FLUID-ROCK INTERACTIONS IN THE MARTIAN METEORITE NORTH WEST AFRICA 817.

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Introduction: North West Africa 817 is a member of the nakhlite group of Martian meteorites and was found as a single 104 g stone in the Saharan desert in November 2000 [1]. It is a clinopyroxenite that also contains olivine and a fine grained mesostasis [1]. NWA 817 contains traces of pre-terrestrial aqueous alteration as intracrystalline veins filled with hydrous minerals, which precipitated from low temperature aqueous fluid during secondary processing [2]. The alteration texture and products and their distribution within the rock reflects the nature of fluid-rock interaction, which provides invaluable insight into the Martian groundwater. Understanding the nature of fluid-rock interaction involves studying the mechanism of circulation and chemical evolution of fluids, especially the provenance of solutes and their "loss" by mineral precipitation or fluid removal. Fluid circulation can occur either by advection using interconnected fractures and pores or by slowly permeating its way through the rock by dissolution of igneous material. The different modes of circulation impact the transport distance of the solutes, the precipitation mechanism and spatiotemporal coupling between dissolution and precipitation. Here, we have focused on understanding the nature of fluid-rock interaction by examining the alteration texture, products and distribution within NWA 817.

Methods: This study used both rough and polished surfaces of slices of NWA 817. The meteorite was first examined by light microscopy, then using a FEI Quanta 200F field-emission environmental SEM for back-scattered electron imaging, electron backscattered diffraction crystallographic orientation determination, and energy dispersive X-ray element mapping.

Results and discussion: Our NWA 817 samples contain abundant veins of Ca-carbonate, probably calcite, which are likely the products of terrestrial weathering. Veins of hydrous secondary minerals occur within olivine grains. Most veins have a sawtooth shape, and within the same olivine grain vein axes are oriented parallel to each other. Rough surfaces of the olivine grains reveal the presence of smectite (identified from the distinctive morphology of its constituent crystallites), but more work is needed to determine its origin (i.e. terrestrial *vs* martian). Funnel-shaped etch pits have also been observed in olivine grains. They are randomly distributed but share a same orientation and shape, and are largely devoid of secondary minerals.

The formation of etch pits may be the result of preferential leaching at the fluid-mineral interface, and are interpreted to be responsible for vein enlargement, contributing to both the solute load and creation of space necessary for precipitation. Thus, olivine dissolution and secondary hydrous mineral precipitation are at least spatially connected. However, the existence of empty etch pits and volume (and not molar) preservation during secondary mineralization show that some of the primary material has been lost to the fluids, which may be a key to understand temporal dissolution-precipitation connectivity.

References: [1] Sautter V. et al. 2002. *Earth and Planetary Science Letters* 195:223–238. [2] Gillet Ph. et al. 2002. *Earth and Planetary Science Letters* 203:431-444.