Strategy for Developing and Calibrating Shale and Mudstone Chemostratigraphies Using Hand-Held X-ray Fluorescence Units

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Chemostratigraphy involves the identification of shifts in geochemistry within a section of strata, which can be used as a correlation tool or to help make inferences about the paleodepositional environment of a unit. Traditionally methods such as wavelength-dispersive x-ray fluorescence (WD-XRF) or inductively coupled plasma mass spectrometry (ICP-MS) have been used to obtain geochemical data; however, energy dispersive x-ray fluorescence (ED-XRF) provides a more efficient means of data collection by using portable equipment that allows the investigator to take non destructive direct measurements.

While undertaking ED-XRF analysis of mudstones, it has been determined that calibrated results from the handheld ED-XRF effectively define chemostratigraphic changes in real time. When compared with WD-XRF systems, the much lower cost and enhanced portability of the typical ED-XRF systems provide an exceptional tool for linking down core geochemical changes to stratigraphic, sedimentological, and paleontological observations. Furthermore, with a working calibration, quantitative results can be used to assess the dominant mineral phases within an interval. Results from several cores are evaluated in the study, including: the Devonian-Mississippian Woodford and Barnett shales; Pennsylvanian Smithwick shale; Cretaceous Eagle Ford shale. Pressed pellet standards from the Smithwick, Barnett, Woodford, and Eagle Ford, along with various international standards were used to create a matrix-specific calibration for organic-rich and organic-poor mudstones. The calibration is used to quantify major and trace elements for all cores.