NOBLE GASES IN GIANT CLUSTER IDP U2-20GCA.
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Introduction: U2-20GCA appeared on its U2 collector plate as a 350 µm dense core of <40µm particles surrounded by a less dense debris field a mm across. It was probably a highly porous "anhydrous chondritic" IDP that pancaked on impact to form a monolayer of thousands of particles. Extreme porosity and chemical [1,2] and noble gas [1] data support a cometary origin.

Helium and Ne in earlier studies of ~40 cluster IDP fragments (references in [3]) are dominated by implanted solar wind (SW). The large size of U2-20GCA suggests that many of its constituents could have been shielded from short-range SW ion implantation, permitting a search for other noble gas components in the absence of a masking SW component. Indeed, isotopic evidence for SW-Ne appears in only 3 of the 15 particles examined in this study, and non-solar $^{20}Ne/^{22}Ne$ ratios were found in subsets of the other 12. Almost all of the U2-20GCA grains contain high abundances of spallogenic ^{21}Ne, indicating exposure to intense energetic proton radiation at some point in their histories.

Neon and helium. Trapped $^{20}Ne/^{22}Ne$ ratios fall in three isotopic groups: 6 particles with low $^{20}Ne/^{22}Ne$, scattering between HL-Ne [4] and Q-Ne [5]; another 6 with ratios in the Q-Ne field; and 3 suggesting implanted SW. The Q-Ne composition, widespread in chondritic and achondritic meteorites [5], has now also been identified in the "Manchanito" cluster IDP L2071F1 [6], in grain fragments from Stardust track 41 [7], and recently in secondary particles lodged in the surface of Stardust cell C2028 [8]. Q-Ne appears not to be confined just to meteorites.

$^{4}He/^{20}Ne$ ratios in the U2-20GCA samples are low, ranging from <0.1 to 34 and implying substantial He loss. Approximate corrections for He loss and spallation ^{3}He yield an average trapped $^{3}He/^{4}He$ ratio of $\sim 1.4 \pm 0.8 \times 10^{-4}$, similar to $^{3}He/^{4}He$ in Q-He [5] and HL-He [4] but with large scatter.

Spallation Ne and irradiation scenarios. Spallogenic enhancements of $^{21}Ne/^{22}Ne$ in these particles are large relative to spallation-free ratios in SW, Q, and air. Production of their spallation Ne by galactic cosmic rays (GCR) is unlikely: calculated exposure ages for regolith burial at depths of maximum ^{21}Ne production rates by GCR irradiation range from ~350 Ma to >30 Ga. Even the lower ages far exceed expected stability times for asteroidal regoliths. An alternate model adopts Reedy's [9] calculations of spallation Ne generation in small grains irradiated in space by solar cosmic rays (SCR), together with estimates of energetic flare-generated proton fluxes near young solar-type stars in the Orion Nebula that exceed present-day SCR fluxes by $\sim 10^5$ [10]. Resulting exposure ages of the U2-20GCA particles at ~0.3 AU from a similarly flaring early sun, prior to their ejection to comet-forming regions of the nebula, are centuries to millennia.

References: [1] Pepin R. O. et al. 2015. *LPSC 46th,* #1705. [2] Brownlee D. E. et al. 2015. *78th Meteoritical Society Meeting* (this conference). [3] Pepin R. O. et al. 2011. *ApJ 742:86*. [4] Huss G. R. & Lewis R. S. 1994. *Meteoritics 29,* 791. [5] Busemann H. et al. 2000. *Meteorit. Planet. Sci. 35,* 949. [6] Palma R. L. et al. 2013. *LPSC 44th,* #1694. [7] Marty B. et al. 2008. *Science 319,* 75. [8] Palma R. L. et al. 2015. *LPSC 46th,* #2378. [9] Reedy R. C. 1987. *Proc. 17th LPSC, Part 2,* E697. [10] Feigelson E. D. et al. 2002. *ApJ 572:335.*