RiO5 METHOD (7)

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^{134}Cs, ^{137}Cs – Gamma – Seawater

Radiometric determination of ^{134}Cs/^{137}Cs in seawater samples

Disclaimer

It is the responsibility of the analyst to follow established safety and health practices. Although each laboratory identified as the source has tested the methods, each user should perform an individual validation procedure.

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1 SCOPE

In this paper, improved radiometric methods of 134Cs/137Cs in seawater (5 -100 litter) are presented.

2 EQUIPMENT and CHEMICAL REAGENTS

2.1 Equipment and consumables

- Water storage vessel for sample size (5-100 liters)
- Water filtration set up
- 5B filters
- 4ml Teflon tube for counting

2.2 Tracers

- No radioactive tracers used in this method.

2.3 Chemical reagents

- All reagents used for $^{134}Cs/^{137}Cs$ assay are special (G.R.) grade for analytical use. All experiments and sample treatments are carried out at ambient temperature except stated. It is very important to know background γ activity of reagents. The ^{137}Cs activity in CsCl was less than 0.03 mBq g^{-1} by using extremely low background γ–spectrometry. The ^{137}Cs activity in AMP was less than 0.00_8 mBq g^{-1}. There is no serious contamination of ^{137}Cs from other reagents.
- conc.HNO_3
- CsCl
- the ammonium phosphomolybdate (AMP) (low solubility, homemade)
- NaOH

2.4 Solutions

- chloroplatinic acid (1g/5ml D.W)

3 PROCEDURE

Proposed improved AMP procedure with the ground-level γ-spectrometer is as follows:

1) Measure the seawater volume (5-100 liters) and put into a tank with appropriate size.
2) pH should be adjusted to be 1.6-2.0 by adding concentrated HNO_3 (addition of 40 ml conc.HNO_3 for 20 litre seawater sample makes pH of sample seawater about 1.6).
3) Add CsCl of 0.26g and stir at a rate of 25 litre per minute or alternative method for one hour.
4) Weigh AMP of 4g and pour it into a tank to disperse the AMP with seawater.
5) 1 hour stirring at the rate of 25 litre air per minute or alternative method.

6) Settle until the supernate becomes clear. A settling time is usually 6 hours to overnight, but no longer than 24 hours.
7) Take an aliquot of 50 ml supernate to calculate the amount of the residual caesium in the supernate.
8) Loosen the AMP/Cs compound from the bottom of the tank and transfer into a 1-2 litre of beaker, if it is necessary do additional step of decantation.
9) Collect the AMP/Cs compound onto 5B filter by filtration and wash the compound with 1M HNO_3
10) Dry up the AMP/Cs compound for several days in room temperature
11) Weigh the AMP/Cs compound and determine weight yield
12) Transfer the AMP/Cs compound into a Teflon tube of 4ml volume and subject to γ-ray spectrometry

For Underground γ-spectrometry

13) the same procedure from step 1) to step 12)
14) Dissolve AMP/Cs compound by adding alkali solution, NaOH
15) Adjust the volume of solution ca. 70 ml and boiling to form Mo_2O_3 precipitate for 30 min.
16) pH should be adjusted to be ca. 8.1 by adding 2M HCl and adjust the volume of solution ca. 40 ml. Then keep room temperature 30 min. This solution should be kept one night in the refrigerator.
17) Remove formed Mo_2O_3 precipitate by filtration using 5C
18) Perform precipitation of $Cs_2Pt(Cl)_4$ to add chloroplatinic acid (1g/5ml D.W) at pH = 8.1 and keep in refrigerator during a half-day.
19) Collect the $Cs_2Pt(Cl)_4$ precipitate onto filter by filtration and wash the compound with solution (pH = 8.1)
20) Dry up the $Cs_2Pt(Cl)_4$ precipitate for several days in room temperature
21) Weigh the $Cs_2Pt(Cl)_4$ precipitate and determine weight yield
22) Transfer the $Cs_2Pt(Cl)_4$ precipitate into a Teflon tube of 4ml volume and subject to underground γ-spectrometry

4 REFERENCES

Aoyama, M., Hirose, K., Miyao, T. & Igarashi, Y. (2000). Low level ^{137}Cs measurements in deep seawater samples. *Appl. Radiat. Isot.*, 53, 159-162.

Aoyama, M., Hirose, K., (2008) Radiometric determination of anthropogenic radionuclides in seawater, in: Pavel, P.P. (Ed.), Radioactivity in the Environment. Elsevier, pp. 137-162. doi:10.1016/S1569-4860(07)11004-4

5 IMAGES (following pages)

Figure 1 Formed AMP/Cs compound at step 3

Figure 2 Formed AMP/Cs compound at step 4

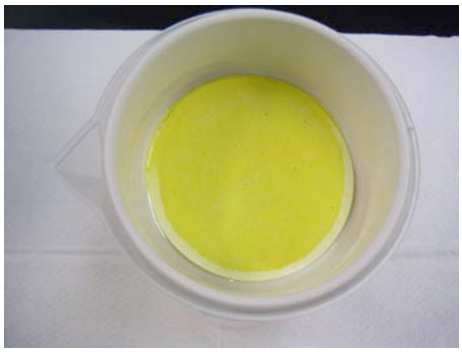

Figure 3 Formed AMP/Cs compound at step 10

Figure 4 Dissolve AMP/Cs compound by adding alkali solution at step 14

Figure 5 Formed Mo_2O_3 precipitate at step 16

Figure 6 The $Cs_2Pt(Cl)_4$ precipitate at step 18

Figure 6 Dry upped $Cs_2Pt(Cl)_4$ precipitate at step 20