SOLAR WIND NEON IN THE GENESIS CONCENTRATOR GOLD CROSS BY UV LASER ABLATION: FIRST PRELIMINARY DATA. Veronika S. Heber[1], Roger C. Wiens[2], Don S. Burnett[3], Heinrich Baur[1], Uwe Wiechert[1], Rainer Wieler[1]; [1]Isotope Geology, NO C61, ETH, CH-8092 Zürich Switzerland, heber@erdw.ethz.ch; [2]LANL, Space & Atmospheric Sci., Los Alamos, USA; [3]CalTech, JPL, Pasadena, CA 91109 USA.

Introduction: To determine the oxygen isotopic composition of the present day solar wind is one of the key goals of the Genesis solar wind (SW) collection mission, as the solar wind is a proxy for the solar nebula. In order to increase the number of atoms to be analysed and hence analytical precision on O isotopes, SW ions in the mass range up to 28 amu were accelerated and focussed onto a "concentrator target" by an electrostatic mirror. However, the implanted SW ions on this target are isotopically fractionated due to a combination of effects [1]. This fractionation is expected to vary as a function of the radial position on the target. In order to correct the O isotope values in the concentrator targets this fractionation will be determined experimentally for Ne isotopes and by modelling the expected difference between Ne and O fractionation factors. Ne isotopes are most suitable for this purpose because i) it is an abundant element in the Sun, ii) its isotopic composition in SW is well known, and iii) Ne is hardly influenced by terrestrial contamination.

Here we give the first Ne isotopic and abundance data analysed along the radius of one arm of the concentrator gold cross that framed the 4 different concentrator sub-targets. The major goal is to analyse Ne with high precision, comparable to the targeted precision for O isotopic composition (≤0.1 % (2σ)), and high spatial resolution.

Experimental: We analysed Ne isotopic composition and abundances along the "12 o'clock arm" located between the CVD and the SIC targets. The "gold cross" consists of stainless steel covered by electroplated gold. Noble gases were released by UV laser ablation using a Kr-F Eximer laser (248 nm wavelength, 15-20 ns pulse length). Each ablation was done by 12 pulses (at 1 Hz), producing equal pits of about 120 μm diameter. Gases were analysed by a very sensitive noble gas mass spectrometer equipped with a molecular drag pump conveying the gas almost quantitatively into the ion source [2]. Blanks were analysed on a separate ultra-pure electroplated Au target. Blank and interference corrections both amounted to less than 0.1%. Isotopic ratios are additionally corrected for mass discrimination (~0.2%/amu) caused in the mass spectrometer. Data are not corrected for backscattering of implanted SW ions.

Results and Discussion: Here we present preliminary Ne results from three positions along the 12 o'clock arm. More data will be given at the conference. The three analysed positions are at distances of 11, 22, and 26 mm from the center (Fig. 1). At all positions 2 to 4 spots were analysed. One of the 4 analyses at 22 mm was a depth profile (4+4+4 pulses) and served to verify that 12 pulses were enough for a complete extraction of the implanted solar Ne. This was to be expected since the ablation depth per pulse is about 0.1 μm, while the mean implantation energy of ^{20}Ne on the concentrator target was about 60 keV, corresponding to a maximum implantation depth of ~140 nm, according to TRIM simulations [3].

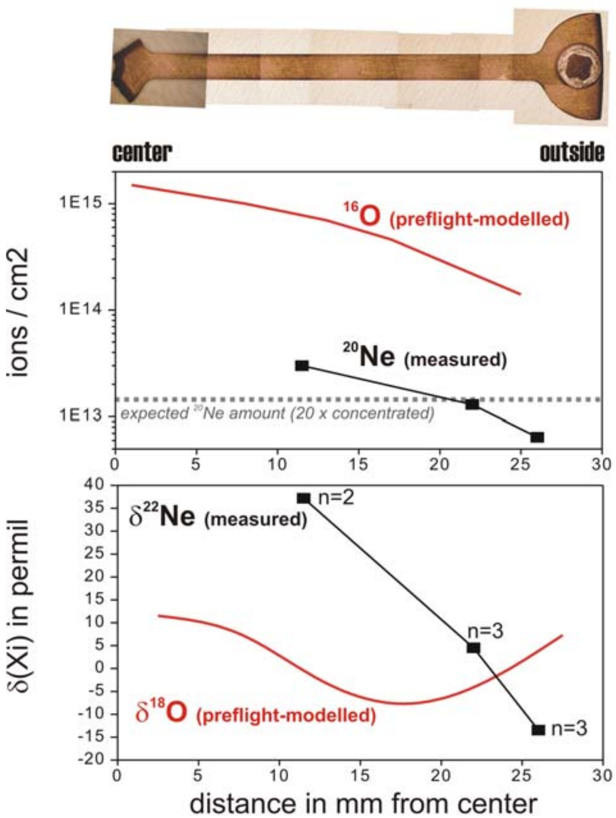

Fig.1. Ne abundance and isotopic composition as function of distance from the center of the concentrator gold cross, compared to oxygen data modelled preflight by [1]. For δ^{18}O the modelled fractionation for SiC is used. Uncertainties in the Ne abundances are ≤ symbol size. The same is true for isotopic composition. n is the number of analysed spots at a given distance. For calculation of the expected ^{20}Ne amount see text.

In Fig. 1 ^{20}Ne abundances and Ne isotopic compositions are given. Measured ^{20}Ne abundances in different spots at the same position agree to within about 1%. This minor variation can be further improved by measuring pit areas precisely. ^{20}Ne abundances range from 6.4E+12 atoms/cm^2 at 26 mm to 3.0E+13 atoms/cm^2 at 11 mm. Remarkably, the concentration interpolated at 20 mm (Fig. 1, middle panel) agrees closely with the expected value at this distance, which we estimated from the measured ^{20}Ne in bulk metallic glass [4] during 803 days of irradiation [5], a concentration factor of 20 expected at r=20 mm [1] and a backscatter loss correction of 38% from Au according to TRIM (using the most probable angle of incidence of 50-55°). This indicates a satisfactory performance of the concentrator in space. Furthermore, ^{20}Ne abundances show the same trend as the preflight modelled oxygen abundances as a function of distance from the center of the target.

^{20}Ne/^{22}Ne ratios agree in most cases within 0.1% (1 σ) similar to the reproducibility of the ^{20}Ne/^{22}Ne ratio of the standard calibration gas of about 0.18% (1 σ, n=11) containing similar Ne amounts as released from one spot in the gold cross. This precision approaches the goal set for the oxygen isotopic analysis of ≤ 0.1% (2 σ). The ^{20}Ne/^{22}Ne ratio varies from 13.30 at 11 mm to 14.00 at 26 mm, close to the edge of the target. In the lower panel of Fig. 1 the Ne isotopic composition is shown in the delta notation to compare extent and direction of the fractionation with the preflight modelled values of the oxygen isotopes [1]. As standard ^{22}Ne/^{20}Ne the solar wind composition of 0.07246 was used (^{20}Ne/^{22}Ne of 14.0 [4] corrected for isotopic fractionation caused by backscattering).

$$\delta^{22}Ne = 1000 \times \frac{\left(\left(\frac{^{22}Ne}{^{20}Ne} \right)_{sample} - \left(\frac{^{22}Ne}{^{20}Ne} \right)_{std} \right)}{\left(\frac{^{22}Ne}{^{20}Ne} \right)_{std}}$$

Remarkably, these preliminary Ne data do not fit the predicted fractionation for oxygen isotopes very well. On the one hand, the maximum Ne fractionation is three times larger than predicted for oxygen isotopes. On the other hand, the measured Ne isotopic ratios monotonously increase towards the center of the target, i.e. they become increasingly isotopically heavier, whereas the predicted O isotopic composition shows a minimum, i.e. an isotopically light composition, at an intermediate distance.

At this moment, we can only speculate about the reasons for the differences between preliminary measured neon and modelled oxygen data. One major difference is certainly the relative difference in atomic masses between the incoming solar wind ion and the target which is SiC, for oxygen and Au for Ne. Backscatter loss of Ne at implantation in Au is large (60 keV, 23-45% for incident angles of 0 to 60° [3], thus, high-angle and low energy ions are poorly represented in the gold, which may cause significant differences in the isotopic profiles. Simulation of Ne fractionation, analogous to that done for oxygen, using actual solar wind charge state, velocity and angular distribution will be presented at the conference.

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