

P-T CONDITIONS AND MECHANISMS OF ENSTATITE TO AKIMOTOITE TRANSFORMATIONS IN THE SHOCKED L-6 CHONDRITE TENHAM. T. Ferroir¹, M. Miyahara², E. Ohtani², P. Beck³, A. Simionovici⁴, P. Gillet¹ and A. El Goresy². ¹LST ENS-Lyon, 69364 Lyon, France. E-mail: tristan.ferroir@ens-lyon.org, ²Graduate School of Science, Tohoku University, Sendai, 980-8758, Japan, ³Laboratoire de Planetologie, Université Joseph Fourier, 38041 Grenoble Cedex 9, France, ⁴OSUG, LGCA, 38041 Grenoble, France, ⁵Bayerisches Geoinstitut, Universität Bayreuth, 95447 Bayreuth, Germany.

Introduction: Our recent studies on the shocked L6 Tenham chondrite revealed different settings of enstatite to akimotoite conversion: (1) complete transformation of enstatite, (2) a lamellar setting mimicking intracrystalline transformation (3) coexisting akimotoite and pyroxene glass, the latter interpreted as amorphization product of former perovskite [1]. The recent report of fractional crystallization of high-pressure olivine liquid to ringwoodite and wadsleyite in chondrules entrained in a shock melt vein [2] motivated us to explore this possibility for pyroxenes in shock-melt veins in Tenham.

Results: We surveyed the different high-pressure assemblages in a shock melt vein as well as the transformations near the vein in Tenham. Three different forms of ringwoodite and akimotoite were encountered in the same settings: (1) a polycrystalline transformation presumably resulting from solid-state transformation, (2) lamellar intergrowth in the low pressure polymorph (3) a crystallization from melt. We also encountered lingunite at the vein wall. This assemblage of different high-pressure polymorphs records a shock pressure in the range of 19-24 GPa and around 2500 K.

We conducted FIB cutting [3] for STEM study in two of the three akimotoite areas and we investigated the conversion mechanisms. In both cases, observations reveal that akimotoite formed from the crystallization of the high-pressure melt. They also suggest that the pyroxene melt is hardly miscible with the chondritic liquid. However, chemical analysis made by STEM-EDS on the akimotoite and enstatite revealed different chemical compositions. Akimotoite compositions distinct from that of enstatite resulted from interaction between melts. The “intracrystalline akimotoite” with the formula $(\text{Ca}_{0.01}, \text{Mg}_{1.44}, \text{Fe}_{0.57}, \text{Al}_{0.02}) (\text{Si}_{1.88}, \text{Al}_{0.12}) \text{O}_6$, is significantly different from the former pyroxene $(\text{Ca}_{0.03}, \text{Mg}_{1.4}, \text{Fe}_{0.64}) (\text{Si}_{1.87}, \text{Al}_{0.13}) \text{O}_6$ and hence didn't emerge from solid-state inversion. The “bulk transformed area” has a chemical formula of $(\text{Ca}_{0.01}, \text{Mg}_{1.64}, \text{Fe}_{0.32}, \text{Al}_{0.02}) \text{Si}_2 \text{O}_6$, different from the intracrystalline akimotoite and the enstatite. This would indicate melting, crystallization and elemental exchange reactions.

Conclusions: Our results confirm that shock melt veins, due to their menagerie of high-pressure minerals contain numerous reliable indicators for the P-T conditions in shocked meteorites and that entrainment of minerals inside the shock melt vein, particularly orthopyroxene, can lead to their partial melting followed by a high pressure crystallization and quenching, barely mixing with the adjacent material.

References: [1] Ferroir T. et al. 2008. *EPSL* 275, 26-31. [2] Miyahara M. et al. 2008. *PNAS* 105, 25:8542-8547. [3] Miyahara M. et al. 2008. *JMPS* 103, 88-93.