

# What and why geometallurgy?

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# GMT's offer



- GMT GeoMet Tech brings
  - The leading geometallurgical methodologies to be applied to your new project
  - MetMatch product will benchmark your project and guide you on what to consider for the project development
    - (MetMatch to be launched Jan 2010)
- This will
  - Help reduce your project technical risk
  - Enable you to learn from similar operations and fast track the project development
  - Enable you to economically optimise the project

# Introduction

- *Geometallurgy is the study of the drivers of metallurgical response that lie in the geology and mineralogy of the rock that is exploited.*
- Why is that important?
  - It provides us a framework or methodology to go about new project development
  - It enables us to technically optimise a new project's economic return
  - Enables us to learn from existing / past operations

# The Geometallurgical Framework

- Rooted in the geological / mineralogical sub-domains that exist in a deposit
- Considers metallurgical parameters at an early stage of project development
- Take spatially discrete samples of all those sub-domains for metallurgical flow sheet development
- Characterisation of samples for mineralogy, grindability and metallurgy
- Data is handled through the block model using geostatistics
- Metallurgical / economic models built to forecast response

# Geometallurgy for Project Technical / Economic Optimisation

- Probable recovery is factored in economic and strategic considerations throughout project life
- Variable metallurgical response is calculated into project economics
- The whole deposit can be considered in techno-economic optimisation
- Sub-domains are weighted to their relative abundance
- Should be integrated with the project feasibility mine plan for cash flow forecast and optimisation

# Learning from existing or past operations

- There are similar geology / mineralogy type deposits in the world
- Learn from these for early project strategic assessment when you have limited information about your new project
- Benchmark your project from development through to operation
- Alternative or new technological routes are indicated
- Fast track project development facilitated, applying past experience

# How does this help?

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- Reduces risk of problems at operation
- Learn from the past – faster track to development
- Optimise cash flow
- Optimise project design
- Maximise economic return
- Build investor and financial partner confidence

# So why is this not widely practised now?

- Traditional, compartmentalised approach
  - We explore
  - We develop our resource base
  - We do pre-feasibility study / feasibility study with metallurgy
  - Metallurgist “receives” the sample
  - Gap in understanding between geologists and metallurgists



# About GMT GeoMet Tech Ltd

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- Formed in 2010
- Senior experienced professionals with broad mining project experience
- Metallurgists and geologists
- Database of mines / deposits of the world past and present
  - With geological, mineralogical and metallurgical information
- Specialised software to describe, compare and match ore types

# Products

## (Jan 2011 release)

- MetMatch
  - Matches a project to similar project(s) and based on that describes the metallurgy that will result, the recovery anticipated, geology and mineralogy, flowsheet, comminution, issues and opportunities, and recommendations for project development.
- MetMatch Mini
  - Fits a project to similar project(s) and based on that describes the metallurgy that will result, the recovery anticipated, geology and mineralogy.
- Project Benchmark
  - Does some preliminary QEMScan analysis on 4 selected samples of this project plus a diagnostic flotation test and based on this and a prior MetMatch refines the anticipated metallurgical response and recovery and updates recommendations for project develop.
- 43-101 reports
  - Write the metallurgical section for 43-101 reports

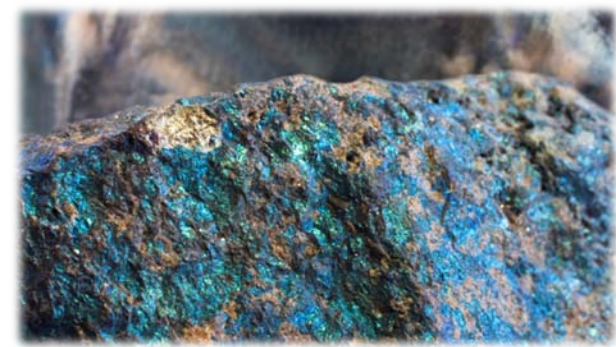
# Consulting Services

- GMT GeoMet Tech offers consulting services for geometallurgy and metallurgy.
- GMT GeoMet Tech consulting services cover:
  - Guidance on how to include geometallurgy in your project development
  - Project benchmarking
  - Strategic guidance for project metallurgical development
  - Sample selection for flow sheet development test work applying geometallurgical methodology
  - Interpretation and evaluation of geometallurgical / metallurgical test work
  - Geometallurgical implementation with block models
  - Project representation for the client to board room, financiers, analysts
  - Project planning and project management for process development
  - Test work definition for flow sheet development
  - Forecasting model development

# Key Players

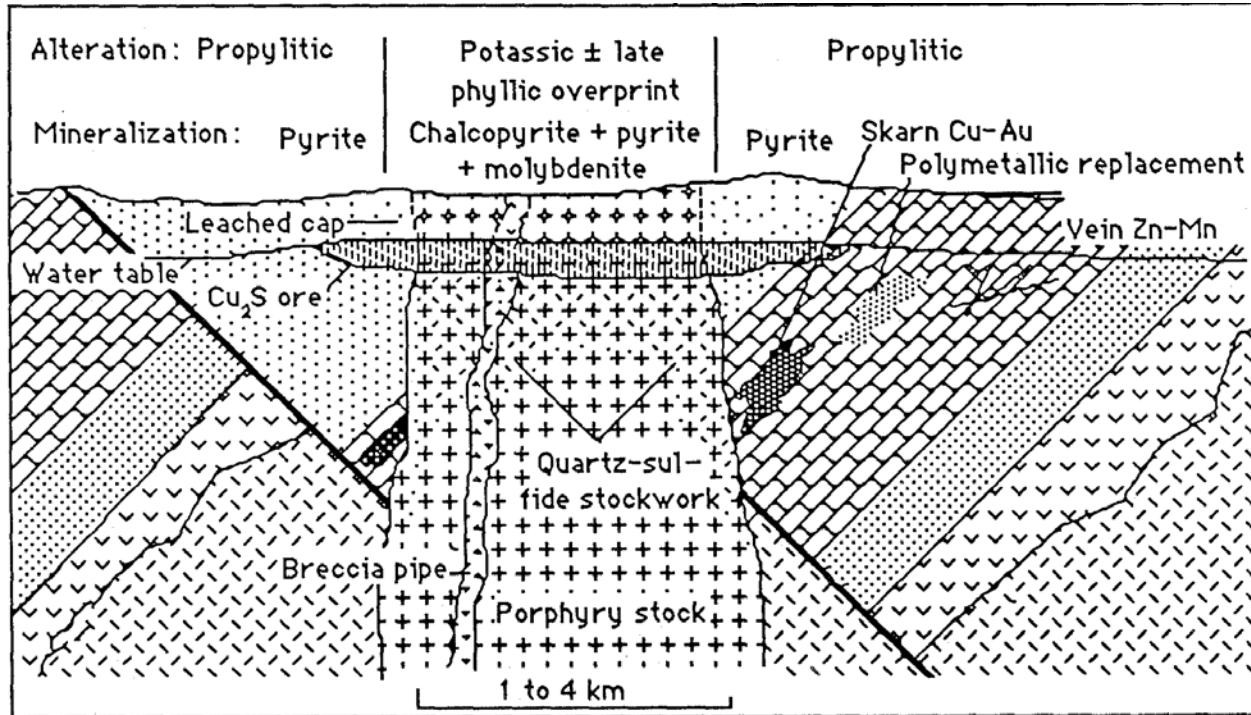
- Steve Williams, President – senior metallurgical engineer with 30+ yrs experience and unique geometallurgy knowledge. Technical author and CIM Distinguished Lecturer on Geometallurgy
- Clinton Smyth, VP Geology – senior geochemist with 30+ yrs experience in geological exploration and unique experience in comparative geological modelling
- Chris Martin, Director – senior metallurgical engineer with 25+ yrs experience and unique knowledge in mineralogy as it drives metallurgy, having applied this to +100 projects

# Example



- Porphyry Cu deposit
  - High degree of variability across the deposit
  - Large number of geological sub-domains
  - Many sub-domains with important mineralogical variability leading to variable metallurgical response
  - Rock type x Alteration x Mineralogy = up to 40 important sub-domains

# A porphyry Cu deposit



**Figure 50.** Cartoon cross section illustrating generalized model for porphyry Cu deposits showing relation of ore minerals, alteration zoning, supergene enrichment and associated skarn, replacement, and vein deposits.

# Porphyry Cu Metallurgy

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- Comminution
  - Large range in variability at the SAG mill size from (Rod WI) from 8 – 24 kwhr/t is common
  - This means large potential variability in throughput
  - Overall, tend to be hard ores
  - Large tonnage operations means very large equipment / large capital cost / extremely long lead time

# Porphyry Cu Metallurgy

- Flotation

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- Large range in variability in metallurgical response
  - Key mineralogical variables are:
    - Copper mineralogy: Chalcopyrite, secondary sulphides, oxides
    - Pyrite content
    - Gangue type – particularly clays / sericite
    - Grain size / liberation
    - Association
    - Au association
    - Mo distribution / grain size
    - Contaminant elements such as As
  - Cu recovery can vary from 65% - 93%; typically 85 – 88%



# Porphyry Cu Metallurgy

## - actual data 2009

**Table 16-4: Locked-Cycle Flotation Test Results**

Sample		Ajax 7	Ajax 9	Ajax 2/6	Ajax 7/9
Test		23	24	25	26
Grind (Feed)		103	64	161	217
Regrind		15	11	15	14
Head	% Cu	0.19	0.41	0.6	0.32
	gpt	0.18	0.32	0.34	0.31
Recovery	% Cu	68.8	80.9	87.5	79.1
	% Au	81.7	81.5	87.3	84.1
Con Grade	% Cu	30.9	33.3	31.2	30.6

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