CONE CRATER CONSORTIUM, APOLLO 14: (1) IDENTIFICATION AND FREQUENCY DISTRIBUTION OF ROCK TYPES IN THE CRATER BASEMENT. K. Bobe, S. Lingner, and D. Stöffler, Institute of Mineralogy, Research Group "Earth-Moon-System", University of Münster, D-44 Münster, Germany

The Cone Crater Consortium has been analyzing samples from the ejecta blanket of Cone crater (age: ~25x10^{6}a; diameter: ~360 m) in an attempt to assess the composition and stratigraphy of the subregolith basement of the Fra Mauro Formation. Since the sampling from the Cone crater ejecta blanket is limited to 12 large rock samples and one soil sample (14140-14143), the only meaningful statistics can be obtained from the lithic clast population of the fragmental breccias 14063, 14064 and 14082/83 which were collected near the rim of Cone crater. We present first results of comprehensive petrographic and microprobe analyses of the lithic clasts of sample 14063. 814 clasts > 0.1 mm in 20 thin sections have been classified texturally on the basis of the highland rock classification of (1); 128 representative clasts were selected for defocussed beam microprobe analysis. The lithic clasts of 14063 can be grouped in 4 broad classes: (a) crystalline impact melt breccias, (b) devitrified impact "glasses", (c) granulitic lithologies, and (d) igneous rocks (Table 1). The impact melt lithologies are subdivided into 13 subclasses on the basis of color, clast-content, grain-size and texture of the matrix. Chemically, the melt breccias and impact glasses can be reduced to three main groups (4, 5, and 6 in Fig. 1). It is obvious from Table 1 and Fig. 1 that igneous rocks are rare; in particular, specific pristine rocks (troctolites, gabbronorites, norites, dunites) identified recently as clasts in various Apollo 14 breccias (2, 3, 4, 5) are extremely rare, i.e. less than 0.5%. Compared to the North Ray crater feldspathic fragmental breccias which are texturally analogous to the white breccia boulders (14063/64 and 14082/83) of Cone crater, the melt breccia and impact "glass" clasts are much more abundant in the Cone crater fragmental breccias (87 vs. 47.5%) whereas granulitic lithologies and cataclastic anorthosites are distinctly less abundant (1.5 vs. 14.5% and 9 vs. 38%, respectively; Fig. 2).

The chemical characteristics of the 14063 lithic clasts are given in Figs. 3, 4, and 5. The impact melt lithologies fall into two major subgroups, a high Mg-, low-K, low-P-group, and a low Mg-, high to intermediate K-, high P-group (Figs. 3 and 5). A third subgroup is probably represented by the dark-brown porphyritic melt breccias which correspond to class 2 of Table 1 and to the square symbol of Fig. 5. It is highest in FeO and lowest in MgO compared to all other melt breccia types. The following major conclusions can be drawn from the chemical data: (a) The impact melt lithologies of the 14063-clast population are dominated by low K-, high Mg-compositions (similar to "low K-Fra-Mauro"). A second abundant melt lithology is KREEPy and medium K, low Mg; (b) All types of melt breccia and impact "glass" fragments in 14063 are different from the large samples of KREEP-rich impact melt breccias collected throughout the landing site; (c) The Cone crater soil 14141 (6) is not representative of the bulk composition of the fragmental breccias of the 14063/64- and 14082/83-type which we interpret as being representative of a deeper section of the subregolith basement at Cone crater. Soil 14141 has a strong similarity to the large rock samples and soils (6) outside of the ejecta blanket of Cone crater and therefore is more closely related to the uppermost section of the subregolith basement.

The frequency distribution of rock types (Table 1, Fig. 1) within fragmental breccia 14063 indicates that the parent impact formation of 14063 is derived from an intensely impact-reworked highland terrain. This is concluded from the extremely high percentage of impact melt clasts (87%) which display a wide variety of textures, grain sizes and compositions reflecting variable cooling histories and mixing ratios of target rocks in the parent impact melt complexes (see also companion abstract (7)). 14063 may be part of a larger megabreccia unit (continuous ejecta blanket) of the youngest pre-Imbrian local craters such as the Phase IC-craters of (8) whose ejecta blanket was incorporated as large blocks into the base-surging Imbrian Fra Mauro Formation by the process of secondary mass wasting (9). As argued previously (10), Cone crater excavated about 32 m deep into of the target of which 8-9 m consisted of regolith. This means that the megabreccia unit from which 14063 and other "white breccia" boulders (14064, 14082/83) are derived, originates from the upper 23-24 m of the subregolith Fra Mauro Formation. This unit is chemically and lithologically different from the associated breccias, collected throughout the landing site, mainly by the lack of high K-KREEP.
The latter represent clasts of a breccia unit which is the parental material of the Apollo 14 regolith.

REFERENCES: (1) Stöffler, D. et al. (1980) Proc. Conf. Lunar Highlands Crust, 51-70. (2) Warren, P.H. et al. (1983) Proc. Lunar Sci. Conf. 13th, A615-630. (3) Shervais, J.W. et al. (1983) Proc. Lunar Sci. Conf. 14th, B177-192. (4) Shervais, J.W. et al. (1984) Proc. Lunar Sci. Conf. 15th, 25-40. (5) Lindstrom, M.M. et al. (1984) Proc. Lunar Sci. Conf. 15th, 41-49. (6) Laul, J.C. et al. (1982) Proc. Lunar Sci. Conf. 13th, A247-259. (7) Stöffler, D. et al. (1986) Cone crater consortium, Apollo 14: (2) Precursor igneous rocks and ages of polymict breccias, in Lunar and Planetary Science XVII. (8) Hawke, B.R. and Head, J.W. (1977), Proc. Lunar Sci. Conf. 8th, 2741-2762. (9) Oberbeck, V.R. (1975), Rev. Geophys. Space Phys. 13, 337-362.

Fig. 1

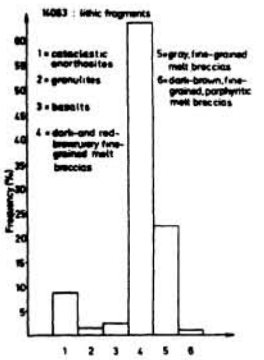

Fig. 5

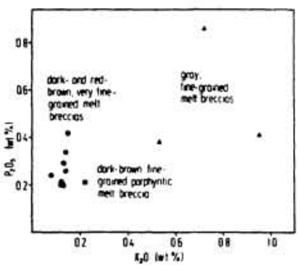

Fig. 3: impact melt breccia clasts of 14063 (dots)

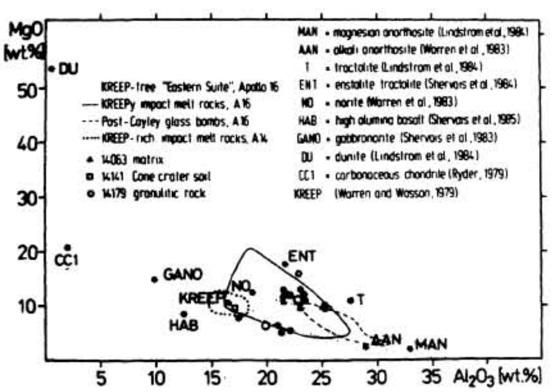

Fig. 4: see Fig. 3

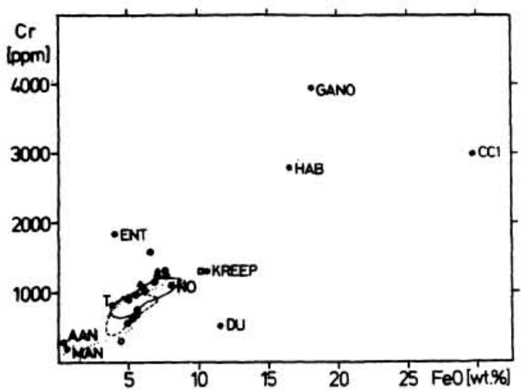

TABLE: Frequency distribution of lithic clasts in the feldspathic fragmental breccia 14063, Cone crater

Impact melt breccias	Vol.%
(1) Dark-brown to opaque, clast-rich, very fine-grained, intergranular	19.4_5
(2) Dark-brown to opaque, clast-poor, fine-grained, porphyritic	1.1_5
(3) Dark-brown, clast-poor, very fine-grained, intergranular to subophitic	6.5
(4) As (3), but with phenocrysts of olivine and spinel in the matrix	1.8_5
(5) Dark-brown, clast-poor, very fine-grained, subophitic	19.5_5
(6) Light-gray, clast-poor, fine-grained, porphyritic	16.6
(7) Gray, clast-poor, fine-grained, ophitic	4.0
(8) Dark-gray, clast-poor, very fine-grained, intergranular	1.7_5
	70.8_5
Devitrified fragment-laden impact glasses	
(9) Red-brown, clast-free, cryptocrystalline	4.3_5
(10) Red-brown, clast-poor, cryptocrystalline with H-plagioclase phenocrysts	2.3_5
(11) As (7) but with olivine and spinel phenocrysts	3.5
(12) Dark red-brown, clast-poor, fine-grained, variolitic	5.8_5
(13) Yellow-brown, clast-poor to clast-free, cryptocrystalline	0.2
	16.2_5
Granulitic lithologies	
(14) Clast-free to clast-poor, very fine-grained	1.5_5
Igneous rocks	
(15) Basalts, fine-grained, subophitic	2.4_5
(16) Anorthosite, cataclastic, recrystallized	8.8_5
	11.3^5
Total	99.95

Fig. 2