LIGHT NOBLE GASES FROM SOLAR WIND REGIMES MEASURED IN GENESIS COLLECTORS FROM DIFFERENT ARRAYS.

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Introduction: The Genesis Mission carried four collector arrays which where exposed to the solar wind depending upon solar conditions, representing the major solar regimes: Interstream is the "normal" SW, <500km/s, collected for 334 days by the L-array; Coronal Hole wind with speeds about 500-800 km/s was collected by the H-array for 313 days; the highest average and variable speed, Coronal Mass Ejection ions, were collected by the E-array for 193 days and the B & C arrays, which were exposed as long as the Science Return Capsule lid was open, collected bulk SW. Ionization depends somewhat on the first ionization potental, though perhaps differently for different regimes, although little is known about this quantitatively. Therefore, we attempt, in this study, to compare He and Ne isotopic compositions in AloS (Aluminum on Sapphire) collectors from different regime arrays.

Samples: It would have been impossible to associate the numerous fragments of AloS collectors after the "hard" landing except for the clever forethought of making each array with a different thickness.

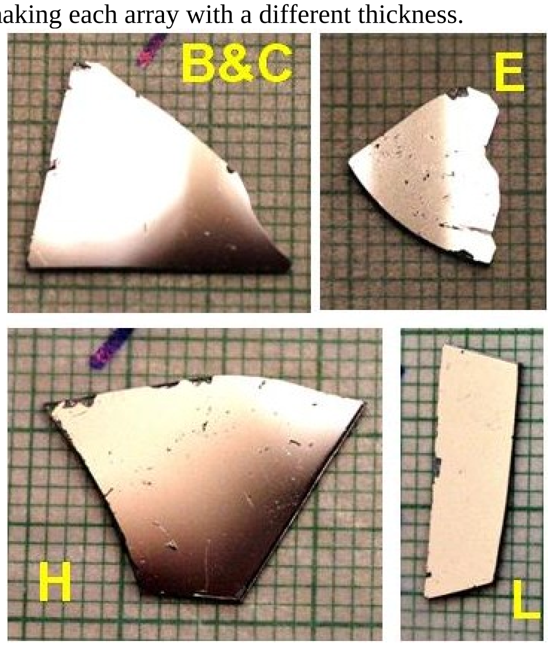

Fig. 1. AloS fragments used in for light noble gas measurements.

As can seen in Figure 1, the AloS has some scratches caused by abrasion during impact, which we tried to avoid when fluences were calculated (worst case abrased area < 1% of the total area).

Noble gas extraction from AloS was done with an IR pulsed laser, a technique previously developed in the study of active capture and anomalous adsorption of heavy noble gases [1]. Since sapphire is transparent at 1064 nm, the Nd-YAG wavelength, only the Al is volatilized by the pulse, greatly reducing the blank. The power output is controlled by a pair of air-spaced water-cooled Glan-Thomson polarizer cubes, the second of which can be rotated. The beam is then reflected by a 45-degree dychroic mirror onto the optical axis of a microscope and finally focused variably below the Al-film to achieve optimum spot size and power density.

Mass-spectrometry: We encountered two problems specific to the high precision Ne analyses in solar wind collectors: First, is the formation of NeH, an interference at ^{21}Ne and, second, the large amounts of SW He which increases the ion density in the ionization region of the GS-61 ion sourcewhich can lead to sufficient space charge to cause non-linear behavior.

These two problems were addressed by first analyzing a small test area of each detector, then adjusting the areas rastered to produce equal gas amounts. In this way, comparisons among different regimes can be made even in the presence of non-linear effects. The NeH problem was improved by getters with more H capacity (avoiding conventional "flash" getters).

Results from these measurements, and other SW data, are summarized in Table 1. Figs. 2 and 3 show the measured He and Ne fluences in different regimes. The first two (light) bars for each regime represent two independent measurements; the third (dark) is the average. As can be seen, consistent results are found in replicate analysis, and they are generally in good agreement with predictions [3], but the bulk He and Ne fluences are significantly higher than expected. This disagreement cannot be due to experimental artifacts since all measurements were made under the same conditions including the total pressure, and H and He partial pressures, and the same He and Ne fluences were observed for the polished Al "kidney" (Table 1).

Figs. 4 shows the ^{4}He/^{20}Ne ratios measured for the different regimes. For each regime the first two bars show results from replicate measurements with the third bar the average. Consistent results are obtained in the independent determinations, with all values except the interstream in good agreement with data from the Apollo foils [2]. It is not understood why the interstream ("normal" SW) should differ. Perhaps this effect is due to the "brown stain", so followup measurements with different AloS collectors should be done.

In summary, precision isotopic measurements have been done on Ne (and, to a lesser extent, He since the calibration is less certain) extracted from a 1 mm^2 area with uncertainties an order of magnitude better than those obtained from the Apollo foils. Some unexpected, and unexplained, results exist, but the fluences generally agree well with those predicted from real-time flight particle data. There is little difference in elemental and isotopic compositions measured for the different regimes.

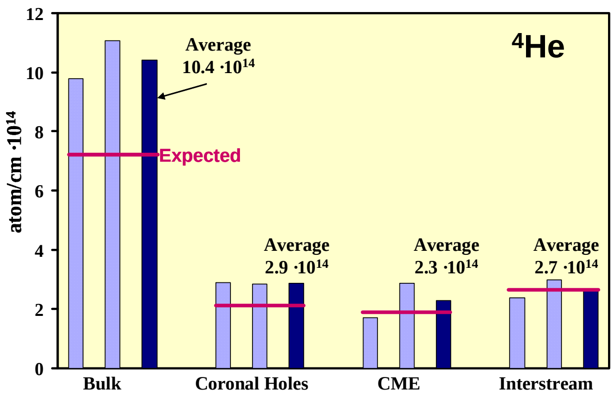

Fig. 2. He in solar wind regimes.

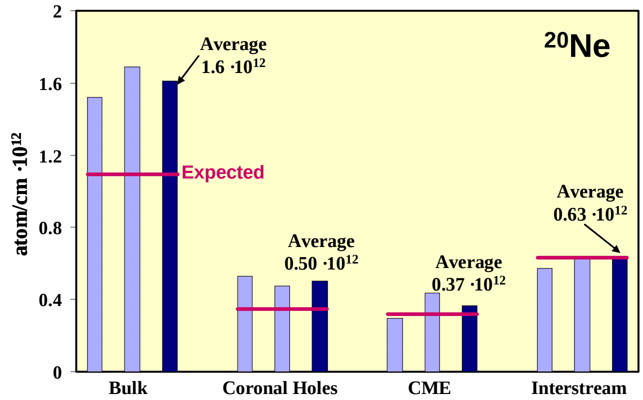

Fig. 3. Ne fluences in solar wind regimes

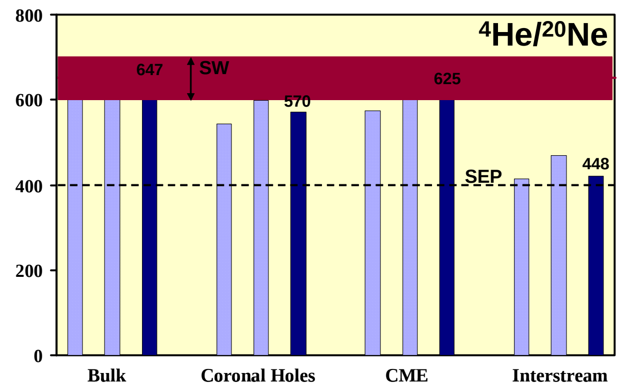

Fig. 4. He/Ne ratios in solar wind regimes

References: [1] Hohenberg C. M., et al (2002) MAPS 37, 257-267; Allton J. H., *et al*. (2005) *LPSC XXXVI*, #1806 [2] Geiss J. et al (2004) Space Sci. Rev. 110: 307-335. [3] Reisenfeld D. B. et al. (2005) *LPSC XXXVI*, #1278.

Table 1. Ne compositions from the different solar regimes: Bulk, Interstream (IS), Coronal Holes (CH), Coronal Mass Ejection (CME) and bulk composition from B&C array compared with Ne composition found in Genesis Polished Aluminum Collector and some previously known solar component [2].

Source	^{4}He/cm^2 ×10^{14}	^{20}Ne/cm^2 ×10^{12}	^{20}Ne/^{22}Ne	^{21}Ne/^{22}Ne
Apollo foils			13.7 ± 0.3	0.0333 ± 0.0044
SOHO			13.8 ± 0.7	0.0314 ± 0.0080
Moon/meteorites			13.8 ± 0.1	0.0328 ± 0.0005
Genesis polished Al-collector areas of 2.5, 1.0, and 0.1 mm^2	10.0	1.49	13.70 ± 0.04 13.61 ± 0.06 13.62 ± 0.09	0.0337 ± 0.0004 0.0329 ± 0.0004 0.0339 ± 0.0012
Bulk (B&C array)	10.4	1.61	13.86 ± 0.06	0.0336 ± 0.0005
IS	2.67	0.63	13.89 ± 0.04	0.0328 ± 0.0006
CH	2.86	0.50	13.93 ± 0.09	0.0340 ± 0.0009
CME	2.29	0.37	13.99 ± 0.08	0.0332 ± 0.0006