Helium isotopes of seawater in adjacent sea of Japan

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Helium isotope data have been used to study the circulation of various water masses using the mantle derived helium [1] and to estimate the ventilation age of surface seawater based on the T-^{3}He system [2]. In order to clarify the origin of helium in the Japan Sea, we have collected 55 seawater samples at seven stations of Off Niigata, Yamato Basin, and Japan Basin with various depths (300m ~ 3500m) on the KT05-11 cruise of the Research Vessel, Tansei. Observed data are compared with those of Pacific waters from adjacent seas of Honshu [3] and the Nansei Islands [4].

The ^{3}He/^{4}He ratios were measured on a conventional noble gas mass spectrometer after extraction, purification and separation using Ti getters and cryogenic charcoal traps. The observed ^{3}He/^{4}He ratios were calibrated against atmospheric helium. The ^{4}He/^{20}Ne ratios were measured by on-line quadrupole mass spectrometer before cryogenic separation.

The ^{3}He/^{4}He and ^{4}He/^{20}Ne ratios vary from 0.997 R_{atm} to 1.085 R_{atm} and from 0.246 to 0.277, respectively. The maximum excess ^{3}He of 8.5 % is observed at mid-depth (1000 m) of the Japan Sea, which is consistent with those reported by other group [5]. The excess is signficantly smaller than those observed in deep Pacific waters (2500 m) of 17% at Off Joban, and 21% at Nankai Trough, and those in deep Northwestern Philippine Sea (2000 m) of 23~24%.

Since the Japan Sea is an almost landlocked marginal sea, the water exchange between the Japan Sea and its surrounding seas (Pacific Ocean, Philippine Sea, East China Sea and Okhotsk Sea) is restricted by shallow sill depths (<150 m). Therefore mantle-derived helium of deep Pacific water can not enter the Japan Sea. Observed 8.5 % excess ^{3}He may be attributable to the decay product of natural as well as anthoropogeic tritium and the ventilation age shallow seawater (~700 m) is calculated based on the excess ^{3}He and tritium concentration.

References

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