DEPTH-DEPENDENT FRACTIONATION OF LIGHT SOLAR WIND NOBLE GASES IN A GENESIS TARGET.

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We analyzed light noble gases in a bulk metallic glass (BMG) that was exposed to solar wind (SW) irradiation on Genesis for its total exposure time and all SW regimes [1]. The BMG was especially designed to look for a putative Solar Energetic Particle (SEP) component, reported to be present in lunar soils [2], by using the closed system stepwise etching (CSSE) technique. Here we present the depth distribution of He and Ne isotopes and discuss different processes leading to the observed fractionation patterns. Moreover, this will be compared with measurements of Ar isotopes that are actually in progress.

The Ne isotope depth distribution measured in the BMG resembles a fractionation pattern that follows a mass dependant fractionation line. Lighter isotopes are enriched at shallow depth with initial $^{20}Ne/^{22}Ne$ higher then the bulk SW value, whereas the heavier isotopes are enriched in deeper layers. This distribution is fully consistent with model calculations using the SRIM code [3] of an isotopically uniform SW that fractionates within the BMG upon implantation, assuming a velocity distribution as measured by Genesis. From this it follows that there is no evidence for a distinct isotopic fractionation of Ne among the different SW regimes. Most importantly, the use of BMG data in combination with SRIM simulations, which allow for surface sputtering and cosmogenic Ne production in lunar grains, shows that no “SEP-Ne” component, that would be isotopically heavier than the SW-Ne, is needed to explain the lunar soil data.

The measured He isotopic distribution in the BMG is very different from the Ne fractionation pattern and also from the He distribution as simulated with SRIM for the same SW conditions applied for Ne. The $^{3}He/^{4}He$ ratios released from shallow depth first increase by 10 % and later drop to almost constant values 13 % lower than the initial in all remaining steps. This is in contrast to SRIM simulations that predict a steep decrease of $^{3}He/^{4}He$ with depth by more than a factor of 6. A diffusional loss, which in turn would have led to a smearing of the He isotope distribution, is unlikely. Bulk analyses show no difference of the He abundance compared to other Genesis targets [4] or in-situ spacecraft measurements. On the other hand it is well conceivable that the SRIM code overestimates the fractionation with depth for very light elements as He. However, the largely different isotope pattern between He and Ne suggests that the trapped solar He suffered an additional fractionation process not yet identified.

References: [1] Grimberg, A. et al. 2006. *Lunar Planet. Sci. Conf.* XXXVII, #1782. [2] Wieler R. et al. 1986. *Geochim. Cosmochim. Acta* 50: 1997-2017. [3] Ziegler J.F. 2004. *Nucl. Instr. Meth. Phys. Research* 219/220: 1027-1036. [4] Hohenberg, C.M. et al. 2006. *Lunar Planet. Sci. Conf.* XXXVII, #2439.