NITROGEN AND ^{129}XE IN A METAL-RICH SEPARATE OF THE ACAPULCO METEORITE;

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Sturgeon and Marti (1) presented nitrogen data obtained on a sample of Acapulco, a unique meteorite with highly recrystallized texture and mineral chemistries indicating formation or metamorphic temperatures of around 1100°C but with unexpectedly high contents of volatile elements and trapped noble gases (2,3,4), in which they observed the presence of at least two nitrogen components in addition to spallogenic ^{15}N. One of these, released at or above 1000°C, was unusually light ($\leq$ -114‰), while the second, released by pyrolysis at temperatures as low as 600°C, had a δ^{15}N value of about 9‰. Since the latter value is similar to that of terrestrial organic matter, and it appears to be difficult to explain an indigenous component that survived an 1100°C event yet could be released by vacuum heating at 600°C, and since Acapulco contains ~200 ppm of carbon combustible at $\leq$ 400°C (5), I thought it would be important to verify the observations of Sturgeon and Marti, with the added precaution of pre-cleaning sample surfaces by oxidation at 400°C. Rather than simply repeating the experiment of (1) on bulk Acapulco, however, it was decided to look at a metal-rich separate, as a first step in a search for those phases which might contain the different nitrogen components. For completeness, the noble gases were included in the analytical procedure.

The sample analyzed was 20.3 mg of material magnetically separated from a crushed sample of Acapulco. Gas preparation and analysis were as previously reported (6). Three combustion steps at 400°C with limited amounts of O_2 yielded 1.8, 1.4 and 0.1 ppm of N_2 (having a δ^{15}N of 12-15‰), with essentially no condensible gases produced in the 3rd step. The sample was then pyrolyzed using the same temperature schedule as in (1) through 1130°C. Because δ^{15}N did not decline to the degree seen in (1), the sample was withdrawn from the combustion finger with a magnet and the finger was heated with O_2 at 600°C to check for possible contamination, yielding blank levels of N_2. The sample was reinserted, heated at 600°C in O_2 (yielding no significant N_2 but some noble gases), and then pyrolyzed at 1180°C. Because of this interruption in the schedule, the final steps planned for the sample were not completed in time for this abstract.

An unexpected result of the clean-up steps was an observation with respect to ^{129}Xe. Previous bulk analyses of Acapulco (2,3) showed small enhancements in ^{129}Xe/^{132}Xe. In the present sample, a ratio of 3.5 was obtained in the first 400°C step, in which 25% of the total excess ^{129}Xe through 1180°C was released. This is probably a lower limit to the ^{129}Xe/^{132}Xe ratio for this step, since there may well be air adsorbed on the sample. Ratios of 3 or greater are also observed at 800-1000°C, where amounts of excess ^{129}Xe released are correlated with production of a gas condensible in liquid N_2 (either CO_2 or SO_2). The total ^{132}Xe released through 1180°C is a factor of 8 less than for the bulk meteorite. It therefore appears (a) that the trapped "planetary" noble gases in Acapulco are associated with the non-magnetic phases, and (b) that live ^{129}I was taken up and concentrated in a C- or S-bearing phase or phases prior to or during the formation or recrystallization of Acapulco, phases which are at least partially labile to oxygen at 400°C.

Results obtained so far for nitrogen are shown in Fig. 1. As can be seen, even after removal of combustible phases at 400°C, there is still evidence of the heavier component observed in (1). In fact, because the total nitrogen represented by Fig. 1 is nearly twice that

Nitrogen and 129Xe in Acapulco metal: Becker R. H.

seen in bulk Acapulco (1), the absolute concentration of this component in the metal separate is close to that of the bulk. Although one still cannot rule out a relatively combustion-resistant organic contaminant, the case for the low temperature N_2 being indigenous is strengthened, although the problem of its survival through the high-temperature history of Acapulco remains. On the other hand, while Fig. 1 shows the presence of a second, isotopically lighter component, it does not reproduce the remarkably light values reported in (1). The profile in Fig. 1 is very much like that in (1), if anything decreasing in $\delta^{15}N$ at lower temperatures than in that paper, but the isotopic ratio levels out at about -70‰. The very light component might appear when the final steps are completed, but the observed plateau suggests otherwise. It is possible that this component is concentrated in the silicate-rich fraction of the meteorite, while the metal contains the component of intermediate $\delta^{15}N$ seen in Fig. 1. Sturgeon and Marti (1) did note the possibility of a third non-spallogenic component heavier than the lightest component in their data, although it would appear to have been present in much smaller amounts than would be suggested by the concentration seen in the present sample. Note that no spallogenic effects are expected in the metal-rich separate.
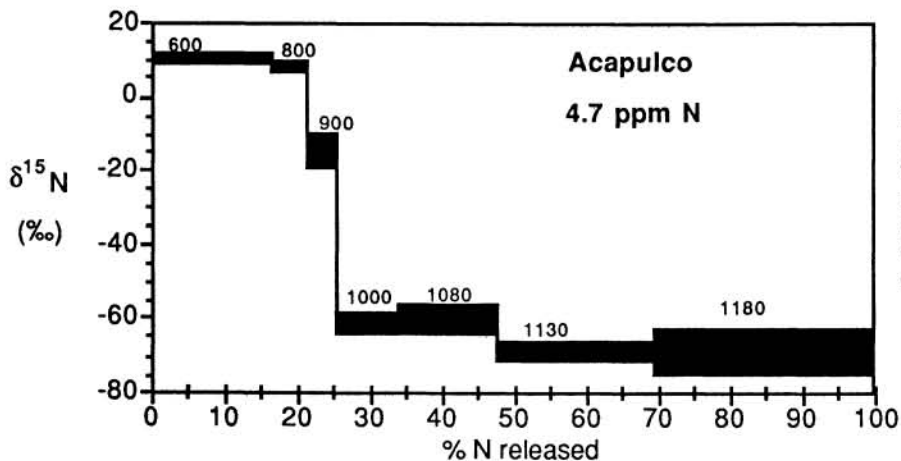

Fig. 1. Isotopic ratios vs. % of N released from Acapulco metal-rich separate by pyrolysis, after removal of 3.3 ppm N by combustion at 400°C.

It is perhaps worth pointing out, in view of the associations sometimes made between Acapulco and the silicates of IAB iron meteorites (2,4), that the $\delta^{15}N$ value of -70‰ observed here for the metal-rich separate at high temperatures is similar to, though slightly lighter than, $\delta^{15}N$ values seen in the IAB irons (7). This might be taken to support the suggested association, although it must also be noted that data on carbon isotopes in Acapulco (5) suggest in contrast that while the silicate portion of Acapulco may have a relationship to IAB silicates, the metal portion originates elsewhere.

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