Short Communication

Determination of Tellurium in Sea Water

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Abstract

The content of tellurium in sea water is not yet known because of its low concentration and the lack of an appropriate means for separation and determination up to now. By using a new method of XAD-Bismuthiol-II system to separate and determine a minute amount of tellurium ion in sea water, the content Te(IV) in surface water in the open sea was determined as ranging from 0.3 to 0.9 ng l⁻¹.

Introduction

The content of tellurium in sea water is not yet known because of its low concentration, the lack of an appropriate means to separate it from a large volume of sea water and also the lack of a sensitive method for determination. It is of interest to know the content and behavior of tellurium in marine environment.

Recently, a new method was developed in our laboratory to separate and determine a trace amount of metallic elements in sea water by combining the use of chelating agent and macroreticular resin (Amberlite XAD-2) (Sugimura et al., 1976, 1977, 1978a, b, 1980).

In this short paper, the authors intend to report a new method of XAD-Bismuthiol-II system for determining a minute amount of tellurium in sea water and some of the preliminary results on the content of Te(IV) in surface water in the open sea.

Method:

Bismuthiol-II (3-phenyl-5 mercapto-1, 3, 4-thiodiazole-2-thione potassium salt) is one of

the few selective reagents for Te(IV) determination. Te(IV) ion can be separated from a large volume of sea water by adsorption of Te(IV) ion on Bismuthiol-II coated XAD-2 resin.

Reagents: Unless otherwise stated, all reagents were of analytical reagent grade. Macroreticular resin beads (Amberlite XAD-2, Rohm and Haas Co., USA) were washed with methyl alcohol and distilled water before use.

Preparation of Bismuthiol coated beads: 50 g of wet beads are packed into a glass column of 25 mm dia. and 20 cm long, and 20 ml of 1% solution of Bismuthiol-II was passed through the column at a flow rate of 5 ml per minute. The resin was washed with a dilute solution of HCl at pH 1 before use.

Analytical Procedure:

Immediately after the sampling of sea water (500 l), its acidity was adjusted to pH 1 by adding conc. HCl. After a further addition to it of 20 ml of 10% EDTA solution, it was passed through the adsorption column at a flow rate of 50 ml per minute.

After washing the resin with dilute HCl solution (pH 1), elution of tellurium complexes was done by using 200 ml of a mixed solution of NH_4OH and methyl alcohol (1:1), 100 ml of 5 M HNO_3 and 50 ml of conc. HClO_4 . The effluent was dried up and the residue was dissolved in 2 M HCl.

To eliminate the influence by the presence of selenium and arsenics on the spectrophotometric determination of tellurium, purification was done by successive uses of chelating resin and cation exchange resin. The effluent was subjected to the analysis of Te(IV).

Determination of a minute amount of tellurium was done by spectrophotometric

method by measuring the absorption of light at wavelength 395 nm due to Bismuthiol-Te(IV) complex (Yoshida and Hikime, 1956, Cheng, 1961).

Results:

The preliminary results on the content of Te(IV) in surface water in the western North Pacific is shown in Table 1. In order to secure the reliability in the spectrophotometric method, the colored complex used for the spectrophotometry was decomposed and its tellurium content was determined by catalytic reduction method (Kuroda et al.,

Table 1. Content of tellurium (IV) in the open ocean water.

N	Location E	Salinity ‰	temp. °C	Tellurium (IV) ng l^{-1}
26°24'	151°18'	34.92	26.0	0.6
23°40'	129°22'	34.83	23.0	0.3
05°50'	134°15'	34.14	29.1	0.9

Table 2. A comparison of the result of this method with that of the catalytic reduction method.

Sample No.	This method ng l^{-1}	Catalytic reduction method ng l^{-1}
1	0.6	0.54
2	0.3	0.25
3	0.9	0.82
4A	1.0	0.95
4B	0.9	1.02
4C	1.0	0.98

No. 1 to 3 correspond to the sample of Table 1., and No. 4A-C are prepared for the comparison and reproducibility of the analytical result of a known amount of tellurium (IV).

Table 3. Recovery of this method from 200 liter of sea water.

No.	Te(IV) added ng l^{-1}	Te(IV) found ng l^{-1}	Recovery %
1	0.0	0.6	
2	1.0	1.2	60
3	2.0	1.7	55
4	5.0	3.7	62
5	10.0	6.4	58
average			61 ± 3

1975). The values obtained by both spectrophotometric and catalytic reduction methods were in good agreement in each other as shown in Table 2.

As shown in Table 3, overall recovery of Te(IV) through the procedure which is examined by the addition of a known amount of Te(IV) ion to the sea water sample is given as $61 \pm 3\%$.

The XAD-2 resin coated with Bismuthiol-II is highly selective and a rather stable recovery of tellurium from a saline water sample can be achieved. This method is useful in collecting and determining a minute amount of tellurium from a large volume of sea water.

Further study is required to clarify the content and behavior of tellurium in marine environment.

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海水中のテルル含量

杉村行勇・鈴木 款

海水中のテルル含量の報告値は、現在までえられていない。ビスムチオールⅡがテルル (IV) に対する選択的な有機試薬であることを利用し、ビスムチオールⅡとテルル (IV) 錯体を XAD-2 樹脂上に捕集する方法を用い、5001 の海水からテルルを分離定量した。その結果、北太平洋西部表面水 3 例について、 $0.3 \sim 0.9 \text{ ng l}^{-1}$ であることがわかった。