TRAPPING OF COSMIC RAY HELIUM BY INTERSTELLAR DIAMOND.

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Introduction: Nanodiamond was the first of the pre-solar phases to be recognized in primitive meteorites, but progress in understanding them has been much slower than in cases of other pre-solar ("stardust") grains. Major problems are the small size of the nanodiamonds, which does not allow for single grain analysis, and the fact that the most diagnostic isotopic features are carried by trace noble gases, which are only present in a minority of the diamonds (e.g., [1]). In fact, at present it is unclear whether all diamonds are of pre-solar origin or just a small fraction.

Implantation Experiments: Some progress regarding the origin and trapping of the noble gases has been made thanks to ion implantation experiments using terrestrial artificial nanodiamond as an analogue material [2, 3]. Taking these experiments at face value and using them to interpret meteoritic nanodiamonds, it follows that the bi-modal release and isotopic difference between low-T and high-T releases can be largely explained by release of a single component (P3) to which Kr- and Xe-HL have been added [4,5]. Variations in $^{38}Ar/^{36}Ar$ and $^{20}Ne/^{22}Ne$ can be accounted for without calling for a major contribution from a nucleosynthetic component.

Neon-21 and ^{3}He: The rare isotopes ^{21}Ne and ^{3}He show excesses relative to fractionated P3, a fact that naturally brings cosmogenic contributions to mind. There are three problems associated with this, however: a) cosmogenic ^{21}Ne is not produced from carbon; b) nanodiamonds are so small that cosmogenic nuclides produced within them are lost due to recoil. Only if produced in a larger entity (≥ tens of µm), with which the nanodiamonds are associated, can cosmogenic products be trapped [5]; c) the observed high ratio of excess ^{3}He to excess ^{21}Ne of >40 [5].

Cosmic ray trapping: Galactic cosmic rays arriving at the top of the atmosphere are rich in ^{3}He ($^{3}He/^{21}Ne$ ~300 [6-8]). In interstellar space, cosmogenic production of ^{3}He in grains by (high energy) protons cannot be avoided, although the ^{3}He may be lost. Similarly, trapping of GCR ^{3}He cannot be avoided after it has been slowed down sufficiently. For a preliminary estimate of the efficiency of ^{3}He trapping by nanodiamonds dispersed in an interstellar cloud presenting an obstacle < 0.02 g/cm^2 to cosmic rays, we have used the mean interstellar proton flux and energy spectrum of [9] with the requisite abundance of ^{3}He ($^{3}He/H$ ~ 0.02; [7]). Under these conditions trapping of GCR ^{3}He is more efficient than production in carbon following [9]. *Assuming* all the nanodiamonds to be pre-solar, a CRT (cosmic ray trapping) age is suggested to be in the range 25 - 100 Ma.

References: [1] Nittler L. R. 2003. *Earth and Planetary Science Letters* 209:259–273. [2] Verchovsky A.B. et al. 2000. *Journal of Conference Abstracts (Goldschmidt 2000)*, Abstract #1050. [3] Koscheev A. P. et al. 2001. *Nature* 412:615-617. [4] Huss G. R. et al. 2000. *Meteoritics & Planetary Science* 35:A79-A80. [5] Huss G. R. et al. 2008. *Meteoritics & Planetary Science*, in revision. [6] Lund N. 1984. *Advances in Space Research* 4:5-14. [7] Wang J. Z. et al. 2002. *Astrophysical Journal* 564:244-259. [8] Israel M.H. et al. 2005. *Nuclear Physics A* 758:201c-208c. [9] Reedy R. C. 1989. 20th Lunar and Planetary Science Conference. pp. 888–889.