HYDROGEN ISOTOPE SIGNATURES AND WATER ABUNDANCES IN NOMINALLY ANHYDROUS MINERALS FROM THE OLIVINE-PHYRIC SHERGOTTITE LAR 06319. N. Z. Boctor[1], J. Wang[2], C. M. O'D. Alexander[2], A. Steele[1], and J. Armstrong,[1]. [1]GL, Carnegie Institution of Washington, 5251 Broad Branch Road, Washington, DC 20015. boctor@gl.ciw.edu. [2]DTM, Carnegie Institution of Washington, 5241 Broad Branch Road, Washington DC 20015.

Introduction: Water and other volatiles play a significant role in partial melting processes. On Earth, water degassing at shallow depths is the main source of energy for volcanic eruptions. Nominally anhydrous minerals contain trace or minor amounts of OH, and constitute the main H reservoir in the Earth's mantle and perhaps the Martian interior. Water in nominally anhydrous minerals also has a profound effect on the rates of high-pressure phase transitions in planetary interiors. In this investigation, we report on water abundances and H isotope signatures in nominally anhydrous minerals and glasses from the recently discovered olivine-phyric shergottite LAR 06319.

Experimental: A small chip of LAR 06319 was mounted in indium metal to avoid contamination from epoxy and polished with alumina to avoid contamination from carbon-based abrasives. The water abundances were measured with a Cameca 6F ion probe using standard SIMS techniques. Routine detection limits measured on synthetic forsterite are 2-4 ppm. Glass standards with appropriate water concentrations were used. SIMS operating conditions for H isotopic measurements were 15 kV Cs+ primary beam of ~ 2 nA, 5 kV secondary accelerating voltage, a 50 eV energy window, a mass resolution of ~ 400 and an electron flood gun for charge compensation.

Results: The δD values for olivine, pyroxene, and feldspathic glass in LAR 06319 are among the highest we have measured for Martian meteorites; the ranges are: 785-2429‰ for olivine, 253-1055‰ for pyroxene, and 1300-4632‰ for feldspathic glass. Our preliminary measurements of water abundances in minerals and glass in LAR 06319 are low compared to their terrestrial mantle analogs. For example, the range of water abundances in olivines from LAR is 23-52 ppm, compared with 140-280 ppm for those of mantle-derived terrestrial olivines, and 370-1220 ppm for the most primitive MORB.

Discussion: The nominally anhydrous minerals and feldspathic glass from LAR 06319 all show extraterrestrial H isotope signatures. It has been suggested that there are at least two volatile reservoirs on Mars: a near-surface reservoir that is highly fractionated because it has undergone exchange with the Martian atmosphere and a deeper unfractionated reservoir that may be a juvenile reservoir. The highly fractionated H isotope compositions suggest that the nominally anhydrous minerals and the glass interacted with a water reservoir on Mars that equilibrated with the Martian atmosphere (δD ~ 4200‰). The low volatile abundance in LAR 06319 nominally anhydrous minerals, relative to terrestrial analogs, suggests one of three possibilities: (1) the parent melt degassed prior to crystallization, (2) water was depleted in the source region of the magma, or (3) there was impact driven devolatilization, especially if partial melting occurred, as suggested by the presence of impact-melt veins.