NEON PRODUCED BY SOLAR COSMIC RAYS IN CHONDRITES WITH SMALL PRE-ATMOSPHERIC SIZES

A. S. G. Roth[1], K. Metzler[2], B. Hofmann[3], and I. Leya[1]. [1]Institute of Physics, University of Bern, Switzerland. E-mail: antoine.roth@space.unibe.ch. [2]Institute for Planetology, University of Münster, Germany, [3]Natural History Museum Bern, Switzerland.

Introduction: Solar-cosmic-ray-produced Ne (SCR-Ne) is rather uncommon among meteorites from our collections. This can be rationalized by the fact that SCRs have a shallow mean penetration depth of only a few cm and that the outermost few cm of meteoroids are typically ablated during atmospheric entry. However, it is surprising that SCR-Ne is more frequently found in rare meteorite classes, such as Shergottites [1–3], acapulcoites and lodranites [4], and angrites [5], than in chondrites—the most common meteorite type. Here we postulate that this observation is actually the result of a sampling bias. Rare meteorite classes are indeed small specimens that are systematically studied for noble gases. On the other hand, small chondrites are studied for this in very rare occasions only. SCR-Ne might thus be preserved in meteorites with small pre-atmospheric sizes simply because less material is ablated during their atmospheric entry. To test this hypothesis we selected nine *unpaired* chondrites with a total known weight *smaller than 10 grams* and studied their Ne isotopic composition. Note that these two criteria are not sufficient to ensure that our selection comprises exclusively meteorites with small pre-atmospheric sizes because possible unidentified pairs cannot be excluded. Therefore, we also conducted a study of cosmic ray tracks (i.e. nuclear tracks formed by heavy ions in olivine minerals during meteoroid transit). Track densities depend strongly on shielding depth and can thus be used—at first glance—to estimate the pre-atmospheric size of meteorites.

Methods: Bulk samples of ca. 2 mg were extracted from the center of each chondrite and measured for Ne isotopic composition by laser melting at the University of Bern. Our analytical procedure has been shown to be successful in precisely measuring tiny amounts of cosmogenic Ne of the order of 10^{-11} cm^3STP without any compromising effects due to blanks. Thin sections were prepared using adjacent material for *in-situ* study of tracks in olivine minerals [6].

Results: Five chondrites have galactic-cosmic-ray-produced Ne with $^{20}Ne/^{22}Ne$ and $^{21}Ne/^{22}Ne$ ratios that range from 0.9 to 1.1 and from 0.85 to 0.94, respectively. Two chondrites have isotope compositions that are dominated by trapped Ne, which precludes the identification of their cosmogenic component. However, RaW 008 (L4) and JaH 216 (L5-6) show SCR-Ne with $^{20}Ne/^{22}Ne$ of 2.057±0.076 and 1.995±0.063 (2 SD), respectively, and with $^{21}Ne/^{22}Ne$ of 0.724±0.023 and 0.657±0.017 (2 SD), respectively. Our study of cosmic ray tracks is underway and will be presented at the conference. We speculate that RaW 008 and JaH 216 actually had small pre-atmospheric sizes and will exhibit high track densities.

References: [1] Garrison D. H. et al. 1995. *Meteoritics & Planetary Science* 30:738–747. [2] Schwenzer S. P. et al. 2007. *Meteoritics & Planetary Science* 42:387–412. [3] Huber L. et al. 2013. Abstract #1534. 44th Lunar & Planetary Science Conference. [4] Weigel A. et al. 1999. *Geochimica and Cosmochimica Acta* 63:175–192. [5] Busemann H. et al. 2006. *Geochimica and Cosmochimica Acta* 70:5403–5425. [6] Metzler K. 2004. *Meteoritics & Planetary Science* 39:1307–1319.