Noble gases in an Almahata Sitta sample rich in C1 like material

M.E.I. RIEBE*[1], H. BUSEMANN[1], C.A. GOODRICH[2] AND C. MADEN[1]

[1]Institute of Geochemistry and Petrology, ETH Zürich, Clausiusstrasse 25, CH-8092 Zürich, Switzerland (*correspondance: my.riebe@erdw.ethz.ch)

[2]Lunar and Planetary Institute, Universities Space Research Association, 3600 Bay Area Blvd, Houston, Texas 77058, USA

Almahata Sitta (AhS) is a unique meteorite that contains monolithic clasts of various meteorite classes, mostly ureilites [1]. There are two main hypotheses for its formation: (a) exogenous material was added to a second generation ureilite body during re-accretion of the ureilite parent body after its catastrophic break-up [e.g., 1] and (b) exogenous materials are fragments of impactors, added during regolith gardening [e.g., 2]. Recently, a sample containing material of different meteorite classes, AhS 91A, was described [2]. It mostly consists of unique C1 chondrite like material, but also ordinary chondrite and ureilite grains. AhS 91A is likely a sample of the hitherto missing matrix material surrounding the more rigid, monolithic AhS clasts found previously [2].

Previous bulk fusion analyses of AhS 91A showed that it contains high concentrations of trapped noble gases with high Ar/Xe and Kr/Xe ratios indicating the presence of a solar or subsolar component but also a $^{20}Ne/^{22}Ne$ of ~10.45 [2], similar to Ne in Phase Q and ureilites. Here we investigate the sample in more detail using the Closed System Step Etching technique, dedicated to targeting phases susceptible to specific etching agents, to answer: (1) What is the nature of the trapped gases in AhS 91A, are they related to similar gases recently examined in detail in a CR chondrite [3]? (2) Does AhS 91A contain solar wind (SW) noble gases? Their presence would show that the sample formed in a regolith, supporting model (b). So far, we have analysed the sample using acetic acid, mainly targeting carbonates. Large amounts of trapped noble gases were released, in particular Ne and Ar. The trapped Ne has a composition that resembles that observed in the bulk samples and released during water treatment of a CR chondrite [3]. The Ar/Xe and Kr/Xe ratios in the acetic acid solubles are high. We are currently etching the sample with hydrofluoric acid, the results will ultimately tell us if AhS 91A contains SW noble gases.

[1] Horstmann & Bischoff (2014), *Chemie der Erde - Geochemistry* **74**,149–183. [2] Goodrich et al. (2019) *MAPS* **54**, 2769-2813. [3] Krietsch et al. (2019) *Ann. Meeting Meteor. Soc.* Abstract #2157.