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Comparing Analysis of Hydrogen Concentration in Astromaterials Nominally Anhydrous Minerals by Multiple SIMS

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Secondary Ion Mass Spectrometry (SIMS) is utilized to determine hydrogen (H) concentration in astromaterials nominally anhydrous minerals (NAMs) and their inclusions [e.g., 1]. This data is interpreted to refine the volatile history of planetary bodies.

Four instruments are being used to compare H concentration analysis: a large geometry SIMS (The University of Hawai‘i Cameca IMS 1280), a compact SIMS (Arizona State University (ASU) Cameca IMS 6f), and two Cameca NanoSIMS 50L at ASU and NASA-Johnson Space Center (JSC). Results on the first three instruments are available. Although fundamentally similar, SIMS instruments and their modifications [2] may produce different values or pose advantages for H analysis, especially for shocked samples that are susceptible to contamination filling their fractures.

New data from the IMS 1280 is reported, using its microchannel plate (MCP) to image high H signals in grain fractures during pre-sputtering to avoid them as much as possible. Between fractures, $^{16}OH/^{30}Si$ was measured with a Cs^+ 4 nA primary beam, 30 micron spot size, and central ~5x5 micron collection area.

First order comparison of H concentration (reported in ppm H_2O) is achieved on a terrestrial gem quality clinopyroxene (SLP114, 162±12 ppm H_2O [3]), with 157±7 and 215±40 ppm H_2O by the IMS 1280 and 6f respectively. SIMS comparison is then extended to analysis of two Martian shergottites: RBT 04262 and NWA 5789. Due to a dense fracture network (< 20 micron) in RBT 04262, only one clinopyroxene hosted glassy inclusion was analyzed (n=6, ≤1 ppm H_2O), while six olivine grains in NWA 5789 (n=12, ≤ 2 ppm H_2O) (1s ±0.21) were analyzed. Higher concentrations were obtained for RBT 04262 olivine by the ASU NanoSIMS 50L (up to 350 ppm H_2O [4]), and IMS 6f (300+ ppm H_2O, [5]), for which contamination in fractures could not be avoided. Work on the JSC NanoSIMS 50L will further develop the SIMS comparison.

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