Distribution of helium-3 plumes and deep-sea circulation in the central Pacific Ocean

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Introduction

Helium isotope data have been used to study the circulation of various water masses using the mantle derived helium [1]. In order to clarify the origin of helium and deep-sea circulation in the central Pacific basin, we have collected about 200 seawater samples at 20 stations along about 170˚W from 45˚N to 70˚S at various depths (200m ~ 5500m) on the KH-03-1 and KH-04-5 cruises of the Research Vessel, Hakuho Maru. Observed $^3He/^4He$ data are compared with those in the eastern Pacific [1] and over the East Pacific Rise at 25˚S [2].

Analysis

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

Results and Discussion

Homogeneous excess ^3He of ~10% is observed below 1000-m depth over the Antarctic Ridge in the Southern Ocean. The excess is signficantly smaller than those observed over the East Pacific Rise at 25˚S of ~50% [2]. This may be due to the lower supply of mantle helium from the ridge and dilution by well-mixing of deep seawater by fast current around the Antarctica.

In meridional helium transect along 170˚W line in the South Pacific, circulation pattern inferred from salinity and dissolved oxygen distributions is confirmed by $^3He/^4He$ ratio. Moreover a pattern of two helium-3 maxima at 10˚N and 15˚S with a minimum on the equator at 2500-m depth is observed, which is similar to those observed along WOCE P16 (152˚W) and P17 (135˚W) sections [1]. Observed pair of helium plumes may be originated from the EPR based on the lateral distribution of excess ^3He at 2500-m depth, which suggests westward flows at 10˚N and 15˚S in the central Pacific Ocean.

References

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Tungsten isotopic compositions of South Polynesia Islands and Ontong Java Plateau

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The evidences of the core-mantle interaction may be detected by investigating the chemistry of Oceanic Island Basalt or Large Igneous Provinces. To date ongoing geochemistry researches, using Os and W isotopes, PGEs and Fe/Mn, have been carried out to investigate if volcanic rocks with deep origin experienced core-mantle interaction. We analyzed W isotope ratios of the OIBs of four islands, Rarotonga, Mangaia, Rurutu and Tubuai, South Polynesia and Ontong Java Plateau of ODP samples, using MC-ICP-MS. The W separation method of Sahoo *et al*. (2006) was modified. The reproducibility of W isotope ratio measurements in this research has been estimated as $0.4\varepsilon_W$. Considering the analytical precision and assuming that the W abundance in the mantle of 19 ppb following “the forced model” of Scherstén *et al*. (2004), if there is 1% or more of contribution of core material, core-mantle interaction is detectable in this study. Pb isotope ratios of the samples analyzed in this study were inconsistent with previous results. Rarotonga island has EM1 character, while Tubuai, Mangaia and Rurutu islands have HIMU character. W negative isotope anomaly has been observed in neither EM1 nor HIMU OIBs. These results suggest three possibilities about mantle convection and core-mantle interaction. 1) These sources of HIMU and EM1 OIBs analyzed, do not originate from CMB. 2) Negative W isotope ratio anomaly of the core has been later diluted with the entrainment of mantle material with normal W isotope composition. 3) W does not diffuse from outer core into mantle as has been pointed out by Humayun *et al*. (2004).

References

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