CMA 2008

40th Annual Conference and Exhibit

Bathurst, New Brunswick

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Data Management for On-Stream Analyzer Calibration

François Cabaret Chief Chemist, Xstrata Zinc, Brunswick Mine (NB)

This presentation describes the On-Stream Analyzer (OSA) calibration process used at Xstrata Zinc, Brunswick Mine concentrator to follow the metal composition in different slurry streams. The OSA calibration check includes data from X-Ray Fluorescence (XRF), Atomic absorption Spectroscopy (AAS) and chemical titration. It will be explained how this time consuming date is managed using an Excel VBA program and what criteria are used to detect a deviation in OSA calibration.

Peroxide Fusions: A Powerful and Safe Dissolution Method for Mining Sample Analysis by ICP and AA

Luc Bérubé, M Sc, Chemist, Sales, and Services Manager, Corporation Scientifique Claisse, Philippe Daigle, M Sc Chemist, Technical Representative, Corporation Scientifique Claisse

ICP and AA spectroscopy are widely used in the mining industry. As for any other analytical process, sample preparation is crucial in order to obtain accurate and precise results. Acid digestion is the common dissolution method used for mining related samples. Unfortunately, acid digestion of mining samples requires numerous manipulations of concentrated acids, including perchloric acid ($HCLO_4$) that is explosive and hydrofluoric acid (HF) that is extremely dangerous for human health. Moreover, it is often difficult to get full dissolution of the sample even when using these hazardous chemicals.

Peroxide fusion is an advantageous alternative to acid digestion to prepare mining samples for ICP and AA analysis. Sodium peroxide (Na_2O_2) is used to oxidize the sample that becomes soluble in diluted acid solution. Peroxide fusion is a powerful method that allows complete dissolution of numerous refractory compounds like chromite, magnetite, ilmenite, rutile, and even silicon, carbides, alloys, and noble metals. Peroxide fusion can be performed with automated systems to increase productivity, improve safety, maintain repeatable preparation conditions, and even avoid spattering and cross-contamination.

The presentation will introduce the basics of sample preparation by peroxide fusion and demonstrate its efficiency with examples related to the mining industry.

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Iron Ore Analysis – A New Approach for New Requirements

Kai Behren, Bruker AXS GambH, Karlsruh, Germany.
Alexander Seyfarth, Bruker AXS Inc, Madison, Wisconsin, USA.

International standards, such as the Australian ISO 9516-1 method, describe the calibration and elemental analysis of iron ore using a fusion method. The approach is based on synthetic standards uses empirical matrix correction forms. The fusion method, being an excellent tool for this application, is quite complex and benefits from advances in the fusion instrumentation with respect to temperature control and agitation. By using improved matrix correction algorithms, the difficult and very simple sample intensive approach of empirical corrections can be avoided. Computations also allow therefore the use of variable dilutions, a real benefit for complex iron ores.

The iron ore clients request more often trace element data from the mines. Trace elements and volatiles are not possible to be determined accurately using a fusion based preparation. A repeatable, accurate pressed pellet preparation is readily made but has traditionally not achieved the accuracy levels needed and suffered from mineralogical matrix effects.

- How can accurate trace element analysis be obtained in a matrix, which is as variable as iron ores, why not correct using "jump edge" correction?
- Can international reference materials be used to provide accurate analysis?
- Can a turnkey system be delivered to customers for the analysis of iron ore?
- What are the limitations of using the pressed powder method?
- What are the implications of matrix correction for the analysis?

In the talk we will show and discuss a novel approach, which combines the traditional fusion method results with a pressed powder pellet calibration for the analysis of traces in iron ore. The question raised before will be answered and discussed for this linked approach.

Rediscovering the Versatility of the College System – An Opportunity for the Industry

Sylvian Poirer, PhD., CCNB Development and Innovation Branch

In addition to training young people in the mining industry, the CCNB offers customized and on-line training to maintain these human training current, here and abroad. There is also applied research and innovation potential whose development can be orientated, through partnerships, according to the needs of your industry.

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Rhodium Hybrid Fire Assay Procedure at Xstrata Zinc Brunswick Smelter

Denis Foulem, Brunswick Smelter Laboratory

Brunswick Smelter is a lead smelter located in Belledune, New Brunswick. Besides refined lead, the plant produces nearly refined silver (called doré, with gold and copper as the main contaminants) and some by-products (sulphuric acid, copper matte, and copper speiss). Prior to 2003, Fire Assay at Xstrata Zinc Brunswick Smelter was performed strictly for gold and silver only.

Traditionally, the plant feed material consisted mainly of lead concentrates (sulphides) from Brunswick Mine (located south of Bathurst, New Brunswick) and mining operations located in Central and South America, with secondary materials consisting mainly of lead-laden waste materials from industrial site throughout North America.

With China's recent rapid industrial growth, Brunswick Smelter's marketing strategy was revised to meet the new challenges head-on. The current blast furnace design, coupled with two short rotary furnaces, enables the site to process new value-added materials from around the world, such as different lead compounds (sulphates, carbonates, hydroxides, chromates, etc) and silver/gold concentrates.

Fortunately, the laboratory was equipped with an Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). All that was required was getting these PGE's into solution. This is when I became familiar with rhodium's chemical properties. Rhodium is usually not attacked by acids unless it is oxidized in an alkaline fusion first. Conventional litharge-based Fire Assay would be inefficient for the rhodium analysis and the nickel sulphides fusion normally used for PGE's is susceptible to certain contaminants that would be formed in the feed materials analyzed.

I hit upon the idea of combining the two Fire assay methods. Combined with a very simple way of preventing PGE cupel loss, this "Rhodium Hybrid Fire Assay Procedure" was 'fine-tuned" over the course of a year and is now routinely used at Brunswick Smelter. Interesting enough, the combination eliminates the shortcomings of both individual Fire Assay methods.

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ICP-MS – The Analytical Tool for the Geochemist

Luc Dionne, PerkinElmer LAS Canada Inc

This presentation will focus on the progression of the analytical techniques as it pertains to analyzing geochemical samples for metals. From the days of Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) there has been a constant migration to Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for such types of samples. With the inherent sensitivity of ICP-MS, low concentrations levels can be accurately determined and better detection levels can be achieved. Yet its limitation is well known: high concentrated elements levels traditionally observed in such samples cannot be measured due to detector saturation without first performing a physical dilution. This is why today's geochemist utilizes both the ICP-OES (radial view, axial view or both) technique and the ICP-MS technique to meet their analytical requirements. Various strategies will be visited on how to measure both trace level elements and high concentration elements, if possible on one analytical run. An overview of running the current ICP-OES/ICP/MS approach right through to a novel, unique and powerful signal attenuation capability will be discussed.

Good and Bad Practices in Quality Assurance

John Winterbottom, Technical Manager, AssayNet Inc., Ottawa, Ontario

Now a day a diligent laboratory customer implements their own quality checks on assay data. Responsible analysts should welcome this trend since a well-planned, client-side QA program can serve to augment that of the laboratory, providing additional assurances that analytical techniques are within statistical control. Too often, however; poorly designed systems and badly interpreted data lead to confrontation rather than illumination.

This paper addresses some common mistakes seen by the author in client-side quality programs and proposes a basis for improvement.

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Dollars and Sense: Synthetic Standards for Inorganic Analyses

Glenna Keating, Lab Manager, Trace Element Analysis Laboratories, Earth & Planetary Sciences, McGill University

At the Trace Element Analyses laboratories in the Department of Earth and Planetary Sciences at McGill University, we use X-Ray Fluorescence, Atomic Absorption, ICP-MS, X-ray Diffractometry and Carbon Sulphur analyses to analyze a diversity of rock and mineralized samples. To test our protocols and develop methods, synthetic standards are routinely created by the laboratory staff. The practical aspects of creating synthetic standards are the main focus of this talk with a particular emphasis on standards for Carbon-Sulphur analysis of rocks.

ICP-AES Analysis Made Easy for Geological Samples

John Lewzey, Optical Spectroscopy Specialist, Varian Canada Inc

Geological samples have long posed a challenger for analysis by ICP-AES. In this talk we will demonstrate how a combination of modern technology and advances in sample introduction systems has made the analysis of tough geological samples easier.

The talk will cover the application of FACT (Fast Automated Curve-Fitting Technique), which uses Spectral modeling technique to deconvolve (subtract) the interferent from the analyte signal. The selection of the appropriate sample introduction system based on sample type will be covered as well as advances in auto sampler technology.

Value Of Control Charts In The Laboratory:

Eric Arseneault, Laboratory Supervisor, Xstrata Zinc-Brunswick Smelter

Control charts have been used in laboratories for some time. It will be explained how, at the Xstrata Zinc-Brunswick Smelter Laboratory, we use control charts to ensure our assays are in control but also how you can use them in method development and equipment maintenance.

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Automation in Sample Preparation for ICP

Suhas Sudhakar Narhede, Manager Sales & Product Development,
Questron Technologies Corporation

Acid digestion uses a wide variety of acids in their concentrated forms to break down a sample into homogenous solution for analysis. The process of digestion is accelerated by heating the samples. Use of hot blocks for open vessel digestion and microwave energy for closed vessel digestion are the latest practices.

Hot plate digestion is time consuming and typically involves manual addition of multiple acid aliquots in an environment that can be hot and full of acid fumes. Questron Technologies has developed Vulcan 84, an automated hot block digestion and sample work up station, capable of delivering acids such as HF to vials placed in Teflon® coated graphite hot blocks. It controls the temperature of the hot blocks and performs multiple additions of acids at desired intervals. It also dilutes the digested solutions to set levels. The samples can then be transferred and further diluted in regular auto sampler racks so that the analytes fall in the instrument's analysis range.

We analyzed a few samples digested on hot blocks and Vulcan 84 for trace metals. The results sere compared to validate the performance of Vulcan 84. In addition to providing an environment that was contamination free Vulcan 84 was found to be a great instrument for increasing the efficiency of the laboratories and achieving adequate consistency in results.

Ventilation and Equipment Design Flaws

Jack Stanley, Analytical Laboratory Consultants, Vernon, BC

Ventilation And Equipment Design Flaws: How ventilation and equipment design impact personnel safety, affect the environment and influence sample quality.

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Particle Size Analyses by Laser Diffraction Spectrometry: Application of ISA Mill Ultra Fine Grinding Technology

Lyne Coté, Blue Note Mining, Caribou

The caribou underground mine, 50 km west of Bathurst, the Restigouche open-pit mine, another 30 km west and the concentrator located at the Caribou mine site resumed operations in July 2007 after a nine-year shutdown. The caribou operation achieved commercial production on Jan. 1, 2007. By June 2008. all metallurgical targets had been achieved or surpassed with the production of lead and zinc concentrates assaying approximately 50% Zn and 45% Pb respectively with recoveries exceeding 80% for Zn and 70& for Pb.

The deposit features very fine-grained massive sulphides mineralization, which in the past has proven difficult to process. ISA Mill Ultra Fine Grinding Technology in combination with conventional flotation technology is used to process these complex ores.

The importance of particle size analysis in the mineral processing is fundamental. Crushing, grinding, and milling processes release valuable material (usually metal) from the ore. This process involves (energy consumption, efficiency, slimes formation etc.).

This paper describes the application of laser diffraction spectrometry in mineral processing for particles ranging from 35μm to 8μm.

Different technology to measure particle size will be discussed, including the validation of the laser diffraction spectrometer using 6 sigma methodologies.

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Advances in Quantitative (XRPD) for Minerals and Mining Applications

Arnt Kern, Bruker AXS GmbH, Karsruhe, Germany
Alexander Seyfarth, Bruker AXS Inc, Madison, WI, USA

X-ray powder diffraction (XRPD) combined with quantitative Rietveld analysis is an essential tool for the determination of relative phase amounts in crystalline materials including both powdered solids and slurries; analysis times are normally less than 10 minutes per sample. In the minerals and mining industries, quantitative phase analysis by XRPD allows to characterize and optimize the whole process from exploration, processing through to waste stockpiling. Currently XRPD finds exponentially growing interest in important application areas such as in leaching and flotation processes (optimization of acid consumptions, pH control, etc.) and in environmental mineralogy (prediction and control of acid rock drainage, verification and quantification of carbon dioxide sequestration etc.).

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Organic Geochemical Analysis Detects Mineral Signatures in Surficial Samples to Locate and Identify Deeply Buried Exploration Targets

D. Sutherland, Activation Laboratories Ltd.

Surficial soil surveys analyzed for inorganic elements have proven to be a useful predictive geochemistry in determining the location of deeply buried exploration targets. Organic components have also been sited as a potentially useful geochemical tool. Bacteria that leach and metabolize compounds from mineral deposits or petroleum plays at depth eventually release hydrocarbons that migrate to the surface. Surficial samples such as soil, sediments, peat, humus, etc. act as collectors of those hydrocarbons. Past researchers have used very volatile compounds in the C1 to C4 carbon series range, and have also hypothesized the use of heavier hydrocarbons. Over ten years of research has been conducted to study and improve upon the use of organic compounds as a geochemical exploration tool. This has resulted in a geochemistry defined as Soil Gas Hydrocarbons (SGH) which extracts the heavier organic compounds in the C5 to c17 carbon series range. These compounds may migrate from depth in a volatile form but are not gaseous at ambient temperature and pressure. The SGH technique analyzes each sample for over 160 specific hydrocarbons at a detection limit of one-part-per-trillion (ppt). The data was reviewed forensically resulting in specific combinations and ratios of the hydrocarbons monitored which defined different organic signatures found to be directly related to the target. The surficial geochromatographic dispersions of these organic compounds has also been researched and found to be able to vector to the location of buried exploration targets. SGH is thus a dual-purpose deep penetrating predictive geochemistry that both locates and identifies the type of target that may be present. The SGH geochemical signature has been demonstrated at successfully locating mineral targets at depths up to 700 meters and has identified targets of uranium, gold, SEDEX, VMS, nickel, copper, polymetallics, and Kimberlite formations from actual surveys.

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Very High Throughput Sample Introduction Strategies for ICP-AES & ICP-MS

Scott W. McGeorge, Transition Technologies Inc. and Daniel Wiederin, Elemental Scientific Inc.

The theory and performance of high throughput sample introduction techniques based on advanced autosampler design and flow injection principles is described. A significant reduction in the time required to achieve a stable aerosol conditions in the plasma and a very fast washout permits increased in sample throughput by factors of 2 to 5-fold depending on analysis and measurements period conditions. Stand-alone complete autosampler configurations, including the SC-nn Fast systems, are described for ultimate performance enhancements. The autosampler independent one Fast system is shown to be relatively low cost pathway to achieving very high throughput using only the analysts existing autosampler equipment. Specialized accessories for signal enhancement and interference reduction are evaluated.

Analytical Needs in The Environmental World

Bob Butler, Environmental Superintendent, Xstrata Zinc - Brunswick Smelter

Advances in signal processing for Inductively Coupled Plasma (ICP) will be discussed as wells as demonstrating the advantages of these advances as they apply to geochemical analysis. Universal data Acquisition (UDA) is a software feature that uses total signal processing and solid state detector technology. This discussion will include examples of data validation, processing of alternate analyte information and Inter-Element Correction Factor (IEC) determination. The flexibility of (UDA) when applied to all of these examples will also be shown.

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Six Sigma Methodology and Measurement System Analysis

André Roussel, M.Sc. Phy., Six Sigma Black Belt, Xstrata Zinc – Brunswick Smelter

Six sigma is a process improvement methodology that has been in use at Brunswick Smelter for almost 10 years. In order to improve a process, it needs to be measured and a key component of the methodology is the measurement system analysis sep. Since the lab at the smelter provides assays to control the smelter process, many six sigma Black Belts have conducted measurement system analysis on the lab. This presentation will introduce the six sigma methodology as a whole and then focus on the measurement system using examples from the Brunswick Smelter lab.