GENESIS SOLAR WIND COLLECTOR MATERIALS TESTED FOR FRACTIONATION AND LOSS DUE TO DIFFUSION AND BACKSCATTERING: PRELIMINARY DATA. V.S. Heber[1], C. Olinger[2], H. Baur[1], D.S. Burnett[3], R. Wieler[1]. [1]Isotope Geology and Mineral Resources, NW C, ETH, 8092 Zurich, Switzerland; heber@erdw.ethz.ch; [2]LANL, Space & Atmospheric Science, Los Alamos, USA; [3]CalTech, JPL, Pasadena, USA.

Introduction: Genesis solar wind (SW) collector arrays were equipped with a wide variety of materials for SW collection; some specifically tailored for particular elements [1]. Targets exposed at the same time intervals – specifically those collecting bulk SW – have all been encountered the same SW ion fluence and differences in their inventories of SW species must reflect target properties. The most prominent processes to consider are diffusion and backscattering. Both lead to a preferential loss of light elements and isotopes and corresponding elemental and isotopic fractionation. Targets affected by the former process must be discarded for the particular element analysis. For the latter process, a correction has to be applied that becomes larger with increasing mass difference between target and projectile. The correction for backscatter loss can be very substantial, e.g., ~35% for ^{14}N implantation into Au. So far, all corrections for backscatter loss applied to Genesis data are based on simulation by the SRIM code [2], except He and Ne from [3]. However, it was shown [3] that actual backscatter losses determined by irradiation experiments may differ from SRIM predictions.

In this work we compare the elemental and isotopic composition of the light noble gases He, Ne and Ar in all target materials exposed to the bulk SW on Genesis to investigate the extents of backscattering and diffusion. Light noble gases are suited for this kind of experiment, since they are abundant, not compromised by terrestrial contamination and relatively easy to measure. Also, we test the influence of gentle plasma ashing on the inventory of implanted SW ions using the Bulk Metallic Glass (BMG). This is important to evaluate the cleaning procedures for other targets.

Experimental: a) Samples. We analyzed samples from the bulk SW collector array: diamond-like carbon on silicon (DOS), gold on sapphire (AuoS), float-zone silicon (FZ-Si), Czochralski-grown silicon (CZ-Si), aluminium on sapphire (AloS), germanium (Ge), and 2 fragments from the BMG. For a detailed description of the materials see [1]. One fragment of the BMG was cleaned by gentle plasma ashing with oxygen and SF_6 [3] to remove the molecular film ("brown stain"), the other fragment remained uncleaned. Only data from the latter are shown in Fig. 1. All other samples, except AuoS, were cleaned by rinsing in ultra-pure water in a megasonic device. **b) Analytical procedure.** Analyzed isotopes were ^{3}He, ^{4}He, ^{20}Ne, ^{22}Ne and ^{36}Ar. ^{36}Ar serves as a "baseline" since it is probably least influ-

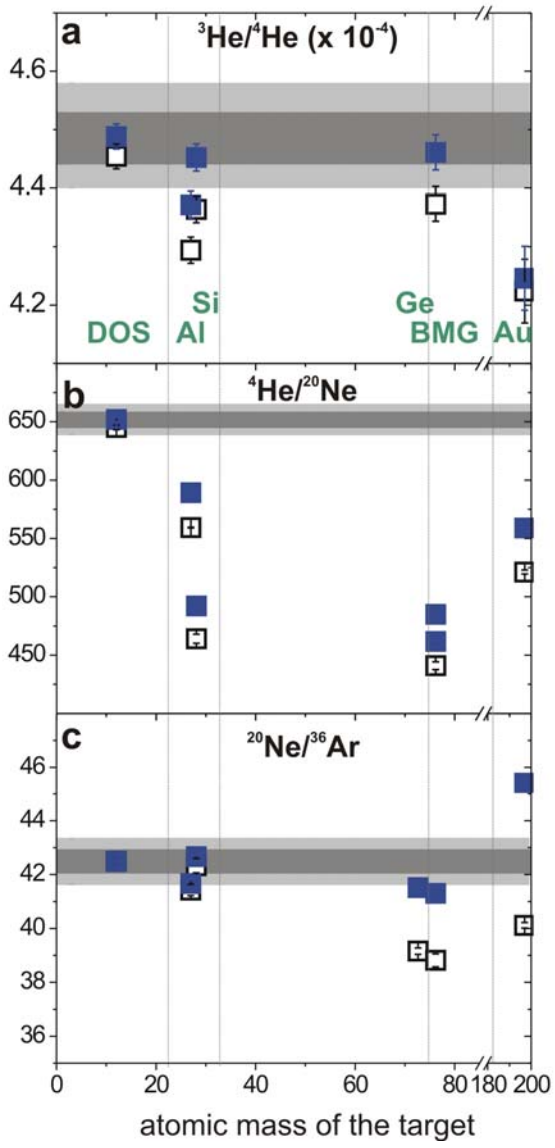

Fig. 1. The He isotopic composition (a), ^{4}He/^{20}Ne (b) and ^{20}Ne/^{36}Ar (c) of measured (white squares) and backscatter-loss corrected (blue squares) data are plotted versus the atomic mass of the target material. Targets are named in (a). Dark and light grey bars represent 1% and 2% deviation from the DOS value, respectively. Two blue data points in b) for BMG represent experimental (lower) and SRIM-based (upper) backscatter correction. No ^{3}He/^{4}He and ^{4}He/^{20}Ne data are given for Ge (see text).

enced by diffusive loss, and backscatter correction is negligible for the light-element targets (DOS, Al, and Si) according to SRIM. Noble gases were released by UV laser ablation. Raster sizes were 0.7-1.3mm^2 and chosen that gas amounts could be measured with sufficient precision. Since most fragments were small, ~3x4 mm^2, only 2 to 3 replicate analyses were carried out per target material. Data points in Fig. 1 represent averages and uncertainties are statistical but generally in the range of single analytical errors. Blank correction was insignificant for He and Ne and 1-2% for ^{36}Ar. Material blanks were measured on flight spares for all targets except Ge. None of them contained any noble gas amounts above extraction line and mass spectrometer blank values, except Ar in BMG that was manufactured in an Ar atmosphere. **c) Backscatter correction**. Backscatter loss was modelled for each isotope in all given materials by SRIM [2]. Corrected ratios are given in Fig. 1 (blue solid squares). Simulations were run for 1E+6 ions using the He, Ne and Si (for Ar) velocity distributions, respectively, of the SW ions prevailing during Genesis collection period determined by ACE [4]. Backscatter-correction for BMG was modelled by SRIM for the pure material in this work without considering the brown stain cover. Experimentally derived correction factors [3] are agree with SRIM for ^{3}He/^{4}He, but suggest a smaller correction for ^{4}He/^{20}Ne (Fig. 1b).

Results: Fig. 1 shows the ^{3}He/^{4}He (a), ^{4}He/^{20}Ne (b) and ^{20}Ne/^{36}Ar (c) ratios plotted versus the atomic mass of the target material. Since backscatter correction for DOS is minor and He diffusion presumably extremely low [5] we compare all data from the other targets in the following to DOS. The measured **^{3}He/^{4}He** of all samples is lower than in DOS, however, backscatter-corrected data agree within 2% with DOS, except those from Al and Au. This agreement for DOS, Si, and BMG indicates that backscatter correction of the He isotopic composition with SRIM is generally correct. We have no explanation for the low Al-value yet. The lower ^{3}He/^{4}He of the Au indicates that fractionation due to backscattering is underestimated by SRIM. The SRIM modelled fractionation factor for ^{3}He/^{4}He is astonishingly low at 0.5% only, although He backscatter losses from Au are >30% and lighter targets (Al, Si) predict a ^{3}He/^{4}He fractionation of ~2%. The measured **^{4}He/^{20}Ne** ratios of all targets are considerably lower than the measured DOS reference value. Even backscatter-corrected values do not fall near the 2% band centred at the DOS value. One reason for this observation might be diffusive loss. Diffusion of He from Ge is evident (see below) and also Si is known [1] and BMG suspected [3] to lose He. For Al and Au we cannot decide yet whether the low ^{4}He/^{20}Ne ratios result from diffusion, inaccurate backscatter correction, or both. Measured and corrected **^{20}Ne/^{36}Ar** ratios of DOS, Si, and Al agree within 2%. This is not surprising as backscatter correction for Ne and Ar according SRIM is almost insignificant in those light-element targets and diffusive loss of Ne and Ar is apparently absent. Even, backscatter-corrected Ge and BMG values are within 2% of the DOS value. An exception is again Au, this time with an overestimated correction.

Remarks to single targets: DOS: Isotopic and elemental composition of the analysed DOS fragment in this work agrees well with data of another bulk SW DOS fragment given in [6]. **AloS:** The backscatter-corrected ^{20}Ne/^{22}Ne (13.75±0.02) of AloS is consistent with the respective value for DOS (13.74±0.03). Thus, the high value of 13.97±0.03 by [7] could not be confirmed here. We can neither confirm the high ^{20}Ne/^{36}Ar of 59±7given by [7]. Our value for AloS is 41.7±0.02 and similar to the respective value for DOS (42.5±0.02). **Si:** FZ- and CZ-Si are identical in their noble gas elemental and isotopic composition, suggesting that the different Si manufacturing processes have no influence on noble gas implantation properties. Therefore, Si data are shown as average from 2 FZ- and 2 CZ-Si analyses. **Ge:** More than 99.9% of implanted SW He has been lost from the Ge target presumably by diffusion. Despite the three orders of magnitude lower He abundances the ^{3}He/^{4}He (3.31×10^{-4}) is only ~25% lower than the respective DOS value. Perhaps the remaining traces of He are those implanted very late, immediately before the sample canister was closed for return causing a temperature decrease. Ar abundance and the ^{20}Ne/^{36}Ar indicate that Ne and Ar were presumably not compromised. **BMG:** The plasma-cleaned BMG sample has 10%, 5% and 3% less ^{4}He, ^{20}Ne, and ^{36}Ar, respectively, compared to the uncleaned sample. This amount of SW gases might have been implanted into the brown stain since the cleaning process was considered not to attack the BMG material itself. The lower He abundance in the cleaned sample had only a minor influence on the ^{3}He/^{4}He ratio which is 1% lower than in the uncleaned. Considering that the brown stain originated from glue fixing the BMG target, stain thickness is presumably highest on BMG. Thus the amount of implanted SW into brown stain should be lower in other targets.

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References: [1] Jurewicz A.J.G., et al. (2003) SSR 105 535-560; [2] Ziegler J.F. (2004) Nucl. Inst. Meth. Phys. Res. 219/220 1027-1036; [3] Grimberg A., et al. (2008) GCA 72 626-645; [4] Reisenfeld D.B., et al. (2007) SSR 130 79-86; [5] Vainonen E., et al. (1997) J. Appl. Phys. 82 3791-3796; [6] Heber V.S., et al. (2008) LPSC 39th CD#1779; [7] Meshik A.P., et al. (2007) Science 318 433-435;