NOBLE GASES IN DARWIN GLASS; ANOMALOUS NEON ENRICHMENT

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Darwin glass is one of natural glasses from Tasmania, Australia, and is considered as being produced by melting of the country rocks during the the meteorite collision. Chemical compositions (1) and REE patterns (2) of Darwin glass indicated that the parent material of the glass might be an argillaceous sandstone, and are consistent with a terrestrial origin. The age of Darwin glass was reported to be 0.73 m.y. by the K-Ar and the fission track methods (3).

We have determined noble gas concentrations in chipped samples and 60-100 mesh fraction by size separation of Darwin glass (Table 1). The data of DG#2 shows that the lighter noble gases released the larger amounts in the low temperature fraction. The noble gases in DG#3 (60-100 mesh fraction) are lower than half of those in the chipped samples of DG#2 and DG#1. It approximately corresponds to the fact that the large amounts of noble gases in the high temperature fraction in DG#2 were not observed in DG#3 except for He. All Ne were degassed almost completely below 800°C in DG#3. Taylor and Solomon (1) reported that numerous bubble pits are present in Darwin glass. It is conceivable that the gas in these bubbles escaped by crushing. The decrease of noble gases in the high temperature fractions in DG#3 might be fortuitous, and the difference in degassing patterns may be due to the grain sizes in these samples.

A fractionation factor F(m) defined by $F(m)=(^{m}X/^{36}Ar)_{sample}/(^{m}X/^{36}Ar)_{air}$ is used for examining the fractionation effect of noble gases (Fig. 1). F(84) and F(132) of DG#2 are similar to 1, whereas F(20) is as high as 64, suggesting that Ne/Ar ratio in Darwin glass is much higher than that in air. The sample DG#3 also shows F(20) as high as 78. Such high fractionation factors of Ne have been observed in similar natural silica-rich glasses. Hennecke et al. (4) reported noble gas data in Thailand tektites of which F(20) was as high as 1800. Recently, Bogard et al. (5) measured Lonar tektites from India, of which F(20) was about 10. Thus, the high Ne/Ar ratio seems to be common feature in tektites and the impact glass. The data in Table 1 imply that the gas escaped by crushing also has high Ne/Ar ratio similar to those in DG#2 and DG#3, suggesting that the bubble gas has high Ne/Ar ratio. Jessberger and Gentner (6) analyzed gas inclusions in Libyan Desert impact glass and Muong Nong type tektite, and revealed that N_2, Ar, Kr and Xe and their isotopes occurred in the similar proportions of air. They did not measure the abundances of light noble gases. O'Keefe et al. (7) showed that the main gases in the bubble of tektite were Ne, He and O_2, and indicated that Ne and He have probably diffused in from the atmosphere. The high Ne/Ar ratio in Darwin Glass might be also accounted for by diffusion of Ne from the atmosphere.

References (1) S. R. Taylor and M. Solomon (1964) Geochim. Cosmochim. Acta 28, 471-494. (2) C. Koeberl, F. Kluger and W.Kiesl

(1985) Chem. Erde 44,107-121. (3) W. Gentner, T. Kirsten, D. Storzer and G. A. Wagner (1973) Earth Planet. Sci. Lett. 20, 204-210. (4) E. W. Hennecke, O. K. Manuel and D. D. Sabu (1975) J. Geophys. Res. 80, 2931-2934. (5) D. D. Bogard, F. Horz and P. H. Johnson (1986) Proc. Lunar Planet. Sci. Conf. 17th; J. Geophys. Res. 91, E99-E114. (6) Jessberger and Gentner (1972) Earth Planet. Sci. Lett. 14, 221-225. (7) J. A. O'Keefe, P. D. Lowman Jr. and K. L. Dunning (1962) Science 137, 228.

Table 1 Noble gases in Darwin glass

Sample	Weight (mg)	Temp. (°C)	^{4}He	^{20}Ne	^{36}Ar	^{84}Kr	^{132}Xe
			$\times 10^{-10} cm^3 STP/g$			$\times 10^{-12} cm^3 STP/g$	
DG#1 (chip)	104.6	1600	(261)	2970	(80.5)	(124)	<37.7
DG#2 (chip)	910.8	800	175	1220	2.97	(4.90)	(0.349)
		1600	(19.0)	1640	85.1	161	(4.60)
		Total	195	2930	88.1	166	(4.94)
DG#3 (60-100 mesh)	374.9	800	(26.4)	1260	(5.52)	<10.0	<1.86
		1000	<44.6	0.653	(12.6)	<6.37	<2.48
		1200	<36.2	<0.534	(7.13)	<8.89	<1.24
		1400	<37.5	<1.36	(3.01)	<11.4	<1.24
		1600	<37.5	<1.78	(2.66)	<18.4	<2.48
		Total	(33.3)	1260	(30.8)	<55.1	<9.30

The numerical value of data is in parentheses when blank correction was 10-70%. If blank correction is larger than 70%, upper limit was listed without blank correction.

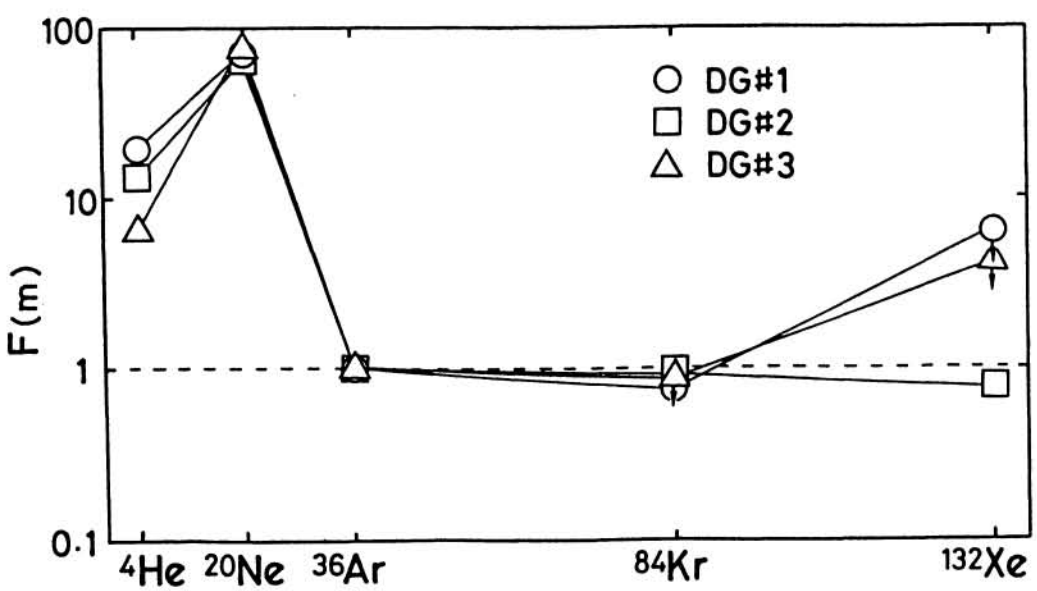

Fig. 1