NITROGEN ISOTOPIC COMPOSITION OF TYPE 3 ORDINARY CHONDRITES;

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Searching for presolar components and other anomalous components, nitrogen isotopic compositions of type 3 ordinary chondrites have been measured with a static mass-spectrometer by stepwise combustion. As presented at the last year's Meteoritical Society Meeting (but not given in the abstract (1)), two isotopically anomalous nitrogen have been detected. Additional 4 type 3 chondrites were examined lately and none of them showed strikingly anomalous nitrogen, although one sample had slightly heavy nitrogen of solar-wind origin. Features of the two anomalous nitrogen of probably presolar origin and nitrogen of probably solar-wind origin are described below. Petrographic classification is mainly obtained from (2).

Y-74191 (L3.7): The highest delta-^{15}N is about 990 permil observed for a H_2O_2 treated sample, which is probably presolar origin. Preliminary data on this chondrite are given in (1,3). The abundance of the excess ^{15}N is about 5 ppb. The heavy nitrogen is lost by HCl treatment. A very good correlation is observed between the release pattern of excess ^{15}N and primordial Ar. There is no petrographic or chemical evidence that this chondrite is anomalous.

A-77214 (L3.4): A typical release pattern of nitrogen is shown in Fig.1. The lowest delta-^{15}N is -226 permil observed for a H_2O_2 treated sample, which is probably presolar origin. The abundance of excess ^{15}N is about -2 ppb. The anomalous nitrogen seems to be slightly enriched in nonmagnetic fraction and the carrier phase is soluble in HCl. A fairly good correlation is observed between the release pattern of excess ^{15}N and primordial Ar. This chondrite contains C-rich aggregates and the carbon is isotopically one of the heaviest among ordinary chondrites (4). It is interesting to see if this association of light nitrogen and heavy carbon holds for other samples.

At present, the probability of finding presolar components in type 3 ordinary chondrites by anomalous nitrogen is about 17 % (2 out of 12). Since some of the chondrites (e.g. Chainpur) which do not have anomalous nitrogen are more primitive than Y-74191 or A-77214, it is argued that anomalous nitrogen due to presolar grains were not found in more primitive chondrites (e.g. Chainpur) not because they were destroyed during metamorphism but because they were not incorporated in the beginning. In other words, the parent body of L chondrites was made of isotopically distinct regions (bodies), which were formed in isotopically heterogeneous nebula.

A-77216 (H3.7/3.9): The release pattern of nitrogen is shown in Fig.2. The highest delta-^{15}N is 103 permil. The abundance of excess ^{15}N is 0.615 ppb. This chondrite has a fairly long (47.5 my) cosmic ray exposure age. Cosmogenic excess ^{15}N is calculated to be 0.227 ppb. Hence the real excess ^{15}N is 0.338 ppb. Since this chondrite is a gas rich chondrite (5), the excess is probably due to solar-wind nitrogen. It is not possible to clearly separate the cosmogenic nitrogen and the solar nitrogen from the stepwise combustion pattern (Fig.2), but usually the former is released at the highest temperatures (1100-1200 C). Therefore, the delta-^{15}N for the solar-wind nitrogen is estimated to be about 100 permil. This is a conservative estimate because there must be some indigenous nitrogen whose isotopic composition is nearly normal (6). Kung and Clayton (7) argued that solar nitrogen in ordinary chondrites is unobservable masked by the indigenous nitrogen. The reasons that we were able to detect the solar-wind nitrogen are (a) this is one of the most gas rich ordinary chondrites and (b) abundance of indigenous nitrogen (6) is smaller than that expected by (7). The ratio of solar ^{20}Ne to solar nitrogen is similar to that for lunar samples. The solar-wind nitrogen isotopic composition has been estimated based on the measurements on lunar soil samples, and has been suggested to have varied with time (8). It is not known exactly when A-77216 was formed, but probably it was nearly 4.5 billion years ago. Then, the present data suggest that the isotopic composition of the solar-wind nitrogen did not change with time. The change in nitrogen isotopic composition recorded in lunar soils may be affected by indigenous lunar nitrogen (9) emanating from the interior of the moon.

References

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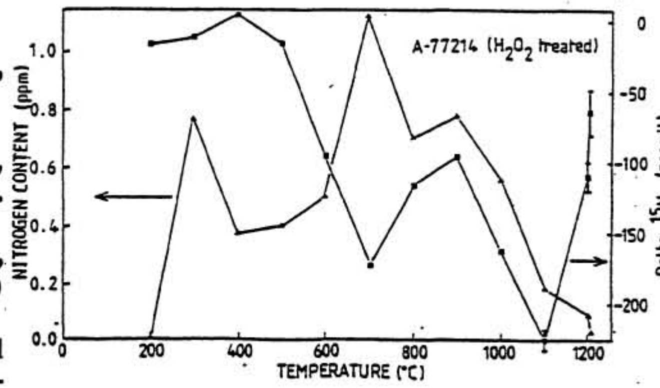

Fig.1 Nitrogen release from ALH77214 by stepwise combustion.

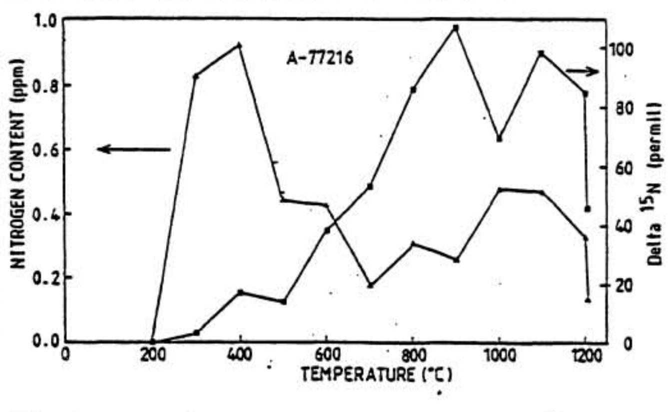

Fig.2 Nitrogen release from ALH77216 by stepwise combustion.