

THE SYNERGY OF XRD AND XRF IN A SHALE AND SLATE ANALYSIS

L. Fields*, M. Martin, Rigaku Americas Corporation, The Woodlands, TX, USA

A sample of slate and shale were each analyzed with X-Ray diffraction and X-Ray fluorescence techniques. Phase identification was possible from XRD and elemental analysis combined with mapping was possible with XRF.

Results are displayed in XRD as 2 plots with line markers overlaid for phases present and, in XRF, as a semi-quantitative “standard-less” elemental results table. Additionally, individual elements are mapped across the surface of both samples.

The combined analytical techniques of XRD and XRF prove synergistic, specifically in cases with high amorphous content, moisture /organics, sulfur, and low crystallite size (clays). These sample characteristics limit or hinder the XRD ability to identify specific phases without elemental confirmation from XRF.

XRF can detect trace elements (possibly hidden to XRD) and provides relative elemental abundance. By sampling multiple (500 micron diameter) points across the samples’ surface, XRF’s 3-D elemental mapping creates an elemental “topographical” view of the specimen.

This information can illustrate homogenous or non-homogenous distribution. The mapping can provide insight to the composition of inclusions, for example, faster than a microprobe. Since many microscopy labs can be inundated with work, an XRF with mapping capability can relieve the burden in a cost effective manner, as it still maintains its primary purpose as a tool for bulk elemental analysis.

With both XRF and XRD, better phase identification is possible. It is also possible to assign likely geological points of origin by determining a similar set of trace elements and specific combinations of phases.

The XRF-derived elemental information can also be used by the to support, or as an indication of, possible environmental conditions and the period of elapsed time for the (diagenesis) phase transition to occur.