IMPACT MELTS AND ANORTHOSITIC CLASTS IN LUNAR METEORITES QUE93069 and MAC88105; **Jennifer A. Grier, David A. Kring and Timothy D. Swindle**, University of Arizona, Lunar and Planetary Laboratory, Tucson, Arizona, 85721.

QUE93069 is a 21.4g meteorite that has been classified as an anorthositic breccia of lunar origin [1]. We present petrographic and electron microprobe analyses of QUE93069 and a new thin section of MAC88105. In particular, we compare the impact glasses in these meteorites with other lunar meteorites, and Apollo 16 sample 64001 to gain insights into the compositional origin and history of these samples. Our results confirm that QUE93069 is an anorthositic breccia with highland affinities.

The matrix of the sample in our QUE93069 thin-section (,38) is translucent to semi-opaque with a large number of anorthositic clasts with compositions of An_{97}, which is similar to previous analyses of 0.3-0.4% Na_2O and <0.1% K_2O [1]. Similarly, our thin-section MAC88105,131 contains anorthositic clasts with An_{97}, and clasts of impact melts with relic grains of An_{97}. These plagioclase compositions are similar to those in other anorthositic breccias in the lunar meteorite collection [2,3,4]. Conversely, several important differences do exist between the two thin-sections we have examined. The clasts in MAC88105 are larger than those in QUE93069, and the impact melts in QUE93069 are generally glassy, while those in MAC88105 are generally partially crystalline and cryptocrystalline.

A series of glass spherules and glass fragments in QUE93069 are of particular interest since they are impact melts which represent bulk samples of the regolith components on the lunar surface. Figure (1) is a ternary diagram (after [5]) which illustrates the range of compositions found in glass spherules and fragments in QUE93069. (Glasses were identified as those homogeneous fragments with non-stoichiometric compositions.) The spherules appear to have a wider range of compositions than the glass fragments, but the bulk of them correspond to the highland group and highland basalt subgroup in the classification scheme of [6]. These compositions are centered on the same area of the diagram as the highland impact glasses of ALHA81005,8, and those of other lunar meteorites, although meaningful differences exist [5]. The population of glasses occurring in the lunar meteorites, including MAC88105 and QUE93069, do not appear to have compositions derived from a predominantly KREEPy region, unlike some glasses in 64001 [5], consistent with a bulk chemical analysis of QUE93069 [7]. Conversely, QUE93069 and MAC88105 may have glasses that incorporate a mare component not sampled by 64001 glasses.

A plot of wt% MgO/FeO (after [8]) also illustrates the compositional differences in these glass populations. The glass fragments of QUE93069 fall in a narrow range, which coincides with an area indicated as Apollo 16 anorthositic rocks, which suggests they may be derived largely from anorthositic rocks [8]. The same is not true for the glass spherules present in QUE93069. These analyses fall over a much greater area, and represent much more diverse compositions, which is the same conclusion reached from Figure (1). These spherules sampled many different lithologies; clearly more than the other glasses. This diagram seems to indicate that the spherules have incorporated a component with very high aluminum content, which was not part of the parent material from which the other glasses have been formed. The data set for MAC88105 has only a few points due to the scarcity of glasses in this section, but it is clear that the glasses sampled represent several lithologies; more than that of the glasses and glass fragments of QUE93069.

The QUE93069 glasses were produced from rocks with a broad range of atomic Mg/(Mg+Fe) (Figure 2). This range is as great as the range seen among the bulk atomic Mg/(Mg+Fe) of the other lunar meteorites. (Figure 2). The bulk atomic Mg/(Mg+Fe) [7] falls near the center of this range, and might indicate that the rock is primarily derived from local materials. This is consistent with the composition of a vesicular melt vein that crosscuts the rock. The lunar meteorites MAC88105, Y791197, and Y82192 sampled a region

of the Moon with an atomic Mg/(Mg+Fe) of approximately 0.63, while ALHA81005 represents an area with an atomic Mg/(Mg+Fe) of 0.73 [5].

Our examination of QUE93069 confirms that this is an anorthositic breccia of probable lunar origin. It has a large number of glasses as compared to MAC88105, and these glasses represent a relatively broad range of regolith compositions. These compositions, however are representative of a highland terrain similar to, though not identical to those sampled by the other anorthositic breccias in the lunar meteorite collection. We intend to continue our petrographic and electron microprobe analyses of QUE93069 and MAC88105 in preparation for determination of $^{40}Ar/^{39}Ar$ ages of the glasses in these sections using our laser-based gas extraction system.

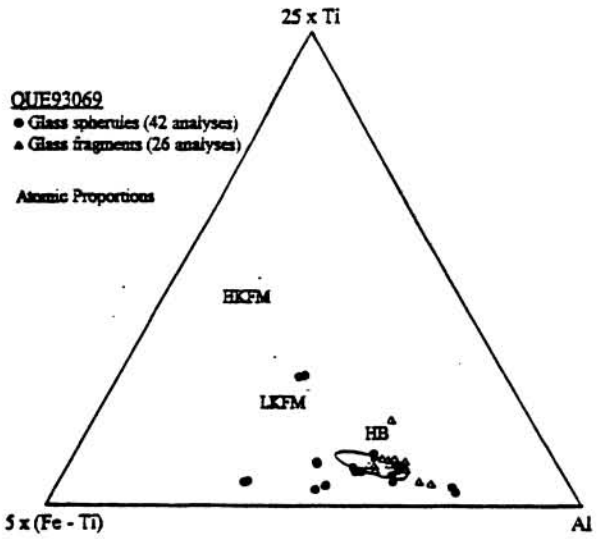

Figure 1 - Ternary diagram (after [5]) showing the compositions of glass spherules and glass fragments in QUE93069. For comparison, the range of bulk regolith compositions represented by other lunar meteorites are shown as an ellipse, and three groups of highland glasses (highland basalt, Low-K Fra Mauro basalt, and High-K Fra Mauro basalt) are plotted.

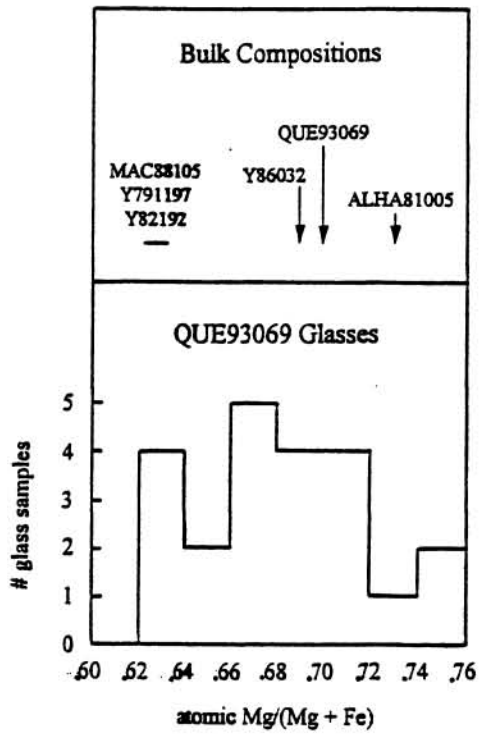

Figure 2 - The atomic Mg/(Mg+Fe) ratio in glasses in QUE93069. For comparison, the bulk compositions of several lunar meteorites are shown [5], including QUE93069 [7].

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