HELIUM AND NEON ISOTOPES IN INDIVIDUAL STRATOSPHERIC PARTICLES --A FURTHER STUDY

A. O. Nier and D. J. Schlutter, School of Physics and Astronomy, University of Minnesota, Minneapolis, MN 55455.

Earlier, we reported [1] on the isotopic composition of the helium and neon extracted from eight individual stratospheric particles obtained from the Johnson Space Center's collection. Eight additional particles have now been analyzed. As before, the particles were folded in a small piece of Ta foil which was heated to 1600° C. by a direct passage of an electric current through the foil. The gas released was purified, using a liquid nitrogen-cooled charcoal trap and a rare earth getter. The mass spectrometer employed was run in a static mode, and was similar to one described earlier [2].

The table below lists all of the results to date. Particles 1-8 refer to the earlier samples, 9-16, to the recent ones. Some of the data for the earlier samples have been recalculated, so the numerical values may differ somewhat from those previously presented [1]. Data have been corrected for instrument residual background. Errors given are standard deviations.

Particle	"dia."	^{4}He(ccSTP)	^{3}He/^{4}He	^{4}He/^{20}Ne	^{20}Ne/^{22}Ne	^{21}Ne/^{22}Ne
1. W7013 G9	16 µm	7.2E-11	(1.5±0.4)E-4	16	12.6±4.2	<0.06,
2. W7013 F12	15	1.0E-11	(2.5±1.3)E-4	12	- -	--
3. W7013 F13	18	8.5E-12	(1.4±0.5)E-4	22	† 10.0±1.1	< 0.04
4. W7013 B15	40	2.7E-11	- -	10	9.7±1.9	0.08±0.06
5. U2015 B11	15	5.6E-12	- -	5	- -	- -
6. U2015 B18	8	- -	- -	--	--	--
7. U2015 C8	18	3.7E-10	*(2.3±0.2)E-4	54	†12.2±0.8	0.046±0.02
8. U2015 C11	18	8.6E-10	*(2.2±0.1)E-4	53	†10.9±0.4	0.026±0.007
9.U2015*B3	25	1.6E-10	*(4.1±0.5)E-4	40	12.9±2.9	--
10.U2015*A5	30	3.4E-10	*(1.45±0.05)E-3	4.2	†11.3±0.3	0.032±0.003
11.W7029*A32	15	1.9E-11	--	--	--	--
12.W7069*B3	15	3.3E-10	*(3.1±0.2)E-4	83	13.3±2.1	--
13.U2011*A4	15	1.8E-11	- -	2.7	13.9±1.8	--
14.U2011*B3	15	6.1E-11	- -	8.8	13.5±1.5	--
15.W7066*A5	15	7.3E-11	(2.5±0.7)E-4	56	- -	--
16.W7069*A4	15	7.3E-11	(1.7±0.7)E-4	23	- -	--

* < 20% ^{3}He blank correction † < 30% ^{22}Ne blank correction

Because of the small amounts of gas measured, the greatest uncertainty in the results comes from the correction for instrument blank. Those data for which the blank correction is lowest are indicated above.

STRATOSPHERIC PARTICLES

Nier, A. O,. and Schlutter, D. J.

SUMMARY:

(1) If particle No.10 is excluded, the average $^3He/^4He$ ratio is (2.4±0.3)E-4. Particle No. 10 appears to be an interesting anomaly.

(2) $^{21}Ne/^{22}Ne$ ratios, where measurable, lie in the range found for solar or planetary neon and exclude presence of cosmic ray spallogenic neon.

(3) The average $^{20}Ne/^{22}Ne$ ratio is 12.0± 0.5; for the four most reliable cases it is 11.1 ± 0.5. Both values fall well below13.7, attributed to solar wind neon [3] but near 11.3±0.3 attributed to solar energetic particles [4].

(4) With the exception of particle No. 12, where a $^4He/^{20}Ne$ ratio of 83 was found, all of the remaining ratios were much lower, the overall average for the 14 cases where ratios could be calculated being 24 ±6. This is appreciably less than: 850 given for the solar system [5], 600 for the solar wind [3], and 200 for deep Pacific magnetic fines [6]. It falls in the same range as observed for lunar regolith fines [7].

(5). If the particles are assumed spherical with a mass density of I g/cm^3, the average ^4He density computed is 5 E-2 ccSTP/g, comparable to that for lunar fines. The $^3He/^4He$, $^{20}Ne/^{22}Ne$, and $^4He/^{20}Ne$ ratios are all lower than 4 E-4, 13.7, and 600, respectively, found for the solar wind [3]. The observed ratios are qualitatively consistent with the postulate that the helium and neon observed could be due to embedded solar wind, the bulk of which has been lost through diffusion, resulting in fractionation. This explanation, however, is inconsistent with the fact that the gas concentrations are relatively high, and that the particles are sufficiently large that embedded solar wind would be present only in the outer surface of the particles. It seems likely that a substantial proportion of the gas observed is "trapped" , or primordial in nature. The results show interesting variations, not readily explained; additional studies appear justified.

REFERENCES: [1] Nier, A. O. and D. J. Schlutter, 1989, LPSC XX, 790-791. [2] Nier, A. O. and D. J. Schlutter, 1985, Rev. Sci, Instr. **56**. 214-219. [3] Geiss, J., F. Buhler, H. Cerrutti, P. Everhardt, and Ch. Filleux, 1972, Apollo 16 Prelim. Sci. Rep., NASA SP-315, 14.1. [4] Wieler, R., H. Baur. and P. Signer, 1986, GCA **50**, 1997 - 2017. [5] Anders, E. and N. Grevesse, 1989, GCA **53**, 197-214. [6] Nier, A. O., D. J. Schlutter, and D. E. Brownlee, 1990, GCA **54**, in press. [7] Heymann, D., 1977 , Phys. Chem. Earth **X**, 45-55.