

TRACE ELEMENTS IN THE OCEAN: CRITICAL IMPORTANCE AND HUMAN FOOTPRINT

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Trace elements play important roles in the ocean as regulators of processes, including marine ecosystem dynamics and carbon cycling. They can act as nutrients, contaminants, and tracers of present and past ocean processes and conditions. Their biogeochemical cycling has direct implications for research in such diverse areas as climate change, ocean ecosystems, and environmental contamination. Measuring these elements is a tremendous challenge due to their low concentration levels, high salinity of seawater and difficulties in sample collection in remote ocean locations. Recent advances in clean sampling and analytical procedures developed in the framework of the GEOTRACES international programme (www.geotraces.org) are providing us with the capability for measuring a wide range of trace metals in the ocean with an unprecedented precision and accuracy. The GEOTRACES mission is to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean and to establish the sensitivity of these distributions to changing environmental conditions. While the main fieldwork is still underway, GEOTRACES has published two open-source intermediate data products (IDP2014 and IDP2017), which together facilitate access to the data by the geochemical community.

The objective of this presentation is to discuss the critical importance of trace metal, and the various processes that control their distribution (e.g., input, removal, and circulation) and biogeochemical cycling. This understanding is a requirement if we are to predict future ocean changes due to natural and anthropogenic pressures. I will then describe how anthropogenic activities, such as the addition of Pb to gasoline, the smelting of metal ores, the burning of fossil fuels and development of new technologies have dramatically increased the fluxes of metals (e.g., Pb and Hg) to the oceans, changing their natural distribution patterns. Despite the low dissolved levels of some of these contaminants, bioaccumulation and magnification of Hg, for instance, can pose human and ecological health risks. Technology critical elements, such as rare earth elements (REE) and the platinum group elements, are required by an ever-expanding list of technologies. They represent examples of emerging problems, which impose new analytical challenges and environmental concerns. Defining the baselines of these contaminants and understanding the processes that control their transport, fate, and cycling are important issues to protect environmental functioning and human health, and to support informed decision making.

Keywords: GEOTRACES, trace metals, ocean, contamination.