

**CARBON, NITROGEN AND NOBLE GASES IN A VIGARANO (CV) CAI: EVIDENCE FOR SILICON CARBIDE IN REFRACTORY INCLUSIONS.** S. S. Russell<sup>1</sup>, I. A. Franchi<sup>2</sup>, A. B. Verchovsky<sup>2</sup>, R. D. Ash<sup>3</sup>, and C. T. Pillinger<sup>2</sup> <sup>1</sup>Department of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD, UK, <sup>2</sup>Planetary Sciences Research Institute, Open University, Milton Keynes, MK7 6AA, UK, <sup>3</sup>Geophysical Laboratory and Department of Terrestrial Magnetism, Carnegie Institution, 5251 Broad Branch Road, Washington DC 20015, USA.

**Introduction:** Isotope anomalies are observed in CAIs, implying that they formed before isotopic homogenisation had been completed. Isotopic studies have concentrated on refractory elements (e.g., Ti, Ca), and O. The more volatile elements, although likely to be under-abundant in CAIs, may also shed some light on CAI precursor materials and formation mechanisms. Here we report the results of a pilot study into the abundance and isotopic composition of C, N and noble gases in CAIs from Vigarano (CV3). Vigarano was chosen as it contains large CAIs that have suffered less alteration than their counterparts in the more-studied Allende. The results were compared to C data previously obtained on an Allende CAI [1].

**Technique:** The interior of a CAI, VS2, was picked out from a slab of Vigarano using a needle. VS2 (4mm × 3mm) consists predominantly of melilite (Ak<sub>-5</sub>), with abundant spinel, hibonite laths (TiO<sub>2</sub> ~2%), and Fe-Ni beads and minor Al-rich diopside. Gases liberated from a stepped combustion extraction to 1400°C of 5.7mg of VS2 were analysed on an automated mass spectrometer system (FINESSE) for the abundance and isotopic composition of He, C, N, Ne and Ar.

**Results: Carbon:** Discounting C released below 500°C, which appears to be mainly terrestrial contamination, the C abundance of VS2 is ~100ppm, at the lower end of the range observed for chondrules [2]. The mean  $\delta^{13}\text{C}$  is -12‰, approximately 6‰ heavier than bulk Vigarano [3], and is constant over a broad temperature range, suggesting most of the C is dissolved in silicates. A peak in  $\delta^{13}\text{C}$  of  $-8 \pm 1\%$  at 550°C suggests the presence of minor carbonate (~10 ppm). In the highest temperature steps the  $\delta^{13}\text{C}$  increases to  $-5 \pm 1\%$ , consistent with the presence of SiC. A previously measured CAI from Allende released even heavier C at high temperatures ( $\delta^{13}\text{C} = +29 \pm 1\%$ , [1]).

**Nitrogen:** The bulk N content of the CAI is 16 ppm, calculated assuming only material released above 500°C is indigenous. Nitrogen is released over a wide temperature range. The mean  $\delta^{15}\text{N}$  over the whole release is +17‰, distinguishable from bulk CV meteorites that yield  $\delta^{15}\text{N} < 0\%$ ;  $\delta^{15}\text{N}$  for Vigarano is -11‰ [3,4]. The difference in  $\delta^{15}\text{N}$  between this CAI

and bulk CV suggests that the CAI sampled isotopically distinct material or was subject to an evaporation event that caused fractionation of N (and perhaps C). In the highest temperature steps, a <sup>14</sup>N-rich component (minimum  $\delta^{15}\text{N} = -53\%$ ) is released, that has similar combustion characteristics to presolar SiC.

**Noble gases:** Two main release peaks for He and Ar are observed, at 400°C and 700°C. Ar has a planetary isotopic signature. A small amount of cosmogenic <sup>21</sup>Ne is detected around 700°C. Over the highest temperature range no detectable noble gases are released, with the exception of <sup>22</sup>Ne at a level ~15% above blank. Such a signature is indicative of Ne-E.

**Discussion:** The C, N and Ne data suggest the presence of relict presolar SiC in VS2, indicating the reservoir from which CAIs formed contained presolar dust, some of which survived the CAI formation event without melting or degassing. Assuming CAI SiC has similar characteristics to that in the matrix, the abundance of SiC is estimated as 0.1 ppm from the C data, and 5 ppm from the N data. The small amount of <sup>22</sup>Ne detected suggests a value of a few parts per million, but with considerable uncertainty. The disparity in SiC abundance determinations from C and N may reflect the presence of components that are unaccounted for in our calculations. Alternatively, the CAI SiC may have a different mean N abundance or isotopic composition to matrix SiC. Whichever abundance estimate is correct, it appears that the SiC concentration in this CAI is of a similar order of magnitude, or higher, than the 0.2 ppm present in bulk Vigarano [5]. An estimate of the SiC abundance in an Allende CAI (1 ppm) [1] was also higher than in bulk Allende (0.01 ppm, [5]). Together these data suggest the CAI formation region may, in fact, have been enriched in presolar SiC.

**References:** [1] Ash and Russell (1994) in *Chondrules and the Protoplanetary Disk* (R. H. Hewins et al., eds.) p. 2, Cambridge Univ. [2] Hanon et al. (1995) *Meteoritics*, 30, 516. [3] Kerridge (1985) *GCA*, 49, 1707. [4] Chung and Clayton (1978) *EPSL*, 38, 421 [5] Russell et al. (1992) *Meteoritics*, 27, 283.