CHARACTERISTICS OF MARTIAN CRUSTAL MATERIALS AND IMPLICATIONS FOR MAGMATIC ASSIMILATION: PRELIMINARY Re-Os ISOTOPE AND HIGHLY SIDEROPHILE ELEMENT ABUNDANCE DATA FOR NAKHLITES AND TISSINT

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Introduction: Highly siderophile elements (HSE: Re, Au, Os, Ir, Ru, Pt, Rh, and Pd) are particularly important in constraining planetary formation and evolution processes [1] and they exhibit chalcophile element behaviour in the absence of metals, preferring to partition into sulphides [2 and references therein]. Rhenium-osmium isotope data for the nakhlite martian meteorites are currently limited to only a single analysis of Nakhla [3]. A recent S-isotope study by Franz et al. [4] suggested that the nakhlites are affected by variable degrees/types of crustal assimilation, hence Nakhla may not be a reliable indicator of the Re-Os isotope composition of the nakhlite parental magma. Our project, for the first time, aims to integrate nakhlite Os-isotope compositions and HSE abundance data with S-isotope compositions for sample fractions for which textural information is constrained prior to destructive analyses. These new data will place valuable constraints on the composition of martian parental melts and the nature of assimilation/contamination processes involved in nakhlite magma genesis.

The shergottite Tissint was included in our work to test if there is a measureable difference in the Re-Os isotope and HSE systematics of the nakhlite group and this shergottite - hypothesised to have assimilated crustal sulphur [5].

Novel methodologies: To precisely and accurately measure HSE abundances and Re-Os isotope compositions in nakhlite samples we studied two 250 mg chips of both Nakhla and Lafayette, for which textural information was constrained prior to analyses (Fig. 1). The University of Glasgow ZEISS field-emission SEM within the the Imaging Spectroscopy and Analysis Centre (ISAAC) was used for textural analyses. Each chip was cut and roughly dry-polished on one side to allow for SEM X-ray imaging. We also studied multiple saw-cut fractions of Tissint to constrain its textural characteristics and their variance prior to destructive analyses. We will utilize ultra-low–blank, isotope-dilution techniques for HSE and Re-Os isotope analyses at the University of Durham, which are suited to studies of small sample quantities with low blank/sample ratios and efficient HSE separation.

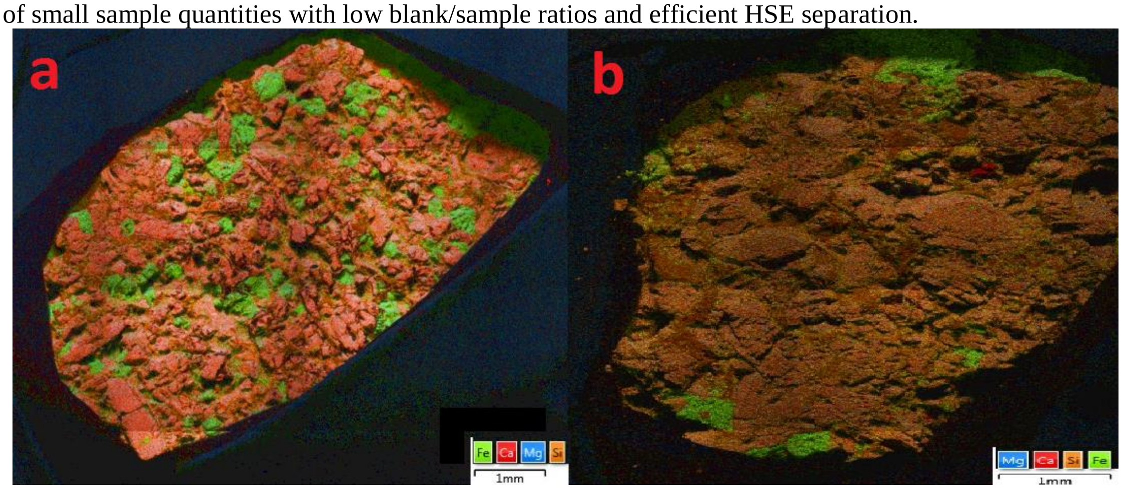

Fig. 1 - X-ray elemental maps used to retain information on textural characterization of some of our nakhlites prior to destructive isotopic analyses. (a) Si, Mg, Fe, Ca map of Lafayette, showing abundant cumulus clinopyroxene (red-orange areas) and minor Fe-rich olivine (green areas); (b) Si, Mg, Fe, Ca map of Nakhla shows that augite (areas slightly more Mg-rich than Lafayette) and Fe-rich olivine (green areas) are the dominant phases. It is also possible to see a large sulphate (in dark red, upper right) that we interpret to result from martian crustal alteration.

Future work: We will expand and present new nakhlite Re-Os datasets to include the Miller Range nakhlites. These samples, relative to Lafayette, plot at an extreme of the S-isotope compositional range reported for this meteorite group. These data will complement that for Nakhla, which has a S-isotope composition intermediate to that of the other samples. These new data will constrain how Re-Os isotope compositions and HSE-abundances are affected by crustal assimilation and will advance our understanding of the derivation of nakhlite parental magmas.

References: [1] Shirey S. B. and Walker R. J. (1998) *Annu. Rev. Earth Planet. Sci.* 26:423-500. [2] Day J. M. D. et al. (2016) *Reviews in Mineralogy & Geochemistry* 81:161-238. [3] Brandon et al. (2000) *Geochimica & Cosmochimica Acta* 64:4083-4095. [4] Franz et al. (2014) *Nature* 508:364-368. [5] Gattacceca J. et al. (2013) Meteoritics & Planetary Science 48:1919-1936.