LIGHT NOBLE GAS DIFFUSION IN GENESIS SAMPLES. J. C. Mabry[1], A. P. Meshik[1], C. M. Hohenberg[1], D. S. Burnett[2], and J. Allton[3]; [1]Washington University, Physics Department, St. Louis, MO, 63130 USA. E-mail: jcmabry@wustl.edu, [2]Geology 100-23, Caltech, Pasadena, CA 91125 USA, [3]Lockheed Martin c/o NASA/JSC, Mail Code KT, Houston, TX 77058 USA.

Introduction: One of the primary goals of the Genesis mission is to obtain very high precision isotopic measurements of the solar wind. The collector materials were carefully chosen for purity and gas retention properties. However, at high enough temperatures, it is possible for the lighter gases to undergo some diffusion, potentially modifying elemental and isotopic ratios. All possible sources of losses should, therefore, be investigated to improve the precision and coinfidence in the results.

Motivation: Previously, Meshik et al [1] did UV-laser and step-wise pyrolysis of He and Ne in aluminum on sapphire (AloS) and polished aluminum samples. The AloS samples were part of the collector arrays, and are pure aluminum deposited on a sapphire substrate. AloS was specifically chosen for its noble gases retention properties. The polished aluminum sample came from what was originally a shield for the battery compartment and is made of a highly-polished 6061 T6 aluminum alloy.

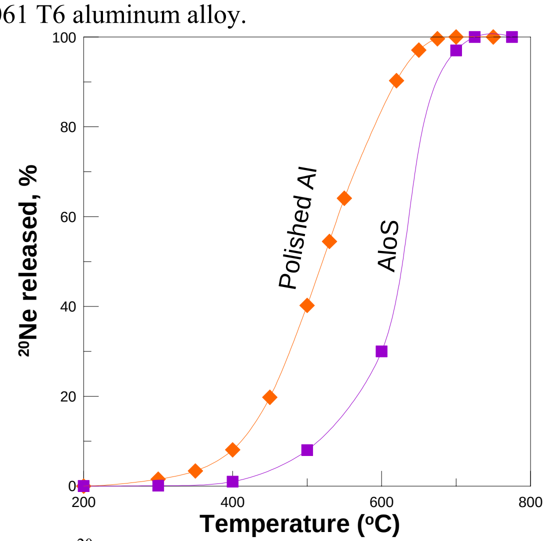

Figure 1: ^{20}Ne temperature release profiles from polished Al and AloS.

The first motivation for doing diffusion experiments on these samples is that light noble gases are released at lower temperatures from the polished aluminum than from AloS as shown for ^{20}Ne in Figure 1. This means that the polished aluminum has a higher potential for losing light gases from diffusion. The second motivation comes from the isotopic release profiles. As seen in Figure 2, they are flattened, as opposed to the linear profiles predicted by SRIM simulations [2]. This suggests a broadening of the implanted profile, which could be an indication that measurable diffusion has occured.

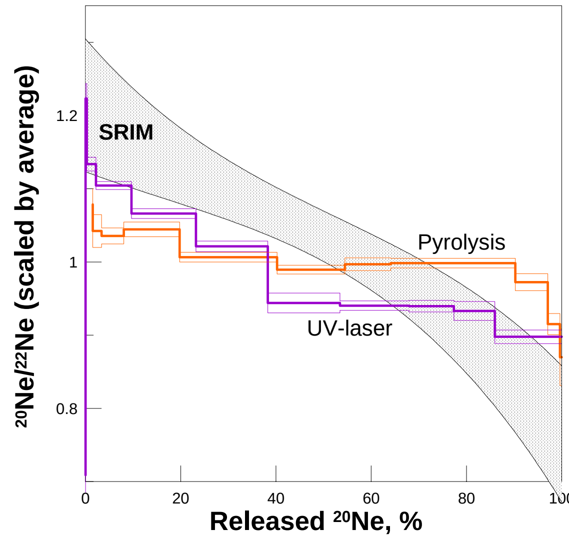

Figure 2: ^{20}Ne/^{22}Ne step-wise release profiles from polished aluminum along with the SRIM prediction.

Diffusion Calculations: Calculations based on these step-wise extractions give fractional losses of ^{20}Ne of up to 15% from the AloS collector and 60% from the polished aluminum collector at a temperature of 330 °C. These calculations were based on several assumptions: that the original (un-diffused) implantation profile is close to the SRIM calculated profile and that the collectors were being heated for 852 days (the exposure time of the bulk collector) during the Genesis mission. Table 1 below shows the calculated fractional loss of ^{20}Ne from AloS and polished aluminum for a range of temperatures. While we have no precise α/ε data for this material, we believe that the temperature of the collectors during the mission was between 130 °C and 260 °C, with 330 °C chosen as an extreme upper limit.

Temp (^{o}C)	*Frac. Loss: AloS*	*Frac. Loss: Polished Al*
130	0.005%	1%
260	2%	26%
330	15%	60%

Table 1: Predicted fractional loss of ^{20}Ne from AloS and polished Al samples based on step-wise heating extractions.

Diffusion Experiment: To better quantify these potential losses of light gases, we are performing an extended duration diffusion experiment using three different sample materials: AloS, polished Al, and silicon on sapphire (SoS).

We made 7 stainless steel fingers and put into each 1 SoS, 1 AloS, and 2 polished Al pieces of sizes on the order of 10 mm^2. Then we constructed heaters made of a copper body which fits snugly around the length of the steel finger and was then wrapped with 36-AWG nichrome wire. Each finger was separately insulated with silicon tape and fiberglass. All of this was done to keep the volume inside the finger evenly heated with TC-408 programmable PID temperature controllers, which can maintain the temperature to within 0.2%. The temperature controllers were connected to a latching relay which shuts off all of the heaters if any one of the controllers measures a temperature 5 °C above or below the set temperature, or in case of power interrupttion or surges. These fingers are all connected to a high vacuum manifold with one finger left at room temperature and the other 6 maintained at 160, 200, 240, 280, 320, and 360 ˚C. They will be held at these temperatures for several months, after which we will then perform full extractions and step-wise extractions of the light noble gases in order to calculate diffusion rates.

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References: [1] Meshik A. P. et al. (2006) *69th Meteoritical Society Meeting,* Abstract #5083 [2] http://www.srim.org