

Lanthanides as tracers of sediment export from the Mackenzie River to coastal and abyssal Arctic Ocean

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The lanthanides (La to Lu) are a group of trace elements whose similar properties and redox state (+3) are thought to confer them similar geochemical behavior. Their ratios are used as tracers of sediment sources since their relative proportion may respond more to their geogenic origins than to their reactivity.

The goal of this investigation was to assess the potential of lanthanide series elements to trace the Mackenzie River sediments exported to the Mackenzie Delta, Beaufort Sea Margin, and abyssal Canada Plain of the Arctic Ocean, given that the Mackenzie River delivers more sediments to the Arctic Ocean than all other Arctic Rivers combined[1].

We have determined the vertical distributions of all lanthanide elements in sediment cores from 21 sampling sites in the Mackenzie River and Delta, the North American Arctic Margin (NAAM), and the Canada Basin. These cores were subsampled as a function of depth down to about 30–40 cm below the sediment-water interface and the lanthanides were subsequently determined by ICP-QQQ-MS. The concentration, normalized with North American Shale Composite values, allowed for the determination of signatures for each site.

The profiles of the relative abundances of the lanthanides in Mackenzie River sediments exhibit a pattern where the light (La to Nd) and heavy (Ho to Lu) elements are significantly and systematically less abundant than the intermediate elements (Sm to Dy). Although this typical pattern tends to fade with distance from the river mouth, it is always observed in the sediments of the Mackenzie Delta, Beaufort Shelf and Slope, and Canada Basin, but not in the sediments of adjacent Arctic margin regions. When plotted as a function of depth in each core, signatures show an increase of the Mackenzie typical pattern in the recent years. This suggests environmental changes have enhanced the export of Mackenzie sediments to the Arctic Ocean. Our results imply that the lanthanide series are promising tools to document sediment transport and origin in the Arctic Ocean. More work is needed to assess the post-depositional