American Mineralogist, Volume 89, pages 1510–1515, 2004

Polytypism of cookeite in low-grade metapelites of the Cameros Basin, Spain: Lack of correlation of well-ordered polytypes with pressure

M. Pilar Mata,[1,*] Donald R. Peacor,[2] and Francisco López-Aguayo[1]

[1]Department of Geology, University of Cádiz, Campus Río San Pedro, 11510, Puerto Real, (Cádiz), Spain
[2]Department of Geological Sciences, University of Michigan, Ann Arbor, Michigan 48109, U.S.A.

Abstract

Cookeite occurs in low-grade, chloritoid-bearing metapelites of the Cameros Basin, northern Iberian Range, Spain, as thin coatings on poikiloblastic pyrite crystals <25 cm on edge. Textural relations imply formation via hydrothermal fluids in a syn- to late-regional metamorphic environment. Selected-area electron diffraction patterns of cookeite display a wide range of stacking order-disorder, from patterns with streaking parallel to **c*** in $k \neq 3n$ reflections to sharply defined reflections having one-, two-, and greater than two-layer periodicities. Well-ordered polytypes in crystals up to 0.1 μm thick are of type *Ia*, as determined by powder X-ray diffraction. Coexisting chamosite likewise displays a range of order in polytypism from complete disorder to the well-ordered *IIb* polytype which is typical of low-grade metamorphism.

Contrary to assertions that ordered cookeite polytypes are indicators of medium- to high-pressure metamorphism, the occurrence of ordered stacking sequences is direct evidence that, although ordered cookeite may occur in medium- to high-*P* environments, it is equally indicative of low-*P* environments. It can therefore not be used as an indicator of high pressure. The occurrence of several ordered and disordered polytypes in the same sample is compatible with the generally accepted notion that free-energy differences between polytypes are too small to be indicators of specific stable-equilibrium *P-T* conditions. The general occurrence of semirandom stacking is attributed to a lack of equilibrium in structure that is generally characteristic of phyllosilicates in low *P-T* environments of formation.