Structure of framboidal pyrite: an electron backscatter diffraction study

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The detailed crystallography of natural pyrite framboids has been determined for the first time, using electron backscatter diffraction techniques. The crystallographic ordering of microcrystals correlates positively with morphological ordering: the crystallographic orientations are random in morphologically disordered framboids and almost ordered in morphologically ordered framboids. Morphologically ordered framboids involve two types of systematic misorientations across the microcrystal boundaries: low angle (ca. less than 20 degrees) and high angle (ca. 70–90 degrees) misorientations. The low angle misorientation probably simply reflects slight physical misalignment of microcrystals in the packing structure, whereas the high angle misorientation is considered to result from the dichotomy of the pyrite microcrystals having four-fold morphological symmetry but only two-fold crystallographic symmetry about 100 directions. Thus, crystallographic orientation of microcrystals even in highly ordered framboids is not uniform. The result suggests that the self-organization of microcrystals in pyrite framboids is not crystallographically controlled, such as by sequential replication of existing microcrystals, since this would not result in high lattice misorientation angles between adjacent microcrystals. Presumably, the self-organization process is a consequence of aggregation of multiple equidimensional and equimorphic microcrystals that have nucleated in a fixed volume. We suggest that the regular arrangements of microcrystals occur by the physical rotation (reorientation) of individual microcrystals, driven by the reduction in surface free energy between neighbors.