SHOCK-INDUCED PHASE TRANSFORMATIONS IN MELT POCKETS WITHIN MARTIAN METEORITE NWA 4468. Suporn Boonsue and John Spray, Planetary and Space Science Centre, University of New Brunswick, NB E3B 5A3, Canada. sboonsue@unb.ca, jgs@unb.ca

Northwest Africa (NWA) 4468 is 675 g martian meteorite recovered from the Western Sahara in 2006 [1]. It is an olivine basaltic shergottite, comprising clinopyroxene, olivine, maskelynite, chromite, ilmenite, Ca-phosphate polymorphs, troilite and pyrrhotite. The sample shows both bulk (maskelynite formation) and localized shock effects (excursions in veins and melt pockets). There have been several studies of NWA 4468, including geochronology, petrology and bulk composition. The formation of high pressure polymorphs in melt pockets, however, has been only noted. Here we report the presence of high pressure polymorphs in melt pockets and their relation to the presence of $Ca_3(PO_4)_2$ phases using Field Emission Scanning Electron Microscopy (FESEM) and micro-Raman Spectroscopy, including Raman mapping (Figures 1, 2 & 3). We have discovered three different $CaPO_4$ polymorphs in the melt pockets, and their crystal structure has been confirmed by Raman analysis [2] [3]. The mineral assemblages of the melt pockets are apatite, merrillite, tuite, Fe-rich clinopyroxene, pigeonite, chromite, troilite, stishovite, and hollandite in a microcrystalline matrix comprising pyroxene, apatite, merrillite, Fe-Ti-Cr oxide and silica glass. Ringwoodite is developed at the rims of pockets. The mineral assemblages of the melt pockets are indicative of solid state transformations, nucleation and recrystallization at high temperatures and pressures. The stability fields of these minerals are used to infer the pressure and temperature conditions reached locally in the melt pockets to 23 GPa, and 2000°C [3] [4].

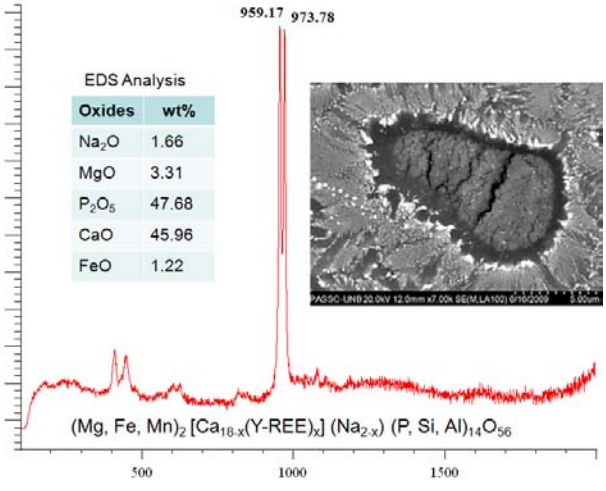

Figure 1. Intense twin peaks at 959 and 974 cm^{-1} and less intense peaks at 410, 577, 637 and 1093 cm^{-1} are characteristic of merrillite (β-apatite) (Xie et al., 2002).

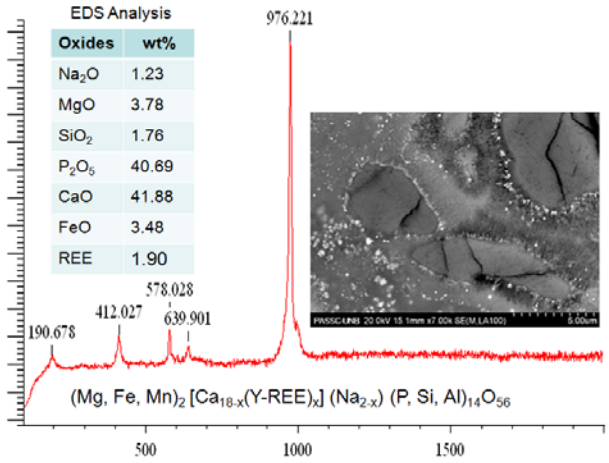

Figure 2. Raman spectrum of tuite (γ-apatite) in the pocket displays only one intense peak at 976 cm^{-1}, and less intense peaks at 1095, 410.8, 577, 639 cm^{-1}. The strong peak at 976 cm^{-1} is induced from symmetrical stretching vibrations of the PO_4 group (Xie et al., 2003).

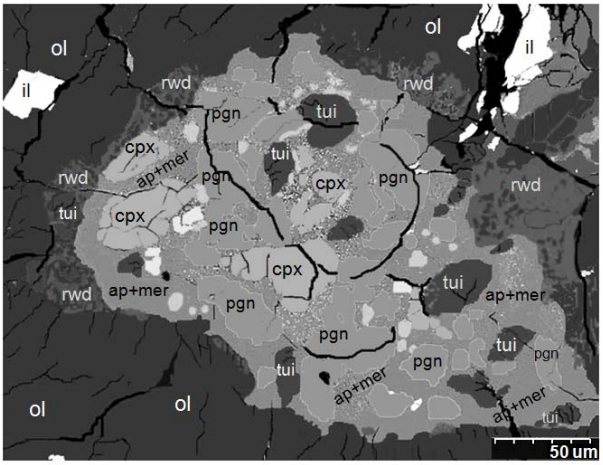

Figure 3. Combined SEM and micro-Raman analysis of a melt pocket and its mineral assemblage (ap- apatite, cpx-clinopyroxene, il-ilmenite, mer-merrillite, ol-olivine, pgn-pigeonite, rwd-ringwoodite, tui-tuite).

References:

[1] A.J. Irving et al., (2007) *LPSC XXXVIII*, Abstr.# 1526. [2] Xie, X., Minitti, M.E., Chen, M., Mao, H.K., Wang, D., Shu, J., Fei, Y., (2002) *Geochim. Cosmochim. Acta, 66*, 2439-2444. [3] X. Xie, , M.E. Minitti, M. Chen, Ho-Kwang Mao, D. Wang, J. Shu and Y. Fei (2003) *Eur. J. Mineral. 15*, 1001-1005. [4] Beck, P., P. Gillet, L. Gautron, I. Daniel, and A. El Goresy (2004), *A Earth Planet. Sci. Lett., 219*, 1 –12.