THE I-Xe RECORD OF PARENT BODY PROCESSING IN METEORITIC NANODIAMONDS. Greg Holland[1] and Jamie Gilmour[1] School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Oxford Road, Manchester M13 9PL, United Kingdom. Greg.holland@manchester.ac.uk, jamie.gilmour@manchester.ac.uk.

Introduction: In a recent study of xenon isotopes in size-separated nanodiamonds from the CV3 chondrite Efremovka (see [1]), it was shown that excesses of ^{129}Xe from ^{129}I decay are present in the P3 component [2]. Here we investigate the I-Xe system in nanodiamonds separates..

Systematics: In Fig. 1, we compare results of a simple model of the nanodiamond I-Xe system with literature data[3,4]. See also reference [2].

In our model, we assume that each meteorite parent body incorporated nanodiamonds from an initially homogeneous population. At some later time, the nanodiamonds were partially degassed of their Xe-P3 in a single event. During this event, such ^{129}Xe as had already been produced by ^{129}I decay was lost in the same proportion. To account for the data, this degassing must have taken place while ^{129}I was still alive.

After degassing, decay of the remaining ^{129}I drove up the ^{129}Xe/^{132}Xe ratio, the magnitude of the increase being higher for nanodiamonds that had been more degassed.

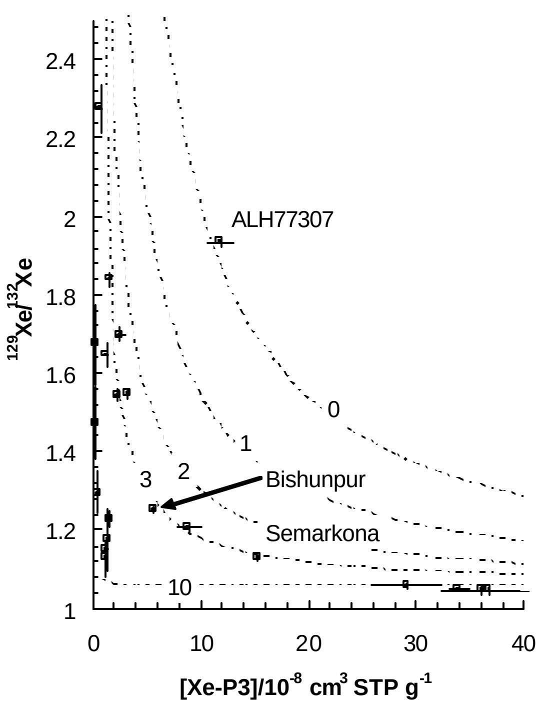

Fig. 1. Comparison of literature xenon data from nanodiamonds [3,4] with simple models of degassing an initially uniform nanodiamond population to different extents at times 1, 2, 3 and 10 half lives of ^{129}I after closure to degassing of the nanodiamond population in ALH77307.

It is noticeable that many nanodiamond separates are consistent with degassing at about the same time, albeit to different extents. For instance, Bishunpur (LL3.1) appears to have lost more of its xenon than Semarkona, but the data are consistent with synchronous closure. Nanodiamonds from the primitive ordinary chondrite ALH77307 [5] are clearly distinct. Other nanodiamond separates closed to xenon loss about 3 half lives of ^{129}I (48 Ma) later. There is nothing inherently absurd about this conclusion – initial iodine ratios derived from isochrons from some chondrules from LL3 chondrites (and other meteorites) require similar late resetting (see Filtness et al., Gilmour et al., accompanying abstracts). In this respect, it is interesting that the "3 halflife" model line of Fig. 1 is close to the data from Colony (CO3), Mokoia (CV3), Tieschitz (H3.6), Renazzo (CR2), Vigarano (CV3) and Ragland (LL3.5), suggesting a similar response to a widespread decline in intensity of processing.

Initial Iodine Ratio: Following on from our original work, we reported in abstract form the results of a con-

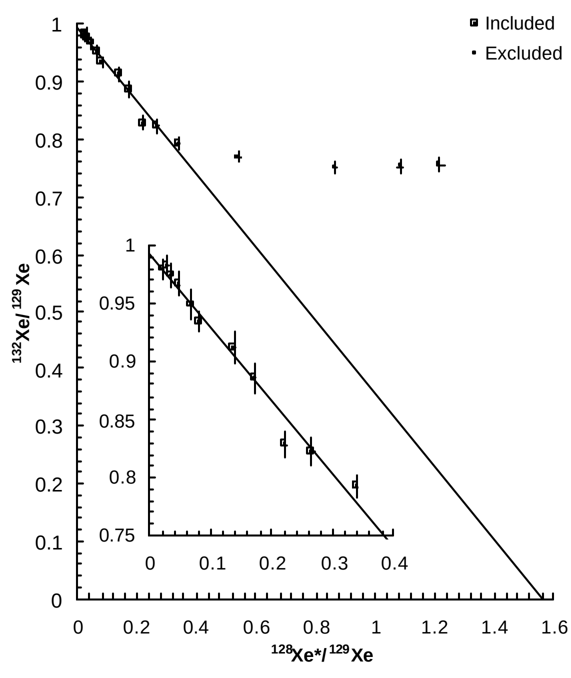

Fig.2. Low temperature data from analysis of a coarse grainsize separate of Efremovka nanodiamonds exhibit an isochron corresponding to closure 25.9 ± 0.9 Ma after closure of Shallowater enstatite.

ventional I-Xe analysis on the largest Efremovka grain size separate, ED12 [6]. Data yield an eleven point I-Xe isochron corresponding to an initial iodine ratio requiring ~26 Ma evolution from the Shallowater standard (Fig. 2).

There is a superficial disagreement between this result and that derived from the models shown in Fig 1, where >48Ma of evolution are required to account for the data from most separates. However, our model effectively treats the concentration of excess ^{129}Xe (^{129}Xe*) in a nanodiamond separate as a proxy for the ^{129}Xe*/I ratio, exploiting the fact that an initially homogeneous nanodiamond reservoir would have a well defined iodine concentration. Thus, rather than comparing our data with the isochron age, we should compare it with the integrated ^{129}Xe*/I ratio of the separate.

Figure 3 shows a step release diagram of the data used in Fig. 2's isochron plot with both isochron and average ratios plotted. The average ^{129}Xe*/I ratio for our analyses of this separate corresponds to closure 35-40 Ma after closure of Shallowater enstatite. Adopting the absolute age for Shallowater closure of 4563.3 Ma [7], this is broadly consistent with the interval deduced between closure of ALH77307 nanodiamonds

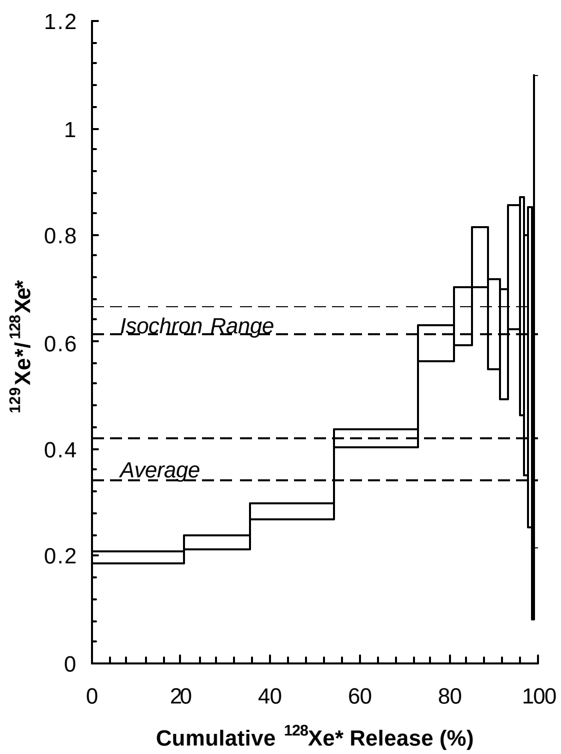

Fig. 3. A step release profile for the early temperature steps in analysis of coarse nanodiamond separate ED12. The average ^{129}Xe/I ratio is significantly lower than that of the isochron calculated in Fig. 2.

and of those closing on around 3 half lives of ^{129}I later (Fig. 1), provided the I-Xe system in ALH77307 nanodiamonds closed very early in the evolution of the solar system. It is possible that an I-Xe analysis of ALH77307 matrix would reveal an unusually early elevated initial iodine ratio. The evidence strongly suggests, however, that the P3 content of most nanodiamond separates was set 10s of Ma after the nebula stage of the solar system. It is also interesting that the ^{129}I/^{127}I ratio of nanodiamonds appears to have evolved concordantly with that of the bulk solar system.

Note on Recoil. Recoil is not usually an issue in studies of the I-Xe system, but the exceptionally fine-grained nature of these samples suggested that it should be considered. Accordingly, our nanodiamond sample was irradiated in an evacuated vial and the contents analysed for the presence of excess ^{128}Xe*. Full details must await formal publication but the quantity observed does not negate the inferences made here.

References: [1] Verchovsky A. B. *et al.* (1998) *Science 281*, 1165-1168. [2] Gilmour J. D. *et al.* (2005) *GCA 69*, 4133-4148. [3[Huss G. R. and Lewis R. S. (1994) *MAPS 29*, 791-810. [4] Huss G. R. *et al.* (2003) *GCA 67*, 4823-4848. [5] Brearley A. J. (1993) *GCA 57*, 1521-1550. [6] Holland G. *et al.* (2003) *MAPS 38*, A123 (abstr.). [7] Gilmour J. D. *et al.* (2006) *MAPS 41*, 19-31.

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