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CHONDRULES OF LUNAR ORIGIN

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Rock 14318 is a complex breccia and consists mainly of breccia and igneous fragments of different sizes, glass fragments and spherules, and chondrules that are embedded into a fine-grained, partly glassy matrix. Although different in composition, this rock exhibits many characteristics of chondrites, i.e., chondrules, non-chondritic metamorphosed fragments, igneous fragments, fine-grained matrix, and a high degree of welding.

The chondrules, which occur exclusively in the fine-grained matrix have spherical to ellipsoidal shapes and range in size from 0.05 to 0.6 mm. Textures are mainly igneous and very similar to those in meteoritic chondrules and range from variolitic to fibrous and excentroradial. There are, however, also gradations towards metamorphic (hornfelsic) textures. The coarser grained igneous chondrule varieties show abundant plagioclase laths with an interstitial fibrous matrix consisting mainly of plagioclase and low-Ca pyroxene with or without glass. Plagioclases are rather uniform in composi-

tion (An_{85-95}) displaying only a weak zoning. Pyroxenes are too fine-grained for analysis with the electron microprobe.

The bulk chemical compositions of the chondrules, except for some of the smaller ones which vary somewhat, are remarkably similar to one another and are of anorthositic norite character. A typical analysis (weight percent) is as follows: SiO_2 – 45.5; TiO_2 – 0.23; Al_2O_3 – 26.1; Cr_2O_3 – 0.12; FeO – 5.6; MnO – 0.10; MgO – 5.1; CaO – 15.8; K_2O – 0.10; Na_2O – 0.42; P_2O_5 – 0.08. This composition closely matches the composition of glass spherules rich in anorthosite components from loose fines and microbreccias of Apollo 11 and 12 samples. They are, however, generally different in composition from the glass spherules that occur in the same sample (14318).

The occurrence, within a lunar impact breccia, of abundant chondrules that have all the textural characteristics of meteoritic chondrules but with drastically different chemical composition suggests that they are of lunar origin and originated in the impact process that formed the breccia. Since the chemical composition of the chondrules closely matches that of anorthosite glass spherules in Apollo 11 and 12 samples they must have formed under different conditions. It is suggested that a different degree of supercooling and/or availability of foreign nuclei is responsible for allowing or preventing crystallization of the molten droplets. Thus, rock 14318 probably formed in a large impact event where the cooling rate of the molten droplets suspended in the impact-produced cloud was relatively slow (due to the shielding effect of the cloud) and where many foreign nuclei were available. Furthermore, the high degree of welding suggests a fast aggregation of the rock to a relatively thick layer, which is necessary to retain the heat for welding and recrystallization. Glass spherules of similar composition in Apollo 11 and 12 samples, on the other hand, apparently formed in relatively small impact events where cooling rates were high and the density of foreign nuclei was low.