Noble gases and halogens in martian meteorites: budgets and processes

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Noble gases and nitrogen have been the key tracers in establishing the link between Mars and the SNC meteorite group [1] and offer important insights into the processes controlling the martian mantle-atmosphere system. Recently, the SAM analyser aboard the Mars Science Laboratory has refined our knowledge of the martian atmospheric composition [2-4], whereas martian meteorites have provided critical insights into the volatile inventory of the martian mantle. Halogens are concentrated in the martian crust and their abundances have been determined in martian meteorites [5], as well as *in situ* by landers and rovers and from orbital missions around Mars [6]. The combined study of noble gases and halogens in martian meteorites has the potential to provide a unique perspective on the volatile composition of the martian mantle and crust, as well as aqueous processes operating on the martian surface.

We will present and discuss the halogen and noble gas data obtained for six shergottites (NWA 6234, Tissint, RBT04261, RBT04262, EETA79001A, ALHA77005) and one nakhlite (MIL03346). Bulk and mineral separate halogen abundances (Cl, Br and I) were obtained using the Neutron-Irradiated Noble Gas Mass Spectrometry (NI-NGMS) technique [7], which allows low concentrations of halogens (<1 ppb) to be measured in small samples (~1 mg) and offers a means to distinguish terrestrial contamination in meteorite samples. We have complemented these measurements with noble gas isotope (He-Xe) determinations on unirradiated aliquots of these samples; this enables correction for trapped and spallation-derived components. Both sets of data were obtained through step heating and analysed using ThermoFisher Scientific ARGUS VI and HELIX MC+ mass spectrometers, for halogens and for noble gas isotopes, respectively, at the University of Manchester.

Our data show that the martian mantle is volatile-depleted and the crust is an important reservoir for halogens.

[1] Becker & Pepin (1984) *EPSL* **69**, 225-242; [2] Mahaffy et al. (2013) *Science* **341**, 263-266; [3] Wong et al. (2013) *Geophys. Res. Letter* **40**, 6033-6037 [4] Conrad et al. (2016), *EPSL* **454**, 1-9 [5] Cartwright et al (2013) *GCA* **105**, 255-293 [6] Keller et al. (2007) *Journ. Geophy. Resear.* **111**, E03S08; [7] Ruzié-Hamilton et al. (2016) *Chem. Geol*. **437**, 77-87.