**NITROGEN ISOTOPIC SIGNATURES FROM THE METAL PHASE OF IIE AND IVA IRON METEORITES**. R. L. Palma[1], K. J. Mathew[2] and K. Marti[2], [1]Dept. of Physics, Sam Houston State University, Huntsville, TX 77341-2267 USA; [2]Dept. of Chemistry 0317. University of California San Diego, La Jolla, CA 92093-0317 USA.

Oxygen isotopic compositions have been used to delineate possible genetic relationships between various meteorite groups [e.g., 1]. Clayton *et al.* [2] first noted similarities in O isotopic signatures between silicates in IIE irons and H chondrites, and between IVA irons and L and/or LL chondrites and suggested a possible common parent body in each case. However, since silicate inclusions represent a minor phase in IIE and especially IVA irons, we examined N isotopic signatures from the metal phase of these meteorites for comparison to N isotopic signatures in H and L/LL chondrites, respectively. Our stepwise heating results represent the first such data from these iron meteorite classes, although bulk measurements in a number of iron meteorites have been reported [3, 4]. The high temperature isotopic signatures are well defined, but small spallation components can be identified. Interestingly, indigenous N components of IIE and IVA irons appear remarkably similar.

Extraterrestrial samples exhibit an enormous range of bulk $\delta^{15}N$ values whose origins remain unknown. The distribution, isotopic composition, and source of N in the metal and separated nonmetallic phases of iron meteorites are likewise not well understood. We have inadvertently carried out an experiment which suggests that low temperature, low pressure processes on iron meteorite parent bodies may significantly alter their N abundance and isotopic composition. The observations may be applicable to studies of impact histories of these objects.

Samples of IIE irons Colomera, Seymchan, Techado and Tobychan, and IVA irons Woods Mountain and Mart, were prepared. Samples came from well shielded locations, and the selected chips of approximately 40 mg were found microscopically to be free of inclusions. Rust was mechanically removed from the samples with a file, and they were thoroughly cleaned with an ethanol-acetone mixture under ultrasonification before air drying. At the time of sample loading several other (non-iron) meteorite samples were also loaded. To remove atmospheric contamination from samples, the entire sample loading line system was heated to 300 °C, while being pumped.

Stepped pyrolysis was employed to extract the gases, first in a quartz furnace with a resistance heater (up to 1120 °C), then up to the melting temperature in a molybdenum crucible with RF induction heating. Nitrogen was analyzed as $N_2$ by static mass spectrometry. In a few cases both large and small volume fractions were analyzed, with resulting isotopic signatures obtained being identical within experimental uncertainty. Excesses observed at mass 30 are due mainly to CO and were used to correct for CO at masses 28 and 29. N fractions were cleaned by exposure to CuO, converting background gases to $CO_2$ and $H_2O$ which were collected on an $LN_2$ trap and later discarded. Xenon abundances and compositions were measured as a means of detecting possible contributions from graphite and/or silicate inclusions. Blank measurement runs were made between all samples.

*Low temperature data:* Nitrogen evolved from non-iron meteorite samples during combustion and/or preheating of the sample line following loading has clearly cross contaminated the N low temperature release fractions of the iron samples. A consistent $\delta^{15}N$ value of +50 +/- 10 ‰ was released in the first temperature step of all samples (Fig. 1). This signature was recognized as nonindigenous by observing the same $\delta^{15}N$ in low temperature steps of a Cape York monitor sample which had also been loaded with the IIE and IVA meteorites. The characteristic release pattern for Cape York has been determined previously [5].

These low temperature data raise interesting questions concerning N siting and acquisition mechanisms in iron meteorites. First, either N was acquired during the preheating, when samples were at 300 °C and open to the vacuum pump, or it was acquired during combustion of other non-iron meteorite samples when the iron meteorite samples were cold. In either instance, the gas is subsequently rather tightly bound to the samples, with the component being clearly removed only by 1000 °C. Thus N is not just being adsorbed by the meteorite, but instead must be chemically reacting with an active surface. The samples were observed to noticeably darken while in the sample loading line prior to analysis, but were again shiny after heating to about 1000 °C. For the low temperature data (<1000 °C), we conclude that whatever the mechanism involved, it may play a role in affecting the N abundance and composition on iron meteorite parent bodies.

*Indigenous nitrogen:* Nitrogen stepped release data for IIE iron Colomera and IVA iron Woods Mountain are shown in Fig. 1a and 1b, respectively. The heavy N component is absent by the 1000 °C fraction, and stepwise lighter signatures seen from 500 to 1000 °C may either reflect an admixture with a small amount of indigenous components, and/or with an atmospheric contamination component. The high temperature release patterns indicate well defined isotopic signatures, but small deviations may be due to spallation effects.

For Colomera (~120 Ma cosmic ray exposure age inferred from [6]), assuming a minimum production rate P($^{15}$N)$_c$ equal to P($^{21}$Ne)$_c$ and -6 ‰ as the trapped $\delta^{15}$N value (observed in the 1250 °C release), the rise in $\delta^{15}$N observed at 1400 and 1550 °C appears consistent with an additional spallation component. A similar argument for Woods Mountain (and the other IVA sample, Mart, which had an indigenous N content of 0.6 ppm) can be made by assuming an exposure age of 360 Ma, typical of the IVA class. (Work on exposure ages from aliquots is in progress [7].) In this case the signature observed in the plateau for gas released above 1250 °C is consistent with a trapped $\delta^{15}$N of -5 ‰ admixed with a spallation component. The spallation component is more clearly seen in the 1250 °C release of Woods Mountain due to a smaller indigenous gas release at that step.

Seymchan's N release pattern, and especially its isotopic composition, are distinct from the other three IIE irons analyzed (Fig. 1c). Its Ir concentration of 0.55 ppm [8] is at the very low end of the range in the IIE grouping. Given its N systematics, its classification should perhaps be reexamined.

The indigenous N isotopic signatures from the metal phase of the IIE and IVA iron meteorites, in comparison to the signatures from H and L/LL chondrites [9], provides a diagnostic tool for distinguishing genetic relationships among these groups. With the available data at present, it appears that the trapped N composition in both classes of irons is approximately the same ($\delta^{15}$N = -5 ‰), despite significant $\Delta^{17}$O differences in their silicates.

*References:* [1] Clayton R. N. and Mayeda T. K. (1996) *GCA* **60**, 1999. [2] Clayton R. N. *et al.* (1983) *EPSL* **65**, 229. [3] Prombo C. A. and Clayton R. N. (1993) *GCA* **57**, 3749. [4] Franchi I. A. *et al.* (1993) *GCA* **57**, 3105. [5] Murty S. V. S. and Marti K. (1994) *GCA* **58**, 1841. [6] Hintenberger H. and Wänke H. (1964) *Z. Naturforsh.* **19a**, 210. [7] Lavielle B. *et al.*, personal communication. [8] Scott E. R. D. and Wasson J. T. (1976) *GCA* **40**, 103. [9] Hashizume K. and Sugiura N. (1995) *GCA* **59**, 4057.

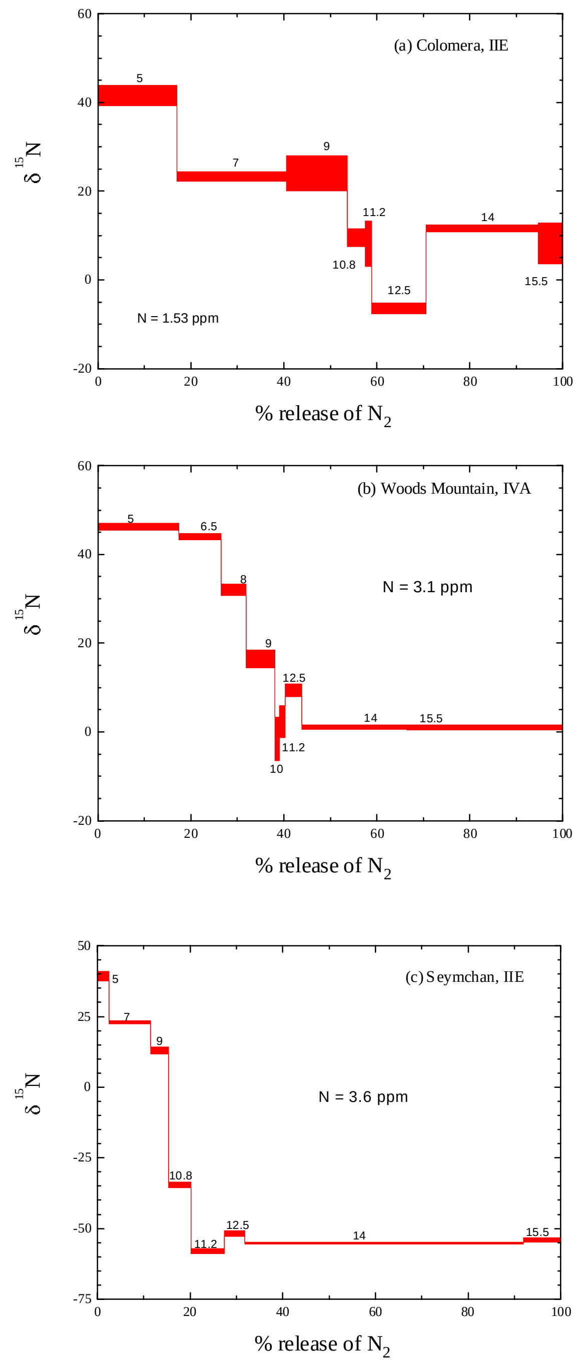


Figure 1. Nitrogen released from the stepped pyrolysis of (a) IIE iron meteorite Colomera, (b) IVA iron meteorite Woods Mountain, and (c) IIE iron meteorite Seymchan.

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