NATURE OF THE APOLLO 16 SUBREGOLITH BASEMENT AS DEDUCED FROM THE COMPOSITION OF LARGE IMPACT GLASS SAMPLES R. Borchardt[1], D. Stöffler[1], R. Ostertag[1], A. Rehfeldt[1], H. Palme[2], and H. Wänke[2], [1]Institut für Mineralogie, Münster, Germany, [2]Max-Planck-Institut für Chemie, Mainz, Germany

Among the large rock samples of the Apollo 16 landing site partially to completely devitrified impact glasses with the characteristic morphologies of quenched liquids are ubiquitous. They comprise some 10 to 20% of all samples > 1 g. With respect to their origin and selenologic significance the basic open questions are: What are the source rocks of these melts, regolith or coherent crystalline rocks and breccias from the subregolith basement? What are the sizes, ages, and locations of their parent impact craters? On the basis of the present data some selenological and impact mechanical constraints to their genesis can be stated: (a) Their age is most probably post-Cayley (1), (b) because of this and for photoselenological reasons they must originate from craters smaller than about 1.5 km in size.

Chemical and petrographic data of impact glasses and typical crystalline rocks from Stations 11 and 13 were obtained in a consortium study of the North Ray crater rocks. Fig. 1 shows the chemical variation within the complete sample population with respect to the MgO - Al_2O_3-correlation from own and literature data (3, 7, 8, 9). The glasses as a whole do not match the composition of the Apollo 16 soils. They display a much greater variation than the soils. In addition, the glass compositions do not cluster near the composition of particular crystalline basement rocks but appear to represent mixtures of such rocks. In order to check this possibility we performed mixing model calculations using a computer program of (2). The calculations started with 9 components representing all major rock types of Apollo 16. The computer reduced the number of components to 5 which appear to be petrographically reasonable. From the results (Table 1) we conclude that most glasses are di- and trilithologic, and only rarely a nearly monolithologic glass composition is present. The number of mixing components in each glass sample of Table 1 represent model minimum numbers. In reality, additional components which themselves are mixtures of the 5 basic components could be present in the melt mixtures. The component ratios for particular glasses are rather variable (Table 1). The main combinations are granulitic noritic anorthosite 67955 + low-K Fra Mauro melt rock 60315 (3) or cataclastic anorthosite 67636 + 60315 ± 67955. KREEPy components such as 64455 are insignificant. Some glasses (67627, 67728) are very similar in composition to the average composition of the North Ray crater basement (Table 1) as calculated from the frequency distribution of the 7 main crystalline rocks of Station 11 according to data of (4). These glasses may represent the North Ray crater melt. Glasses which are more mafic such as 67695, 67568, 63568 (Table 1) may be melt products of crater basements in the Cayley plains. It cannot be excluded at this point that some of the glasses are melt products of the regolith. However Kempa et al. (5) found that four components (67075, 60315, 62295 and 15076) are required to match the chemistry of the soils. Moreover, their ratios are much more constant for the soils than the component ratios in our mixing model for the glasses.

An additional argument in favor of a basement rock origin of the glasses results from the composition of metal spherule inclusions (Fig. 2). The glasses differ in their metal compositions considerably, whereas the metal composition in one glass sample is rather constant. In melts derived from the regolith one should expect a more constant composition of the metal for all samples. Moreover, the metal composition in Apollo 16 soil agglutinates is different from that one of the glasses discussed here (6).

Our results suggest that most glasses of the type described above were formed by shock melting and mixing of subregolith basement lithologies in craters in the 50 to 1500 m size range. The chemical variation of the glasses indicates the presence of a polymict megabreccia basement with blocks sizes on the scale of tens to no more than a few hundreds of meters throughout the Apollo 16 area.

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Glass sample	67636	67955	60315	62295	64455
63559,6	0	88.8	11.2	0	0
63565,6	0	96.9	3.1	0	0
63566,4	0	100.0	0	0	0
63567,7	0	97.6	2.4	0	0
63568,9	61.6	< 0.05	38.4	0	0
67567,2a	0.2	99.8	0	0	0
67567,2b	16.3	83.7	< 0.05	0	< 0.05
67568,1	60.6	< 0.05	39.3	< 0.05	< 0.05
67627,5	71.2	0	28.6	0.1	0.1
67629,6	54.1	4.3	41.6	0	0
67675,1	0	92.6	7.4	0	0
67695,2	0	88.2	11.8	0	0
67695,5	0	60.1	0	39.9	0
67728,2a	75.1	3.1	18.4	3.4	0
67728,2b	73.2	< 0.05	26.8	0	< 0.05
60015*	25.8	28.5	0	0	45.6
60018*	44.4	37.9	17.7	0	< 0.05
60666*	34.2	47.5	18.2	0	< 0.05
64455*	19.2	62.0	18.8	< 0.05	< 0.05
67629*	0	82.1	17.8	< 0.05	< 0.05
67975*	33.8	49.2	17.0	0	0

Table 1

based on data from (10) (11 major elements and Ni, Lu, La, and Sc); chemical analyses for source rocks were taken from (3) and (10)

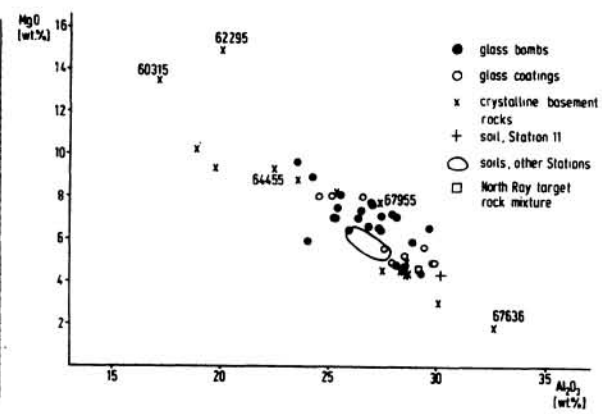

Fig. 1

60015, 60018, 64455, and 67975 are glass coatings (see Table 1)

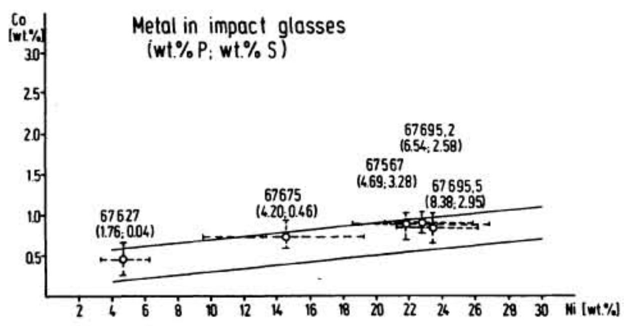

Fig. 2