HELIUM AND NEON IN INDIVIDUAL EXTRATERRESTRIAL PARTICLES;

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We have reported [1,2] on the isotopic composition of helium and neon found in approximately 100 μg composite samples of magnetic fines found in the deep Pacific and on the Greenland ice cap. This is a report on a similar study of 8 individual deep Pacific chondritic particles believed to be of extraterrestrial origin, and on 3 stratospheric particles. Four of the deep Pacific particles appeared to have been partially melted- probably in passage through the earth's atmosphere. The other four were largely unmelted. As in the earlier work, samples were wrapped in a tantalum foil sandwich, and the gas extracted by passing an electric current directly through the sandwich. Extraction temperatures of 850^0, 1200^0, and 1600^0 C were employed. The evolved gas was purified by passing it through liquid nitrogen-cooled charcoal traps before admitting it to the statically-operated mass spectrometer [3]. For helium, $3x10^6$ atoms (10^{-13} ccNTP) are required to give an ion current of 1 ion/sec.

The masses of the four largely unmelted Pacific particles lay between 10 and 27 μg. As was the case for the magnetic fines previously studied, for the 850^0 C extraction, the $^3He/^4He$ ratios in 3 of the 4 fell between 2 and 4×10^{-4}. For the fourth particle it was 3×10^{-3}. In all four 1600^0 extractions it exceeded 10^{-3}. The $^{21}Ne/^{22}Ne$ ratios, where measurable, fell near 0.03, making it unlikely that any appreciable fraction of the helium and neon is of spallogenic origin. While, in general, our helium and neon results for low temperature extractions (850^0 C.) fall near those of other investigators [4,5,6,7,8], both for our magnetic fines and for the present single particles, the $^3He/^4He$ for high temperature extractions (1600^0 C.) tend to run higher, suggesting a different source of the helium. Few of our helium ratios for either the magnetic fines or the single particles fall near 4×10^{-4}, the generally accepted solar wind value. The particles which were believed to have suffered appreciable melting contained less gas and measurements were only fragmentary.

Because of the small size (and mass) of the stratospheric particles investigated (U2022-D11,-E9, and -G10) [9], step heating was not attempted and the extractions were made at 1600 C. In only two of the samples, D11 and E9, was there sufficient gas, roughly 3×10^{-10} ccNTP of helium, for making isotopic analyses. The $^3He/^4He$ ratio in one case was (1.8±0.5)E-4, in the other, (6.4±3.2)E-5. These ratios are in the same general range as found in the deep Pacific particles. For E9 the $^{20}Ne/^{22}Ne$ appeared to be near to 11 and the $^4He/^{20}Ne$ ratio appoximately 9. These ratios also fall in the same general range as those for the deep Pacific particles. With the assumption that the stratospheric particles had an average diameter of 12µm and density of unity, the helium content for the two particles, where measurements were possible, was calculated to be roughly 0.3 ccNTP/g, in the same general range as reported by Rajan et al [10]. The values are orders of magnitude greater than observed in either the deep Pacific or Greenland ice magnetic fines. Our investigation of these particles, a first attempt to determine $^3He/^4He$ ratios, demonstrated that isotopic analyses are possible for single particles as small as this, and further investigations are justified.

In all of our helium isotopic measurements to date, the greatest source of uncertainty is in the determination of the ^3He blank associated with the heating of the tantalum foils containing the samples and other nearby parts- filament leads, housing, etc. - of the manifold. Although considerable pains are taken to outgas the parts in question, we have been unable to reduce, in a predictable manner, the blank ^3He which is associated with the heating of samples. The $^3He/^4He$ ratio in the blanks may exceed 10^{-4} rather than lie near 10^{-6}, as expected, if the background were due to atmospheric helium! Random testing of various materials used in the construction of our sample extraction manifolds generally gives this result and, with reluctance, we have come to the conclusion that the helium found in common shop metals may have an anomalous isotopic composition. Because of the importance of this observation to our measurements, and other implications, we are studying the phenomenon further.

REFERENCES: [1] Nier,A.O., D.J. Schlutter, and D.E. Brownlee, 1987, LPSC XVIII, 720. [2] Nier, A.O., D.J. Schlutter, and D.E. Brownlee, Meteoritics,1987, **22** (in press). [3] Nier, A.O., and D.J. Schlutter, 1985, Rev. Sci. Instr. **56**, 214. [4] Ozima, M., M. Takayanagi, S. Zashu, and S. Amari, 1984, Nature **311**, 448. [5] Amari, S. and M. Ozima, 1985, Nature **317**, 520. [6] Matsuda, J.and K. Nagao, 1986, Geochem. J. **20**, 71. [7] Fukumoto, H., K. Nagao, and J. Matsuda, 1986, Geochim. Cosmochim. Acta **50**, 2245. [8] Amari, S. and M. Ozima, Geochim. Cosmochim. Acta (in press). [9] NASA /Cosmic Dust Catalog, Vol. 7, 1985. [10] Rajan, R.S., D.E. Brownlee, D. Tomandl, P.W. Hodge, H. Farrar IV, and R.A. Britten, 1977, Nature **267**, 133.