PINK ANGEL: ARGON AND XENON DIFFUSION, I-Xe CHRONOLOGY AND THE ^{36}Cl PROBLEM.

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Introduction: The reported presence in Allende Pink Angel sodalite of excess ^{36}S [1] attributed to ^{36}Cl decay is at odds with the apparent absence of a corresponding excess of ^{36}Ar, which is the major decay product of ^{36}Cl. In an attempt to throw light on the problem we have reviewed new and existing data on the diffusion of Ar and Xe in sodalite, carried out new high resolution I-Xe analyses of Pink Angel, and devised a new methodology for searching for small excesses of ^{36}Ar from ^{36}Cl decay.

Diffusion of Ar and Xe in sodalite: Our experiments on neutron irradiated terrestrial sodalite indicate high retentivity of Cl-derived ^{38}Ar. During stepped heating, maximum release occurred around 1100^{o}C and release was essentially complete by 1250^{o}C. An activation energy of 280 kJ/mol/K was calculated. Published data [2] from an I-Xe analysis of Pink Angel sodalite indicates peak release of I-derived ^{128}Xe around 1200^{o}C with significant release up to 1400^{o}C. An activation energy for Xe diffusion of 460 kJ/mol/K is inferred. To calculate the implications for possible Ar and Xe loss over time scales appropriate to the early solar system we scale time, t, and absolute temperature, T, using the expression: $1/T_2 = 1/T_1 + R/E.\ln(t_2/t_1)$ where subscripts 1 and 2 refer to the laboratory and early solar system times and temperatures, respectively. To release essentially all of the Cl-correlated Ar and I-correlated Xe on a timescale of 1 Myr would require sustained temperatures of around 460^{o}C and 740^{o}C respectively.

I-Xe analyses: We have carried out laser stepped heating I-Xe analyses of Pink Angel sodalite using the RELAX resonance ionization spectrometer. Two samples, weighing 40ug and 80ug have been analysed with a total of 90 individual extractions. A well defined plateau indicates ^{129}I/^{127}I = (0.93 ± 0.02) x 10^{-4}, corresponding to an I-Xe age 3.2 ± 0.3 Ma after our monitor, the Shallowater achondrite. Lower ^{129}I/^{127}I ratios in the early release could imply a 12% later loss of ^{129}Xe concomitant with significant loss of ^{36}Ar.

^{36}Cl Searches based on ^{36}Ar: We suggest a new method to search for ^{36}Ar excesses which makes use of a plot of ^{36}Ar/^{38}Ar vs. Ca/^{38}Ar. End members are trapped, cosmogenic and cosmogenic secondary neutron-induced argon. In suitable circumstances excess ^{36}Ar would plot above this mixing triangle. Determination of Ca using a reactor irradiation requires low fluences and Cd-shielding to minimise ^{38}Ar production from Cl.

In conclusion we note that absence of excess ^{36}Ar in spite of the high retentivity of sodalite leaves open the possibility that either the reported ^{36}S excess is an artifact or else it is inherited from an unidentified pre-existing Cl-rich phase which has lost ^{36}Ar and the apparent correlation with Cl/S represents a two component mixing line and not an isochron.

References: [1] Hsu W. et al. 2006. *Astrophysical Journal* 640:525-529. [2] Swindle T.D. et al. 1988. *Geochimica Cosmochimica Acta* 52:2215-2227.