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Majorite-olivine–high-Ca pyroxene assemblage in the shock-melt veins of Pervomaisky L6 chondrite

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Abstract

High-pressure minerals—majorite-pyrope garnet and jadeite—were found in the Pervomaisky L6 ordinary chondrite. Majorite-pyrope (79 mol% majorite) was observed within the fine-grained silicate matrix of a shock-melt vein (SMV), coexisting with olivine and high-Ca pyroxene. This is the first report of a garnet–olivine–high-Ca pyroxene assemblage that crystallized from the melt in the SMV matrix of meteorite. *P-T* conditions of the formation of the SMV matrix with olivine fragments are 13.5–15.0 GPa and 1750–2150 °C, the lowest parameters among all known majorite-bearing (H,L)-chondrites. The estimated conditions include the olivine/(olivine + ringwoodite) phase boundary and there is a possibility that observed olivine is the result of wadsleyite/ringwoodite back-transformation during a cooling and decompression stage. In the framework of this hypothesis, we discuss the problem of survival of the high-pressure phases at the post-shock stage in the meteorites and propose two possible *P-T* paths: (1) the high-pressure mineral is transformed to a low-pressure one during adiabatic decompression above the critical temperature of direct transformation; and (2) quenching below the critical temperature of direct transformation within the stability field of the high-pressure phase and further decompression. The aggregates with plagioclase composition ($Ab_{81.1}An_{14.9}Or_{4.1}$) occur in host-rock fragments near (or inside) of the SMV, and have a radial, concentric "spherulite-like" microstructure previously described in the Novosibirsk meteorite, and that is very similar to the texture of tissintite in the Tissint martian meteorite. It is likely that jadeite is related to crystallization of the SMV and could have formed from albitic feldspar (plagioclase) melt at 13.5–15.0 GPa and ~2000 °C.

Keywords: L6 chondrite Pervomaisky, olivine high-Ca pyroxene majorite-pyrope assemblage, jadeite, shock-melt vein history