

Analytical Procedure for $^{234}\text{Th}/^{238}\text{U}$ in 4-L of seawater

Pinghe Cai, Xiamen University (XMU), caiph@xmu.edu.cna

Michiel Rutgers van der Loeff, AWI Bremerhaven, mloeff@awi.de

Principle of analysis

Sampling, analysis, calibration and data reduction followed Cai et al. (2006) and Pike et al. (2005). For the analysis of total ^{234}Th , the samples were coprecipitated with MnO_2 ppt.

Sample preparation:

collect 4.0 L of seawater

Procedure total ^{234}Th

For the analysis of total ^{234}Th , the samples were acidified to a pH of < 2.0 , spiked with a known amount of ^{230}Th . After 12-24 hours, the pH was then brought up to 8.15-8.30, thorium was coprecipitated on MnO_2 by adding 0.25 ml KMnO_4 (3.0 g/L) and 0.25 ml of MnCl_2 (8.0 g $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}/\text{L}$). The samples were heated in a water bath at $> 90^\circ\text{C}$ for 3 hours, cooled down to room temperature, the MnO_2 ppt was then filtered onto a 25 mm 1.0 mm QMA filter. The QMA filter with MnO_2 ppt was dried overnight in an oven, mounted under a layer of Mylar film and a layer of Al foil (8.00 mg/cm^2), and counted on a RISO beta counter onboard. After 6 months, the background of the MnO_2 ppt was counted on a RISO counter.

Procedure Thorium recovery

The QMA filter with MnO_2 ppt was dismantled, and a known amount of ^{229}Th was added as a second spike. The MnO_2 ppt was dissolved in 8 M $\text{HNO}_3 + \text{H}_2\text{O}_2$ solution and sonicated for 20 minutes. Thorium isotopes were isolated and purified using classic column exchange chemistry. The $^{230}\text{Th}/^{229}\text{Th}$ ratio was measured on an ICP-MS. For samples flagged with * “no spike recovery was determined; the average recovery of 0.957 ± 0.022 was applied.”

Procedure calculation parent ^{238}U

^{238}U (dpm/L) = $0.0713 \times \text{Salinity}$, the associated error is about 3% (Pates and Muir, 2007)

Standards

Total ^{234}Th : calibration with aged deep waters assumed to be in radioactive equilibrium with ^{238}U .

Figures of merit

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|----------------------|-----------------------------------|
| Reporting units: | desintegrations per litre (dpm/L) |
| errors: | 1-sigma propagated errors |
| estimated precision: | 3% at 2.50 dpm/L |
| overall accuracy: | 0.10 dpm/L |

References

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