

Tracing riverine $^{234}\text{U}/^{238}\text{U}$ inputs into the Arctic Ocean

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The Arctic Ocean is derived from a mixture of saline Pacific and Atlantic seawater, together with fresh riverine and ice-melt waters. Changes in flow patterns and an increase in the fresh water contribution to the Arctic Ocean are believed to have major global climatic implications. Open oceans are considered to be uniform with respect to $^{234}\text{U}/^{238}\text{U}$ activity ratios, whereas rivers generally have elevated $^{234}\text{U}/^{238}\text{U}$. This implies that $^{234}\text{U}/^{238}\text{U}$ can be used to trace water masses. Detailed studies within an estuary can identify where U gains and losses have occurred in the water column. High-precision U analyses can potentially characterize a river component in high salinity waters beyond the estuarine zone and determine the net flux of U into the ocean basin.

This study uses highly precise $^{234}\text{U}/^{238}\text{U}$ measurements to characterize river and seawater samples from the Arctic Ocean. Using new developments in MC-ICPMS, we are able to measure $^{234}\text{U}/^{238}\text{U}$ with a precision of better than $\pm 0.3\%$ (2σ) [1]. This represents a vast improvement in performance compared with earlier measurement protocols.

Surface seawater samples from the Makarov Basin and Canadian Basin show elevated $^{234}\text{U}/^{238}\text{U}$ compared with open ocean seawater (~ 12 and $\sim 4\%$, respectively). Samples from the Canadian basin have a significant freshwater component and provide evidence that the Mackenzie River loses $\sim 65\%$ of its U in the shelf/estuary zone before entering the deeper basin. This is in contrast to the Makarov Basin, where the data are consistent with a fresh water input from the major Yenisey River, without addition from the Lena and Ob rivers. The data furthermore suggest that the input from Yenisey River is associated with 100% transport of its riverine U to the ocean basin. This observation offers a more detailed picture of fresh water flow patterns in the Arctic Ocean. The data also suggest a differing behaviour of U in environmentally similar estuaries, which has important implications for the total marine U budget.

[1] Andersen M.B., Stirling C.H., Potter E.K., Halliday A.N. (2004) *IJMS* **237**, 107-118