American Mineralogist, Volume 87, pages 1257–1260, 2002

LETTERS

Natural occurrence of Fe_2SiO_4-spinel in the shocked Umbarger L6 chondrite

ZHIDONG XIE,[1,*] NAOTAKA TOMIOKA,[1,2,*] AND THOMAS G. SHARP[1,*]

[1]Department of Geological Sciences, Arizona State University, Tempe, Arizona 85287-1404, U.S.A.
[2]Present address: Department of Earth and Planetary Sciences, Faculty of Science, Kobe University, Kobe 657-8501, Japan

ABSTRACT

Here we report the first natural occurrence of Fe_2SiO_4-spinel in a shock-induced melt pocket of the Umbarger L6 chondrite. Optical microscopy, scanning electron microscopy, electron microprobe analysis, and analytical transmission electron microscopy were used to examine the sample. Fe_2SiO_4-spinel was identified by TEM using selected-area electron diffraction and energy-dispersive X-ray spectroscopy. The symmetry of the diffraction patterns, the ratios of *d*-spacings, and interplanar angles are consistent with the spinel structure. However, the cell parameter of Fe_2SiO_4-spinel (8.52 Å), calculated from *d*-spacing data, is 3.5% larger than that of synthetic Fe_2SiO_4-spinel (8.235 Å). Chemical analyses of the spinel show olivine stoichiometry with Fe/(Fe + Mg) ratios ranging from 0.62 to 0.99. Fe_2SiO_4-spinel and stishovite occur within FeO-SiO_2-rich zones in the melt pocket, surrounded by SiO_2-rich glass and Fe-rich phyllosilicates. Fe_2SiO_4-spinel plus stishovite also occur with other high-pressure minerals in the melt pocket: ringwoodite, akimotoite, augite, and hollandite-structured plagioclase. We infer that the Fe_2SiO_4-spinel crystallized from a zone of FeO-SiO_2-rich melt within the shock-induced melt pocket. Two models for FeO-SiO_2-rich melt are discussed: it was either a residual melt after crystallization of MgO-rich silicates in a chondritic melt pocket, or it was produced by shock melting of FeO-SiO_2-rich material.