Geochemical Insights into the Paleoceanography of Triassic Arctic Alaska, Shublik and Otuk Formations

Whalen, Michael T.[*1]; Katz, Miriam [2]; Godfrey, Linda [3]; Milligan, Allen J.[4]; Kelly, Landon N.[1]
(1) Geology and Geophysics, University of Alaska Fairbanks, Fairbanks, AK.
(2) Earth & Environmental Sciences, Rensselaer Polytechnic Institute, Troy, NY.
(3) Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ.
(4) Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR.

Major and trace element and stable isotopic data from the Shublik and Otuk formations provide insight into patterns of productivity and redox conditions along the Middle-Upper Triassic continental margin of northern Alaska. Micronutrients (Ba, Cu, Ni, P), total organic carbon (TOC) and stable isotopes of organic (δ13Corg) and carbonate (δ13Ccarb) carbon offer insight into variations in productivity. Elements common to silicate minerals (Al, K, Ti) are interpreted in terms of detrital input. Variations in redox proxies (Mo, U, V) provide a view of changes in bottom water oxygenation. Viewed within a sequence stratigraphic framework the data contributes to our understanding of the relationship between detrital input, productivity, redox conditions, and relative sea level.

Three sequences in the Shublik and Otuk formations have transgressive systems tracts (TSTs) generally characterized by TOC and detrital, productivity and redox proxy enrichment. Lower highstand systems tracts (HSTs) record lower values of all proxies, whereas upper HSTs locally record enrichments. Lowermost TSTs are generally characterized by positive excursions in both δ13Corg and δ13Ccarb, and then record lower values in the upper TST and HST. All sequences display at least a small negative excursion in both δ13Corg and δ13Ccarb in the upper HST or falling stage just below the sequence boundary.

We interpret the multiproxy data to indicate productivity driven at least in part by detrital input as evidenced by the concurrence of TOC and detrital and productivity proxies. Enrichments of such proxies during TSTs and upper HSTs indicate detrital-driven productivity during generally low sea level stands. Coeval enrichment in redox proxies indicates suboxic conditions related to organic decay. Positive δ13C excursions at sequence boundaries are interpreted to indicate carbon burial caused by detrital and nutrient driven productivity during LSTs and early TSTs. Negative δ13C excursions in upper HSTs are associated with generally low values but minor enrichments in productivity, detrital and redox proxies. We interpret these negative excursions as related either to the input of light terrestrially derived organics potentially from soils or due to marine microbial processes. The Shublik and Otuk formations are commonly interpreted as deposits from a paleo-upwelling center. Our data imply that if upwelling were important to high productivity along this margin, it most likely coincided with detrital and micronutrient input during sea level lowstand and early transgression. Upwelling and detrital input appear to generally decline during late transgression and highstand. This is consistent with observations of more recent upwelling systems that are more vigorous during low sea level due to higher pole to equator temperature gradients and higher wind stress, indicating that similar conditions may have existed even in the generally warm Triassic climate.