

Geochemical Data in Salty Situations: Calibrating XRF in the Louann Salt and Mineralogical Variations in the Puma Diapir

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Abstract

Handheld XRF (HHXRF) instruments are widely used in shale chemostratigraphy studies and are starting to showcase their versatility in other lithologies. However, matrix effects influence the accuracy of readings, and each device requires calibration to the specific matrix of interest for accurate quantitative or semi-quantitative analyses. Here, we showcase how HHXRF can be utilized in salty situations through a case study of the Jurassic Louann Salt. Various salt samples were chosen to create a database of 20 samples from various global locations. ICP-MS was conducted on a Perkin Elmer ELAN 6000 DRC ICP-MS to determine the samples' bulk and trace elemental geochemistry, creating calibration curves for the XRF. Cuttings from two wells in the deepwater Gulf of Mexico were then used to verify the instrument's utility. Samples were crushed, sieved, and packed into XRF cups, totaling over 500+ samples. They were run on a Thermo Niton XL3t GOLDD+ HHXRF with an REE calibration on TestAllGeo Mode with the new Salt Calibration. Principal component analysis (PCA) was run using JMP from SAS to (1) reduce the dimensionality of the data (from ~40 variables to ~5) and (2) assess correlations within the data for interpretation. Hierarchical cluster analysis was then run to group similar data. XRD was run on 20 samples on a Bruker D8 Advanced, and thin-section analyses were conducted to determine bulk mineralogy and verify bulk elemental data. Results show that the Louann consists of halite, anhydrite, carnallite, and calcite; the suture zone also contains hematitic fine-grain quartz and clay minerals. The minerals within the canopy are widely mixed and difficult to correlate between wells. PCA helped to identify correlations between the bulk elements (minerals) and then also trace elements to bulk, creating, in a way, "salty chemofacies" that could be used across wells.