Tracing metal inputs and cycles in the South Atlantic with rare earth elements

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Rare earth element (REE) concentrations in seawater are not only controlled by external inputs such as dusts and rivers, but also fractionated by oceanic processes including scavenging and redox [1]. The characteristic REE patterns imposed by different inputs and processes may provide powerful tools with which to improve understanding of the sources and cycles of biolimiting trace metals such as Fe and Zn. REEs and their isotopes, especially Nd isotopes, are also commonly employed as paleoceanographic tracers to infer the status of the ocean in the past, but there is some controversy about the processes controlling their oceanic distribution.

Despite their potential utility, and their relative ease of measurements, high-quality seawater REE data are usually limited to a few single stations, and remain sparse for much of the modern ocean. This limits our ability to fully understand the cycling of REEs in seawater, or their use to trace micronutrient cycles.

In this study, we use isotope-dilution MC-ICP-MS analysis on ~100ml, and a relatively high sample throughput, to report the first full-depth zonal sections of REE-concentrations in South Atlantic along ~11^{o}S collected by the CoFeMUG cruise, and along 40^{o}S in the Cape Basin collected by UK-GEOTRACES GA10 cruise.

Secondary maxima in REE concentrations at ~1000m observed in these sections are consistent with the presence of UCDW at the same depth, and higher REE concentrations at bottom waters in the western basin than those at Angola Basin conforms to the absence of AABW in Angola Basin which is blocked by Walvis Ridge in the South. Both evidence suggests ocean circulation controlled REE-distribution at ~11^{o}S.

Ce anomalies are used to trace redox-related addition/removal of REEs. Two prominent plumes with elevated Ce-anomaly values and Ce concetrations occur nearshore in Angola Basin in the CoFeMUG section at ~500m and ~1500m respectively, indicating the addition of REEs possibly from reducing shelf sediments. An additional source of REEs is supported by more negative seawater ε_{Nd} than typical for the Angola Basin [2]. Inter-element comparison with Fe and Mn demonstrates elevated Ce anomalies associated with Fe on the east of the basin, but this is not accompanied by increased Mn concentrations, indicating unusual decoupled cycling of Ce and Mn.

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The preliminary study on prospecting uranium mine in radioactively physical geography using factor analysis method

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In natural radioactive energy spectrum measurement, to explain radioactive anomalies an distinguish the type of some soil and rock on the basis of three combination factors of uranium, thorium and potassium were more reasonable and accurate than a single radioactive element [1]. So the original data, based on the collection original data of reconnaissance ground energy spectrum measurement of uranium district in Yanzhuang, Wengyuan County, Guangdong Province, were processed by the method of R type factor analysis. The KMO test value of the Yanzhuang mining area was 0.68 by the calculation, greater than 0.6,and Bartlett's significant parameter was less than 0.05,which reached a significant level, showing that the variables were suitable for principal components analysis .Then the model of factor analysis was established, seen the formula (1), (2).

The first principal component is:

$$y1 = 0.71std.U - 0.03std.Th + 0.70std.K \quad (1)$$

The second principal component is:

$$y2 = -0.19std.U + 0.96std.Th + 0.22std.K \quad (2)$$

Collect original data into the model to calculate the abnormal lower limit for mining area: y1 = 1.793935, y2 = 1.537696. The y1, y2 anomalies delineated figure made by MAPGIS showed that the delimitation from the working drawing of abnormal and practical exploration was unified, which indicated that factor analysis could be a good combination of several factors to form a single measurement for radioactive exploration data interpretation.

This study was granted by open education fund (HJSJYB2010-14) of Engineering Research Center of Nuclear Technology Application, East China Institute of Technology, Ministry of Education, China.

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