# Water and D/H in Ungrouped Achondrite Northwest Africa 8409

TIMOTHY M. HAHN JR*[1], MAITRAYEE BOSE[1], AND ANTHONY J. IRVING[2]

[1]Center for Isotope Analysis, School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287.
[2]Department of Earth and Space Sciences, University of Washington, Seattle, WA 98195.
(*correspondence: thahn1@asu.edu)

Ungrouped achondrites provide important insights into the diversity and volatile inventories of planetary building blocks in the early solar system. We investigated Northwest Africa (NWA) 8409 that is paired with NWA 7325, both formed very early in the solar system history [1]. Neither shares affinities to known achondrite groups [2-4]. NWA 7325 is a highly reduced cumulate rock [5] containing extremely magnesian mafic silicates and calcic plagioclase with chromium-bearing sulfides [3,4]. The parent body of this pairing group was highly reduced (~IW-3), underwent extensive crust-mantle-core differentiation [6] and was capable of producing an anorthositic crust [7], yet seemingly lacking a significant core dynamo [8]. Irving et. al. [3] suggested that NWA 7325 may be the first Mercurian sample, which is however controversial [1,9]. Regardless, NWA 7325 and its paired stone NWA 8409 are remarkable samples and are likely volatile depleted (based on elemental ratios Na/Al, Zn/Al, and Ga/Al in NWA 7325) [4]. Here, we report on the water content and hydrogen isotopic composition of nominally anhydrous minerals (NAMs) in NWA 8409 using the NanoSIMS 50L at Arizona State University to constrain the volatile contents of its achondrite parent body.

The $H_2O$ content (13–140 ppm) and average $\delta D$ -118 ± 56 ‰ ratios significantly overlap with the range of volatile-depleted achondrites that originated within the inner solar system (e.g., angrites [10] and HEDs [11]). Our data indicates that NWA 7325 originated from a planetary embryo-sized object that accreted nebular hydrogen within a few Myr after CAIs and likely sequestered light hydrogen into the core of its parent body [12]. We will examine our data within the context of current knowledge on the volatile budget of Mercury and planetesimals in the early solar system.

**References:** [1] Koefoed *et. al.* (2016) *GCA* 183, 31-45. [2] Irving *et. al.* (2013) *44th LPSC*, #2164. [3] Goodrich *et. al.* (2017) *GCA* 203, 381-403. [4] Barrat *et. al.* (2015) *GCA* 168, 280-292. [5] Sutton *et. al.* (2017) *GCA* 204, 313-330. [6] Archer *et. al.* (2019) *MAPS* 54, 1042-1050. [7] Fossard *et. al.* (2019) *50th LPSC*, #1772. [8] Weiss *et. al.* (2017) *EPSL* 468, 119-132. [9] Weber *et. al.* (2016) *MAPS* 51, 3-30. [10] Sarafian *et. al.* (2017) *GCA* 212, 156-166. [11] Stephant *et. al.* (2016) 79th *METSOC*, #6212. [12] Sharp (2017) *Chemical Geology* 448, 137-150.