

## **Anthropogenic Impacts on the Distributions of Rare Earth Elements in Coastal Waters**

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During the past few decades, there has been an increased demand for Rare Earth Elements (REEs) due to their versatility, specificity and large applicability in technological developments. As a result, there has been an increase in anthropogenic inputs of REEs to the environment. As emerging contaminants, there is still relatively little knowledge on the distribution and the potential impacts of anthropogenic REEs in marine ecosystems. In this study, we assessed the effects of two submarine sewage outflows in the distributions of REEs in waters off the coast of Salvador, Northeast Brazil.

Samples were collected at the surface with a trace-metal clean pump system, whereas a teflon coated GO-FLO bottle was employed for depth sample collection. Seawater samples were pre-concentrated using the seaFAST-pico system. Dissolved REEs were determined using multi-element isotope dilution inductively coupled mass spectrometry (ID ICP-MS). Accuracy and precision were checked with replicates of GEOTRACES reference samples (SAFe - North Pacific and GSC - coastal Santa Barbara Basin).

The REE abundances normalized to Post-Archean Australian Shale (PAAS) show negative Ce anomalies and an enrichment of the heavy over the light REEs, characteristic of marine waters. Positive Gd anomalies were observed in most of the sampling sites, with the highest anomalies observed in the vicinity of the submarine sewage outflows. The submarine outflow closest to downtown Salvador, where most of the hospitals and clinics are found, presented the highest anthropogenic Gd anomalies, which decreased with increasing distance.

The results indicate that the application of Gd as contrast agents in magnetic resonance imaging (MRI) for medical diagnostics is the main source of anthropogenic Gd to coastal waters under the influence of submarine sewage outflows and that Gd can be used to trace the dispersion of sewage plumes in the marine environment.