

# Mining Exploration and Geochemical Analysis of Mining Samples

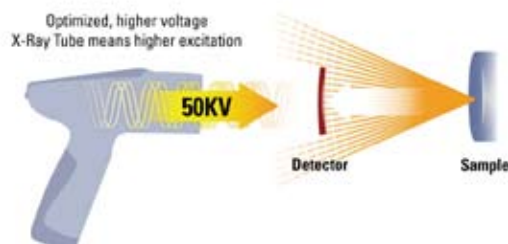
*Thermo Scientific Niton XL3t Series Handheld XRF Mining Analyzers*



## Lab-Quality Analysis in the Palm of Your Hand

In all stages of the mining process, you make decisions based upon your mine model, judgment, and experience. Meanwhile, quickly obtaining accurate geochemical data to guide operations is one of the biggest obstacles to high productivity. The swift acquisition of this data for rapid delineation of ore boundaries and the in-depth, quantitative analysis of metal concentrations that you require for mine mapping and grade control is critically important for efficient mining operations.

The ideal tool for these demanding jobs? The handheld Thermo Scientific Niton XL3t 500 Series x-ray fluorescence (XRF) analyzer, now available with groundbreaking GOLDD technology. The low detection limits achievable with the new Niton® XL3t 500 with GOLDD technology – plus light element analysis (Mg, Al, Si, P, S) without helium or vacuum purging – allow you to identify element concentrations at unprecedented low levels, even at or below the averages naturally found in the earth's crust, detecting even the most subtle geochemical anomalies.



Larger drift detector and optimized geometry for more x-ray counts: you get faster and more precise readings.

## Thermo Scientific Niton Analyzers – The Revolution Continues

Since 1998, Thermo Scientific Niton analyzers have represented the state-of-the-art in-field analysis for mining applications, allowing you to perform rapid, on-the-spot screening for qualitative elemental identification with a single measurement. With more than 1,400 of our instruments deployed in the mining industry, the ability to obtain instant, nondestructive data in situ significantly reduces the cost, time, and labor involved in exploration and grade control activities and allows you to make decisions promptly, before samples are dispatched to the laboratory.

- Real-time modeling – ability to determine new drilling/soil-sampling locations before moving your drill rig
- The ability to send and share XRF data to headquarters allows you to make integrated decisions, receiving input when you need it most
- Infill and step-out decisions made in real time
- No need to re-drill targets
- Reduced lead times – especially important when exploration season is short

### Niton XL3t with GOLDD Technology Benefits At-a-Glance

- |                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|
| • Rapid delineation of ore/waste boundaries                                                                                                       |
| • GPS located mine samples that can be integrated real time into production operations                                                            |
| • High sample throughput and increased sample density over traditional lab methods                                                                |
| • Direct analysis of drill core and cuttings to dynamically drive exploration programs                                                            |
| • Light element analysis without helium or vacuum purge directly quantifies Al, Si, and Mg levels to perform effective alteration mineral mapping |

Other benefits Niton XRF analyzers offer you include immediate determination of non-visual ore zones and defensible data to prove financial, environmental, and social responsibility.

Further, you can analyze site samples by placing the instrument directly on the drill cutting or rock face, providing screening results in seconds, while simple sample preparation will yield analytical results in good agreement with traditional laboratory methods.

### The Thermo Scientific Niton Solution

Our robust Niton XL3t 500 Series and Niton XL3t 500 Series with GOLDD technology bring you cutting-edge, rugged, dependable tools with remarkable speed and performance, as well as our trademark point-and-shoot simplicity. This means improved value to you through better precision and lower detection limits compared to previously available handheld XRF instruments. They are the ideal tools for measuring elemental concentrations in:

- Ores
- Soils
- Sediments, cuttings and cores
- Mill heads and tails
- Concentrates
- Filter media

Combining advanced electronics, materials technology, and a 50kV x-ray tube – the most versatile x-ray tube ever used in a handheld XRF instrument – the Niton XL3t 500, the Niton XL3t 500 GOLDD, and Niton XL3t 900 GOLDD with helium purge are in a class by themselves. With optimized excitation parameters, including the ability to target light elements from Mg to S, the Niton XL3t Series of instruments provides greater analytical range, speed, and precision than ever before.

No matter which configuration you choose, a host of new features directly benefits your operation. From the integrated tilting color touch-screen display to customizable menus for ease-of-use, the ergonomic Niton XL3t Series analyzers are both the lightest weight and most ruggedly constructed instruments

that we've ever built, making them appropriate for use under virtually all environmental conditions. Integrated Bluetooth™, USB, and serial communications give you the fastest, most efficient, and easy-to-use ways to move, share, and view your data. In addition, all Thermo Scientific Niton analyzers use third-generation lithium-ion batteries, providing the longest usage cycle of any handheld XRF analyzer.

### And Now...Niton XL3t with GOLDD Technology

Where low detection limits or the highest sample throughput are critical, our combination of hardware, software, and direct industry experience team up to provide you with a solution to your most difficult analytical requirements.

When the Niton XL3t advanced electronics and 50 kV x-ray tube are harnessed to our groundbreaking GOLDD technology, it takes your analytical capabilities to a whole new level. The direct benefits to you include: a Geometrically Optimized Large Area Drift Detector (GOLDD), 80 MHz real-time digital signal processing, and dual state-of-the-art embedded processors for computation, data storage, live video processing, and communication. With their extraordinary speed and precision, Niton XL3t analyzers with GOLDD technology can give you the near instantaneous and reliable feedback you need for confident decision-making.

### The GOLDD Advantage

GOLDD technology provides vast improvements in sensitivity or measurement times – as much as 10 times faster than conventional Si-PIN detectors, and up to 3 times more precise than conventional smaller silicon drift detectors (SDD). Our proprietary large area drift detector provides you with superior performance in the form of faster analysis and lower detection limits. The final product is the Niton XL3t with GOLDD technology – the most powerful and technologically advanced handheld XRF analyzer available today!

Pathfinder Elements for Gold Exploration <sup>1</sup>		
Element	LOD with GOLDD*	What This Means to You
As	< 5 ppm	With a detection limit almost at the average upper crustal abundance (2 ppm), and well below a standard baseline of 20 ppm, even the smallest As anomaly can be accurately and precisely defined.
Ba	< 50 ppm	Well below the crustal average of 668 ppm, this is a key pathfinder element in many types of Au deposits as well as a valuable commodity in the drilling services industry.
Cu	< 15 ppm	Cu anomalies are typically associated with the deeper zones of Au deposits. The LOD using GOLDD is below the average abundance of Cu (14 ppm) in the crust, allowing geologists to obtain detailed surveys of small Cu anomalies that may be useful in the exploration for Au, base metals and Cu-Ni-PGE ores.
Au	< 10 ppm	Approaching the levels necessary for Au exploration, the 6 ppm LOD is low enough to explore historically mined areas, tailings/waste piles, and as an important tool in mine grade control.

Table 1. Sample limits of detection (LODs) for key elements of interest in gold exploration<sup>2</sup>

\* 1 ppm = 0.035 oz/t  
28.3 g/t = 1 oz/t

Pathfinder Elements for Platinum Group Elements (PGE) <sup>1</sup>		
Element	LOD with GOLDD	What This Means to You
Cu	< 15 ppm	With an LOD below the average crustal Cu abundance (14 ppm), the instrument far exceeds the baseline limit for Cu in a geochemical survey program on both local and regional scales.
Ni	< 50 ppm	LOD is comparable to the baseline in many geochemical surveys (roughly 50 ppm) and well below expected for prospective PGE exploration areas.
Cr	< 50 ppm	An LOD roughly equivalent to average Cr abundance in the upper crust makes this PGE-associated element ideal for soil, stream sediment and outcrop geochemical mapping.

Table 2. Sample limits of detection (LODs) for some of the useful elements in prospecting for PGE deposits<sup>2</sup>

### Unparalleled Improvement in LODs

When it comes to performance testing, we decided to test against the best – ourselves. In our comparisons, each sample was measured under the same conditions multiple times using multiple production instruments. The performance data listed can be considered typical of the instrument configuration used to produce it. Performance of individual instruments of this configuration under varying conditions may differ slightly from those shown here.

Figure 1 illustrates the across-the-board improvement in limits of detection<sup>2</sup> of the Niton XL3t 500 with GOLDD technology in a head-to-head comparison against the Niton XLt 500 Series and the Niton XL3t 500.

The instruments' unparalleled speed and higher precision mean results you can depend on.

### Outstanding Performance – Lab-Quality Geochemical Analysis

Mine mapping, development, and grade control require accurate elemental composition data in large numbers of samples. The handheld Niton XL3t XRF analyzer makes it easy to do trend analysis by averaging readings in real-time on the instrument or evaluating downloaded readings on a PC afterwards. If you need rapid laboratory-grade sample analysis, you only have to prepare your samples and then test them on-site with your Niton analyzer; in other words, lab-quality sample preparation yields lab-quality results in the field. The Niton XL3t high speed and sample

throughput ensure that samples which are sent to a laboratory are representative of the local geochemical values.

Niton XL3t analyzers easily identify a wide range of elements including Mg, Al, Si, S, Cu, Ni, Ta, Ag, Zn, Mo, Ca, K, Rare Earth Elements (REEs), and platinum group metals (PGMs). They are ideal for a wide variety of samples such as rock face, bagged or ground samples, drill cores, mineral sands, and clays.

### Environmental Monitoring and Cultural Resource Management

Mining processes produce large volumes of waste, some of it toxic. This waste can result in acid mine drainage and groundwater contamination and needs to be closely monitored to ensure proper impoundment. In addition to being used for exploration and mining applications, Niton XL3t analyzers are very effective doing “double duty” when used to monitor elemental contaminants, such as S, Pb, and As – at mine sites, in waste streams, and during mine closure procedures.

Cultural resource management (CRM) requirements are another challenge for the mining industry. Many sites require miners and developers to ensure that they are not disturbing sites of historic cultural value such as burial grounds of native peoples during their operations.

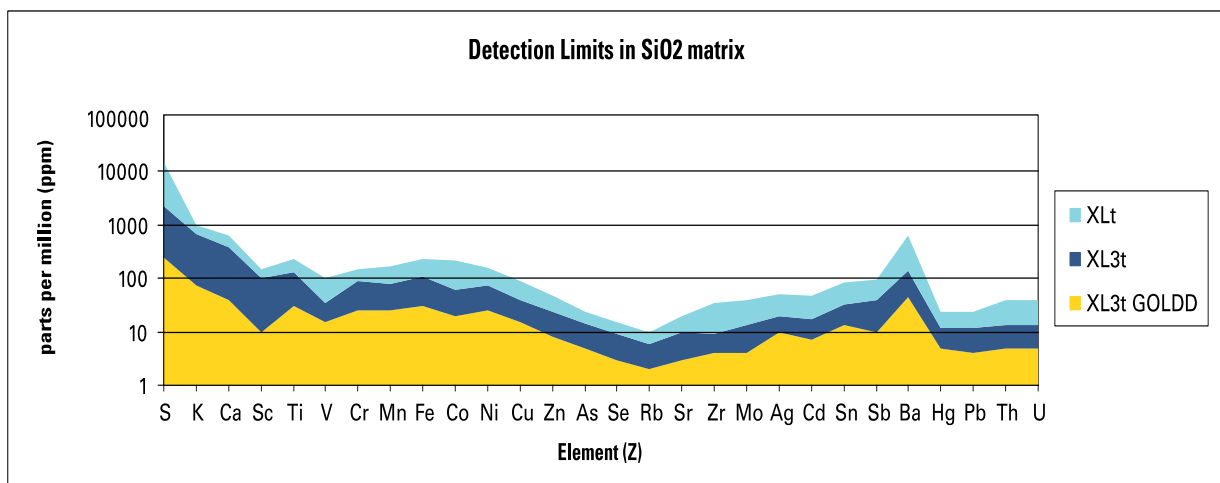


Figure 1. Instrument comparison data for LODs of various elements in an SiO<sub>2</sub> matrix. Note the greatly improved detection limits for XL3t with GOLDD technology.

The wide range of capabilities of a Niton XL3t analyzer allows the user to conduct in-situ soil analysis to detect evidence of historic human activity.

### The Right Tools for Your Analysis Needs

Providing you with the right XRF tools for your analytical and budgetary requirements means offering you the widest range of options – powerful tools that will revolutionize the way you conduct your business.

All Niton analyzers come with a waterproof carrying case and shielded belt holster. By taking advantage of the standard Thermo Scientific Niton Data Transfer (NDT©) PC software suite to customize the instrument, you can set user permissions, generate custom reports and print certificates of analysis personalized with your own company logo, or remotely monitor and operate the instrument hands-free from your PC. The NDT file format preserves and protects the data from each analysis, ensuring that it is not compromised. This versatile software suite helps you document test results and ensures the quality and integrity of the data produced by your Niton XL3t Series analyzer.

Additionally, you can locate areas of interest on a sample using the integrated color CCD camera (standard on GOLDD models, optional on other models) and the optional integrated 3 mm small-spot collimation, and then store the test area image along with the analysis data. This helps you isolate inclusions or anomalies in rock faces and drill cores, providing valuable information about the chemical composition of a discrete section of the sample.

### A Range of Accessories for Versatility and Ease-of-Use

Niton XL3t analyzers offer integrated Bluetooth GPS readings for rapid mine mapping or for identifying areas of interest during exploration activities. When combined with your laptop or PC, the Niton XL3t Thermo Scientific SmartStand shielded portable test stand instantly converts the instrument into a benchtop analyzer for measuring drill cores and bagged or cupped samples. When you are in the field measuring many hundreds of samples per day, you will certainly appreciate the Thermo Scientific Extend-a-Pole telescoping extension pole, improving ergonomics to minimize fatigue.

### Service and Support

Thermo Scientific Niton XL3t Series analyzers have been designed to be the most durable and dependable portable analyzers ever made. From the rugged housing to our precision detectors, each individual component

has been engineered to be dependable as well as easily serviceable.

When routine service is required, we have made it convenient and easy for you with more than 30 factory-trained service centers located across six continents.

### Serving Mining Needs Around the World

Our breakthrough instruments can be found serving the needs of some of the world's largest mining operations, as well as some of the most innovative ones. We work closely with you, our customer, to create new solutions, or enhance existing ones, to ensure that we continue to deliver the groundbreaking technology you need to transform the way you conduct business. Thermo Scientific Niton XL3t 500 Series analyzers, now with models featuring GOLDD technology – designed for the way you work.



The Thermo Scientific Extend-a-Pole telescoping extension pole and Niton XL3t analyzer with GOLDD technology are the ideal combination for mining and mineral exploration.

In addition to these offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

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1. Wedepohl, K.H., 1995, *The composition of the continental crust: Geochimica et Cosmochimica Acta*, v. 59, p. 1217-1232.

2. Limits of detection (LODs) are dependent on testing time, interferences/matrix, and level of statistical confidence. Ongoing research and advancements in our Niton XL3t, XLi, XLP, and XLt Series analyzers will lead to continual refinement of many of the values detailed in the tables. Contact a Thermo Fisher Scientific office, or your local Thermo Fisher Scientific representative for the latest performance or for specifications related to your application.