EVIDENCE FOR UNFRACTIONATED MAGNESIUM ISOTOPES IN GENESIS SOS WAFERS.

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Introduction: Oxygen isotopes measured by MegaSIMS on Genesis Concentrator samples indicate a solar wind (SW) oxygen isotope composition that is related to the ^{16}O-enriched CAI composition by a large mass dependent fractionation [1]. Isotope fractionation during acceleration of the solar wind is expected to create such a large mass fractionation, but a direct test of the presence of mass fractionation in the solar wind has not been possible with sufficient precision. Unlike O and Ne, Mg isotopes are sufficiently uniform in chondrites, terrestrial samples, and other meteoritic and planetary materials from the inner solar system [2], and so offer the best opportunity for a precise (±1‰) test of the Coulomb Drag mechanism for solar wind isotope fractionation. We have previously reported Mg isotopes from flight Si-on-Sapphire (SoS) wafer #20403 fractionated by ~-4‰ w.r.t. Mg isotope standard DSM-3 [3, 4]. Backside depth profiling of Mg isotopes in Si wafers by SIMS yielded possibly fractionated SW Mg with large errors [5]. Interpretations of the measurements we reported earlier [3] were complicated by a lack of knowledge on whether the aggressive acid cleaning procedures employed at FSU were removing some of the SW layer. Since then, SIMS Mg profiles performed on Si wafers cleaned in the same batch of samples as SoS #20304 provide confirmation that the FSU cleaning technique preserves the depth profile of SW Mg in the Si wafers. Below, we consider the implications of the SIMS data and SRIM calculations for SoS wafers.

Discussion: The epitaxially grown Si layer on Genesis flight SoS wafers has a thickness (170-200 nm) less than the original design specification of 300 nm, so that SW ions are not completely stopped within the extractable Si layer. Therefore, SRIM calculations were performed to assess the isotope fractionation induced by the different stopping ranges of Mg isotopes. The SW Mg ion velocity profiles of [6] were used. A backscatter correction is applied. About 95% of the Mg is stopped by the Si layer with an isotopic composition of δ^{25}Mg~-5‰, with the heavier Mg implanted preferentially in the sapphire layer. Thus, isotopically unfractionated SW Mg (w.r.t. chondrites) would be measured at -5‰ by our method. SW Mg fractionated by Coulomb Drag should appear as -15‰. SoS wafer #20304 and four other wafers plot on a mixing line defined between UTTR dirt Mg isotope composition (-0.3‰) and -5‰, with #20304 exhibiting a Mg fluence of ~2E12 atoms/cm^2, expected of the solar wind. Its δ^{25}Mg= -3.6±1.5‰ (2σ) indicates that the solar wind as measured by Genesis SoS wafers is consistent with no fractionation of the SW during acceleration. This result is surprising in view of O and noble gas results [1, 5]. A new set of measurements on Si wafers is in progress to better establish the SW Mg isotope composition.

References: [1] McKeegan K. D. et al. 2011. *Science* 332: 1528-1532. [2] Teng F.-Z. et al. 2010. *Geochimica et Cosmochimica Acta* 47: 4150-4166. [3] Humayun M. et al. 2011. Abstract #1211. 42th Lunar & Planetary Science Conference. [4] Galy A. et al. 2003. *Journal of Analytical Atomic Spectrometry* 18: 1352-1356. [5] Heber V. S. et al. 2012. Abstract #2921. 43rd Lunar & Planetary Science Conference. [6] Reisenfeld D. B. et al. 2007 Space Sci. Rev. 130: 79-86.