Mineralogy and Shock Effects in Martian Breccia NWA 8171 by microXRD and Raman Spectroscopy

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The meteorite NWA 8171 and its pairings (NWA 7034, NWA 7475, NWA 7533, NWA 7906, NWA 8114) represent Martian regolith breccia similar to the southern highlands [1, 2]. We present mineralogy and shock metamorphism of NWA 8171, determined by *in situ* micro X-ray diffraction (μXRD) and Raman spectroscopy. NWA 8171 contains medium- to fine-grained mixtures of orthopyroxene (opx), clinopyroxene (cpx), plagioclase, and magnetite, as well as occasional hematite, and ilmenite in the matrix and opx, cpx, plagioclase as single crystal clasts. Pyrite occurs in lithic clasts. Fine-grained magnetite is the most abundant matrix phase. Cl-rich apatite, as the only detected phosphate phase, is widely distributed in the sample and has some OH substitutions for Cl. Ti-, Mn-bearing jacobsite occurs in a single lithic clast. Fe-rich olivine occurs in the spherule. Calcite veins are identified as weathering products. μXRD provides a quantitative measurement of shock metamorphism of single clasts through measuring strain-related mosaicity (SRM) [3]. The majority of medium-grained clasts in NWA 8171 have shown streaking to varying degrees - presumably due to SRM associated with shock events (Fig. 1b). Our goal is to assess the degree of cumulative shock experienced by this ancient martian crust, as preserved by its rock-forming minerals.

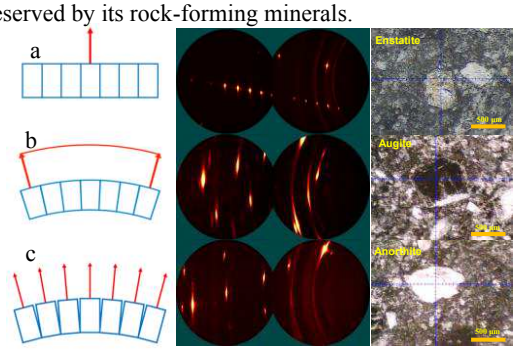

Fig. 1. (a) unstrained single crystal producing diffraction spots. (b) non-uniformly strained single crystal, producing a continuous dispersion of XRD intensity or streaking. (c) the mosaic spread of misoriented subgrains, producing a row of discrete diffracted X-ray spots (i.e. asterism) (modified from [3])

[1] Agee *et al.* (2013). *Science* **339**, 780-785. [2] Humayun *et al.* (2013). *Nature* **503**, 513-516. [3] Flemming (2007) *Can. J. Earth Sci* **44**, 1333-1346.