

BIOGEOCHEMICAL STUDIES OF SELENIUM IN THE INDIAN OCEAN

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Selenium that is a one of trace essential elements exists mainly in the chemical form of Se(IV), Se(VI) and organic selenium in ocean. Moreover, the monitoring of the selenium species has become a matter of interest as a mean of estimating their influence in biological processes in ocean. In recent works, some investigators reported that Se(IV) shows nutrient-type especially like silica's behavior[1][2], Se(VI) shows an approximately constant value, and the biological activities control the distribution of organic selenium. However, these reports were not included the whole world's oceans. It is necessary to research several oceans for the explication of fate on selenium. We investigated at the most interesting area - the Eastern Indian Ocean where should play a key role in global ocean's cycle - for acquiring the new knowledge of selenium species at first.

High Performance Liquid Chromatography (HPLC) with fluorescence detection was used for determination of selenium in the samples. Se(IV) was fluorometric determined after extracting the complex of 2,3-diaminonaphthalene (DAN) into cyclohexane[3]. Se(VI) was first reduced to Se(VI) by adding KBr in 1.2 M hydrochloric acid solution, then the total inorganic selenium was determined by the same technique. The amount of Se(VI) was estimated by subtracting the amount of Se(IV) from the sum of Se(IV) and Se(VI). Organic selenium was determined as follows: the amount of total selenium was decomposed to inorganic ones with nitric acid and perchloric acid, and to Se(IV) by HCl and H₂O₂ was determined by the same technique. The amount of organic selenium was estimated by subtracting the amount of total inorganic selenium from the total amount of selenium.

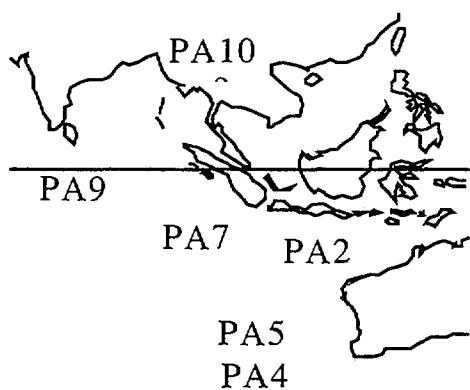
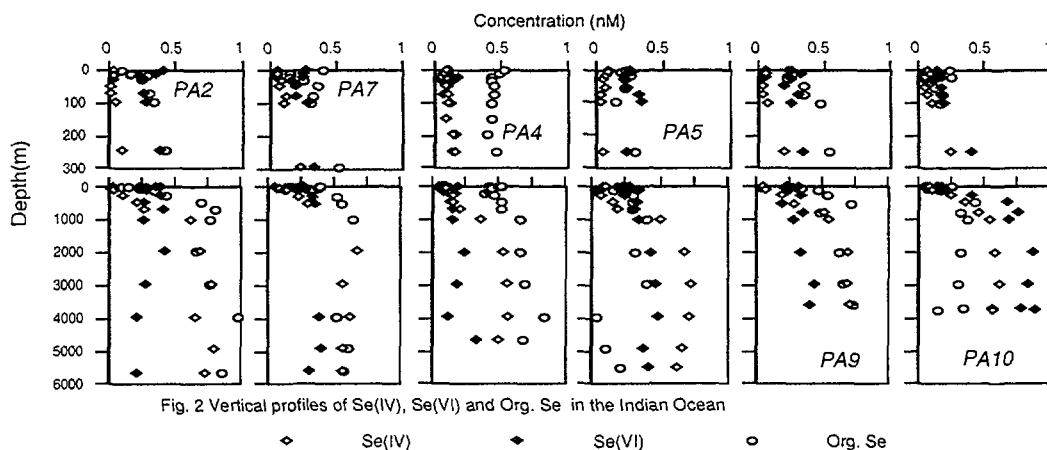


FIG.1 Sampling location

The seawater samples were collected from aboard the R/V "Hakuhou-Maru" (University of Tokyo) KH96-5 cruise at the stations PA2 (12°50'S, 117°E), PA4 (40°S, 110°E), PA5 (30°S, 110°E), PA7 (10°S, 102°E), PA9 (8°N, 89°E) and PA10 (9°52'N, 94°03'E). Our samples were collected with CTD-Carousel Multi Sampling (with 36 12-liters bottles) system. The samples were filtered through 0.45µm Membrane filters with vacuum filtration system immediately after the collection, follow by storage in a freezer (-20°C) Se(VI) and organic selenium. Se(IV) shows nutrient-type profiles of each station, and appears to have good relation-

ships with nutrients (see Table 1). Interestingly, correlation coefficient value (r) of Se(IV) and silicate is highest of the others. This may indicate that Se(IV) and silicate have same regenerating process in ocean. The concentrations of Se(VI) are approximately constant from surface to bottom (PA2, 4, 5, 7 and 9), while the profile of PA10 shows peculiar trend that the concentration is gradually increase: the averages of 0~300m and 300m~bottom are 0.168 ± 0.010 nM and 0.786 ± 0.035 nM. The factors that are significant influence on this profile may give the following: the oxidation reaction from Se(IV) to Se(VI) or the elution of Se(VI) from bottom sediments and particulate matter from around continent.



The profiles of organic selenium show two different trends. The one side, the concentrations increase slowly from surface to bottom (PA2, 7, 9 and 10). The other side, the concentrations are nearly constant of its water column (PA4 and 5). Furthermore, it appears that the correlation between the former and dissolved organic carbon is better than the latter (see Table II). This correlation indicates that each organic species in the tropics and frigid area are different substances.

TABLE I. RELATIONSHIPS OF Se(IV) (nM) VERSUS SILCATE, PHOSPHATE AND NITRATE+NITRITE(μ M) IN THE INDIAN OCEAN

Zone	correlation coefficient(r)		
	SiO ₂	PO ₄	NO ₂ +NO ₃
surface to bottom (n=90)	0.969	0.862	0.883
aphotic zone (n=47)	0.927	0.568	0.665

TABLE II. RELATIONSHIPS OF ORG. SE(nM) VERSUS DOC(μ M) IN THE INDIAN OCEAN

Station	correlation coefficient(r)
PA2	0.969
PA7	0.866
PA4	0.395
PA5	0.105
PA9	0.933
PA10	0.585

References

- [1] CUTTER, G. A. and L. S. CUTTER, Mar. Chem., **49**, (1995) 295-306
- [2] MEASURES, C. I., R. E. McDUFF and J. M. EDMOND, Earth Planet. Sci. Lett., **49**, (1980) 102-108
- [3] NAKAGUCHI, Y., et al., Anal. Sci., **1**, (1985) 247-252