H-isotopic composition of apatite in Northwest Africa 7034

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Introduction: Northwest Africa (NWA) 7034 and its pairings comprise a regolith breccia with a basaltic bulk composition [1] that yields a better match than any other martian meteorite to estimates of Mars' bulk crust composition [1]. Given the similarities between NWA 7034 and the martian crust, NWA 7034 may represent an important sample for constraining the crustal composition of components that cannot be measured directly by remote sensing. In the present study, we seek to constrain the H isotopic composition of the martian crust using Cl-rich apatite in NWA 7034.

Methods: The H isotopic composition and abundances of H_2O in apatite from two thin sections of NWA 7034 were measured using the Cameca NanoSIMS 50L ion probe at The Open University, following protocols described in [2] and standards in [3]. Real time isotope imaging was utilized to monitor for and navigate away from cracks.

Results: Apatites in NWA 7034 were measured in basaltic clasts, Fe-Ti-P-rich (FTP) clasts, and large crystal clasts within the bulk matrix domain [4, 5]. All apatites were Cl-rich and ranged in H_2O abundances from 238-1343 ppm. In addition, the δD values of the apatites ranged from approximately 453‰ to 2564‰.

Discussion: all of the H-isotopic compositions of apatite in NWA 7034 fall within ~500‰ of the range of values reported for the intermediate reservoir predicted for the martian crust by [6]. However, we cannot rule out incomplete exchange of H between the martian mantle and atmosphere to explain the H isotopic compositions of apatites in NWA 7034.

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