TRISOCTAHEDRAL IRON IN LUNAR BRECCIAS. U.S. Clanton, D.S. McKay and R.B. Laughon, NASA Johnson Space Center, Houston, TX 77058 and G.H. Ladle, Lockheed Electronics Company, Houston, TX 77058.

An iron crystal with a previously unreported crystal habit, the trigonal trisoctahedron, has been found in a vuggy breccia fragment from sample 67482 (Fig. 1). The dominant form is the trapezohedron {hll} modified by cube {100} and trisoctahedron {hkl} faces (Fig. 2, 3). The crystal shows two values for {hll}; two sets of trapezohedron faces are present. Only one crystal with trisoctahedral faces has been found, all other iron crystals have a habit that has been previously reported[1,2].

Based on Energy Dispersive X-ray analysis (EDX), the crystal is relatively pure iron; nickel, phosphorous, cobalt, and sulfur, if present, are below the detection limit, i.e., less than 0.5%.

Iron crystals are isometric, crystalizing in space group Im3m[3]. The various forms possible in the hexoctahedral class of the isometric system are the (1) cube {100}, (2) octahedron {111}, (3) dodecahedron {110}, (4) tetrahedahedron {hk0}, (5) trisoctahedron {hkl}, (6) trapezohedron {hll}, and (7) hexoctahedron {hkl}.

Prior to the Apollo program various investigators had reported terrestrial and meteoritic occurrences of iron crystals with octahedral, dodecahedral and cubic habits[3]. SEM micrographs of lunar material by McKay et al[1] and Clanton et al[2] documented the presence of iron crystals with trapezohedron and tetrahexahedron forms. The presence of the hexoctahedral form was suggested as a possible interpretation of the oscillatory combinations or "striations" on the tetrahexahedron faces but clear documentation was not possible because of the submicron size of the faces[2]. The discovery of an iron crystal with trisoctahedral faces now unquestionably documents iron occurring in six of the seven crystal forms of the hexoctahedral class.

As previously discussed[1], the open network of euhedral crystals in the vuggy breccias is strongly suggestive of vapor-phase crystallization. The euhedral iron crystals with highly modified crystal faces also suggests a relatively slow rate of growth from an iron bearing vapor. The reason for the occurrence of multiple habits of lunar iron crystals remains unexplained. The crystal habit of the iron in the vugs of the breccias does not appear to be simply related to the host rock or degree of metamorphism. It may be related to rate of crystal growth, the presence of other species in the vapor, or temperature and pressure conditions.

As additional data become available it may be possible to relate crystal habit to breccia environment and ultimately explain some of the large scale impact processes.

REFERENCES

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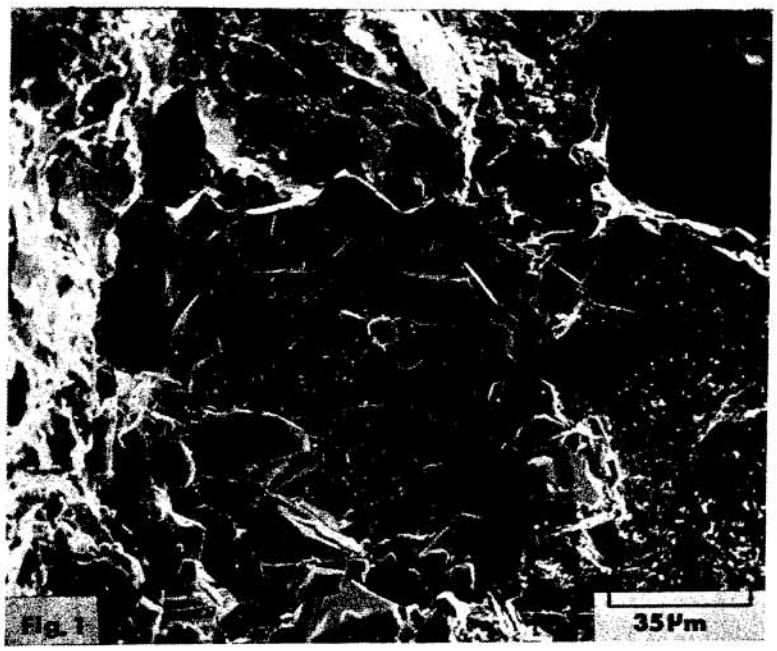

Fig. 1: SEM micrograph of a vuggy breccia fragment. The euhedral crystal of iron sits in a vug surrounded by plagioclase and pyroxene crystals; porosity of the vug extends well into the fragment. The geometrical relationship indicates that the iron crystal was late in forming, perhaps the last mineral to crystallize in the vug.

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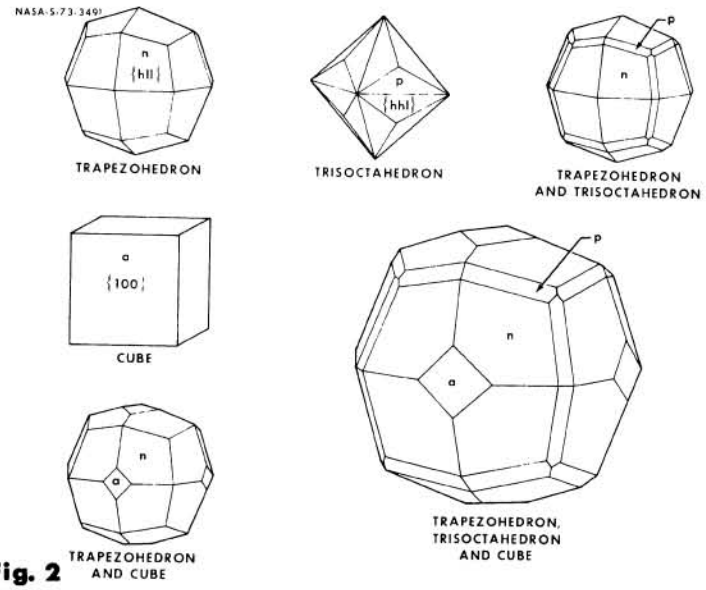

Fig. 2: Drawing showing modifications and combinations of the trapezohedron {hll}, cube {100} and trisoctahedron {hhl} forms.

Fig. 3: SEM micrograph of an iron crystal. The dominant form is the trapezohedron {hll}; the cube {100} and trisoctahedron {hhl} faces are smaller. Two values for {hll} occur on this crystal; there are two sets of trapezohedron faces.