Application of Thermo Scientific Portable XRF Analyzers for U-Th Exploration

An Example from Nopal Project, NE Mexico

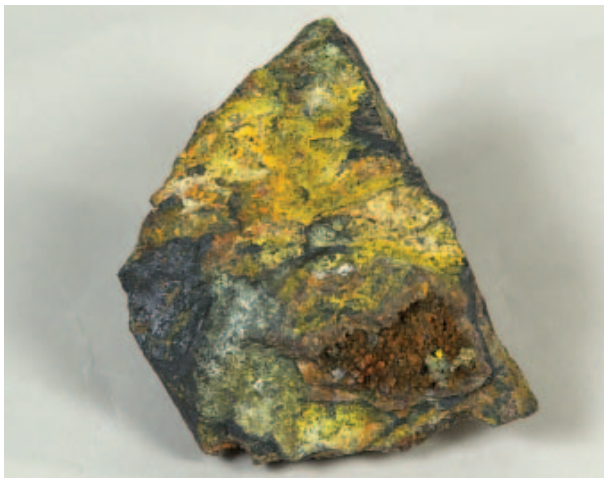
Application Note

Introduction

Uranium is a rare element with an average concentration of 2.7 ppm on the earth's crust. In nature, it occurs mainly as U238 (>99%) whereas U235 (fissionable) is only about 0.7%. U234 is less than 0.1%. The large size of the U atom tends to prevent it from entering into the early crystallizing minerals in magmas. Hence, it is commonly concentrated in the final products of magma crystallization in silica-rich rocks such as granites (in minerals such as zircon, sphene, and apatite). In such rocks, U may reach up to tens or even hundreds of ppm and form a mineral called uraninite or pitchblende (UO2).

Uranium ore is mined in several ways: by open pit, underground, in-situ leaching, and borehole mining (by high pressure water jets). Low-grade U ore mined typically contains 0.01 to 0.25% uranium oxides (commonly reported as U3O8) however some deposits have high concentrations of U up to several percent. In nature, uranium occurs in a few deposit types including unconformity-related deposits, Olympic Dam type deposits, sandstone deposits, quartz-pebble conglomerate deposits, surficial deposits (calcrete deposits), vein deposits, volcanic and caldera-related deposits, intrusive deposits, and metasomatite deposits.

Thorium is another naturally occurring radioactive chemical element that is fissionable. It is about three to four times more abundant than uranium in the Earth's crust (9.6 ppm), and is chiefly refined from monazite sands as a by-product of extracting rare earth metals.



Uraninite (black color) and uranophane (yellow weathering product of uraninite) are common U minerals. Field portable XRF analyzers are commonly used for U-Th exploration.

Field Portable XRF Analyzers in Mining

Field portable XRF is a technique with the ability to deliver fast and accurate results with little or no sample preparation in various stages of mining activity from grass root exploration to exploitation, ore grade control, and even environmental investigations.

There are more than 3,000 Thermo Scientific™ portable XRF analyzers that are used extensively in the mining industry worldwide. A broad range of elements from magnesium (Mg) to uranium (U) can be analyzed using these instruments.

Handheld Thermo Scientific™ Niton™ XL3t , Niton XL2 Series analyzers and the Niton FXL field x-ray lab bring huge improvements in detection limits, accuracy, and acquisition time. These benefits derive from the Thermo Scientific geometrically optimized large area drift detector (GOLDD™) technology, and the high-power x-ray tube. When our handheld analyzers are combined with a test stand, they can also be used in the lab on prepared samples.

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Method

This investigation was carried out in the Nopal area, northeast Mexico by SGM (Servicio Geologico Mexicano) geologists. A total of 1,334 samples were analyzed systematically in 31 stations on 40 linear sections with 100 m spacing. Uranium content of each sample was measured by radiometric method, laboratory analysis, and field portable XRF on prepared samples. For the radiometric method, scintillometers were used. These instruments are commonly used for U-Th exploration and some models can provide semi-quantitative data. The geochemical maps of U, based on these three methods, were prepared and are shown in Figure 1.

Results

As Figure 1 shows, there is a very good overlap between geochemical anomalies of U identified by lab and field portable XRF. Also Th fromXRF assays shows the same anomalies as U. Laboratory Th data were not available for comparison. Although scintillometers are very effective tools for fast identification of radioactive samples, their data may not be as reliable as lab or portable XRF assays because their U and Th anomalies do not overlap with those from lab or portable XRF assays. Such instruments can be more effective if used in conjunction with field portable XRF in the field.

To discuss your particular applications and performance requirements, or to schedule an on-site demonstration, please contact your local Thermo Scientific portable analyzer representative or contact us directly by email at niton@thermofisher.com, or visit our website at www.thermoscientific.com/niton.

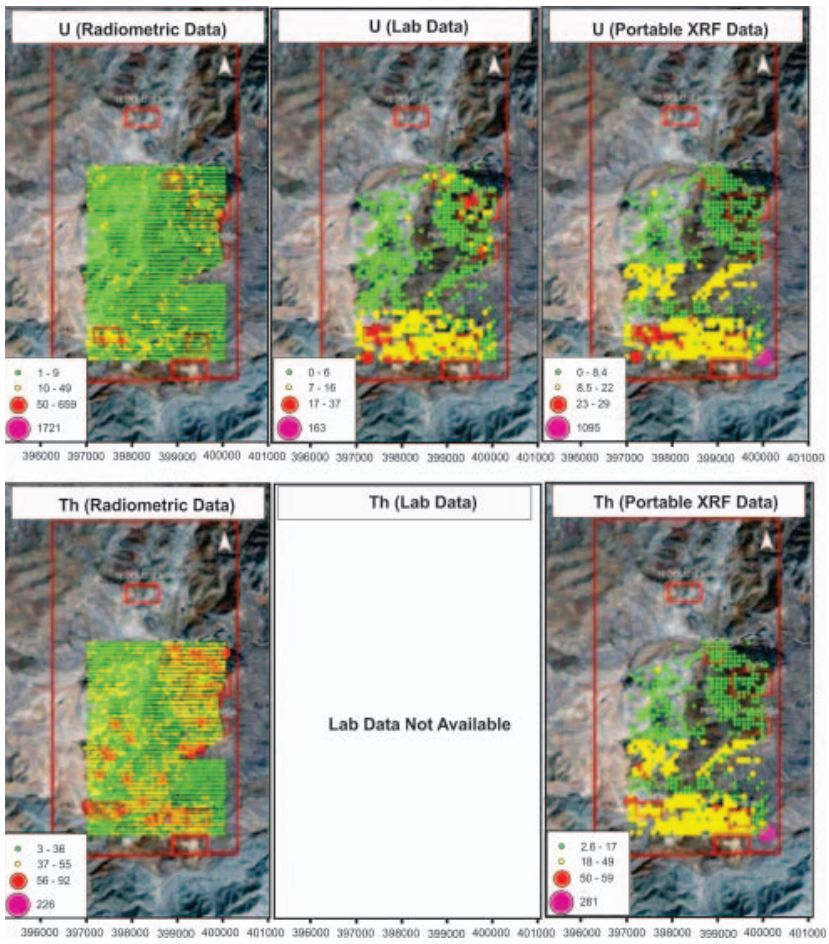

Figure 1. Geochemical map of U and Th measured by radiometry, lab, and field portable XRF.

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