TERRESTRIAL ORGANIC AND INORGANIC CONTAMINATION OF THE NWA 5790 NAKHLITE

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Introduction: Meteorites from Mars are very important tools for investigating the history of the planet's crust, hydrosphere, atmosphere and possibly biosphere. As most of the Mars meteorites in our collections are finds from hot and cold deserts, it is essential to be able to reliably distinguish signatures of martian processes from products of terrestrial alteration. For example, terrestrial gypsum and jarosite have recently been described within the four Miller (MIL) range (Antarctic) nakhlites [1], but the same inorganic materials have been identified by Mars rovers [2, 3]. Organic contamination in the form of fungal hyphae has been found on the Antarctic find ALH 84001 [4] and the museum curated fall Nakhla [5]. In this study we have sought to understand the impact of terrestrial residence on martian meteorites recovered from hot deserts, using the nakhlite NWA 5790. Our work has focused on establishing petrographic criteria to distinguish inorganic and organic terrestrial contaminants from materials of martian origin.

Methods: The study used a 2.7 g external chip sourced from the Macovich Collection. This meteorite was recovered from the Sahara in 2009 and contains augite (51%), olivine (9%) and mesostasis (40%) [6]. It also has a 'caliche' (Ca-carbonate) coating [7]. The outer surface and interior of this sample was imaged and chemically analysed using a Zeiss Sigma field-emission SEM operated at 20 kV/1 nA.

Results: The external surface of the sample is encrusted by ~20 µm sized euhedral grains of Ca-carbonate together with microbial filaments 50-300 µm in length by ~5-25 µm in diameter. Olivine grains have a very finely crystalline coating of clay analogous to the fill of veins within other nakhlites. On olivine grains exposed at the meteorite's external surface these clay coatings are breaking away. A 10×6 mm^2 polished cross-section of the sample showed that Ca-carbonate penetrates into the interior as veins, which are most abundant in the outermost 1 mm and very rare below 5 mm depth. No modification to the appearance of augite and mesostasis was observed beneath the external surface.

Discussion and implications: The fungal hyphae do not penetrate into the interior of NWA 5790, but evidence for veining by terrestrial Ca-carbonate and breakdown of original (martian) clays shows that terrestrial water-mediated alteration extends to >5 mm. However, no decay of the primary silicates was detected, indicating no extensive water exposure. These findings add to our knowledge on terrestrial contamination of martian meteorites, but further work is needed to ensure that models developed from the finds reliably describe processes in the crust of Mars.

References: [1] Hallis, L. J. and Taylor, G. J. 2011. *Meteoritics & Planetary Science* 12:1787-1803. [2] Showstack, R. 2011. *EOS* 92 :479. [3] Klingelhöfer, G. et al. 2004. *Science* 306:1740-1745 [4] Steele, A. et al. 2000. *Meteoritics & Planetary Science* 35 :237-241. [5] Toporski. J. and Steele A. 2007. *Astrobiology* 7 :389-401. [6] Jambon, A. et al. 2010. Abstract #1696 41st Lunar & Planetary Science Conference [7] Shih C.-Y. et al. (2010) Abstract #1367 41st Lunar & Planetary Science Conference.