The role of modern marine systems in paleoproxy development

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Paleoceanographic research has advanced rapidly in recent years owing to development of a plethora of new elemental, isotopic, and biomarker proxies. Critical to the successful application of any new paleoenvironmental proxy is a thorough understanding of its behavior in modern marine systems. Relationships between environmental conditions or watermass chemistry on the one hand and sediment chemistry on the other can be accurately determined in modern systems, potentially establishing a quantitative basis for environmental analysis of paleomarine systems.

Recent advances in trace metal proxy development provide examples of the value of modern marine systems as a baseline. Prior to 15 years ago, trace-metal concentration data were applied only in a qualitative manner to assess paleoredox conditions, with little understanding of any other influences on their sedimentary accumulation. Now, the use of trace metals for paleoredox analysis has become quantitative in nature, and it has been demonstrated that sediment trace-metal concentrations can also provide information about aqueous trace-metal concentrations and influences thereon (such as watermass restriction and long-term changes in seawater chemistry).

Analysis of modern marine systems has been integral to recent development of other paleoproxies as well. Although estimation of paleomarine productivity is fundamentally challenging, assessment of large modern global datasets for marine productivity and sediment proxies (TOC, P, and Ba) has yielded relationships that can provide moderately reliable estimates of productivity in paleomarine systems. Another paleoenvironmental parameter that has proven difficult to constrain is watermass salinity, but recent research on the relationship of salinity to key elemental proxies (B/Ga, Sr/Ba, S/TOC) in the clay fractions of modern marine sediments has provided a basis for analysis of paleo-watermass salinities.