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Symplectites derived from metastable phases in martian basaltic meteorites

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ABSTRACT

The martian basalts Los Angeles, QUE 94201, Shergotty, and Zagami contain several late-stage mineral types including oxides, sulfides, phosphates, and associated silicate assemblages. Symplectites consisting of two- and three-phase assemblages are present in Los Angeles, QUE 94201, and Shergotty. The three-phase symplectite is composed of hedenbergitic pyroxene, fayalitic olivine, and an SiO_2 polymorph, and the two-phase symplectite consists of fayalitic olivine and an SiO_2 polymorph. These symplectites are commonly found in close association with the Ca-phosphate merrillite [general formula $Ca_9(Mg,Fe^{2+})(PO_4)_7$]. Scanning Electron Microscopy was used to examine the distribution and occurrence of the symplectites, and point-count and electron-microprobe data were used to recast symplectites in terms of pyroxene stoichiometry. The reconstructed three-phase symplectite compositions plot close to lunar (metastable) pyroxferroite on the pyroxene quadrilateral diagram and indicate that pyroxene compositions ranged into the "forbidden region" and eventually crystallized pyroxferroite, which subsequently broke down to the three-phase symplectite upon cooling. Two-phase symplectites, which occur directly adjacent to merrillite, may be the result of breakdown of metastable ferrosilite. The crystal chemistry of merrillite and its close association with the symplectites indicates that during crystallization of pyroxene, co-crystallizing merrillite contributes to depletion of Ca and Mg and the formation of metastable pyroxferroite and ferrosilite.