HALOGENS IN NAKHLA AND NWA 998: EVIDENCE OF MARTIAN WEATHERING? J. A. Cartwright, J. D. Gilmour and R. Burgess. School of Earth, Atmospheric and Environmental Sciences, University of Manchester, UK. Email: julia.cartwright@postgrad.manchester.ac.uk

The halogen concentrations of a number of Martian meteorites vary significantly, with larger variations observed in I/Cl compared to Br/Cl. One striking feature is the high I/Cl ratios associated with those meteorites found in Antarctica. Removal of low temperature, superficial contamination does not significantly reduce the I/Cl ratio [1], indicating that processing in Antarctica is responsible for binding iodine into meteorite phases. We suggest that weathering during a meteorite’s terrestrial residence acts to increase the I/Cl ratio, whilst not significantly affecting the Br/Cl ratio. Br/Cl and I/Cl ratios in non-antarctic nakhlites and Martian meteorite falls show a wide range which extends down to among the lowest I/Cl values in Martian meteorites [2-3]. In addition, the elevated Br/Cl ratios in Nakhla have been attributed to Martian weathering [4].

We report the halogen concentrations from analyses of Nakhla and NWA 998 to investigate and assess the effect of Martian weathering on meteorites. Nakhlites are relatively unshocked, and Nakhla, as a fall, should be unaffected by terrestrial weathering, and thus retain strong evidence of Martian weathering. By contrast, NWA 998, a desert find, may have been terrestrially weathered. Mineral separates of both meteorites, including bulk, olivine, pyroxene and feldspar aliquots, were neutron-irradiated and analysed for halogen content using laser step-heating and noble gas mass spectrometry.

Our bulk sample of Nakhla has relatively low Br/Cl (~ 3.5 x 10^{-3}) and I/Cl (~ 2.9 x 10^{-5}), whilst olivine has elevated Br/Cl (~ 2.5 x 10^{-2}) and I/Cl (~ 6.7 x 10^{-4}). The elevated olivine Br/Cl ratio is consistent with values reported for Martian weathering by [4]. The highest halogen concentrations are observed within the pyroxene, compared to bulk and olivine aliquots.

We therefore suggest that the weathering processes and halogen cycles on Earth and Mars are significantly different. Terrestrial iodine contamination is controlled by methyl iodide [5], and is distinct from sources of bromine and chlorine. Terrestrial weathering of meteorites thus leads to elevated I/Cl ratios. On Mars, iodine and bromine are controlled by groundwater/brines acting on the Martian sub-surface. Martian weathering therefore increases both iodine and bromine, at the expense of chlorine, causing elevated Br/Cl and I/Cl. Our preliminary NWA 998 analyses have shown higher halogen concentrations within feldspar compared to mafic aliquots, a feature observed in other Martian meteorites (e.g [1]). Further analysis of NWA 998, with comparison to Nakhla, will assess the prevalence of Martian weathering.