamorphically partially equilibrated.

Metabreccias : All granulitic metabreccias are members of the Mg-suite (Fig.3, Table 2) and are of anorthositic noritic-troctolitic composition. Some are Mg-spinel bearing. Metabreccia B is a unique rock fragment consisting mainly of olivine, low-Ca pyroxene, some plagioclase and Cr-Ti spinel. Its real nature is not clear yet.

Chondrules : Three chondrules are present in ALHA 81005,8. All are of the typical ANT composition (5).

Mineral fragments : Most common is plagioclase followed by low-Ca pyroxenes and olivines. Rare are pink Mg-spinel, chromite, and metal. The mafic minerals belong to both Mg-Fe groups.

Summary : ALHA 81005 is a feldspathic lunar highland breccia. Its composition is dominated by highly magnesian, olivine bearing metabreccias and melt rocks derived thereof. The ferroan rock suite is relatively rare and consists of anorthosites, meta-igneous rocks, one metabreccia, and some mineral fragments. Most glasses compositionally overlap with the melt-rocks but not with the mag-

nesian metabreccias. A search for KREEP revealed only one glass (1) and one basalt fragment of low-K composition.

References : (1) Fudali R.F. et al., this volume. (2) Dowty E. et al. (1974), Earth Planet.Sci.Letts.24, 15-25. (3) James O. B.(1980) Proc.Lunar Planet.Sci.Conf.11th, 365-393. (4) Haskin L. A.et al. (1981) Proc.Lunar Planet.Sci.12B, 41-66. (5) Kurat et al. (1972) Proc.Lunar Planet.Sci.Conf.3rd, 707-721.

Table 1 : Electron microprobe analyses of mafic minerals in igneous lithic fragments, ALHA 81005.

| | Basalt A | | | | Metabasalt H | | Metabas J | Metabas L |
|---|---|---|---|---|---|---|---|---|
| | Olivine | Pyroxene | | | Pyroxene | | Px | Px |
| | | lo Ca | hi Ca | hi Fe | lo Ca | hi Ca | | |
| No.of anal. | 5 | 1 | 1 | 1 | 8 | 2 | 5 | 2 |
| $SiO_2$ | 39.8 | 52.7 | 53.3 | 49.3 | 50.6 | 51.2 | 51.1 | 53.7 |
| $TiO_2$ | 0.03 | 0.36 | 0.42 | 1.64 | 0.27 | 0.53 | 0.74 | 0.87 |
| $Al_2O_3$ | 0.06 | 1.65 | 1.24 | 1.46 | 0.36 | 0.87 | 0.73 | 1.66 |
| $Cr_2O_3$ | 0.18 | 0.45 | 0.36 | 0.15 | 0.15 | 0.24 | 0.20 | 0.60 |
| FeO | 17.8 | 16.2 | 14.5 | 27.1 | 31.2 | 17.3 | 24.3 | 12.3 |
| MnO | 0.28 | 0.29 | 0.28 | 0.48 | 0.61 | 0.35 | 0.49 | 0.30 |
| MgO | 41.5 | 21.0 | 16.7 | 8.4 | 11.8 | 9.6 | 15.4 | 23.9 |
| CaO | 0.26 | 5.8 | 13.7 | 11.2 | 4.2 | 18.7 | 5.9 | 5.3 |
| $Na_2O$ | - | - | 0.09 | 0.07 | 0.06 | 0.06 | 0.06 | 0.07 |
| Total | 99.91 | 98.45 | 100.59 | 99.80 | 99.25 | 98.85 | 98.92 | 98.70 |

Table 2 : Electron microprobe analyses of mafic minerals in anorthosites and metabreccias from ALHA 81005.

| | Fe-suite | | | | Mg-suite | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Anorthosites | | Metabreccia | | Metabreccias | | | | | |
| | G | M | B | | N | | Q | S | U | |
| | Px | Px | Ol | Px | Ol | Px | Px | Ol | Ol | Px |
| No.of anal. | 2 | 6 | 4 | 4 | 5 | 2 | 5 | 6 | 1 | 8 |
| $SiO_2$ | 51.7 | 52.5 | 36.3 | 52.9 | 40.5 | 56.0 | 54.5 | 40.5 | 40.0 | 56.8 |
| $TiO_2$ | 1.11 | 0.34 | 0.07 | 0.55 | 0.12 | 0.50 | 0.85 | 0.12 | 0.17 | 0.64 |
| $Al_2O_3$ | 1.60 | 0.53 | 0.09 | 0.81 | 0.06 | 1.07 | 1.81 | 0.08 | 0.08 | 1.22 |
| $Cr_2O_3$ | 0.51 | 0.23 | 0.02 | 0.22 | 0.08 | 0.44 | 0.46 | 0.05 | 0.19 | 0.47 |
| FeO | 13.3 | 24.6 | 34.2 | 19.3 | 16.7 | 10.3 | 11.9 | 15.1 | 18.0 | 10.3 |
| MnO | 0.43 | 0.46 | 0.40 | 0.36 | 0.21 | 0.19 | 0.22 | 0.23 | 0.23 | 0.26 |
| MgO | 13.6 | 19.4 | 27.1 | 21.0 | 45.2 | 31.9 | 29.3 | 44.6 | 43.0 | 29.3 |
| CaO | 17.6 | 2.43 | 0.20 | 4.3 | 0.10 | 1.22 | 1.47 | 0.11 | 0.10 | 2.10 |
| $Na_2O$ | 0.11 | 0.07 | - | 0.04 | - | 0.02 | 0.04 | - | - | 0.05 |
| Total | 99.96 | 100.56 | 98.38 | 99.48 | 102.97 | 101.64 | 100.55 | 100.79 | 101.77 | 101.14 |

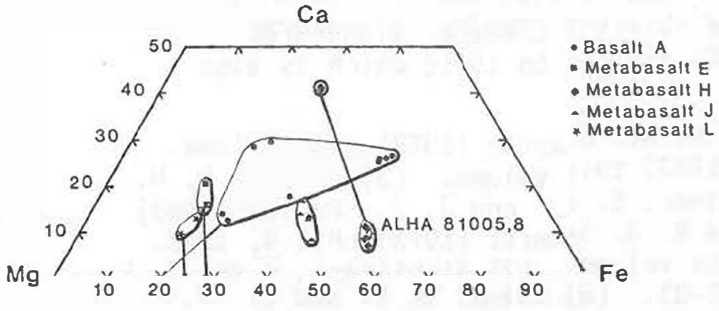


Figure 2 : Olivine (bottom) and pyroxene compositions in igneous lithic fragments.

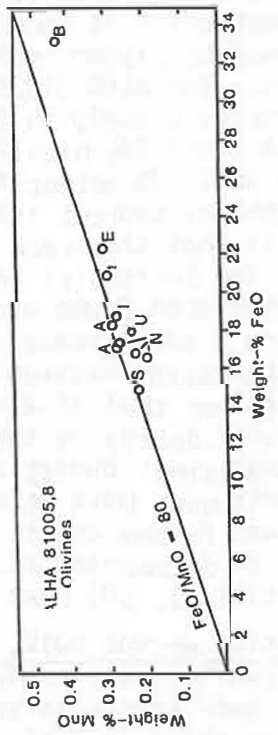


Figure 1

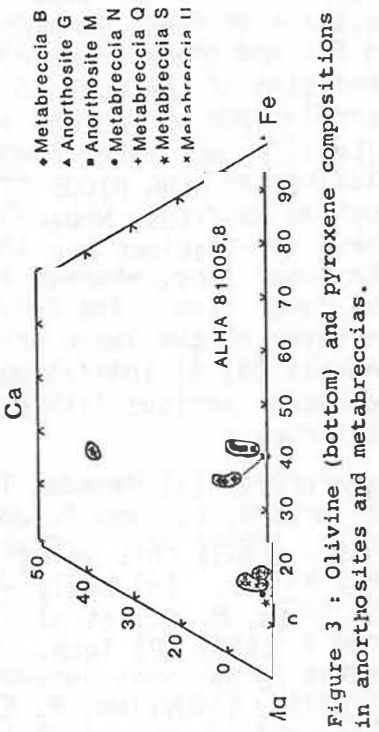


Figure 3 : Olivine (bottom) and pyroxene compositions in anorthosites and metabreccias.