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NANOSIMS STUDY OF SHOCK-INDUCED MELT VEINS IN THE ENRICHED LHERZOLITIC SHERGOTTITE GROVE MOUNTAINS (GRV) 020090

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Introduction: GRV 020090 is a lherzolitic shergottite found in Antarctica [1]. The lower modal abundance of olivine, higher abundance of plagioclase, more ferroan compositions of ma-fic minerals and higher REE-enrichment of phosphates [2] distinguish it from most lherzolitic shergottites. GRV 020090 shares the same petrography and geochemistry of RBT 04262 [3], probably sampled an enriched upper mantle of Mars or the top stratigraphy of the lherzolitic shergottite igneous unit. Like other lherzolitic shergottites, GRV 020090 experienced heavy shock metamorphism, as indicated by transformation of all plagioclases to maskelynite and the presence of shock-induced melt veins [4]. However, complete extinction of maskelynite in the host rock and preservation of olivine and pyroxene glass in the shock-induced melt veins suggest that GRV 020090 was quenched from the shock event, followed by little post-shock thermal metamorphism. In this study, we applied nanoSIMS to the shock-induced melt veins, in order to constrain the shock metamorphism.

Experiments and Results: A few shock-induced melt veins (up to 100 um wide) were ob-served in two polished sections of GRV 020090, confined in the poikilitic part that consists of predominant low-Ca pyroxene oikocrysts with less abundant olivine chadacrysts and minor chromite inclusions. Hence, fragments of the melt veins are composed of monominerals. 23Na+, 24Mg+, 28Si+, 40Ca+, 52Cr+, 55Mn+ and 60Ni+ images of areas of 20x20 um were acquired in multi-collection mode of a CAMECA nanoSIMS 50L at the Institute of Geology and Geophysics, Chi-nese Academy of Sciences. The O- beam of ˜5 pA and ˜600 nm in diameter was used, and the mass resolution power was ˜6000.

Olivine grains adjacent to or entrained in the veins were transformed to ringwoodite - oli-vine glass assemblages, surrounded by a layer of olivine glass with a Raman band at 666 cm-1. Element mapping revealed enhanced concentrations of Mg, Ca, Mn and Ni in ringwoodite rela-tive to Si and olivine glass, with little variation in Na and Cr. Pyroxene glass with smooth sur-face was found along the walls of the melt veins. Ca distribution shows presence of lamellae (<1 um in width) in the pyroxene glass, which are continuous to the host pyroxene. Coexisting with ringwoodite and majorite-pyrope solid solution, pyroxene grains were converted to lamellae of akimotoite and amorphous material. Distributions of Ca, Na and probably Mn show lamellae with an orientation different from the akimotoite lamellae.

Discussion and Summary: Presence of high-pressure polymorph assemblages of ring-woodite, majorite-pyrope solid solution, akimotoite and tuite in the melt veins suggests a shock-induced condition of 18-20 GPa, ˜1800C. The olivine glass has a Raman band at 666 cm-1 simi-lar to the olivine dissociation assemblages [5] that composed of magesiowustite+poorly crystal-lized (Mg, Fe)SiO3. The nanoSIMS mapping reveals redistribution of elements during the phase transformation. Preservation of the Ca distribution lamellae in the pyroxene glass suggests that it was formed by solid-solid transformation without melting, or vitrified from (Mg, Fe)SiO3 perovskite.

References: [1] Miao B., et al. 2004. Acta Geologica Sinica 78: 1034-1041. [2] Lin Y., et al. 2008. Meteoritics & Planetary Science 43: A86. [3] Usui T., et al. 2010. Geochimica et Cosmochimica Acta 74: 7283-7306. [4] Lin Y., et al. 2011. JpGU [5] Miyahara M., et al. 2011. Proceedings of the National Academy of Sciences of the United States of America 108: 5999-6003.

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