Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)
©2011. Japan Geoscience Union. All Rights Reserved.

PPS003-10 会場:202 時間:5 月 26 日 17:45-18:00

Shock Conditions and Formation Mechanism of Akimotoite-Pyroxene Glass Assemblages in the Grove Mountains (GRV) 052082

Shock Conditions and Formation Mechanism of Akimotoite-Pyroxene Glass Assemblages in the Grove Mountains (GRV) 052082

Lu Feng[1*], Masaaki Miyahara[2], Toshiro Nagase[2], Eiji Ohtani[2], Sen Hu[1], Ahmed El Goresy[3], Yangting Lin[1]
Lu Feng[1*], Masaaki Miyahara[2], Toshiro Nagase[2], Eiji Ohtani[2], Sen Hu[1], Ahmed El Goresy[3], Yangting Lin[1]

[1]Institute of Geology and Geophysics, CAS, [2]Tohoku University, [3]Bayerisches Geoinstitut
[1]Institute of Geology and Geophysics, CAS, [2]Tohoku University, [3]Bayerisches Geoinstitut

Introduction: Aggregates of high-pressure minerals in heavily shocked meteorites were generally considered to have formed via solid-solid phase transformation [e.g., 1]. On the other hand, several previous studies demonstrated that some high-pressure minerals were formed from a chondritic or mono-mineralic melt induced by a dynamic event [e.g., 2, 3].

Grove Mountains (GRV) 052082 is an L6 chondrite found in Grove Mountains, Antarctica. GRV 052082 was severely shocked, producing melt veins up to 2 mm wide intersecting the whole studied section. The shock-induced melt veins were studied to estimate the pressure-temperature conditions of the natural shock event, and to clarify formation mechanisms of the high-pressure minerals.

Results: The matrix of the melt veins mainly consists of fine-grained majorite-pyrope solid solution and ringwoodite. The host-rock clasts entrained in the veins are mostly rounded or ovoid. Ringwoodite, majorite, akimotoite, pyroxene glass, jadeite, lingunite and maskelynite were identified by Raman in the clasts.

Most low-Ca pyroxene in the clasts has been partially or totally replaced by akimotoite-pyroxene glass assemblages, which contains micron-sized areas with variable brightness in the back-scattered electron images. This is in contrast to the homogeneous grains in the host-rock ($Fs_{20.5-21.3}$). FIB-TEM investigation of areas depicting different brightness reveals that they are composed of idiomorphic akimotoite (Fs_{15-17}) grains (ranging from 100 nm to 400 nm) scattered in pyroxene glass (Fs_{31-39}). The CaO contents of pyroxene glass (0.4-4.5 wt%) are slightly higher than those of akimotoite (0.1-3.1 wt%) and the pyroxene grains in the host (0.8-1.0 wt%). However, the Al_2O_3 contents of them are almost identical.

Discussion: The existence of majorite-pyrope solid solution and ringwoodite in the melt veins is similar to those reported in other shocked L6 meteorites[4-6], suggestive of crystal-liquid origin at a peak shock pressure and temperature of 18-23 GPa and $>$ 2,000^o C, respectively, based on phase diagrams obtained by high-pressure and -temperature melting experiments of Allende meteorite and KLB-1peridotite [e.g., 7]. The euhedral habit, and heterogeneous compositions of akimotoite that is different from the parental unmelted pyroxene suggest crystallization of akimotoite from a shock-induced pyroxene melt rather than by solid-solid state phase transformation. The inherited shapes and low bulk concentrations of Al_2O_3, CaO and Na_2O of these akimotoite?pyroxene glass assemblages suggest that the surrounding chondritic materials did not contaminate the pyroxene melt. The FeO content of the pyroxene glass is significantly higher than the maximum solubility of FeO in $MgSiO_3$ perovskite at 18-23 GPa [8], thus negating a back-transformation from preexisting silicate-perovskite. As crystallization of akimotoite with high Mg# proceeded, the residual melt became richer in Fe and Ca, which quenched to pyroxene glass under high pressure.

References:[1] Xie et al. (2007) EPSL, 254, 433-445. [2] Miyahara et al.(2008) PNAS, 105, 8542-8547. [3] Miyahara et al. (2009) PEPI, 177, 116-121. [4] Xie et al. (2006) GCA, 70, 504-515. [5] Chen et al. (1996) Science, 271, 1570-1573.[6] Ohtani et al.(2004) EPSL, 227, 505-515. [7] Agee et al. (1995) JGR, 100, 17725-17740. [8] Ohtani et al. (1991) EPSL, 102, 158-166.

キーワード: meteorite, ordinary chondrite, shock, high-pressure polymorph, pyrxoene, transformation mechanism
Keywords: meteorite, ordinary chondrite, shock, high-pressure polymorph, pyrxoene, transformation mechanism