

RARE EARTHS AND OTHER ELEMENTS IN ADMIRALTY BAY SEDIMENTS: EVIDENCE OF WEATHERING AND DIAGENETIC PROCESSES?

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The distribution and fractionation patterns of rare earth elements (REE) in sediments relative to local sources may be related to weathering, transportation, deposition and diagenetic processes. One may assume that, if the concentration of REE in sediments is similar to local rocks, rock weathering and post-depositional processes, such as re-working and diagenesis, are not significant. In this paper, we made an attempt to understand trace and REE behavior in three coastal sediment cores of Admiralty Bay (King George Island, Antarctica), in order to contribute to a better understanding of the influence of source rocks and diagenetic processes on the sedimentary cycle of polar environments.

Three sediment cores (up to 25 cm long) (MP- Macchu Picchu; BP- Botanic Point; and, CF- Comandante Ferraz Station) were collected with a box-corer in the coastal region of Admiralty Bay in January of 2004 during the XXII Brazilian Antarctic Expedition in a water depth of nearly 30m. Redox potential (Eh) and pH were measured *in situ* with portable electrodes. Organic matter (OM) was determined by loss on ignition (450°C, 24 hours) and fine-grained sediment (<0.062 mm) percentage was obtained after mechanical separation through wet sieving. Bulk samples were lyophilized (48 hours at -46°C and 133x10⁻³ mbar) and ground for chemical analysis. Trace and REE were determined by Instrumental Neutron Activation Analysis technique (INAA) in the IEA-R1m nuclear research reactor at IPEN – Instituto de Pesquisas Energéticas e Nucleares, São Paulo, Brazil.

All three cores under study are characterized by approximately 8% of organic matter and a large fraction of muddy sediments. The MP core had the largest variability of fine-grained sediments and the lowest mean. Similar content and distribution of organic matter and grain size in CF and BP cores indicates that the BP core could be used as a reference in order to assess the influence of Ferraz Station on chemistry of its adjacent sediments. In the CF core, <0.062 mm sediment content slightly decreased with depth. The sediments of Admiralty Bay had a slightly alkaline pH (6.98 to 7.54), with a negligible depth-related variability. On the other hand, we found a strong redox potential gradient within the sedimentary environment of Admiralty Bay, which may influence the accumulation patterns of redox-sensitive elements, such as U, Fe, Ce, and Eu. As expected, higher Eh values were found in surface layers. The lowest Eh value (-407 mv) was observed in the 8-10 cm layer of BP core, indicating a quite reducing environment.

Concentrations of elements were uncorrelated with organic matter and fine grained sediment content (Pearson's test; $p > 0.01$) and did not vary considerably within each core. Coefficients of variation ranged from 3% to 47%, with most of them below 15%. Based on the enrichment factor (EF), defined as the ratios between observed element concentrations and average upper continental crust content, the elements measured in sediments of Admiralty Bay can be separated into three groups: (i) enriched elements ($EF > 1.1$): As, Br, Sb, Fe, Na, Nd, Sc, U, and Zn; (ii) non-enriched elements ($0.9 < EF < 1.1$): Eu, Hf, La, Lu, Sm, Tb, and Yb; and, (iii) depleted elements ($EF < 0.9$): Ba, Ce, Co, Cr, Cs, K, Rb, and Th.

We used Sc as a geochemical normalizer, taking into account that Sc has been considered a reliable indicator of the contribution of terrestrial materials and is immobile in aqueous solutions. In order to access the possible occurrence of recent diagenetic processes in Antarctic sediments, we compared the profiles of Sc-normalized redox-sensitive, diagenetically active elements (i.e., Eu, Ce, Fe, and U) with the profile of redox potential and other variables. In spite of strong Eh gradients, element/Sc ratios showed little or unpredictable variability in all three sediment cores under study, indicating negligible

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influence of redox potential on their behavior probably as a result of the insufficient time for the diagenetic reactions to take place. In addition, the absence of relationships among REE and their most important geochemical controls (pH, Eh, grain size, and organic matter) imply that they are bound structurally, so they are not mobile.

Comparisons between elemental concentrations in their probable source (rocks) and sink (sediments) may give insights into weathering processes in Antarctica. A comparison with published REE data from local rocks (Yeo *et al.*, *Geosciences Journal*, 8, 11-25, 2004) that represent the major eroding units showed that characteristics of source rock REE fractionation patterns could be recognized in our data from coastal sediments of Admiralty Bay. The similar REE fractionation pattern observed between sediments and the source rocks indicates little alteration during weathering and sediment transport in the coastal region of the Admiralty Bay. This implies that local bedrocks are the main source of sediments and that other sediment sources, such as biological activity and ice-rafted debris, do not control sediment composition in Admiralty Bay. In addition, our data indicate that, in spite of the regional environmental setting (i.e., widespread sulphide mineral occurrence, high moisture, and high temperatures), physical weathering is much more important than chemical weathering on the King George Island.

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