

# Open Pit Copper Grade Control

*Thermo Electron Corporation's NITON Field Portable XRF Provides On-Site Delineation of Ore Boundaries in Open Pit Copper Mines*



## Application

Open pit copper mining involves the extraction of millions of tons of ore annually that is then hauled to a processing facility to produce concentrate or London Metal Exchange (LME) grade metal. Many copper mines, particularly oxidized low-grade copper deposits, are located close to the surface and amenable to low cost, open pit truck/shovel operation.

Open pit grade control is typically determined by collecting 1 kg samples either during grade control drilling or blast hole sampling. Samples are then assayed at an on-site mine laboratory or sent to an off-site commercial laboratory. Lab turnaround times present a limiting factor in grade control decisions and productivity. Results from on-site labs typically take 2 to 7 days, depending on sample throughput and mill demand. Off-site labs can take considerably longer when transportation and additional sample volumes from other sites are considered.

This application bulletin investigates the effectiveness of using one of Thermo Electron's portable NITON x-ray fluorescence (XRF) analyzers to immediately determine grade control data, allowing the geology department to define ore/waste boundaries in the pit.

## Method

A NITON XLi 500 Series portable XRF analyzer was used to test unprepared blast hole cuttings directly in calico sample bags. Samples were analyzed for a minimum of 30 seconds. [Note blast hole cuttings can be tested in-situ around drill holes on the pad.] Samples were then riffle split with one sample dispatched to the on-site mine laboratory, and the other sample to a commercial lab.

## Results

Excellent linear correlation was demonstrated between the laboratory and NITON analyzer data sets, reporting an  $R^2$  value of 0.97.

For those portable XRF values that reported outside a 20% relative percentage difference from the lab, copper concentrations were below 1500 ppm. On average, the NITON analyzer reported copper concentrations 0.01% lower than the



The NITON XLi 500 Series XRF analyzer testing unprepared blast hole cuttings.

participating commercial laboratory with an average relative percentage difference of +3.42%. This represents an excellent result given the lack of sample preparation carried out prior to analysis with the portable XRF and the short testing times.

Most importantly the NITON analyzer was able to delineate waste from ore in 100% of the blast hole samples tested. No samples classified as waste by the laboratory were reported as ore by the NITON analyzer and vice versa. This clearly demonstrates that Thermo's NITON portable XRF analyzer is highly suitable for use as a grade control tool in open copper pit mines.

### Conclusions and Comments

The results obtained by the NITON XLi 500 Series analyzer show very good agreement with laboratory results and provide clear evidence that the NITON analyzer is an excellent tool for rapidly delineating copper grades in open pit mining operations. The opportunity to obtain reliable data instantly allows the mine geology department to insert the portable XRF analyzer's results into the grade control models on the same day and confidently direct in-pit operations.

Thermo Electron's portable NITON XRF analyzers provide many operational and cost benefits to mining operations; integration of NITON XRF into grade control programs:

- Avoids lab turnaround delays
- Instantly flags grade, sub-grade and waste material
- Rapidly delineates ore boundaries
- Prevents grade dilution at the concentrator
- Prevents hauling ore to the mullock heap
- Improves productivity and efficiency in ore removal

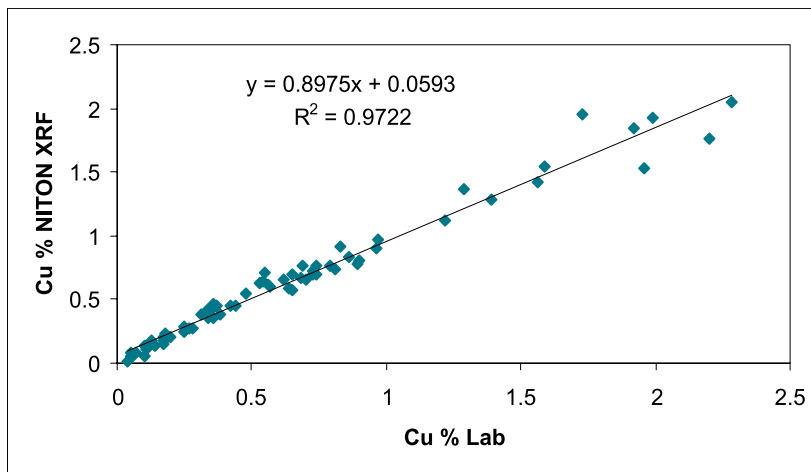


Figure 1 shows comparative copper data as reported by the NITON analyzer and the average of the laboratory results.



### Clients using NITON analyzers for Cu applications in the mining industry:

COMPANY	COUNTRY
Xstrata (Ernest Henry Copper Mine) .....	Australia
Placer Dome (Osborne Copper Mine) .....	Australia
Sterlite (Thalanga Copper Mine) .....	Australia
Perilya Exploration .....	Australia
Exco Resources .....	Australia
Elatsite .....	Bulgaria
Comisa .....	Zambia/Congo
Luanshya Copper Mines .....	Zambia
Noranda .....	Quebec Canada
Bwana Makubwa (First Quantum) .....	Zambia
Phelps Dodge .....	USA
NU World Mining .....	Congo
Sharma Bros International .....	Congo
Yingkou BL Mining Co. Ltd .....	Africa

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