A SPECTROSCOPIC INVESTIGATION OF THE MINERALOGY OF SHOCK GENERATED MELTS IN THE NORTHWEST AFRICA 6234 MARTIAN METEORITE.

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Introduction: The study of meteorites recovered on Earth is critical to our understanding of impact processes. The propagation of a shock-wave will cause deformation and transformation of the target material. This can result in amorphization of crystalline phases, shock-melting, crystallization of high-pressure, high-temperature (HP-HT) phases, etc. Meteorites record impact events by preserving these shock effects as observable features that can be used to indicate specific impact conditions experienced by the sample [1-3]. In particular, HP-HT phases found within or bordering shock generated melt have proven quite useful in the estimation of impact conditions. Further, the behavior of common rock-forming minerals during impact is highly dependent on the pressures and temperatures induced during the event, as well as how long these conditions were experienced [4]. Shock can often result in HP-HT phases that are metastable, structurally dense, or exhibit unusual properties, such as the high concentration of vacancies shown in the mineral, tissintite [5]. The goal of our study is to identify high-pressure, high-temperature minerals associated with shock-generated melt veins within our sample, in particular maskelynite and other related phases. Here we will present some initial findings of our study.

Sample Description: Northwest Africa (NWA) 6234 is an olivine-phyric shergottite Martian meteorite. The sample used here is a thick section provided by the American Museum of Natural History, NY. The dominant mineralogy of NWA 6234 includes mm-size olivine macrocrysts within a fine grained groundmass largely composed of pyroxene, olivine, spinel, and plagioclase (now maskelynite) [6]. The sample is ~2 cm wide and 3 mm thick. A large melt vein runs across and through the sample with smaller veins running perpendicular from the main vein. The average thickness of the melt is < 200 µm with a few areas measuring ~ 300 µm across.

Methods: Areas of interest were first identified using reflected light micrscopy. These areas were then investigated using micro-raman spectral imaging techniques available to us at the Vibrational Spectroscopy Laboratory at Stony Brook University. Raman spectra were collected using the WiTec alpha 300R confocal imaging system, equipped with a 532 nm Nd YAG laser. For each measurement, the spectra were obtained with a 50X objective using a laser power of ~ 0.5 mW and a spot size of ~0.76 µm. A low laser power and longer average scan time was applied to reduce the background associated with fluorescence.

Results: Figure 1 shows a false color Raman spectral map across a portion of the shock-melt vein, and representative Raman spectra. Here we found pyroxene (red), olivine (green), basaltic glass (blue), maskelynite (yellow), and pyroxene + glass (cyan). In other areas we have detected spectra we interpreted as ringwoodite and tuite.

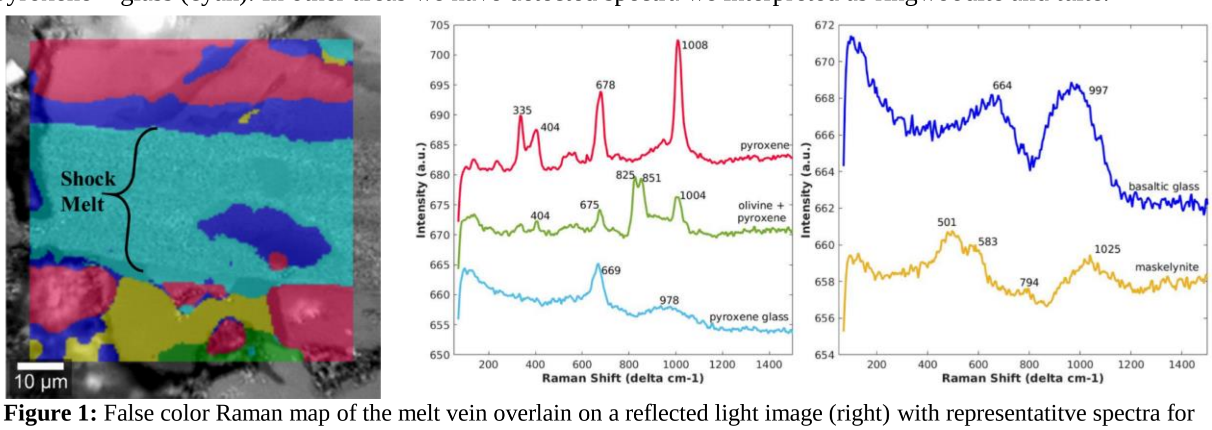

Figure 1: False color Raman map of the melt vein overlain on a reflected light image (right) with representatitve spectra for each phase (left).

Conclusions: Our preliminary findings are consistent with previous studies of other samples of NWA 6234 [6]. The amount of melt present within our sample implies a great potential to be a host to HP-HT minerals such as tissintite. Future work will include 3-D mapping techniques using micro-Raman spectroscopy to aquire a more in depth look into the anatomy of the melt vein. We will also make use of SEM imaging and composition analysis.

References: [1] Artemieva, N. & Ivanov, B. (2004) *Icarus*, 171, 84–101. [2] Xie, Z. & Sharp, T. (2004) *Meteoritics & Planetary Science*, 39, 2043–2054. [3] Walton, E.et al. (2014) *Geochimica et Cosmochimica Acta*, 140, 334-348. [4] Sharp T. & DeCarli P., (2006) *Meteorites and the Early Solar System.* [5] Ma C. et al., (2015). *Earth and Planetary Science Letters*, 422, 194-205. [6] Gross, J. et al. (2013) *Meteoritics & Planetary Science.*, 48, Nr 5, 854-871.