


Assay Laboratories New Technologies

Citi- Mining Exploration Day (27 June 2016)

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www.alsglobal.com





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ALS Business Streams

$2.6bn
Market Capitalisation

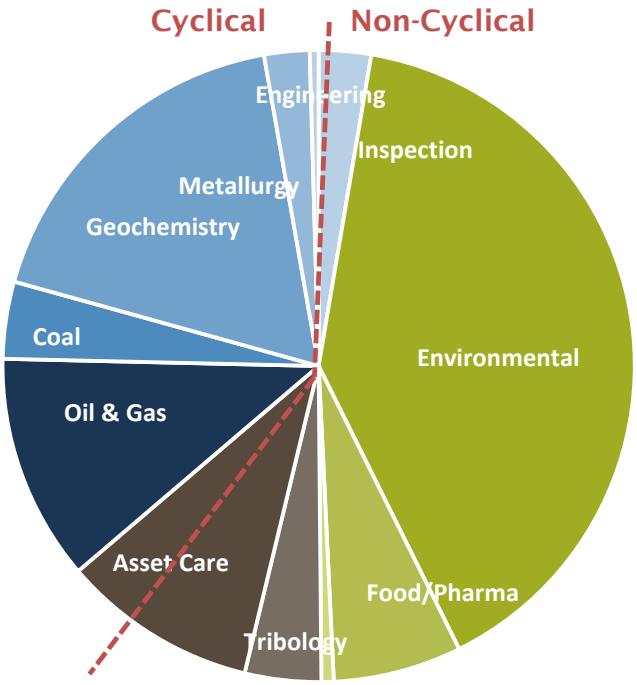
11,500
Employees

$1.4bn
Revenue

65
Countries

370
Operating Sites

FY2016 Revenue



- Environmental
- Food
- Pharmaceutical
- Consumer Products

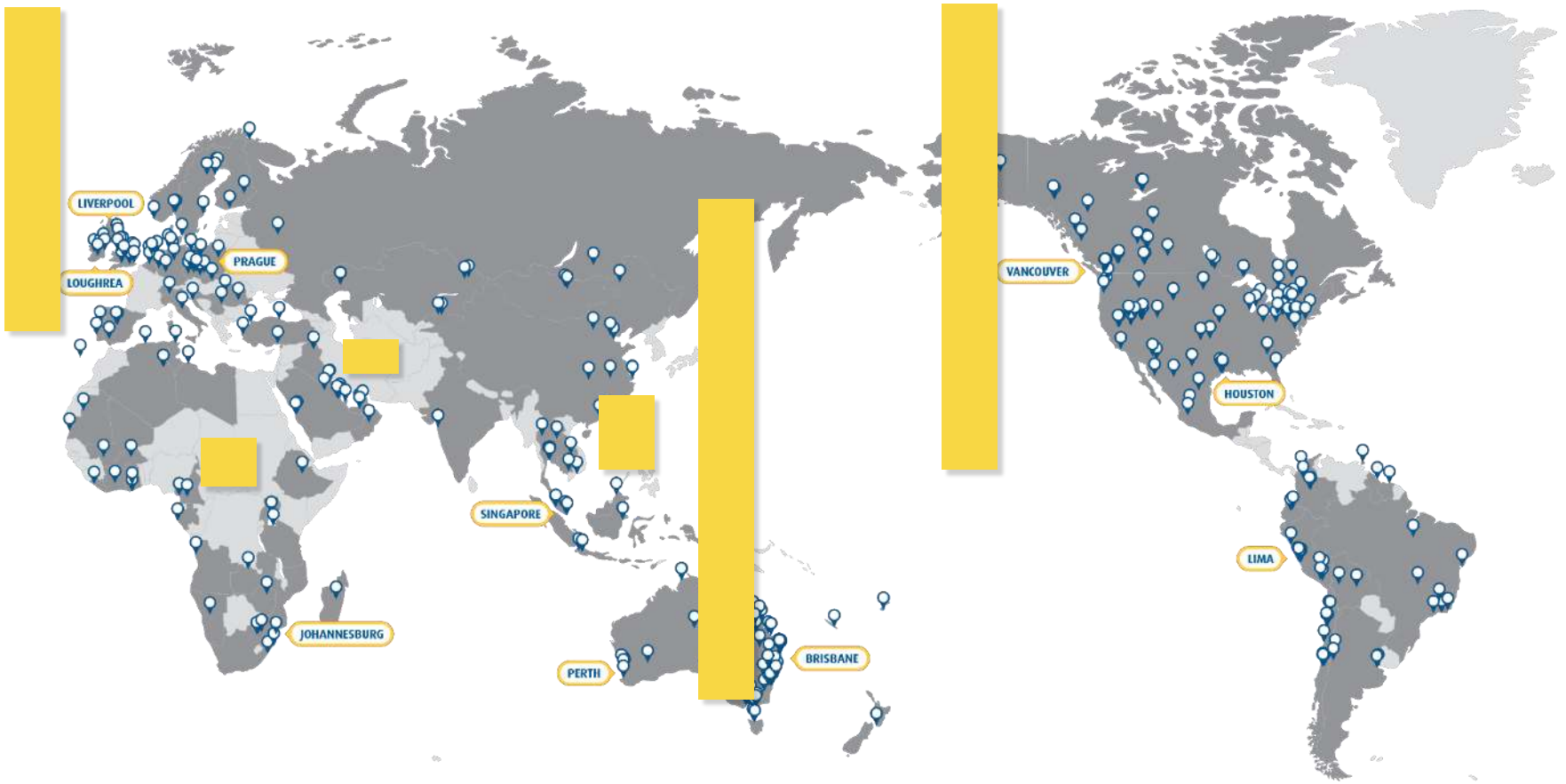
- Geochemistry
- Mine Site
- Metallurgy
- Trade Inspection
- Coal

- Asset Care
- Tribology

- Oil & Gas

Note: the majority of Mine Site work is geochemistry

ALS Locations – A Strategic Asset



Revenue

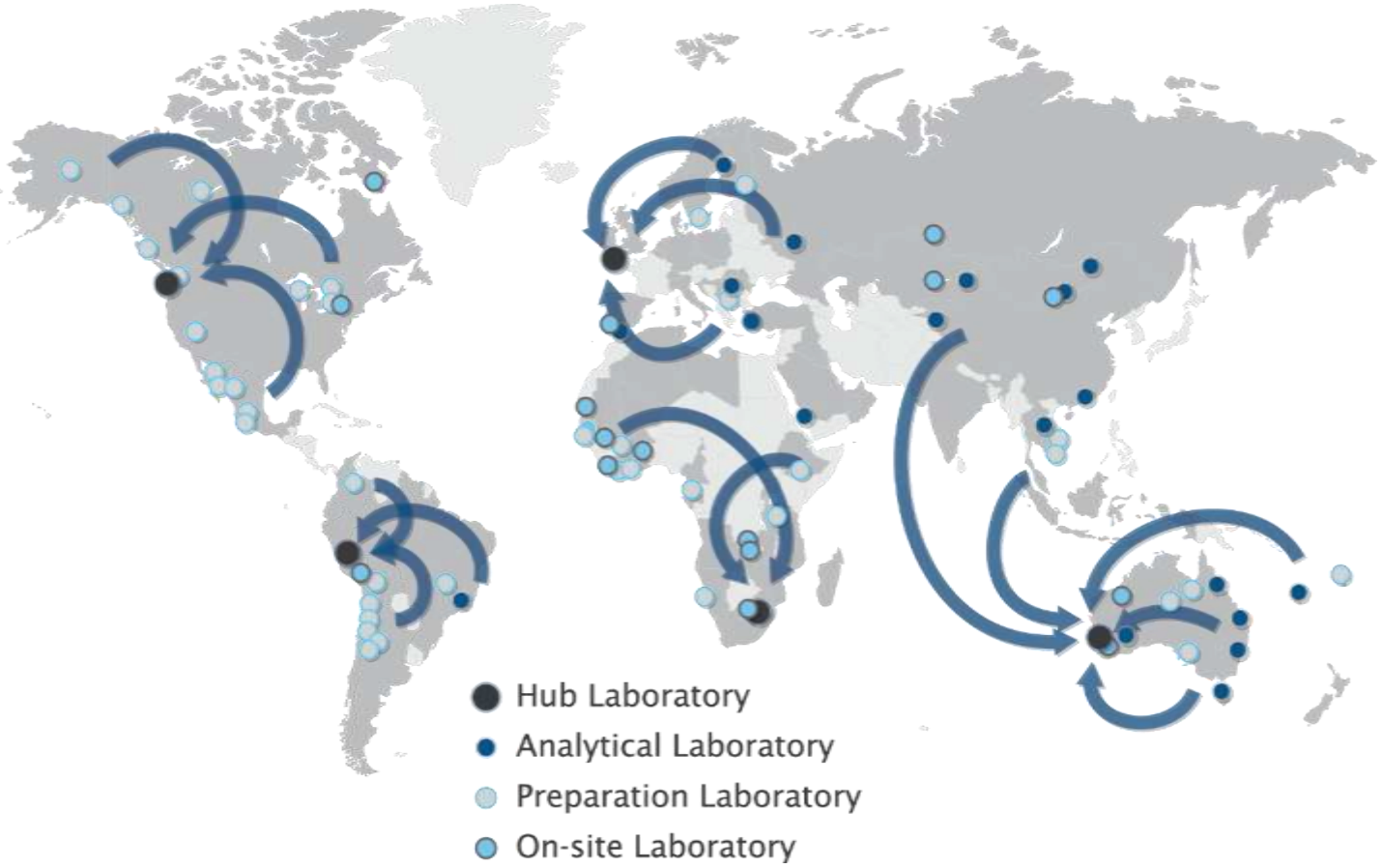
The Hub and Spoke Model in Action

Overview

- Global LIMS
- Single global database
- Standardized methods, equipment and quality
- Logistics tracking

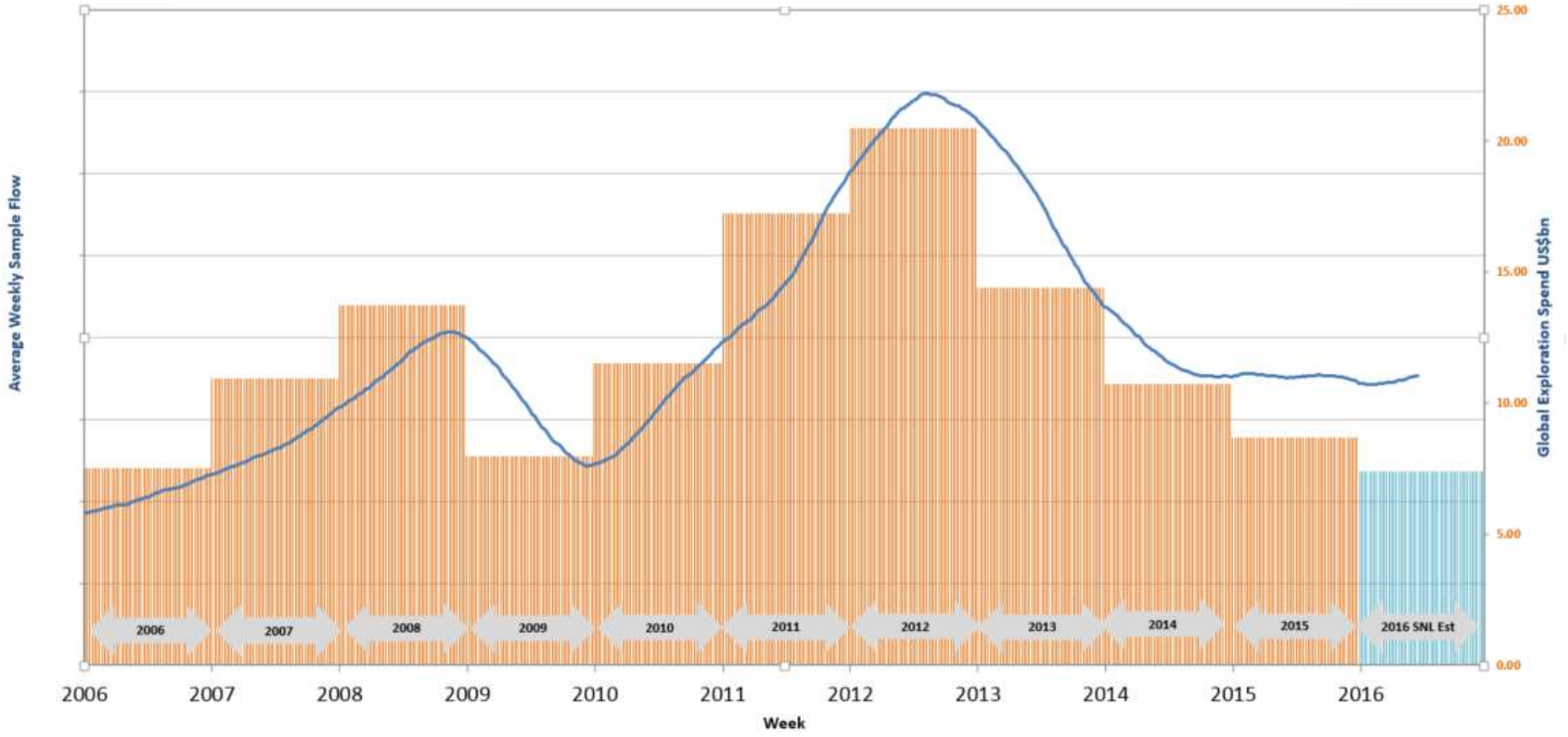
Efficiency & optimal performance (scalability – up & down)

Lower cost base & globally consistent service



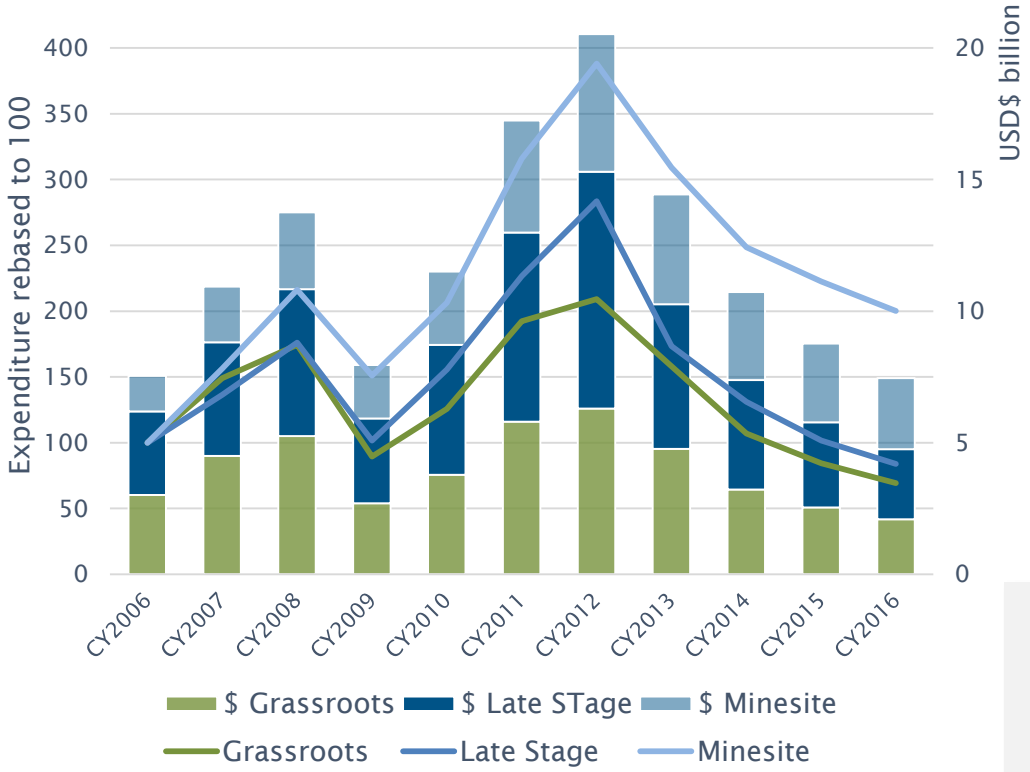
Weathering the Storm

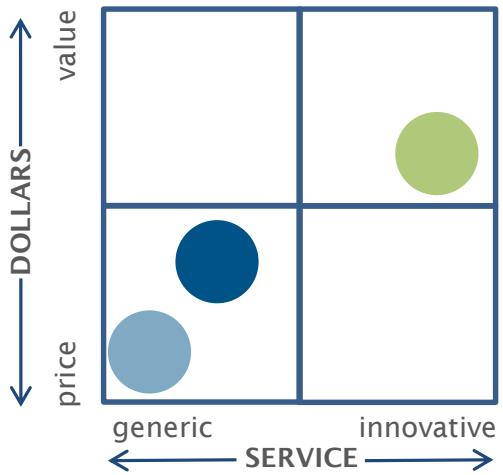
Global Geochemistry Sample Flow (trailing 52 week running average) and Global Exploration Spend



Global Mineral Exploration Market

Market Trends





ALS continued investment to maintain technical capabilities and feed innovation to high end value added services

ALS focus on systems, productivity and cost base to maintain volume in generic services market sector

Extracting greater value from Analysis Dollars – Easier to find the Haystack than the Needle!

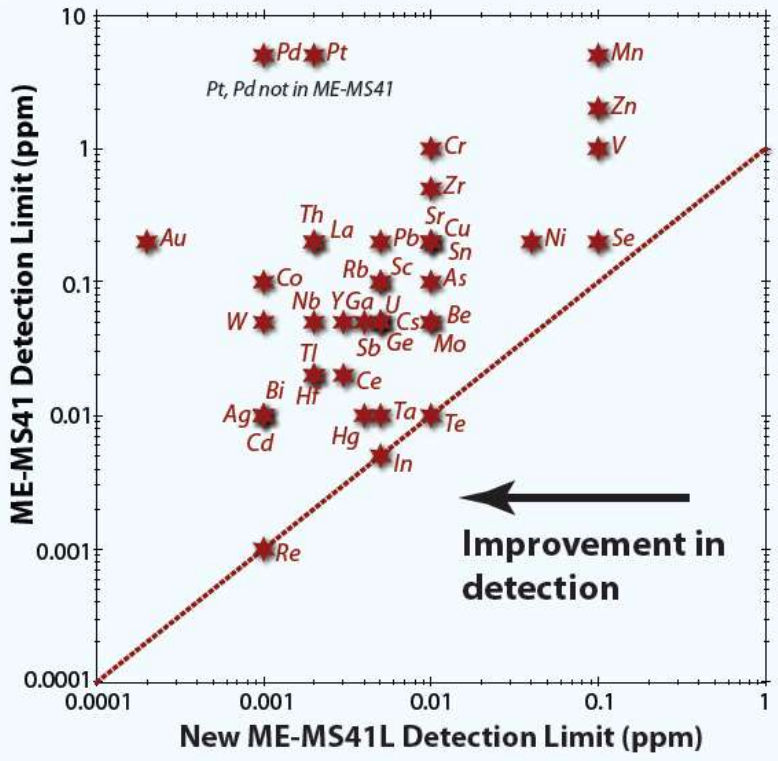
- **Super Ultra Trace Analysis for Soils and Sediments**
- **Selective Extractions**
  - Ionic Leach™
  - Clay Fractionation
  - Vegetation Analysis/BioGeochemistry
  - HydroGeochemistry
- **Isotopic Analysis**
  - Pb Isotopes
  - Carbon and Oxygen Isotopes
- **Mineralogy**
  - Hyperspectral
  - Traditional
- **Rapid Portable XRF Analysis**
- **Instrumentation and Equipment**

Super Trace Analysis for Soils and Sediments

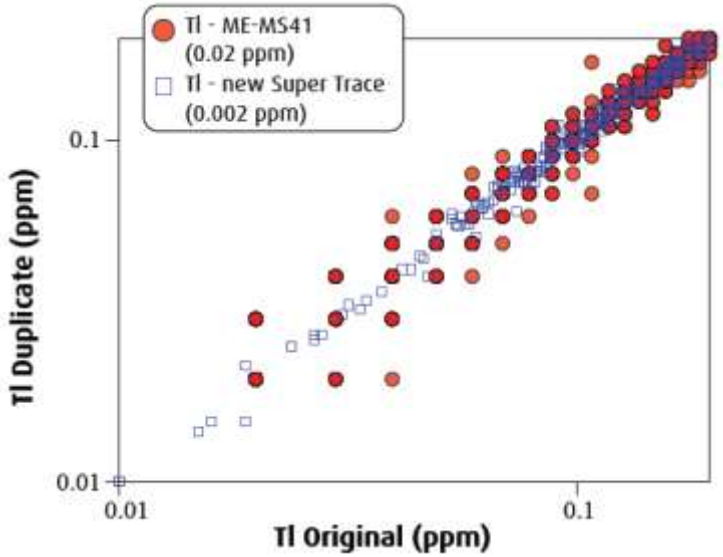
Advancements in ICP/MS Technology – Partnering with Instrument Manufacturers:

- Increased Sensitivity
- Improved Sample Introduction Techniques
- Engagement of Collision/Reaction Cell Technology

- **Higher signal-to-noise ratios**
- **Lower carryover effects**
- **Reduced mass interferences**
- **Detection limits 10-100 times lower than standard ICP-MS packages**
- **Increased precision**

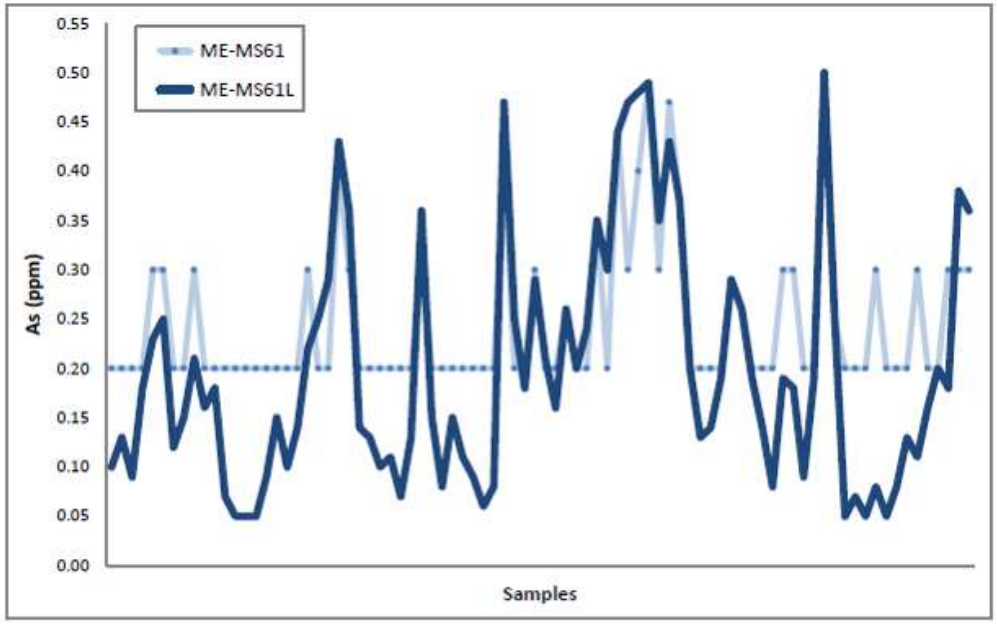


Increased Confidence in Data



Super Trace Analysis by ICP-MS

The precision of a measurement depends on detection limit, method tolerance, and concentration. Lowering detection limits removes analytical noise and may reveal anomalous patterns at levels previously unattainable, as with the example of arsenic.

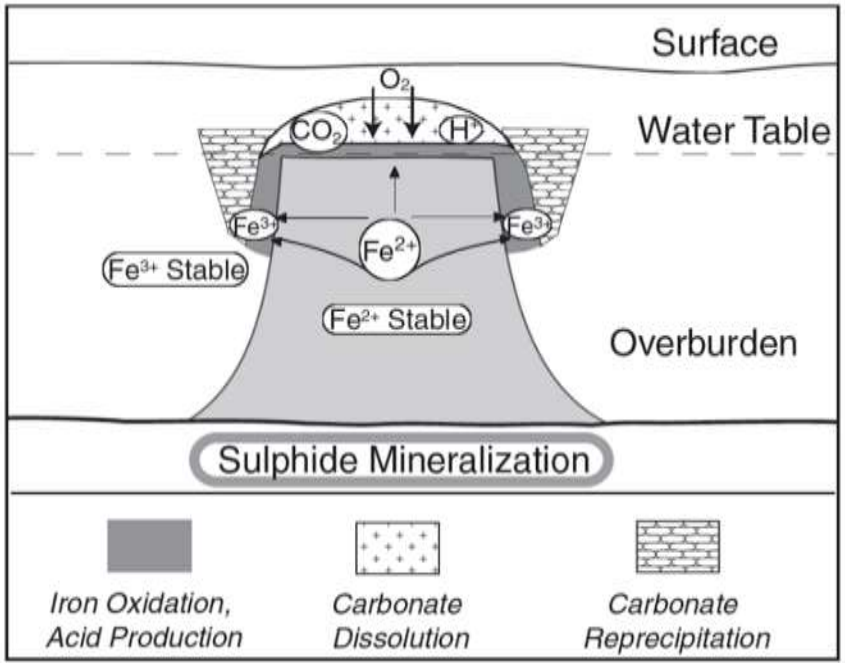


Detection limits below regional background for key pathfinders like Tl, Sb, Te, Cd, Se and As facilitate clear definition of anomalous patterns in unmineralised core.

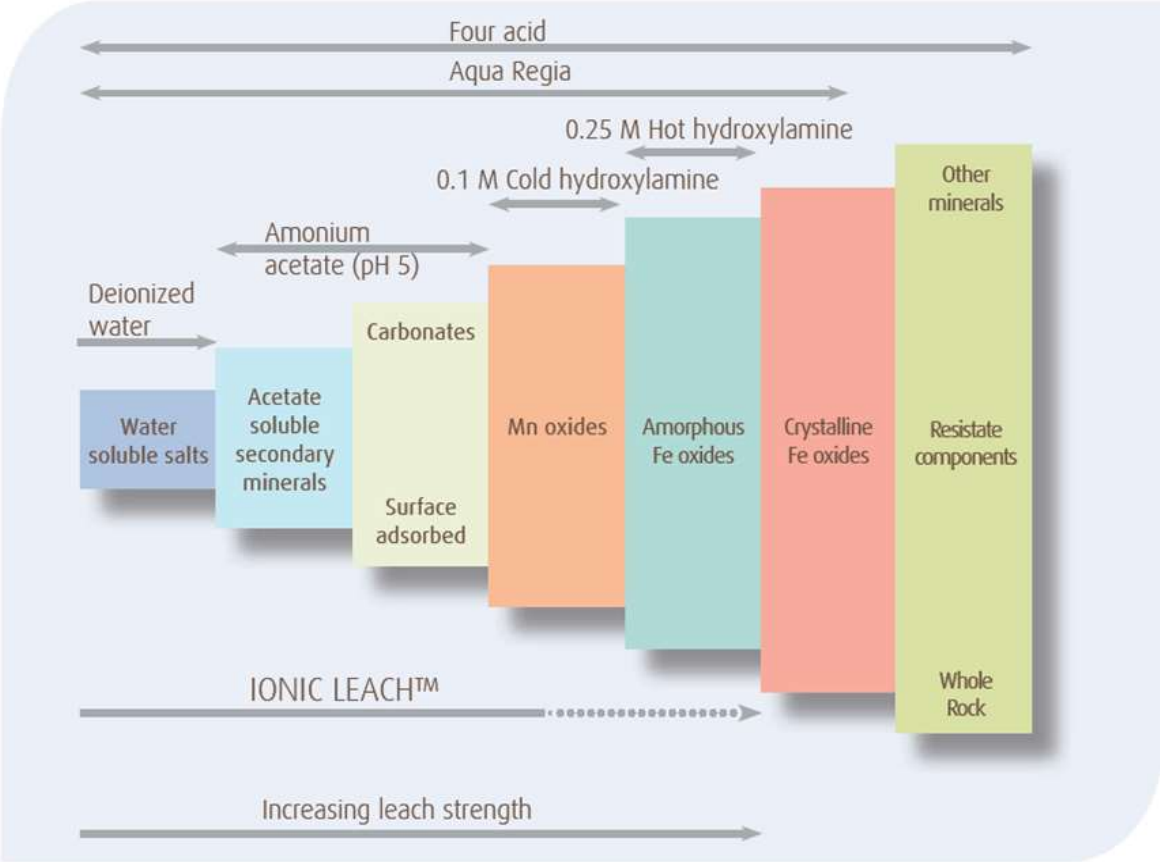
Ionic Leach™ – A 'Selective' Concentration

Differentiating Metal Transport Mechanisms:

- Mechanical Means
- Chemical/Ionic Transportation
- Weakly bound metals can be characteristic of underlying mineralization



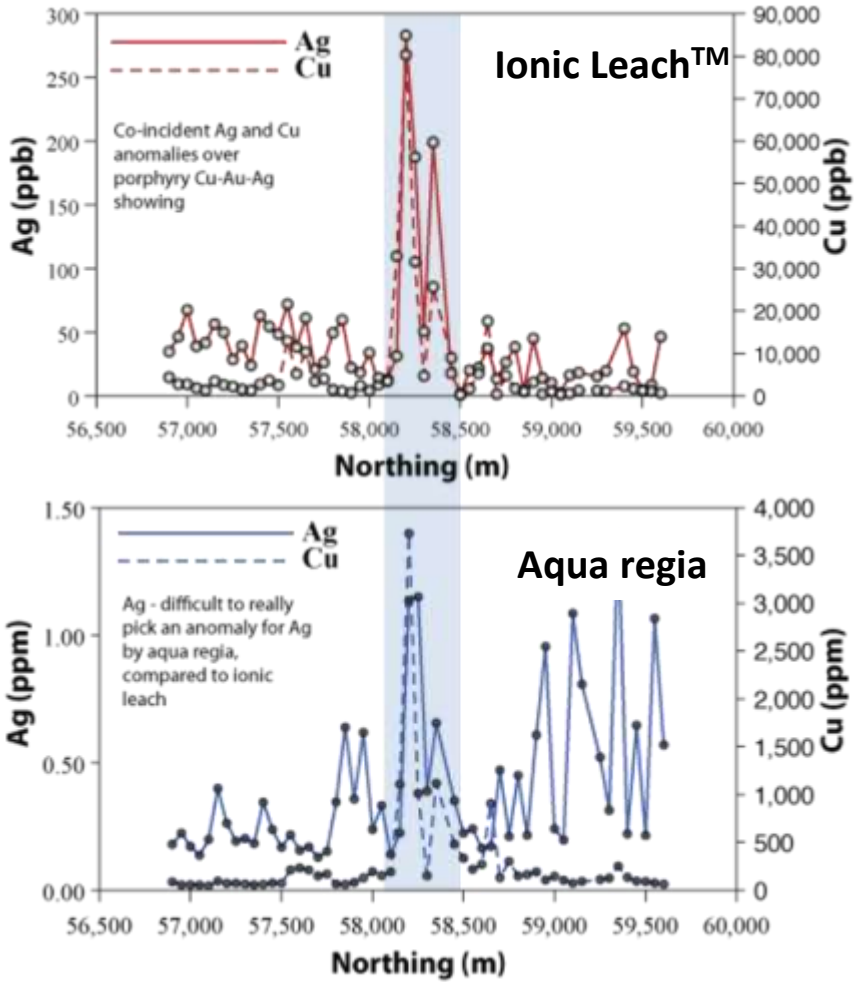
Leach Method and Target Mineralogy



Digestion methods target different components of a soil or sediment pending strength of the leaching media.

Ionic Leach™ is designed to extract commodity and pathfinder species that are weakly bound to oxide surfaces or within carbonate minerals in a soil

Case study: Ionic Leach™ and Aqua Regia



Results of orientation survey comparing Ionic Leach™ with aqua regia digest

Blue band = known Cu-Ag (Au) mineralization.

Both Ionic Leach™ and aqua regia show excellent anomaly/background contrast.

Co-incident Ag anomaly with Cu and high anomaly/background contrast for Ag by Ionic Leach™.

Ionic Leach™ was the better choice for this deposit type.

Clay Fraction Separation – A 'Physical' Concentration

Standard Soil Prep
80 mesh screen

→ **Bulk fraction for analysis**

↓

Sonicate with water & dispersant

Sonicating disaggregates and suspends clay size particles

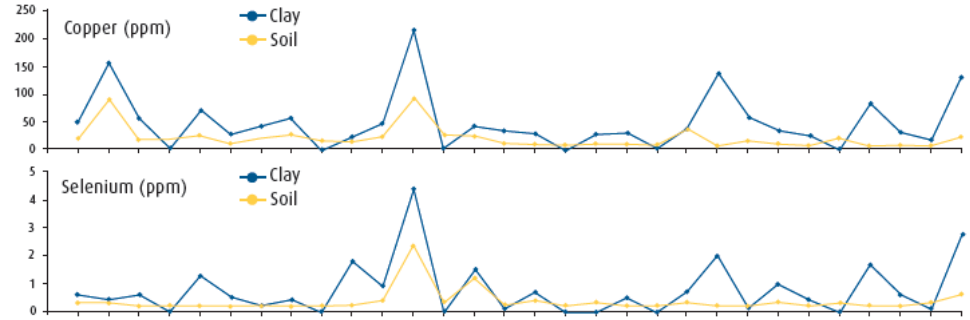
↓

Centrifuge to remove silt & sand

Faster than wet screening, this procedure has been in use for decades in research

↓

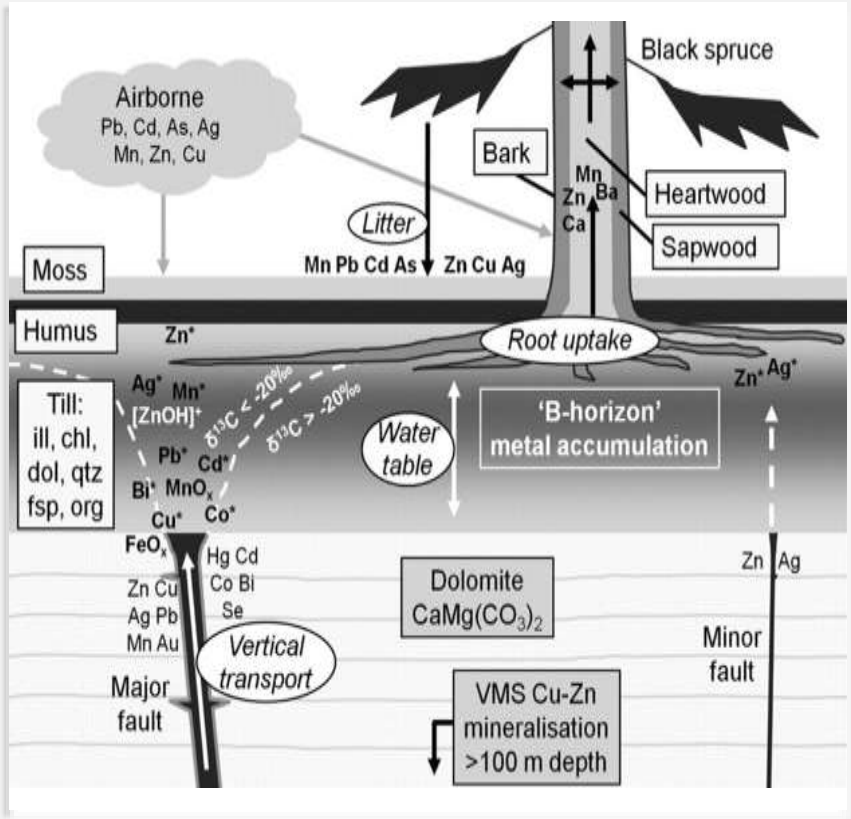
Clay-sized fraction for analysis

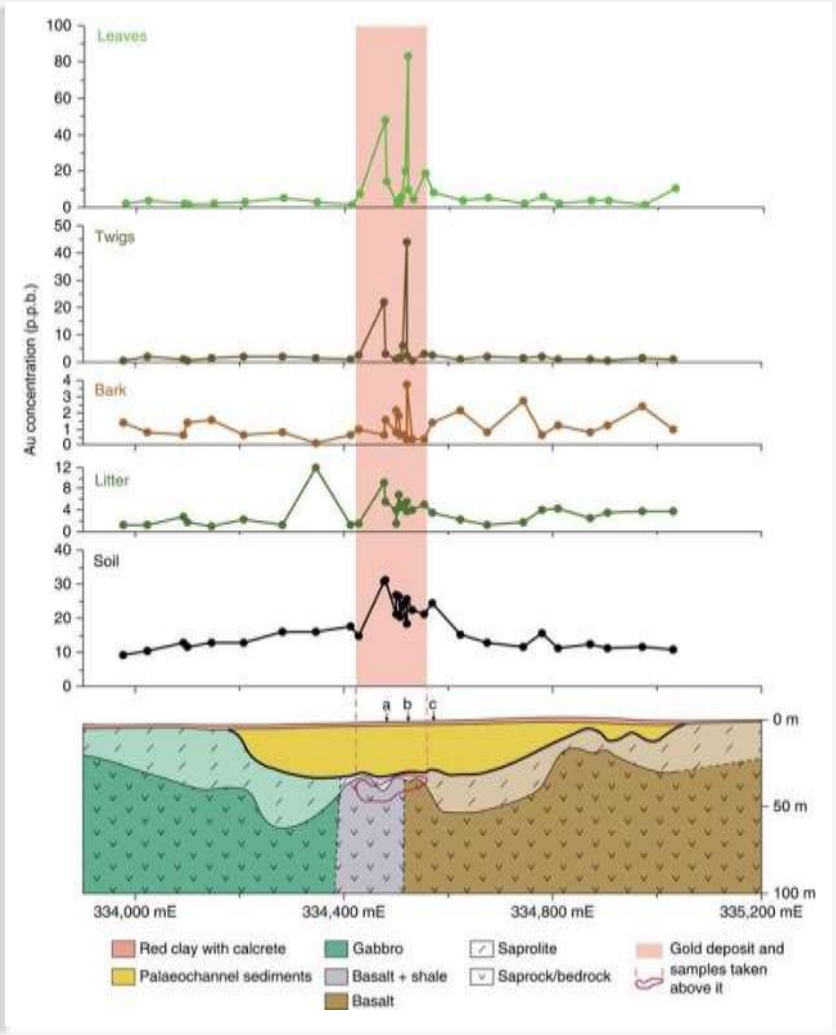


These results are from a B-horizon soil survey line over a copper porphyry with super ultra trace ICPMS detection.

Results from the bulk soil (standard option for soil analysis) and results from the clay fractionation are overlayed.

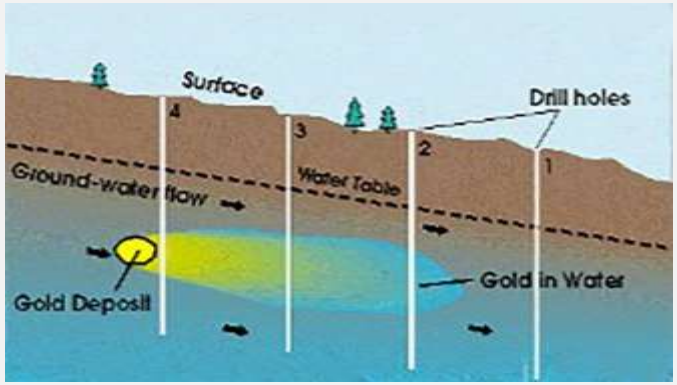
Vegetation Analysis – A 'Natural' Concentration





HydroGeochemistry - Water as an Exploration Medium

Drill-Hole Hydrogeochemical Anomalies



Much like vegetation, water as a sampling media has some unique advantages:

- Sample is influenced by a large volume of subsurface material
- Samples deeper horizons than soils
- Subsurface flow is easily modelled thereby providing a **Vector** towards the ore zone

Isotopic Analysis – Exploration Applications

Stable isotopes are useful for:

- Understanding sources of fluids
- Understanding water-rock reactions
- Determining sources of metals
- Determining temperature of alteration

Radioactive and radiogenic isotopes are useful for:

- Fingerprinting metal sources
- Age dating of geological materials – the main control is time, which depends on the half-life of decay
- Vectoring to mineralization

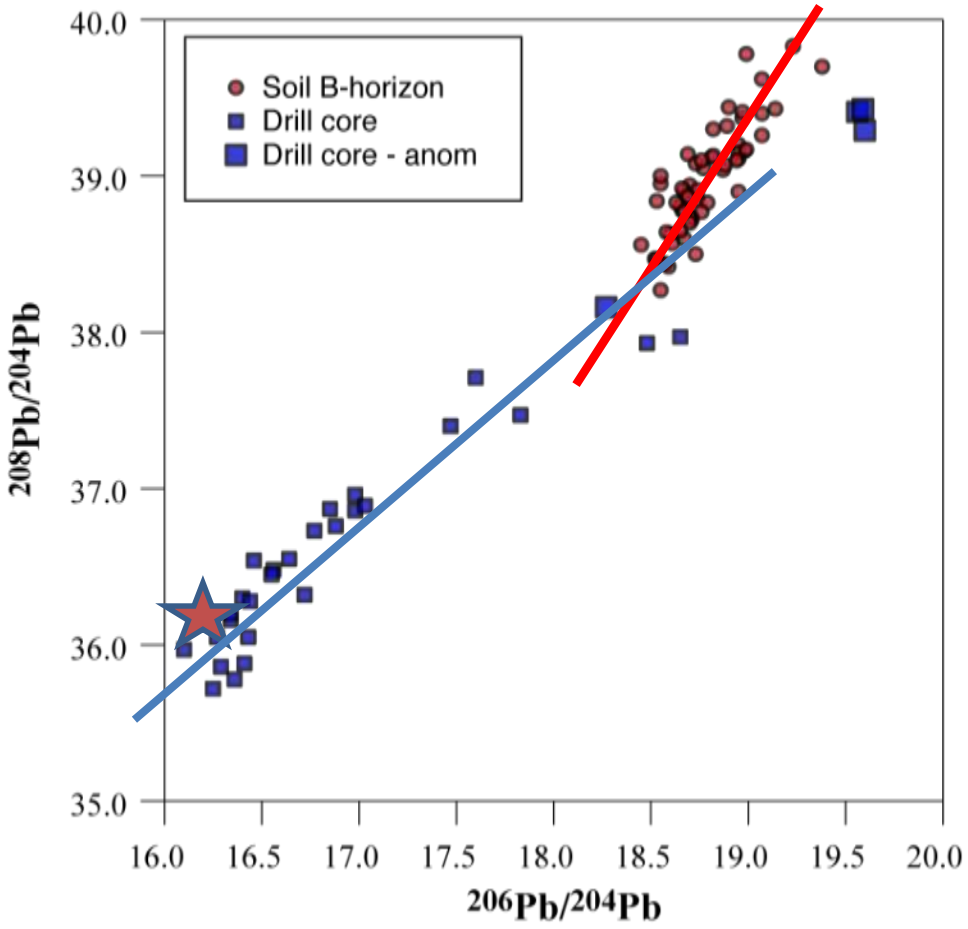
Pb Isotope Analysis

Real samples from massive sulfide mineralization.

Drill core data shows mixing trend between low Pb ratios (non-radiogenic) from the ore to higher Pb ratios (more radiogenic) in the country rocks.

Soils data show a tighter cluster with a different slope.

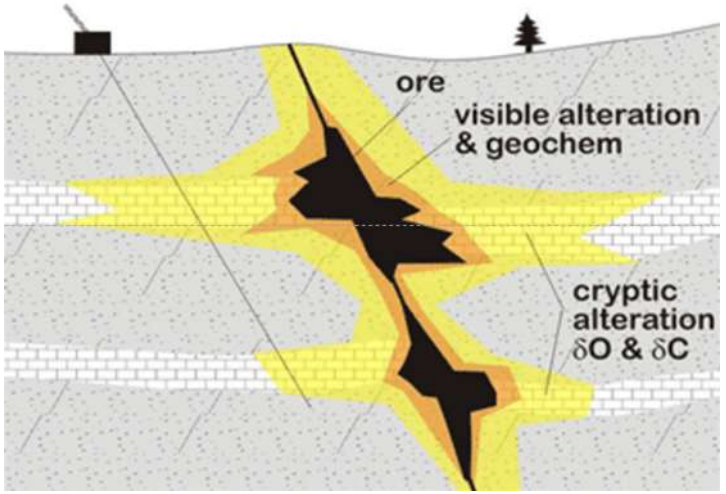
Either the soils are far from mineralization, or they have a different source of Pb compared to the drill core samples close to ore.



Carbon and Oxygen Isotopes in Carbonates

- Isotopically unaltered
- Visually unaltered

- Isotopically altered
- Visually unaltered



MDRU
Mineral Deposit Research Unit

Hyperspectral Mineralogy

The value of Spectral Mineralogy is widely understood and adds valuable information to all phases of mineral exploration and development projects.

To Date uptake has been **hindered** by:	
	Skills required for data acquisition
	Complexity in interpretation of spectra
	Quantification of spectral results for input into databases
	Data integration with other project data

Family of Hyperspectral services

Applications:

- Exploration Pathfinder
- Extractive Metallurgy
- Blend Characterization
- Plant Performance Optimization

Family of Hyperspectral services

TerraSpec
1-1.5 meters

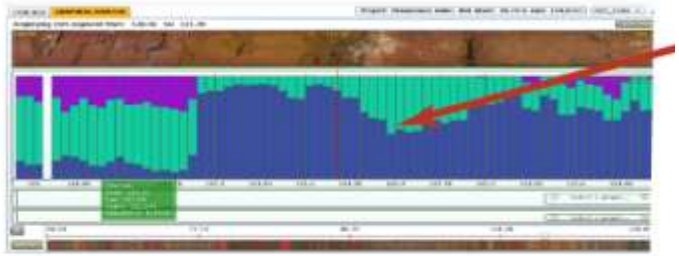
Example of data output using TerraSpec® point testing in combination with core images

Spectral mineralogy collected on

Results binned for entire hole

ASD Inc. IS NOW PANalytical

HyLogger
10-25 mm

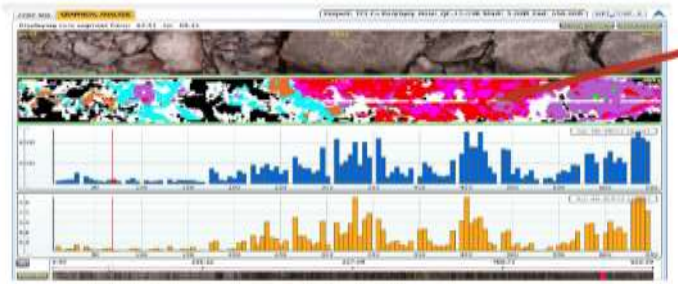


Example data integration using HyLogger™ continuous scanning in combination with core images.

Mineralogy at the centimeter scale

AusSpec International
extracting value from spectral data

TCI - TerraCore
core scanning
1 mm

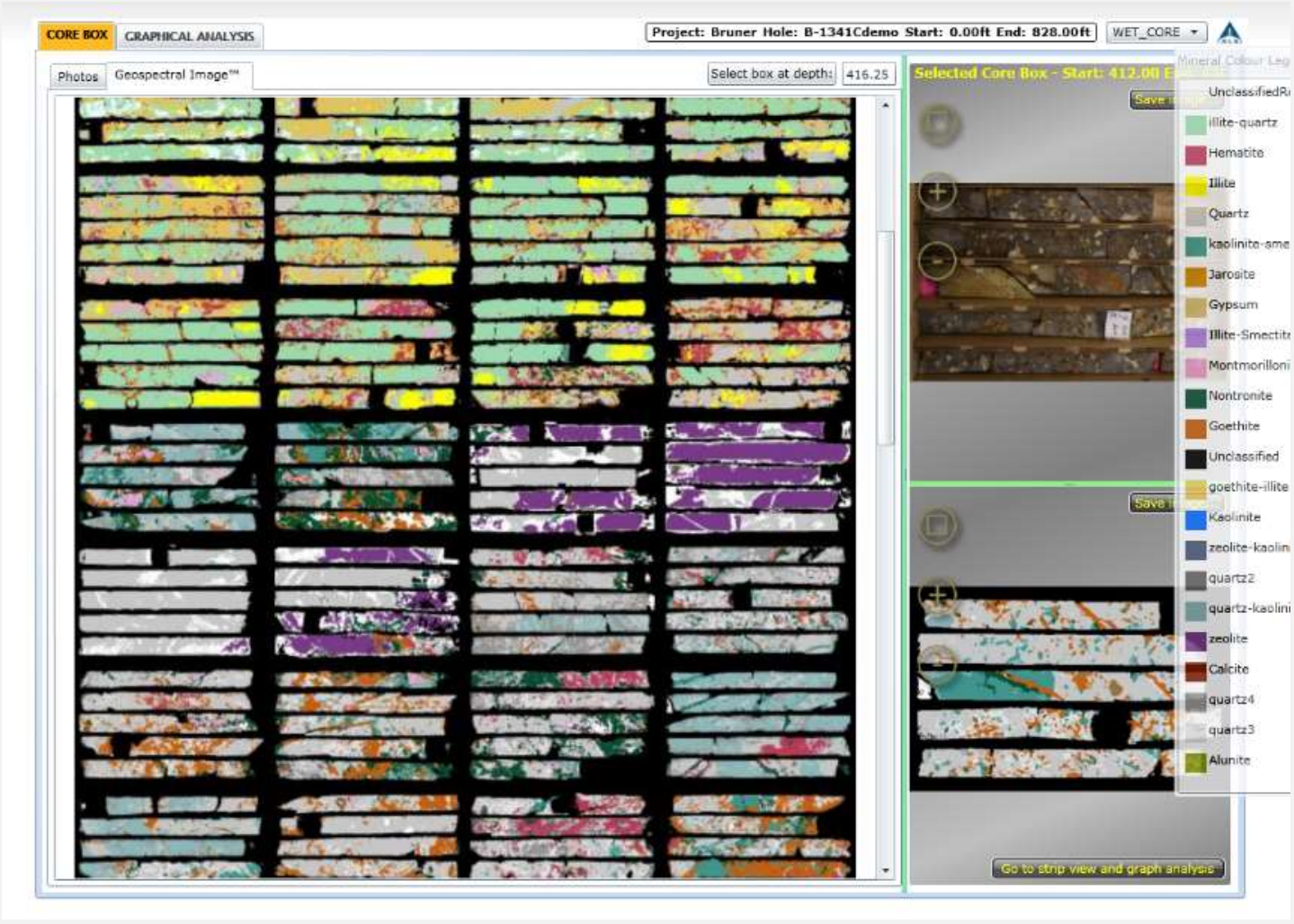


Example data integration using Core Imaging Spectrometer™ continuous scanning in combination with core images.

High resolution GeoSpectral Image™ - each pixel = 1 mm

TERRA CORE INTERNATIONAL

Visualization with ALS CoreViewer™

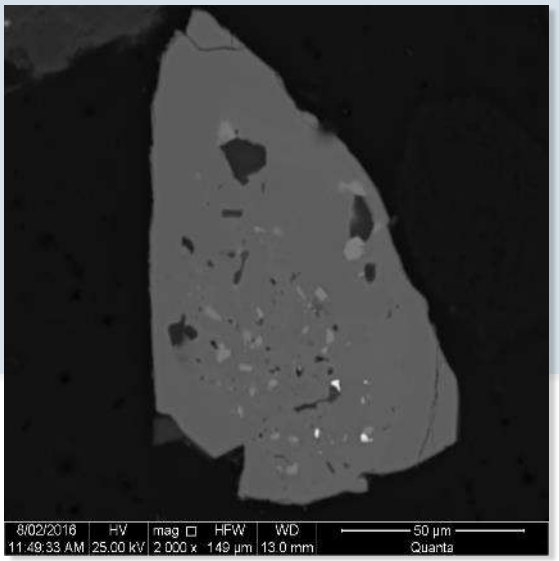


Visualization with ALS CoreViewer™

Traditional Mineralogy Services

Mineralogical examination services

- **XRD, QEMScan, MLA & Microscopic examinations.**
- **Mineralogical examination services provide information towards:**
  1. Process plant trouble shooting
  2. Future ore body characterisation
  3. Process flowsheet development



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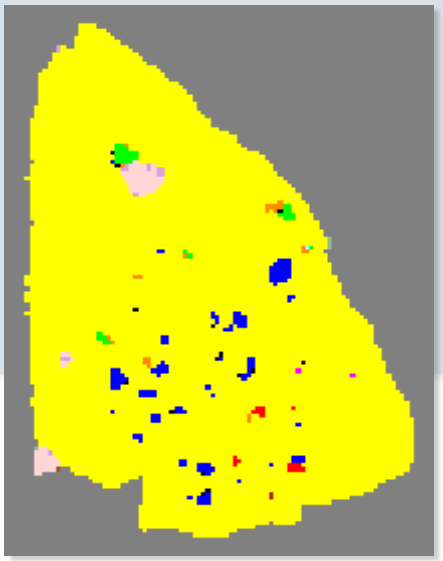

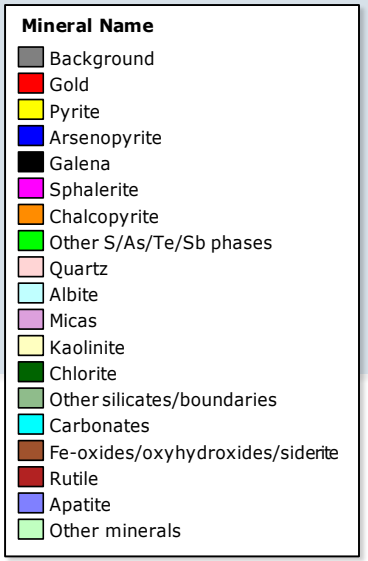

Portable XRF Analysis

A semi-quantitative scan aimed at quickly identifying anomalies.
Key exploration elements are reported at detection limits relevant to aiding in drilling decisions.

Why offer portable XRF in labs?

1. Sample homogeneity by running the analysis immediately after pulverisation
2. Quality control using internal standards, regular calibration checks, etc.
3. Very fast turnaround time through efficient staffing and prep lab management

Instrumentation & Equipment

Robotic Fusion, TGA and XRF Analysis

Robotic Sample Preparation

Advances in Instrumentation

Microwave Plasma ICP/MS

- No flammable gas
- No compressed gas

Synchronous Dual View Torch Technology

- Reduced run time (Radial + Axial View)
- Environmental & Geochemistry applications

Thankyou

More details on all services available in Technical Notes at www.**alsglobal.com**