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Determination of Th-230 and Th-228 in Small-Volume Seawater by Accelerator Mass Spectrometry for Marine Carbon Sink Accounting

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Thorium isotopes Th-234, Th-230 and Th-228 are important tracers for estimating carbon fluxes in the ocean via the biological pump. However, conventional radiological methods for Th-230 and Th-228 in seawater require large-volume samples (100-1000 L), limiting the large-scale application of Th isotopes in carbon sink accounting. This study aims to develop an accelerator mass spectrometry (AMS) method for simultaneous determination of dissolved and particulate Th-230 and Th-228 in small-volume (10 L) seawater samples.

The proposed analytical procedure includes: 1) Establishing an efficient preconcentration and purification protocol for Th in 10 L seawater with >80% recovery; 2) Developing an AMS method for Th-230 and Th-228 to achieve >0.2% total detection efficiency; 3) Minimizing procedural blanks to enable quantification of Th-230 and Th-228 in 10 L seawater.

To validate the developed method, seawater profile samples will be collected from one station in the South China Sea. Dissolved and particulate Th-234, Th-230 and Th-228 in these samples will be analyzed using the small-volume procedure and compared with conventional large-volume analyses. Particulate organic carbon (POC) export fluxes at different depths will also be estimated using a particle dynamics model, and if possible, compared with sediment trap results.

The small-volume AMS method is expected to greatly reduce sampling time and cost while increasing observation density. This technical advancement will provide the international oceanographic community with an effective tool for quantifying and monitoring deep-sea carbon fluxes across vast ocean basins. Improved spatial and temporal coverage of POC export flux data will enhance our understanding of the global ocean carbon cycle and its response to climate change. Furthermore, this research will contribute to the global effort in assessing the potential of marine carbon sequestration as a nature-based solution for mitigating climate change.

Student Submission

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