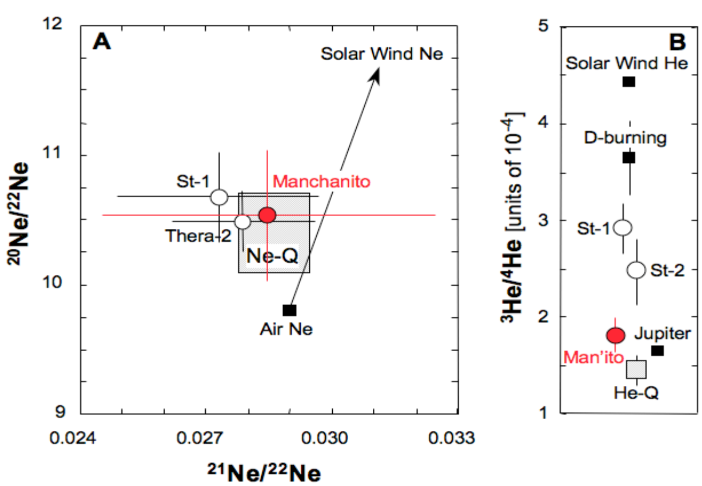
**A LIGHT NOBLE GAS INVENTORY OF STARDUST CELL C2044.** R. L. Palma[1,2], R. O. Pepin[2], A. Westphal[3], D. Schlutter[2] and Z. Gainsforth[3]. [1]Minnesota State University, Mankato, USA. russell.palma@mnsu.edu [2]University of Minnesota, Minneapolis, USA. [3]University of California, Berkeley, USA.

**Introduction:** The Stardust Mission sampled material from comet 81P/Wild 2 and provides the only unambiguously cometary matter for laboratory analysis. Assuming these samples can be considered as proxies for the initial solar nebula, their noble gas compositions provide insight into the conditions existing at the time the first solar system solids formed. We have completed an extensive inventory of the concentrations and isotopic compositions of helium and neon in the following samples from Stardust cell C2044: (a) melted aerogel with embedded particle fragments from the track 41 wall; (b) aerogel wafers adjacent to track 41 without visible particle fragments; (c) surface aerogel wafers; (d) blocks of aerogel without particle fragments from regions around track 41. All samples were loaded in platinum foil and heated by stepwise pyrolysis in procedures similar to those described in [1].

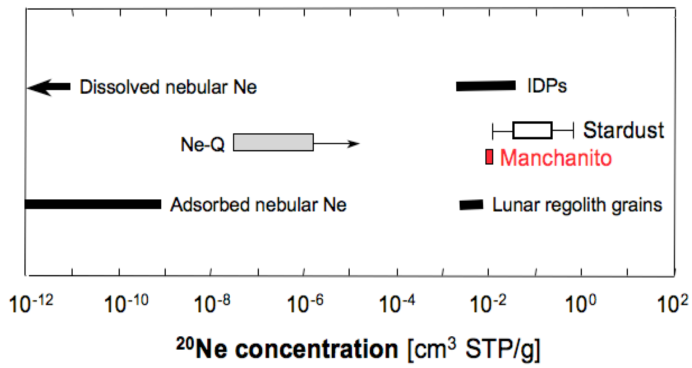
**Track 41 and Wafer Samples:** (a) Track 41 samples analyzed were extracted both lengthwise and from cross sectional slices. Five lengthwise extracted track 41 samples analyzed in two different laboratories by two distinct techniques revealed a Ne-Q composition released at T > 1250 °C [1]. Later analyses of 2 additional samples by Füri and Marty [2] with single step laser desorption confirmed our initial helium composition in these dust bearing samples of ~ (2.5–2.9) x $10^{-4}$. Comparisons between the lengthwise and two cross sectional slice samples from the same track indicate that noble gases are distributed highly heterogeneously [3]. Analysis of helium and neon in amorphous grain "Manchanito" [4] from the giant cluster IDP L2071F1 likewise revealed both He-Q and Ne-Q compositions, potentially identifying its cometary origin (Figs. 1, 2) [5].

**Figure 1**



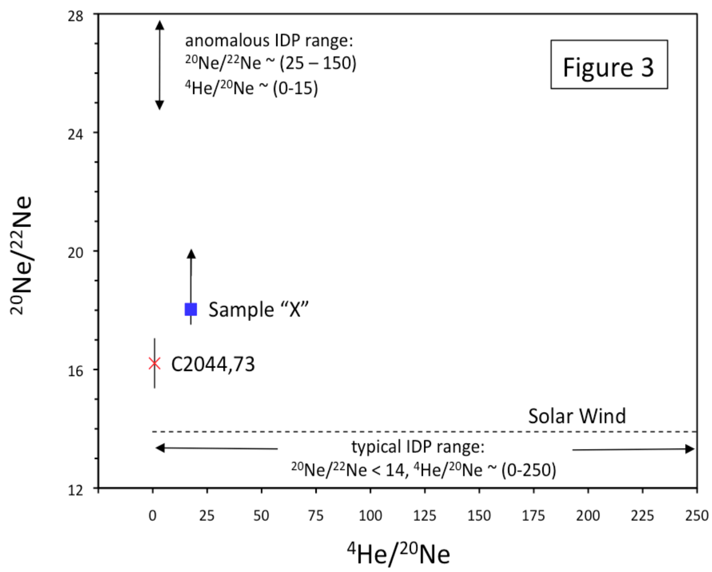

(b) Five 200-µm thick blank aerogel wafer samples were analyzed [3]. Three wafers released sufficient helium and neon for multiple stepwise heating analyses, with integrated compositions of $^3$He/$^4$He = (3.4–3.7) x $10^{-4}$, $^{20}$Ne/$^{22}$Ne = 10.6–13.2 and $^{21}$Ne/$^{22}$Ne = 0.021–0.034. A fourth sample ("X") released extremely high abundances of helium and neon between 800 and 900 °C, accompanied by large amounts of water and hydrocarbons. Mass spectrometer memory effects allowed only limits to be placed on the measured compositions of "X"; nonetheless, these limits, $^3$He/$^4$He < 2.27 x $10^{-4}$ and $^{20}$Ne/$^{22}$Ne > 18.0, are intriguing in light of elevated $^{20}$Ne/$^{22}$Ne ratios observed in IDPs that may have originated in neon novae and been incorporated into comets 26P/Grigg-Skjellerup and 55P/Tempel-Tuttle (Fig. 3) [6].

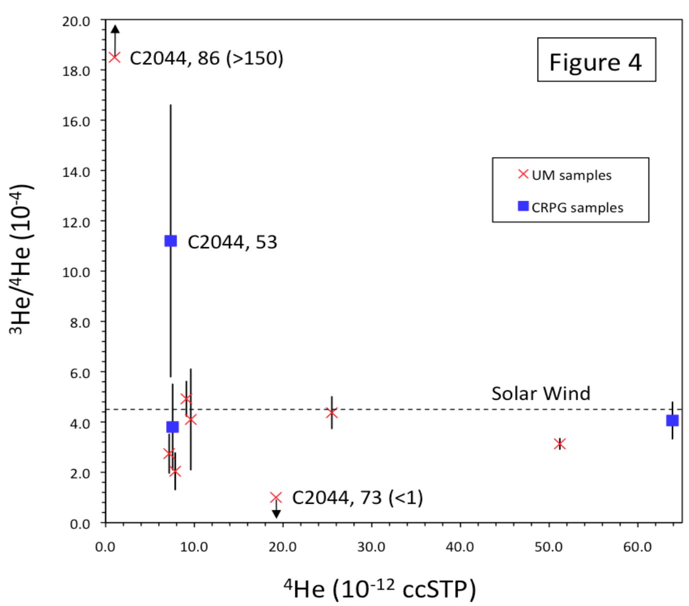
**Figure 2**




(c) Three 200-µm thick surface aerogel wafer fragments from cell C2044 were individually analyzed to explore the possibility that Stardust tile surfaces may have implanted solar wind gases from being obliquely exposed to the solar wind during interstellar particle collection. These samples had a combined $^3$He/$^4$He signature consistent with solar wind, but gas amounts were only approximately twice blank values, precluding a precise isotopic determination. Additionally, a $^{21}$Ne excess consistent with surface solar wind irradiated submicron dust grain implantation was discovered [3]. This $^{21}$Ne excess has been observed and more precisely measured in other surface wafer samples by Meshik et al. [7, 8].

**Aerogel Block Samples and Results:** Due to the interesting and unexpected results from the blank 200-µm aerogel wafer samples, a survey of 70 smaller aerogel blocks without observable particle fragments was undertaken from aerogel around track 41. Earlier progress reports have been made on this project [9, 10]. Of these 70 samples, 49 had gas contents indistinguishable from blank values, 14 had trace amounts of helium and/or neon, and 7 samples had significant amounts of helium and/or neon that allowed isotopic signatures to be determined. Of these 7 samples, one (C2044,73) has the elevated $^{20}$Ne/$^{22}$Ne and low $^4$He/$^{20}$Ne ratios characteristic of Sample "X" and potential presolar grains from neon novae (Figs. 3, 4). Another of the 7 samples, C2044,86, released by far the highest abundance of $^3$He, while $^4$He was consistent with the blank value. The resulting lower limit of ~0.015 for $^3He/^4He$ is similar to the highest values for this ratio observed in IDPs [11]. An elevated $^3He/^4He$ ratio of 1.12 x $10^{-3}$ was also measured by Füri and Marty [2] in another blank aerogel block (C2044,53) with single step laser desorption. Most samples with sufficient helium for $^3He/^4He$ ratio determination had values similar to the modern solar wind, within the uncertainty of the measurements (Fig. 4).




**Conclusions:** Light noble gases appear to be distributed erratically in a "halo" surrounding track 41 in cell C2044. The wide array of helium and neon isotopic compositions and their release from aerogel relatively far from the track 41 center line (up to ~6 mm) pose significant difficulty to understanding the origin of these gases, especially if they are related to the original track 41 impactor.

**References:** [1] Marty B. et al. (2008) *Science* 319, 75-78. [2] Füri E. and Marty B. (2012) 43rd LPS Abstract #1220 and poster. [3] Palma R. et al. (2009) *Meteoritics & Planet. Sci.* 44, A164. [4] Stodolna J. et al. (2012) *Meteoritics & Planet. Sci.* 47, Abstract #5392. [5] Palma R. et al. (2013) this conference. [6] Pepin R. et al. (2011) *ApJ* 742, 2/86, 1-15. [7] Meshik A. et al. (2009) *Meteoritics & Planet. Sci.* 44, A140. [8] Meshik A. et al. (2010) 41st LPS Abstract #2706. [9] Palma R. et al. (2010) *Meteoritics & Planet. Sci.* 45, A160. [10] Palma R. et al. (2012) 43rd LPS Abstract #1076. [11] Nier A. and Schlutter D. (1993) *Meteoritics* 28, 675-681.