Genetic Implications of Chemical and Textural Properties of Some Fra Mauro Breccias (Apollo 14)

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Abstracts

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This volume comprises abstracts of papers to the XI General Meeting of International Mineralogical Association (IMA) presented at the sessions: Crystal Growth, Ore Microscopy, Cosmic Mineralogy.

The volume is intended for the broad section of specialists in mineralogy, petrology, geochemistry and processes of ore-formation.

GENETIC IMPLICATIONS OF CHEMICAL AND TEXTURAL PROPERTIES OF SOME FRA MAURO BRECCIAS (APPOLLO 14)

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The Fra Mauro Formation, which is generally believed to belong to the ejecta-blanket of the Imbrium crater, should bear information on the Pre-Imbrian lunar crust and the Imbrium-event itself. They can only be obtained by investigations of polymict breccias, be - cause the primordial crustal rocks are thoroughly brecciated and mixed by impact events and embedded in polymict breccias or the lunar regolith.

Studies, which included 6072 microprobe analyses of plagioclase , pyroxene and olivine taken from the literature, indicated a difference in the main- and minor-chemistry of these minerals depending on their source rock.

We propose the following model for the formation of the Fra Mauro crystalline matrix breccias: (a) Formation of impact melt in one ore more local, pre-Imbrian craters and mixing of melt and less shocked fragmented rock material during crater excavation with initial melt temperatures of at least 1700°C, (b) Formation of a series of breccia types ranging from coherent fragment-laden melt rocks to suevite-type detrital breccias rich in discrete clods of melt, (c) Concentration of cold clastic material in schlieren-like bodies by flotation effects to form the parent of the light matrix in a breccia like 14311 or formation of an intimate mixture of impact detritus with independent clods of melt to form the parents of light and dark matrix in a second breccia type (14066 and 14320 are transitional to the latter type), (d) First crystallization of melt in the clast-rich areas (light matrix) at high temperatures with clasts acting as nucleations centers: formation of a relatively coarse grained texture with pigeonitic pyroxene and An-rich plagioclase, (e) Subsequent crystallization of melt in clast-poor areas (dark matrix) at lower temperatures (supercooled liquid) with simultaneous formation of a large number of nuclei; formation of a mosaic-like texture with low-Ca-pyroxene; further textural variation in the matrix most probably resulting from variation of the bulk chemistry due to different degrees of clast melting, (f) Breccia material now residing in a more ore less thick impact formation with slow cooling from temperatures of at least 600°C as indicated by the preservation of highly silicous glass.

EXPERIMENTAL AND PETROLOGIC STUDY OF THE SHERGOTTITE ACHONDRITIC METEORITES

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Melting experiments conducted on Shergotty and Zagami indicate the following order of phase crystallization: pigeonite, augite plagioclase. However, the first pigeonites to crystallize are more magnesian than the most magnesian pigeonites in the natural samples. We interpret this as evidence that both meteorites contain cumulus pyroxene. Petrographic observations indicate cumulus augite is also present, but little or no cumulus plagioclase. The experimental results indicate that Zagami consists of approximately 55% intercumulus liquid and 45% cumulus pyroxene, half of which is pigeonite (Wo_{11} En_{57} and half of which is augite (Wo_{33} En_{48}). Shergotty consists of 70% intercumulus liquid of the same composition as that in Zagami, and 20% cumulus pigeonite and 10% augite of the same compositions as cumulus pyroxenes in Zagami. Both meteorites crystallized under fO_2 conditions approximating the QFM buffer assemblage, as determined from analyses of coexisting titanomagnetite and ilmenite. Late-stage differentiation of intercumulus liquid produced intergrowths of feldspar-like glass and silica with whitelockite, sulfides and oxides.