UNUSUAL APATITE IN THE UNUSUAL MARTIAN METEORITE NORTHWEST AFRICA (NWA) 8159.

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Introduction: The newly discovered martian meteorite Northwest Africa (NWA) 8159 is unique as it samples an era and lithology on Mars (early Amazonian) that is not represented elsewhere in meteorite collections [1-4]. We are investigating NWA 8159 apatite to define the parental melt and potential source region volatile composition, and compare this with those of other Martian meteorites.

Methodology: This study utilized one thin-section and one rock chip of NWA 8159. The mineralogy of these samples was characterized using the Carl Zeiss Sigma Variable Pressure Analytical SEM at the University of Glasgow. The University of Edinburgh Cameca SX100 electron microprobe, located at the Grant Institute (School of Geosciences), was subsequently used to determine the stoichiometric composition of NWA 8159 apatite grains.

Results: The NWA 8159 thin-section is cross-cut by calcite veins as a result of its terrestrial residence, and magnetite grains are at least partially altered to hematite and goethite [5,6]. Additional iddingsite-like alteration is present within the core of olivine grains, but this has been reported to be of potential martian origin [7]. Apatites are granular, anhedral and appear to contain a second Si-rich phase (darker in cathodoluminescence images: Figure A). The volatile content of NWA 8159 apatite is F-rich compared with apatite grains within other martian meteorites. The complicated history of this meteorite means that this unusual apatite texture and chemistry could be the result of sub-solidus reactions [8], martian aqueous alteration or terrestrial alteration.

Future Work: Detailed investigations of NWA 8159 apatite texture, chemistry and the nature of the Si-rich intergrown phase are planned, and will include transmission electron microscopy at the University of Glasgow, and atom probe tomography (Cameca Local Electrode Atom Probe (LEAP) 4000X) at the University of Sydney. As Martian mantle D/H ratios are lower than those of crustal fluids [9,10], SIMS D/H ratio analyses may also help us establish the nature of the event that formed the apatite.

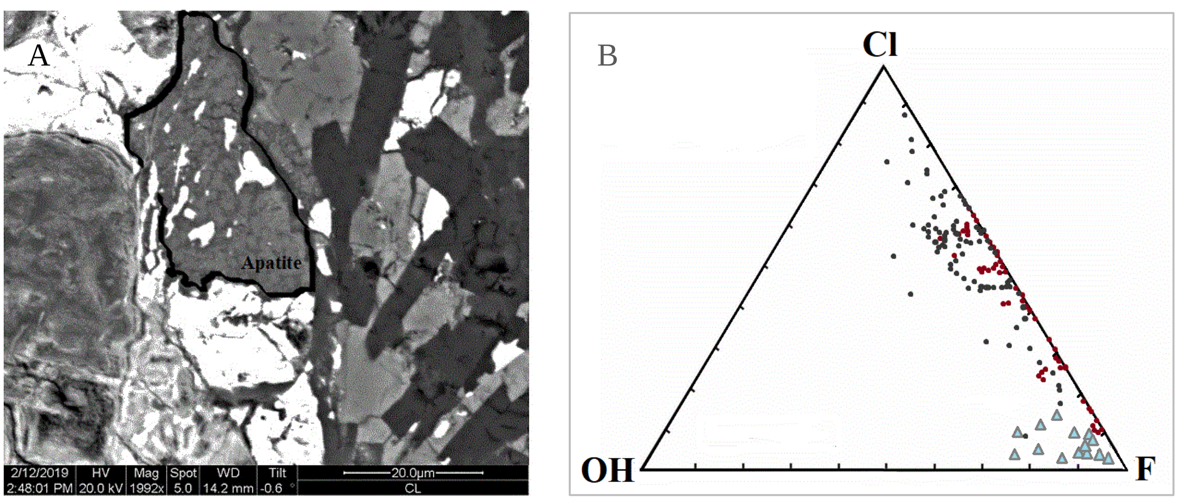

Figure: (A) Cathodoluminescence image for an apatite grain in NWA 8159; this grain has been selected for atom probe analysis. All apatites appear granular, anhedral and intergrown with a more Si-rich phase (darker grey). (B): Triplot diagram of Relative Volatile Abundance (RVA) for the apatites in NWA 8159 (light blue triangles) and comparison with plots (adapted from [11,12]) of apatite in chassignites (red dots) and nakhlites (dark grey dots).

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