American Mineralogist, Volume 92, pages 460–467, 2007

Hammadah al Hamra 193: The first amphibole-bearing winonaite

Christine Floss,[1,*] Bradley L. Jolliff,[2] Gretchen K. Benedix,[2,3] Frank J. Stadermann,[1] and Jay Reid[2]

[1]Laboratory for Space Sciences and Physics Department, Washington University, One Brookings Drive, St. Louis, Missouri 63130, U.S.A.
[2]Department of Earth and Planetary Sciences, Washington University, One Brookings Drive, St. Louis, Missouri 63130, U.S.A.
[3]Department of Mineralogy, The Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

Abstract

The Hammadah al Hamra 193 winonaite was found in the Libyan desert in 1996. Unlike most winonaites with fine- to medium-grained equigranular textures, it consists predominantly of very large (up to 5 mm), optically continuous orthopyroxene grains enclosing smaller grains of olivine and plagioclase. It also contains large (up to 2 mm) poikilitic grains of amphibole enclosing clinopyroxene, plagioclase, olivine, and occasionally orthopyroxene, which occur interstitial to the large orthopyroxene grains. The amphibole is identified as fluoro-edenite, and textures indicate that it replaces clinopyroxene via a reaction in which diopside, olivine, and plagioclase form fluoro-edenite. Trace-element data are consistent with the formation of fluoro-edenite from clinopyroxene and plagioclase. Fluoro-edenite has a REE pattern similar to that of clinopyroxene, but has elevated abundances of Na, K, and Ba, elements typically enriched in plagioclase. The source of the F is uncertain, but may be apatite, which is fluor-apatite in this meteorite. The presence of fluoro-edenite in HaH 193, a meteorite that experienced extensive thermal metamorphism, indicates a significant stability field for this rare mineral.

Keywords: Meteorites, winonaites, amphibole, metamorphism