SOLAR WIND ABUNDANCES OF C AND O

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Introduction: Quantitative understanding of solar wind (SW) elemental fractionation is required to improve knowledge of the solar nebula abundances from Genesis samples, in particular abundances of volatile elements, depleted in CI chondrites. Ratios of elements with low and high first ionization potential (FIP) in the solar wind, e.g. Fe/He, are higher than photospheric abundances. C, O and N have intermediate FIP and are thus critical as to whether this fractionation is stepwise or gradual as a function of FIP.

Analyses: Genesis solar wind O and C fluences are sufficientlty high for precise SIMS analysis; however surface contamination, mixed to depths as large as 50-100 nm, is a major problem. We adopted 3 mitigations: a) conventional front side depth profiling with low energy Cs surface cleaning using the CalTech Cameca 7f, and backside depth profiling on a Genesis bulk solar wind sample thinned to 350nm using (b) 7f and (c) nanoSIMS . All three methods gave useful data with the most precise data from (b).

Results: The Figure inset shows the 7f C concentration measured vs distance from the backside of the thinned sample. The red portion of the curve is ion beam mixed surface contamination reaching instrumental background around 130 nm. Just prior to 200nm, solar wind C is measured, rising to about 8x background levels until contributions from epoxy binding the sample to a substrate terminate the analyses at 350nm. Similar profiles were obtained with O. The non-inset part of the Figure shows that the measured profile matches theoretical predictions. Interferometry showed that the maximum analysis depth was set by non-normal incidence of the ion beam with the sample surface. This effect is reduced with the 20 micron size of the nanoSIMS pits; however, no improvement in SW peak depth resolution was obtained, probably because of a greater amount of mixing at the sample-epoxy interface with the nanoSIMS than with the 7f.

Conclusions: Normalizing to Mg (low FIP element), the Genesis solar wind (C/Mg) and (O/Mg) ratios are 3.7 and 5.1 respectively, indicating a constant solar wind/photosphere depletion factor of about 0.38 despite the higher FIP for O (13.6 v 11.3 for C).