The Tracer X-ray fluorescence (XRF) system is unique amongst handheld units; energy, current, filter, and even the atmosphere (vacuum/helium) can be changed to optimize for elements ranging from Na (11) to U (92). In addition to this, users can recalibrate the machine with additional reference standards to provide empirical, tailored analysis. The Tracer can function as a point-and-shoot in the field and a fully customizable spectrometer in the laboratory.

Tracer’s light element measurement capability extends the reach of handheld XRF from base metals and major/trace elements to critical element ratios with sodium, aluminum, silicon, potassium and calcium. This combined with sophisticated XRF spectral analysis capabilities helps geoscientists determine where to find natural resources such as precious metals, minerals, oil and gas.

- Tracer XRF Spectrometer Systems are fully portable and used in the field or laboratory to analyze elements from sodium to uranium.
- Analysis cost per sample is significantly less than lab services and without the long wait for results.
- Tracers provide 100% non-destructive analysis. The sample is not altered in any way, regardless of the number of times it is subjected to analysis.
- Unique methodologies and calibrations designed for geochemical research can be adapted by the user.
- Bruker experts who understand the nuances of XRF analysis for surface and bulk measurements are available for training, methods development, and after sale support.
**Energy Resource Exploration & Extraction**

Shale deposits are currently one of the most significant sources of energy. Shale-bound gas reserves are highly complex; and, variable deposits pose unique challenges for characterizing the host rock. Therefore, each basin is different and requires its own approach to pinpoint and extract the gas.

Optimized extraction relies on accurate positioning of horizontal turn-offs and vertical outlets in the correct layer. Consequently, chemostratigraphy which is achieved via elemental analysis of depth cores has become a critical tool used to pinpoint extraction and outlet locations.

**Shale and Mudstone Core Analysis Method**

Shale and mudstone rock are not loose powders; they are highly compacted, layered, fine-grained sediments with low permeability. Laboratory quality data and reference material with similar density for chemostratigraphy are essential.

Bruker scientists work with industry professionals to develop methods for data collection that help geoscientists understand and model shale gas deposits and optimize exploration and production.

When data is analyzed as a function of sampling depth from core samples, variability in elemental concentrations through time can be seen and compared with models developed using data from similar deposits or prior drill sites of the same deposit.

Working calibrations for major element chemostratigraphy are critical to define stratigraphic changes in mineralogy; whereas, calibrations for trace elemental chemostratigraphy are required to define depositional conditions.

**Mudrock Calibrations**

The Mudrock calibration set consists of 26 well defined reference samples gathered from multiple drill cores based on elemental diversity. The set covers an array of different matrices, from limestone to near pure silicates, and elemental concentrations from PPM to % levels. Its principle aim is to quickly quantify the content of drill cores.

The Mudrock Calibration can also be used to quantify concentrations of indicator elements for anaerobic conditions critical to reserve formations.
Core Scanning

Cores can be measured manually, but it is more efficient to automate the measurements. A mobile core scanner compatible with the Bruker Tracer XRF System was developed by DeWitt Systems and enables sequential analysis of cores up to 1 meter in length. It operates using 100µm steps, resulting in a resolution of 10,000 measurements per 1 meter section of core.

The Core Scanner integrates the Tracer with a control system, helium purge, camera barcode reader, exact indexed core movement and instrument positioning. The measurement spot is documented with a high-resolution image as well as the indexed position of the core for absolute depth conversion. The full functionality of the standard Tracer software package is included.
Tracer XRF System Solutions for GeoScience

are used for on-site XRF analysis of soil, sediment, ores, mudrock, drill cuttings or core samples to determine concentration differences or trends. Thus, critical decisions can be made to guide and expedite exploration and research while in the field without costly delays.

Exploration - Decision Making - Reclamation

- Determine Critical Light Element Ratios
- Analyze Drill Cuttings and Depth Cores
- Define Elemental Zones of Interest

Recommended References on GeoScience

Fundamentals of mudrock chemostratigraphy: Handheld XRF analysis, calibration, and interpretation; GCAGS Short Course (October 20, 2012); Instructors: Harry Rowe (Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX) and Bruce Kaiser (Chief Scientist, Bruker Elemental, UT).

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Bruker Elemental Guides for GeoScience

Sodium and Potassium (2014); Bruker Elemental HMP Group
Chesapeake Mudrock Analysis (2014); Bruker Elemental HMP Group
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