Transformation mechanisms of nano -iron particles and high-pressure silicate phases in shocked chondrite

ZHIDONG XIE[1]*, SHUOHAO ZUO[1], YANG LI[2]

[1]School of Earth Sciences and Engineering, Nanjing University, China, *zhidongx@nju.edu.cn
[2]Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, China

Shock-induced melt vein in meteorite is a natural gift to understand phase transformation under extreme pressure and temperature, and provide valuable insight to the natural impact events in solar system and useful information about deep mantle mineralogy of the Earth [1-7]. High-pressure phases can be either crystallized from melt or solid-state transformed under shock, which can be used to constrain the shock pressure and duration [1-4]. This study will focus on nano-iron particles and the partial solid-state transformation of major minerals in shocked veins of GRV chondrite, and to better elucidate transformation mechanisms of nano-Fe particles, host silicate fragments, and Fe-Mg diffusion.

Various microanalysis methods, include Raman spectro-scopy and electron microscopes (SEM, EMPA, and FIB-TEM), were used to investigate the microstructure and mineralogy of shock-induced melt veins in one Antarctic GRV 022115 chondrite. The network of shock-induced melt veins encloses abundant host-rock fragments of olivine, pyroxene and plagioclase. Preliminary results show abundant partial solid-state transformation of host fragments and nano-iron particles. Several FIB-TEM samples were made.

Nano-iron particles were reported in lunar soil and breccias [8, 9]. They were not reported in shock-induced melt veins of chondrites as my knowledge. The rounded shape grains with smooth edges embedded in fine matrix in melt veins and mixture of high-pressure phases and low pressure phases in one single grain suggests partial solid-state transformation of host fragments. Based on mineralogy of melt veins and related mineral kinetics, crystallization model, and thermal conduction modelling, we can calculate the duration of element diffusion, crystal growth, and crystalli-zation of melt veins, then estimate the shock duration [2, 4], and discuss the shock condition of parent body of planet embryo in early solar system.

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