

**ABUNDANCES OF PRESOLAR GRAINS IN RENAZZO AND AXTELL: IMPLICATIONS FOR THEIR THERMAL HISTORIES.** Gary R. Huss<sup>1</sup>, Alex P. Meshik<sup>2</sup>, and Charles M. Hohenberg<sup>2</sup>,  
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Presolar grains (e.g., diamond, SiC, graphite, Al<sub>2</sub>O<sub>3</sub>) are found in the fine-grained matrix of all chondrite classes. The abundances and characteristics of presolar grains reflect the thermal history of the host chondrite and of the precursor materials prior to accretion [1-3]. Ne and Xe are sensitive tracers of presolar diamond, SiC, and graphite, and were used by [1] to compile an extensive data base of presolar grain abundances in chondrites. Several meteorite classes were either not studied or received only cursory attention in the study by [1]. The CR2 meteorites, which have large isotopic anomalies in H, N, Xe, etc. [4,5] and thus presumably have high abundances of presolar grains, are one such class. The oxidized CV3 chondrites were represented only by Allende [1]. To fill these gaps, we prepared acid residues and diamond separates from the Renazzo (CR2) and Axtell (CV3<sub>Ox</sub>) chondrites and measured the amounts and isotopic compositions of Ne and Xe in these residues. Diamond abundances were estimated using results for the etched HF/HCl residues and the Xe-HL contents of the diamond separates. Abundances from etched residues are higher by 27% (Renazzo) and 20% (Axtell) than the amounts recovered in diamond separates, reflecting additional processing losses associated with preparing diamond separates [1]. SiC abundances were determined from the Ne-E(H) contents of the etched residues and an assumed Ne-E(H) content for SiC of 16,500x10<sup>-8</sup> ccSTP/g [1]. Graphite abundances were estimated from the Ne-E(L) contents of the etched residues, assuming a Ne-E(L) content for graphite of 14,000x10<sup>-8</sup> ccSTP/g [1]. The abundances of diamond, SiC, and graphite, and the relative abundances of the P3, HL, and P6 noble-gas components in presolar diamonds [3,6] were used to infer the thermal histories of Renazzo and Axtell and their precursors.

**Renazzo:** Abundance data for diamond, SiC, and graphite in Renazzo are shown along with similar data for other meteorites in Table 1. The data have been normalized to matrix abundance to facilitate comparison. The matrix-normalized diamond abundance is slightly higher than those for Orgueil (CI) and Murchison (CM2), significantly higher than those of

LL3.0-3.1 chondrites, and is similar to that for Leoville (CV3<sub>R</sub>). The SiC abundance is lower than those of CI, CM2, and LL3.0-3.1 chondrites and similar to that of Leoville. There is a hint of residual graphite. The Xe release pattern for Renazzo diamonds is shown in Fig. 1a. Renazzo diamonds contain very little of the low-temperature Xe-P3 component found in Orgueil and Murchison diamonds. The contents of Xe-HL and Xe-P6 in Renazzo diamonds are somewhat higher than in Orgueil diamonds, reflecting the loss of the HL- and P6-poor P3 carrier [3]. When the diamond abundance for Renazzo is corrected for loss of the Xe-P3 carrier, the implied abundance of Orgueil-like diamonds in the Renazzo matrix precursor is ~70% higher than the matrix-normalized abundances for CI and CM2 chondrites (Table 1).

Table 1: Matrix-Normalized Abundances (ppm).

Meteorite	Diamond	SiC	Graphite
Orgueil (CI)	1436±56	14.2±0.8	10.3±0.4
Murch. (CM2)	1400±100	15±1	>4
Semark. (LL3.0)	1134±69	10.0±0.8	0.22±0.2
	1515±111*		
Krymka (LL3.1)	1008±82	3.5±0.6	<0.066
	1543±230*		
<b>Renazzo (CR2)</b>	<b>1500±75</b>	<b>0.9-1.8</b>	<b>0.1±0.6</b>
(33.5% matrix)	<b>2450±200*</b>		
Leoville (CV3 <sub>R</sub> )	1554±93	1.12±0.07	ND
	3166±230*		
Allende (CV3 <sub>Ox</sub> )	885±125	0.016±0.013	ND
	1817±278*		
<b>Axtell (CV3<sub>Ox</sub>)</b>	<b>820±55</b>	<b>0.46-0.92</b>	<b>ND</b>
(35% matrix)	<b>1552±125*</b>		

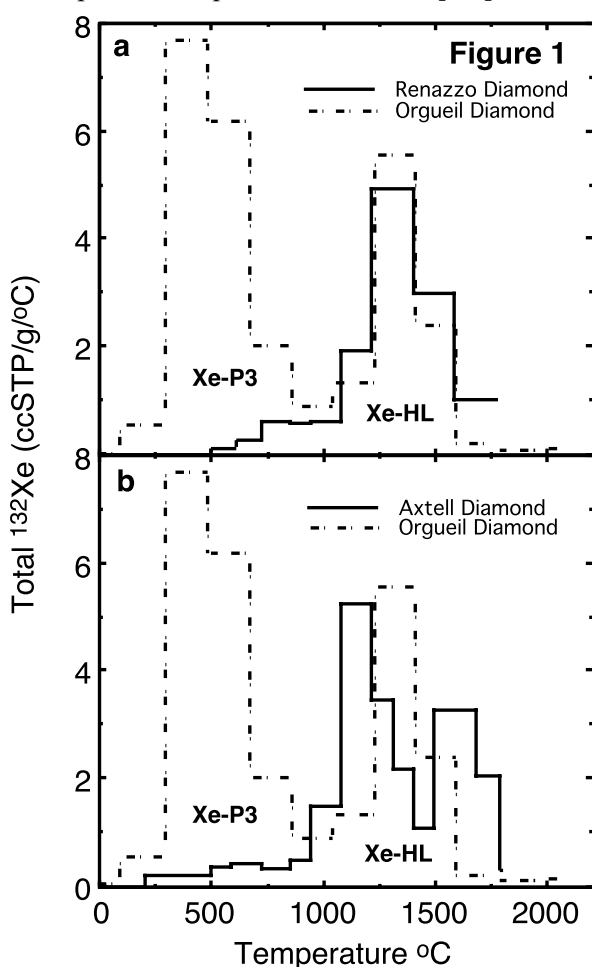
\*Original abundance of Orgueil-like diamonds.

The contents of Xe-P3, Xe-HL, and Xe-P6 in Renazzo diamonds and the low SiC and graphite abundances in Renazzo are consistent with the matrix material having experienced a temperature of 300-350 °C, similar to temperatures experienced by type 3.1-3.2 ordinary chondrites [3]. However, this high temperature may not reflect the metamorphic history of the host meteorite. Renazzo has experienced extensive aqueous alteration. The phyllosilicate assemblage and the absence of tochilinite imply a maximum temperature of ~150 °C for this alteration [7]. The inferred abundance of

Orgueil-like diamonds in the Renazzo precursor is much higher than those inferred for CI, CM2, and LL3.0-3.1 chondrites (Table 1). Abundances higher than that in Orgueil have been interpreted to indicate pre-accretionary thermal processing that removed volatile components from the initial inventory of dust from the sun's parent molecular cloud [1,2]. The bulk composition of Renazzo is enriched by ~40% relative to CI in refractory lithophile elements [8]. Together, the presolar grains data and bulk compositional data imply that the precursor material for Renazzo experienced more-severe nebular heating than the precursors of the ordinary chondrites, but not as much as the precursors of CV3 chondrites [cf. 1,2]. The disagreement between the enrichment factors for refractory lithophiles (~40%) and presolar diamonds (~70%) can be understood by considering the nature of dust in the sun's parent molecular cloud. A significant fraction of the rock-forming elements were present in dirty ices and amorphous coatings on mineral grains formed by condensation at 10-20 K. Condensation at these temperatures is not an equilibrium process, since all elements stick to the first solid they hit. When heated in the early solar system, refractory and volatile elements evaporated together at low temperature, causing an increase in the relative abundances of refractory grains in the dust that was greater than the increase in abundances of refractory elements.

**Axtell:** Axtell (CV3<sub>Ox</sub>) is petrographically similar to Allende (CV3<sub>Ox</sub>), but may be slightly less metamorphosed [9]. The matrix normalized diamond abundances for Axtell and Allende are similar (Table 1). Axtell may have more SiC than Allende, but the data are not very precise. Neither meteorite has any evidence of graphite. Like Allende diamonds, Axtell diamonds have little Xe-P3 (Fig. 1b), and diamonds from the two meteorites have similar contents of Xe-HL and Xe-P6. The bimodal release of Xe-HL from Axtell diamonds is not understood, but is not seen in the etched residue. The abundances of diamond, SiC, and graphite, and the contents of Xe-P3, Xe-HL, and Xe-P6 in the Axtell diamonds imply that Axtell and Allende matrix materials experienced similar temperatures (550-600 °C [3]). This is ~250 °C higher than the temperatures experienced by the reduced CV3s, Leoville and Vigarano [3]. The Axtell meteorite may well have experienced temperatures this high. The Axtell ma-

trix is partially recrystallized like that in type 3.5-3.6 ordinary chondrites, which experienced 450-550 °C [3]. The <sup>26</sup>Al systematics of CAIs and Al-rich chondrules in Axtell imply an upper limit of 600 °C for Axtell metamorphism [10]. However, the abundance data and bulk compositional data for the least metamorphosed CV3s also imply significant nebular heating of the CV3 precursors prior to accretion [1,2].



**References:** [1] Huss G. R. and Lewis R. S. (1995) *GCA* **59**, 115-160. [2] Huss G. R. (1997) in *Astrophysical Implications of the Laboratory Study of Presolar Materials*. AIP, 721-748. [3] Huss G. R. and Lewis R. S. (1994) *Meteoritics* **29**, 811-829. [4] Robert F. and Epstein S. (1982) *GCA* **46**, 81-96. [5] Reynolds J. H. and Turner G. (1964) *JGR* **69**, 3263-3281. [6] Huss G. R. and Lewis R. S. (1994) *Meteoritics* **29**, 791-810. [7] Zolenski M. E. (1991) *Meteoritics* **26**, 414. [8] Kallemeyn G. W. et al. (1994) *GCA* **58**, 2873-2888. [9] Simon S. B. et al. (1995) *Meteoritics* **30**, 42-46. [10] Srinivasan G. et al. (2000) *GCA* submitted. Supported by NASA NAG5-8158 (GRH) and NAG5-4173 (APM and CMH).