Trace Element Distributions in Sediment and Surface Waters from Arcachon Bay and the Gironde Estuary, SW France

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Estuaries are marginal marine environments of considerable complexity, due to their spatial and temporal variations in hydrodynamic energy, water chemistry, and sediment source and composition. This complexity hinders geologists' ability to accurately reconstruct paleoenvironments and geological histories from the rock record. In particular, the geochemical evolution of sediments in the transition from freshwater to marine environments remains poorly understood. The interpretation of estuarine depositional environments is currently predicated on ichnological and micropaleontological analyses. However, the utility of these methods is limited by the preservation potential and subjectivity of trace fossil and microfossil assemblages. In this research, we compare the geochemical signatures of sediment and surface water samples from two modern, marginal marine environments along the southwestern coast of France in an effort to develop an analogue for controls on geochemical signatures in the rock record. We measure the major and trace element content of sediment and surface water samples from the wave-dominated Arcachon Bay and the tidal-fluvial Gironde Estuary. From this data, we determined the chemical indices of alteration (CIA), partition coefficients of trace elements between the surface waters and sediments (K_d), sum totals of rare earth element abundances (∑REEs), and various critical element ratios (Eu/Eu*, Th/Co, La/Sc, La_N/Yb_N, Th/Sc, Zr/Sc). These parameters were compared spatially to infer relationships between sediment geochemistry and locations within each modern coastal environment. The sediments of Arcachon Bay and the Gironde Estuary are interpreted as the early to intermediate weathering products of a source rock with mixed felsic and mafic composition derived from an active continental margin. The results of this study further indicate that the composition of the sediment source rock is the primary control on the availability REEs and trace elements in sediment deposits. However, the spatial variation and preservation of REEs and trace elements in sediments are dictated by organic matter distributions. These observations suggest that the use of trace elements to infer the syn-depositional conditions of sedimentary rocks is problematic, and that other parameters such as sediment source compositions, sedimentary processes, and organic matter content need to be incorporated into these models.

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