The Congo River plume: tracing continental input processes with neodymium, hafnium and radium isotopes and dissolved aluminum concentrations

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Abstract

Radiogenic neodymium (Nd) and hafnium (Hf) isotopes are powerful tools for the investigation of both small- and large-scale water mass mixing processes. This is enabled by their quasi-conservative behavior and an oceanic residence time shorter than the global oceanic circulation time of 1500 years. Nd and Hf are released into the oceans via rivers, aeolian dust and exchange with shelf and slope sediments. Combined with radium (Ra) isotopes and aluminum (Al) concentrations it is possible to comprehensively investigate land-sea exchange processes and to quantify fluxes of trace elements released at ocean boundaries.

The Congo River has the second largest discharge in the world and transports huge amounts of particulate and dissolved loads into the southeastern Atlantic Ocean. Satellite data and models allow tracking the pathway of the Congo River plume but as yet there are no geochemical data tracing its continental inputs and their subsequent distribution.

Here we present the first high-resolution radiogenic Nd isotope and concentration sections based on over 50 water samples obtained at 17 stations from the northeastern Angola Basin during GEOTRACES cruise GA08 in November/December 2015. Our data show that the plume which is tracked by radium isotopes, transports highly concentrated dissolved loads of Nd, Hf, and Al. The flow path of the Congo plume can be followed to the northwest along the West African Coast by its unradiogenic Nd and Hf isotope signatures. ^{228}Ra isotope data show that the plume propagates with ~20 cm/s and indicates a rapid transfer of river-derived metals to the open ocean.