MARTIAN FLUID EVOLUTION RECORDED IN SMECTITE FROM THE NORTHWEST AFRICA (NWA) 817 NAKHLITE METEORITE.

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Introduction: A marvelous feature common to most nakhlites is the presence of secondary minerals deposited at low temperature from Martian aqueous fluids [1-2]. The alteration products, loosely called iddingsite because of their similarity to the alteration products of terrestrial mafic material, correspond to a sub-micrometre scale mixture of clay minerals, iron oxides and salts [3-4]. The mineralogical and chemical compositions of the iddingsite-like products vary between the nakhlites suggesting spatial and/or temporal evolution of the Martian aqueous fluids that remain to be fully understood [5-6]. To enhance our knowledge of the activity of water on Mars, high-precision laboratory investigations of the secondary minerals precipitated from aqueous fluids are essential.

NWA 817 is a nakhlite meteorite that was discovered in Morocco in 2000 [7]. It contains Martian iddingsite-like alteration products whose mineralogical composition is poorly characterized [8]. The alteration assemblage contains smectite clay but also displays compositional zoning of an unknown origin.

Methods: Polished surfaces of slices of NWA 817 were examined using a Carl Zeiss Sigma analytical SEM with Oxford microanalysis to identify the alteration products. Then, foils were cut from the different areas using the FIB technique for microstructure characterization using a FEI Tecnai T20 TEM.

Results and discussion: As is common to most nakhlites, our NWA 817 samples contain traces of Fe-rich alteration products forming-veins and more irregular masses within olivine grains and the mesostasis, respectively. The alteration products are internally compositionally homogeneous but some display chemical zoning along the edges of veins that may contain important new information on fluid evolution [8]. High-resolution TEM imaging has revealed the presence of smectite, as recognized previously [8]. On the axes of veins the smectite is ferromagnesian, poorly crystalline and structurless. Towards the vein margins the smectite becomes progressively coarser and more well crystalline. This marginal smectite is depleted in Mg and enriched in Fe and Mn relative to the central homogeneous ferromagnesian smectite. It also contains Ca.

The NWA 817 alteration products lack evidence for Martian carbonate or sulfate minerals, whereas the smectite presents no Cl, S, C, or P component suggesting the presence of interlayer water. Mineralogical and chemical data argue against a deposition of the alteration products from Martian evaporitic brines. However, a terrestrial origin of the marginal smectite has also to be considered.

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