Handheld X-ray Fluorescence (HHXRF) Analysis of Geochemical Proxies for Productivity in Gas Shales

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Handheld x-ray fluorescence is a powerful tool for detecting geochemical proxies of productive intervals in gas shale. Recent studies have linked the abundance of redox sensitive trace metals (e.g. V, Cr, U, Th, Mo, Re) to shale strata with increased organic paleo-productivity indicators and gas potential (Sageman et al., 2003; Ross and Bustin, 2009). Accurate stratigraphic correlations in these monotonous sequences of shale can be enhanced by chemostratigraphic techniques employing major, minor and trace element abundances and ratios. Handheld XRF provides a tool to rapidly log the inorganic geochemistry of cuttings and cores in minutes at the cm scale.

Comparison of a HHXRF equipped with a silicon drift detector (SDD) and on-board processor with independent laboratory results obtained by ICP-MS on 160 sedimentary rock samples and standards show typical correlations (R2) > 0.90 and repeatability < 5 % relative standard deviation (RSD) for most major, minor and trace elements from Mg to U. Optimal results were obtained on pressed powder pellets with the use of a He purge system. Counting times were 30 seconds each on the low, main, and high energy filters (for analyzing elements K to U), and 60 seconds on the light filter setting (Mg to S) for a total analysis time of 150 seconds.

The Eagle Ford Formation is a sequence of shale, siltstone and limestone that contains an important contact between the Turonian/Cenomanian age rocks, which separates low from high total organic carbon (TOC) shale sequences. Sand-sized drill cuttings in 20-ft composites were analyzed with a hand held XRF with SDD for 150 seconds. We analyzed Mn, V, Cr and Mo content and noted a marked decrease in Mn and increase in V+Cr and Mo below the stage boundary, correlating with increased TOC content of the cuttings. The sharp contrast in trace metals above and below the Turonian/Cenomanian boundary allows us to pinpoint the contact within ft. This case study demonstrates that handheld XRF can be used to accurately define stratigraphic intervals by chemical proxies. Bulk chemistry can be used to determine productive regions in gas shales - which will be an important tool used in onsite well logging and as an aid to routine core analysis.