

RiO5 METHOD (29)

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U-series nuclides and ^{137}Cs —gamma-spectrometry—Sediment sample

Sediment sample preparation for U-series nuclides and ^{137}Cs

Disclaimer

It is the responsibility of each analyst to follow established practices when handling and examining the samples referenced in this Rio5 Cookbook. Although the methods may have been tested by each laboratory identified as the source, each user must perform a validation procedure to ensure the validity of their results. Woods Hole Oceanographic Institution, its officers, directors and employees are not responsible for any of the data or the results that may be achieved from using the information in the Rio5 Cookbook and disclaim all liability for the same.

Table of Contents

| | | |
|------------|---------------------------------------|----------|
| 1 | SCOPE | 1 |
| 2 | EQUIPMENT CHEMICAL REAGENTS | 1 |
| 2.1 | EQUIPMENT | 1 |
| 2.2 | TRACERS | 1 |
| 2.3 | CHEMICAL REAGENTS | 1 |
| 3 | PROCEDURE | 1 |
| | PREPARATION OF SEDIMENT SAMPLE | 1 |
| | MEASUREMENT OF NUCLIDES | 2 |
| 4 | REFERENCES | 2 |
| 5 | FLOW CHART | 3 |

1 SCOPE

This method specifies the minimum requirements and laboratory methods for simultaneously measuring multiple U-series nuclides, including ^{238}U , ^{210}Pb , ^{228}Th , ^{228}Ra , ^{226}Ra , ^{40}K , and ^{137}Cs .

Samples are collected using grab sampler or gravity sampler, sealed on board and finally kept at -18°C . Post processing will take place in the land laboratory by freeze-dry and measuring using gamma-spectrometry. Isotope decay corrections are applied to some specific radionuclides (such as ^{210}Pb , ^{228}Th , ^{228}Ra , and ^{137}Cs) if the time gaps between sampling and measurement introduce discernible variations in activities.

2 EQUIPMENT CHEMICAL REAGENTS

2.1 Equipment

- Sediment sampler
- Gamma-spectrometry
- Analytical balance with an accuracy of ± 0.1 mg
- Counting vial

2.2 Tracers

- Standard materials for counting efficiency calibration

2.3 Chemical reagents

- Free of chemical reagent treatment

3 PROCEDURE

Preparation of sediment sample

Putting dried sediment powder into a gamma counting box or vial, which has well-determined geometrical conditions, accurately determining the geometrical conditions of sample.

Measurement of nuclides

[1] The gamma-ray energies for counting those nuclides are listed in Table 1.

Table 1 Gamma-ray energy for counting nuclides

| Radionuclides | Detected gamma-ray (keV) | Branch (%) |
|-------------------|-----------------------------|------------|
| ²³⁸ U | 63.2 | 3.826 |
| | 92.6 | 5.41 |
| ²¹⁰ Pb | 46.5 | 4.0 |
| ²²⁸ Th | 238.6 (²¹² Pb) | 43.6 |
| | 583.1 (²⁰⁸ Tl) | 30.96 |
| ²²⁸ Ra | 338.7 (²²⁸ Ac) | 11.9 |
| | 911.2 (²²⁸ Ac) | 27 |
| | 968.8 (²²⁸ Ac) | 16.3 |
| ²²⁶ Ra | 351.9 (²¹⁴ Pb) | 37.09 |
| | 609.3 (²¹⁴ Bi) | 46.1 |
| | 1120.3 (²¹⁴ Bi) | 15.0 |
| ⁴⁰ K | 1460.5 | |
| ¹³⁷ Cs | 661.6 | 85 |

[2] The counting efficiencies of detector for those nuclides are well quantified using the standard materials with the same geometric conditions to the prepared sediment samples.

[3] Putting the well-prepared sample on the gamma-detector and counting the activity of nuclides.

4 REFERENCES

Liu G., Huang Y. (1998), Simultaneous measurement of ²³⁸U, ²³⁵U, ²¹⁰Pb, ²²⁸Th, ²²⁸Ra, ²²⁶Ra, ⁴⁰K, ⁶⁰Co and ¹³⁷Cs in sediment samples using HPGe γ spectrometer. *Journal of Oceanography in Taiwan Strait*, 17, 359-363. (in Chinese)

5 FLOW CHART

