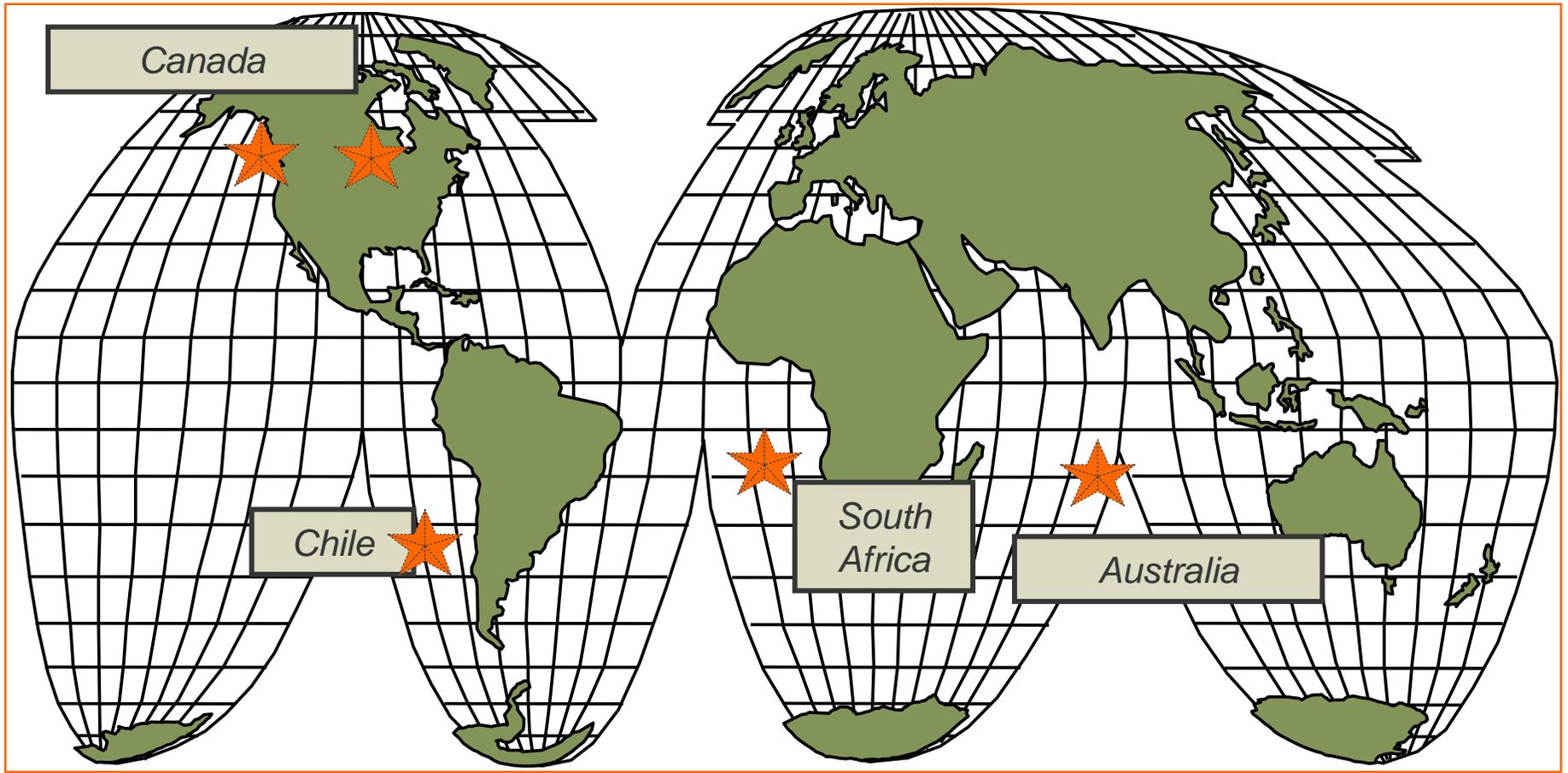


ADVANCED MINERALOGY FACILITIES

WHEN YOU NEED TO BE SURE





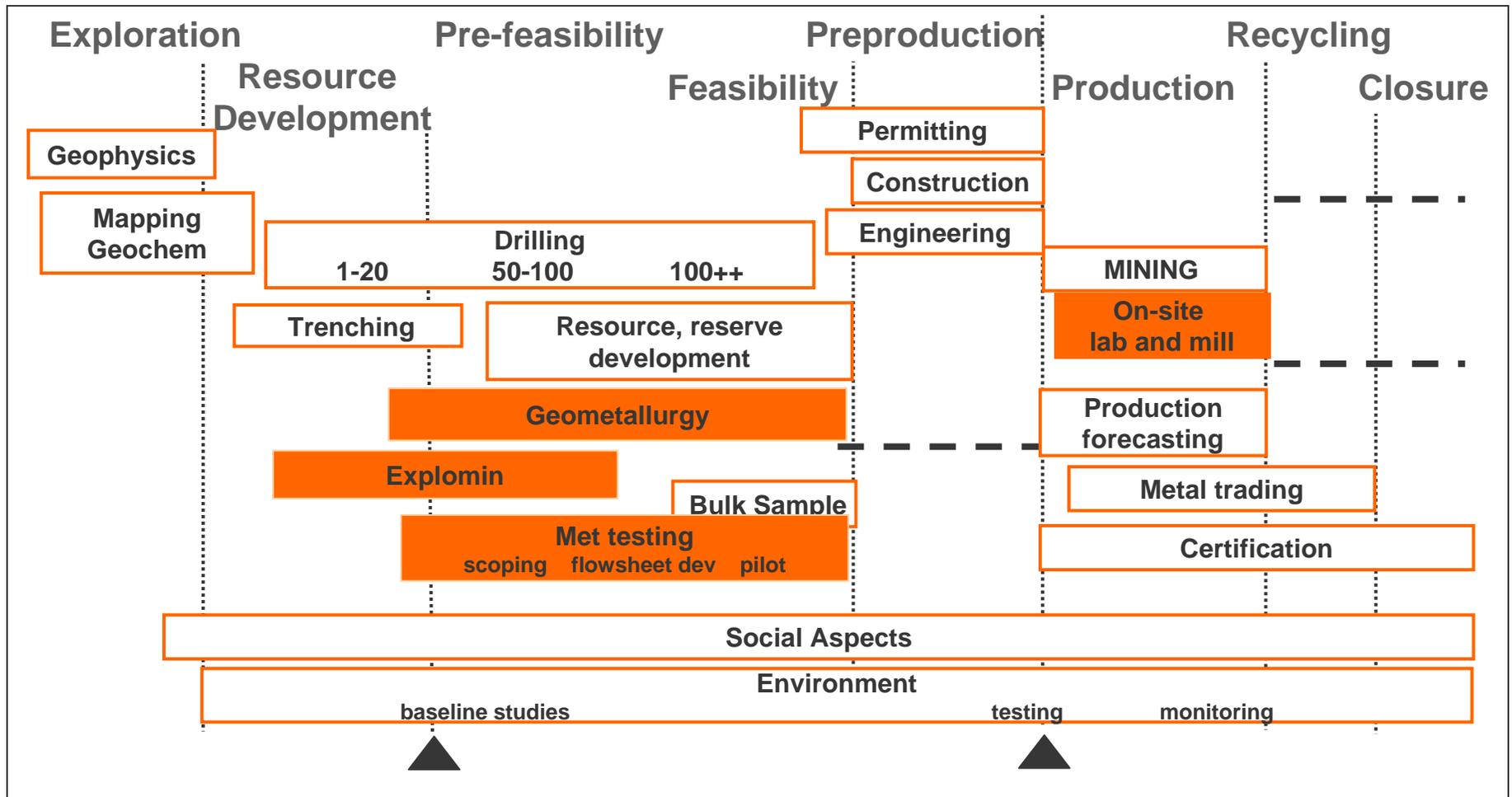


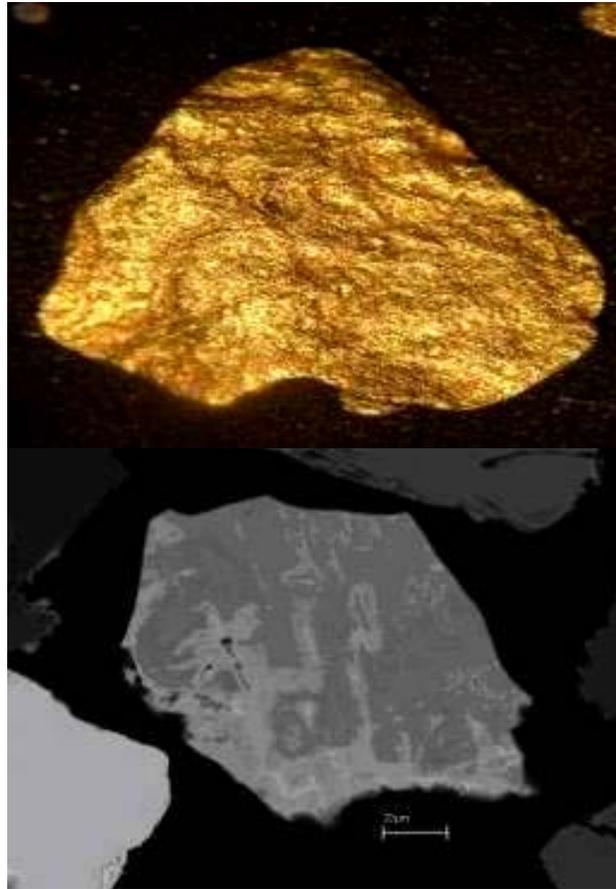
- Lab network providing automated process mineralogy services
 - QEMSCAN (10 yrs experience, 200+ projects, 10 instruments, 4 countries)
 - XRD, SEM, electron microprobe
 - Image analysis
 - Petrography (PTS, PS)

- Applications
 - Exploration mineralogy
 - Geometallurgy
 - Metallurgical flowsheet design support
 - Ore variability characterization
 - Plant control and optimization
 - Environmental and mine planning

- Laboratories dedicated to providing high definition mineralogy services to high volume users
 - Several instruments, technologies
 - Set of methods to provide “fit-for-purpose” data
 - Staffed by technicians backed by scientific expertise
 - Statistically grounded, quality control monitored
- Operational model similar to geochemical laboratory
 - Fee schedule with different test packages
 - High volume, high through-put
 - Standardized methods
 - Custom work available on request
 - Pay-as-you-go or strategic partnership
 - Consulting is separate and readily available

WHERE MINERALOGY REALLY CONTRIBUTES





- Gold
- PGM
- Uranium
- Base metals (Cu, Zn, Pb, Ni, Co)
- Heavy mineral sands (Ti, Zr, REE)
- Diamonds
- Tin, tungsten, tantalum, niobium
- Iron Ore, manganese and chrome
- Industrial minerals
- Refractories, slag & smelter products

- Exploration mineralogy
- Ore characterization
- Petrographic descriptions
- Paragenesis, ore associations & modeling
- Precious metal department (Au, PGE)
- Mineral identification by XRD
- High definition mineralogy and liberation analysis
- Process mineralogy (predictive metallurgy, trouble shooting, process control, plant optimization, etc)
- Geometallurgical mapping
- Environmental mineralogy
- Forensic mineralogy
- Sample preparation and custom lapidary services

VALUE OF ADVANCED MINERALOGY SERVICES

- Exploration target definition
- Risk reduction
- Control and optimization
- Feed-forward control
- Ore-type definition
- Mining planning strategies
- Environmental planning
- Economic analysis
- Future cash-flow forecast

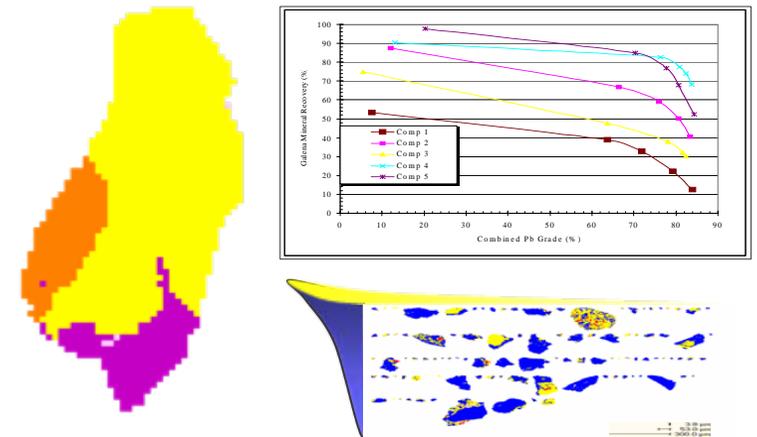
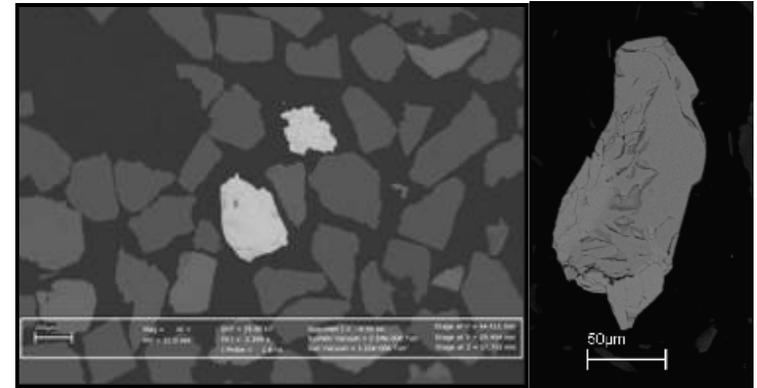
WHAT IS QEMSCAN?

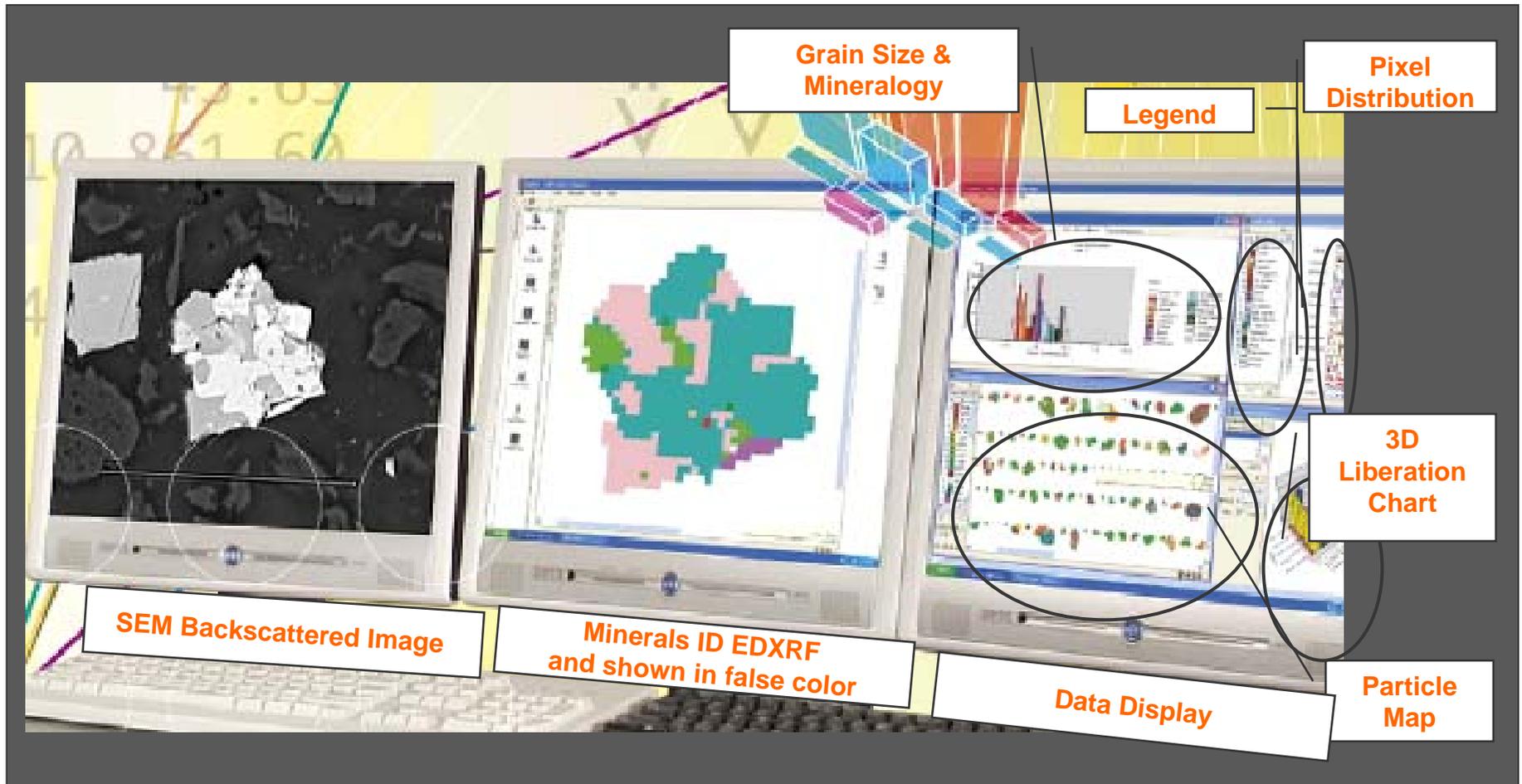
- Quantitative Evaluation of Minerals Using Scanning Electron Microscopy
 - Mineralogical instrument that generates high volume, rapid, reproducible analysis. Consists of:
 - Zeiss EVO 50 scanning electron microscope
 - Gresham SiLi LN2 energy dispersive X-ray fluorescence
 - iExplorer software

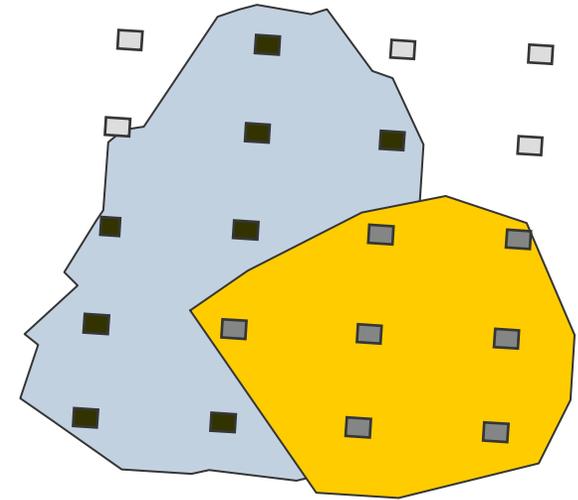
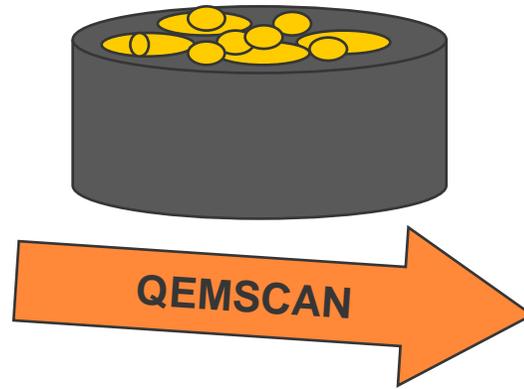
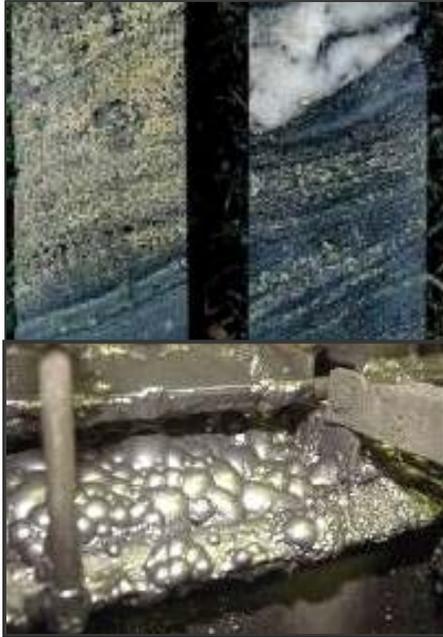


QEMSCAN OPERATIONAL PRINCIPLES

- SEM maps all grains in the section
 - Measures and maps particles at a defined resolution (2–10 μm)
- iExplorer selects particles based on the backscatter electron intensity
 - Creates pseudo-images in false color
- ED-XF identifies minerals on basis of chemistry
- iExplorer extrapolates the locking-liberation characteristics







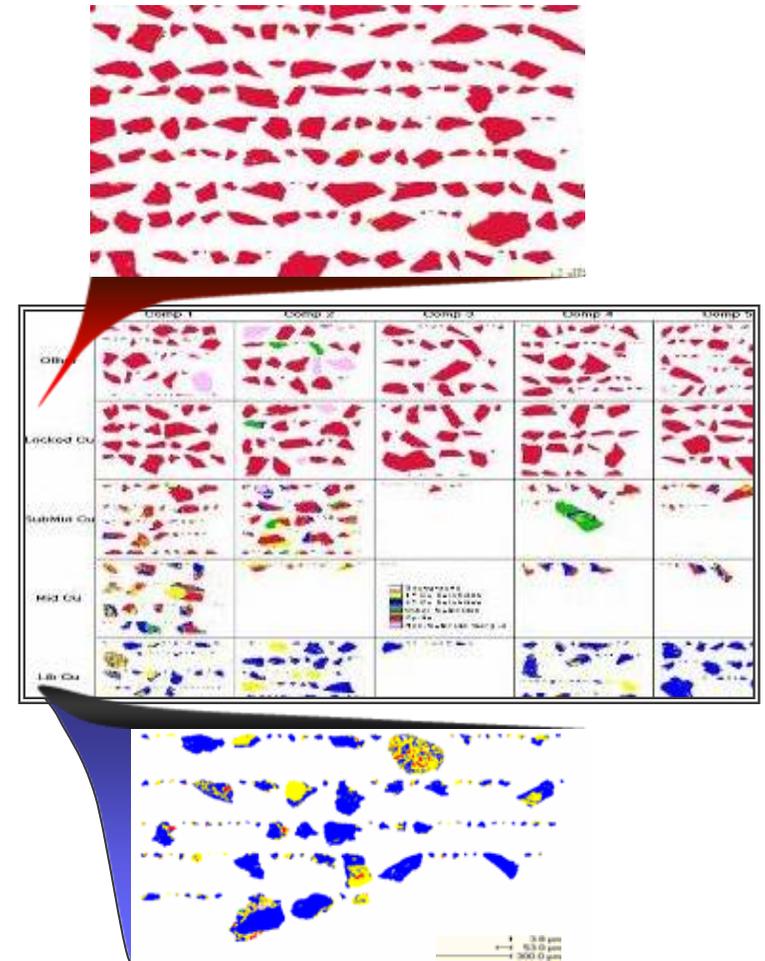
Data collected and measured:

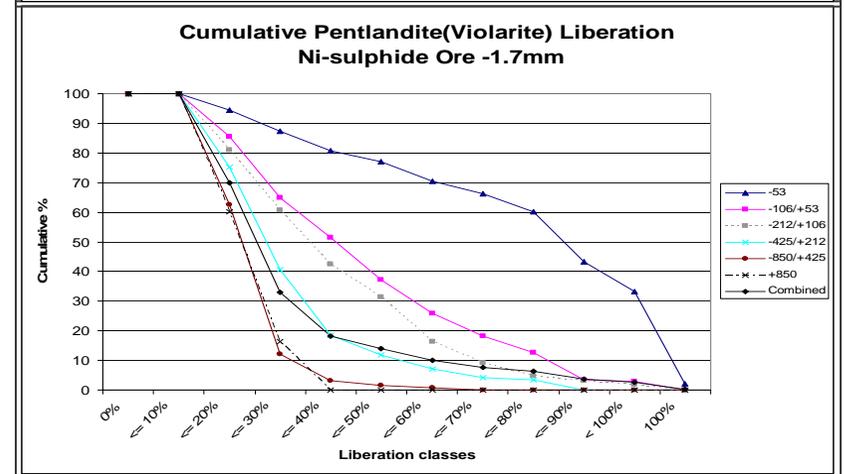
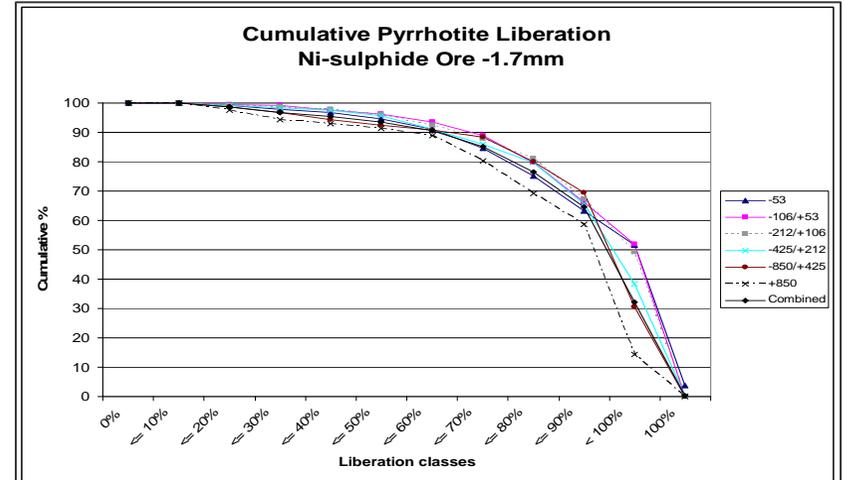
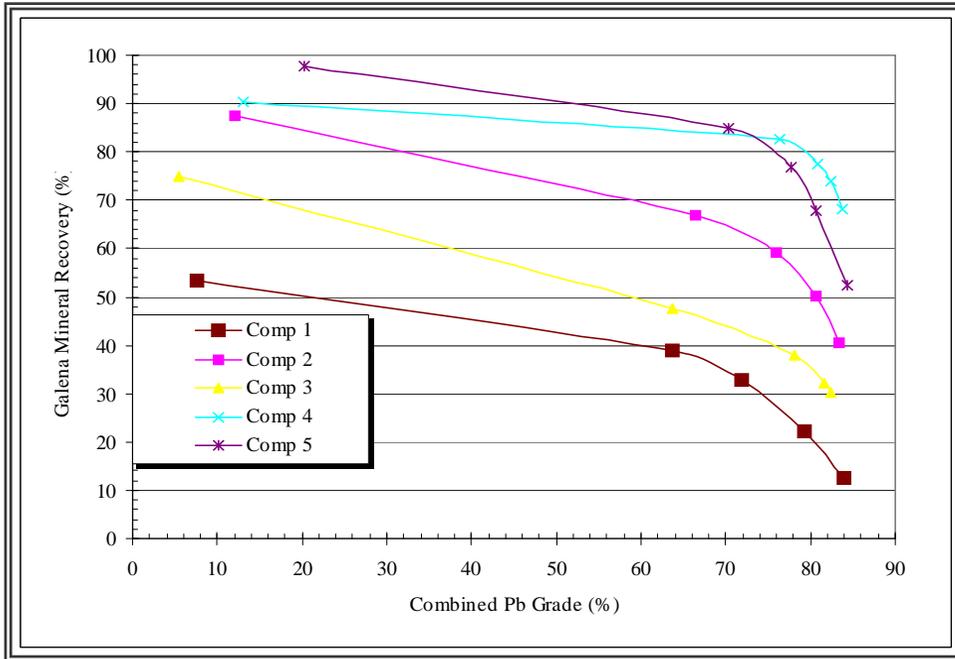
- Identification of all minerals
- Grain size and abundance
- Modal mineralogy

- Particle size, shape factor
- Liberation characteristics
- Mineral associations

Pixel spacing and count time determine statistics

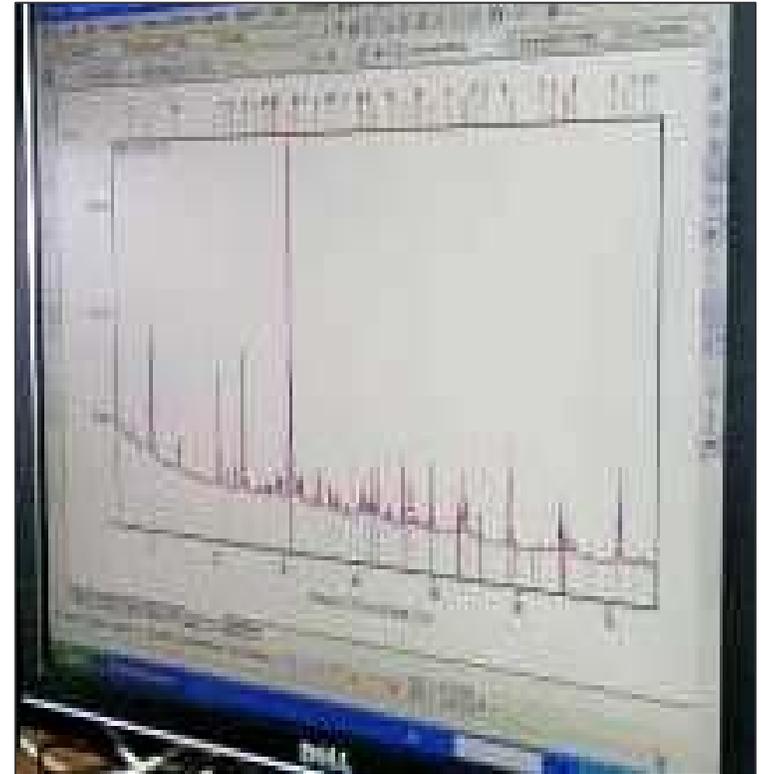
- Data available
 - Particle size
 - Mineral content
 - Mineral grain size
 - Mineral liberation
 - Mineral-mineral ass'n
 - Shape factor







MINERAL IDENTIFICATION BY CRYSTALLOGRAPHY



- High Definition Mineralogy
- QEMSCAN, electron microprobe, XRD, image analysis, optical petrography
- Geometallurgy, exploration mineralogy, ore characterization, liberation modeling



- High Definition Mineralogy
- Geometallurgy
- Ore characterization
- Metallurgical product analysis

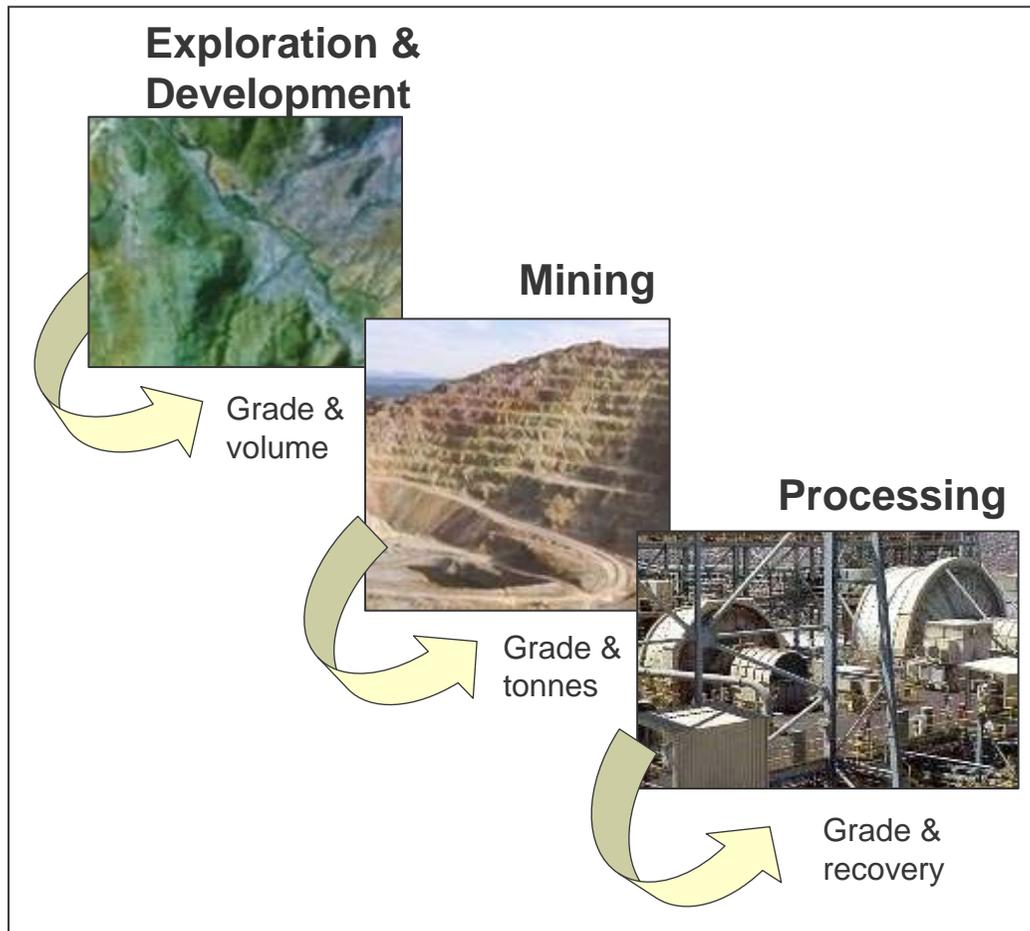


- High Definition Mineralogy
- Precious metal department
- Geometallurgy
- Ore characterization



- High Definition Mineralogy
- QEMSCAN, image analysis, optical petrography
- Geometallurgy, exploration mineralogy, ore characterization





- Exploration
- Geometallurgy
- Process design and development
- Plant metallurgical quality control
- Plant optimization
- Production forecasting

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WHEN YOU NEED TO BE SURE

