The Use of Chemostratigraphy to Refine Ambiguous Sequence Stratigraphic Correlations in Marine Shales: An Example of the Woodford Shale, Oklahoma

Bryan Turner
University of Oklahoma

Abstract

The Woodford Shale provides an opportunity to test recent advances in handheld XRF (HHXRF) technology to develop and refine sequence stratigraphic frameworks by comparing chemostratigraphic profiles directly to gamma ray logs obtained from the same locations. Three cores from Lincoln, Pottawatomie, and Pontotoc Counties in Oklahoma and two outcrops at the Hunton Anticline Quarry (HAQ) in Murray County, OK represent both proximal and distal environments of the Woodford Shale. Clean surfaces at each area are scanned at no greater than one foot intervals using HHXRF to determine the elemental profiles. At the same resolution, a gamma ray profile is scanned using a GR scintillator or core spectral gamma ray. Lithologic descriptions, gamma ray profiles, and elemental profiles are then used to develop a sequence stratigraphic interpretation.

Stratigraphic successions that are correlatively ambiguous based on GR profiles alone are able to be properly correlated by utilizing surfaces that are recognized within chemostratigraphic profiles. Certain elements act as proxies for local depositional and environmental conditions during sedimentation. The principal elements used in this study are titanium (Ti), zirconium (Zr), silicon (Si), Calcium (Ca), strontium (Sr), phosphorous (P), aluminum (Al), potassium (K), molybdenum (Mo), and vanadium (V). Ti and Zr are associated with continentally derived sediment. Ca and Sr are associated with carbonate accumulation. Al and K are associated with feldspars and clays. Mo and V can be used as an indication of redox conditions. Si is found in biogenic quartz, detrital quartz, feldspars, and clays. As such, it is useful to evaluate Si as a ratio between Si/Al. When evaluated in con-junction with the Ti and Zr concentrations, the Si/Al ratio provides a rough approximation for the amount of biogenic quartz present within a horizon. Changes in the trends of these elements can be used to interpret changes in the local shoreline trajectory. These changes, the result of changes in sediment supply and/or accommodation space, can be correlated across the basin. These chemostratigraphic successions are capable of resolving high frequency cyclicity that can refine a sequence stratigraphic framework.