RINGWOODITE RIMS AROUND OLIVINE CORES IN SHOCK-INDUCED MELT VEINS OF AN ANTARCTIC CHONDRITE: MECHANISMS OF TRANSFORMATION AND FE-MG DIFFUSION.

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Introduction: High-pressure minerals, produced by shock metamorphism, are common in the melt veins in highly shocked chondrites. These minerals either crystallized from silicate melt in the shock-induced vein or form by solid-state transformed from host-rock fragments entrained in the melt or along shock-vein margins. The shock duration can be constrained by using transformation kinetics, such as the quench rates of the melt-vein matrix [1-2], growth rates of the high-pressure minerals [3-4], or using diffusion rates [5].

The occurrences of the high-pressure mineral rims were recently reported in shock-induced melt veins in several heavily shocked (S6) chondrites, ALH 78003, Peace River and GRV 052049 [6-8]. Wadsleyite rims around ringwoodite cores in ALH78003 [6] were interpreted as the result of solid-state transformation with Mg-Fe diffusion controlled growth. The ringwoodite rims around wadsleyite cores in Peace River [7] were interpreted as the result of melt crystallization. Here we report EMAP, Raman, and TEM results of the ringwoodite rims around olivine cores in shock veins of the Antarctic chondrites GRV 022321, to elucidate the mechanisms of transformation and Mg-Fe diffusion of the olivine to ringwoodite.

Results: GRV 022321 has a network of black veins which enclose abundant host-rock fragments. The enclosed fragments range from 5 µm to 100 µm in size and have bright rims, up to several µm wide, in reflected-light and BSE image. The Raman data reveal that the rims are ringwoodite and the cores are dominated by olivine with minor ringwoodite. EMAP data confirm that the ringwoodite rim is richer in faylite (Fa50) than the olivine core (Fa10 to Fa23). The cores are heterogeneous and have variable contrast, with some regions having the same Fa content as the host olivine (Fa 23). TEM data confirm the same result.

Discussion: The rounded shape and smooth edges of transformed olivine grains in the melt-vein matrix suggest that they were being resorbed into the matrix melt and not crystallizing form it. This implies that the ringwoodite rims were transformed by solid-state transformation from olivine. The variable extent of transformation is likely a result of temperature variations during shock, with the hottest outer olivine forming the ringwoodite rim. The strong partitioning of Fe to the ringwoodite rims and the Fe-Mg inter-diffusion over 10 µm implies that the olivine transformed at very high temperatures. The sample is unique because it allows us to explore transformation temperatures for reasonable shock durations.

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