



# Automated logging of drill core

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# Introduction

- The aim is to find solutions to automate aspects of geological drill core logging based on the multi-element geochemistry of the rock
- The samples for this study were provided by Glencore plc from the George Fisher Mine in Mt Isa
- 31 drill holes were scanned with an X-Ray Fluorescence (XRF) Scanner
- The XRF scanning was performed with a Minalyzer CS (core scanner)

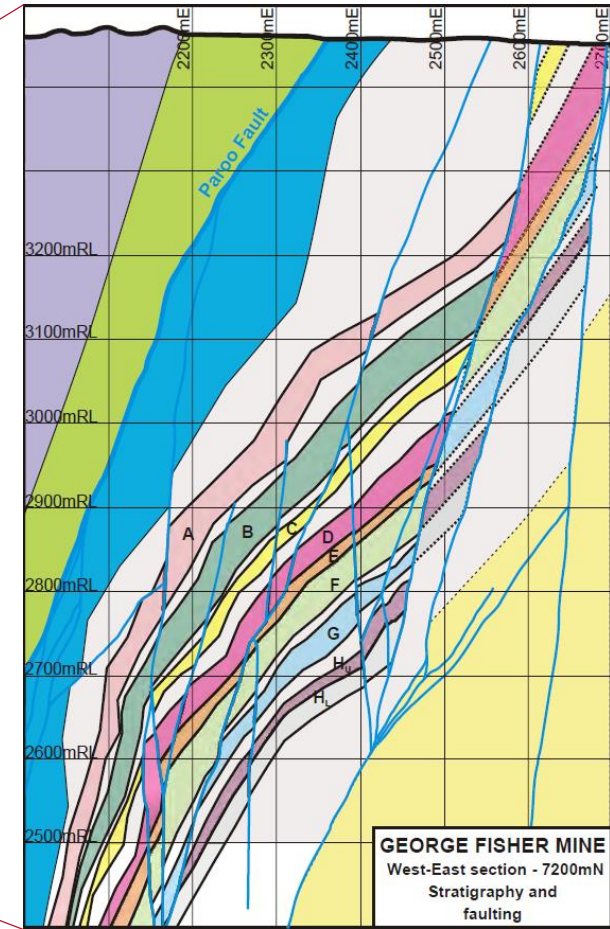
GLENCORE

  
MINALYZE

# Introduction Geology



glencore.com



Murphy, 2004

# Introduction Minalyzer CS



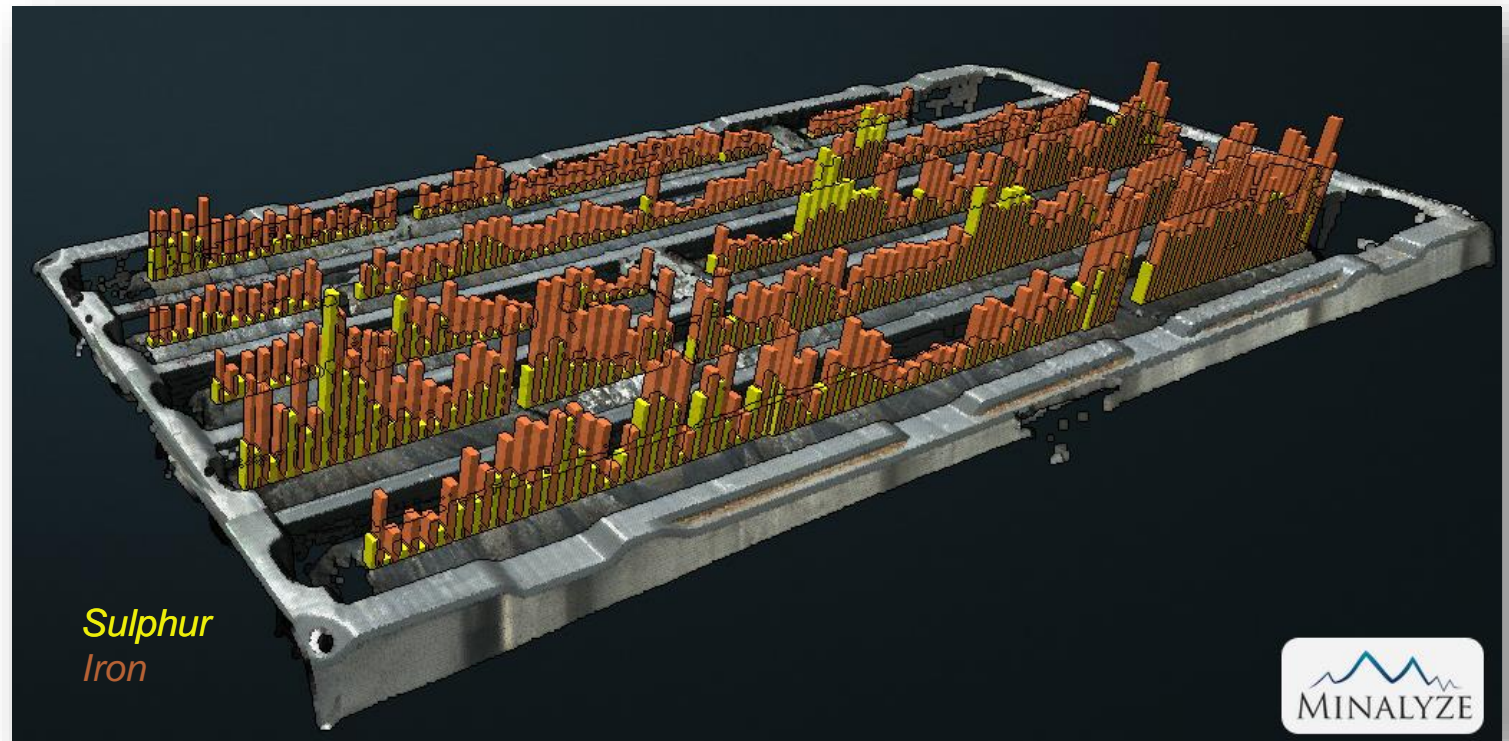
*chalmersventures.com*

The Minalyzer CS provides:

- Chemical Assays
  - From Mg to U
- Photography
- Topography
- Rock Quality
- Structural Logging
- Specific Gravity

# Data Acquisition

- Non-destructive XRF scanning on full core length
- Scanning on the core in trays
- Scanning rate: 1 cm/s
- Outcome data intervals:
  - 1 cm / 10 cm / 1 m



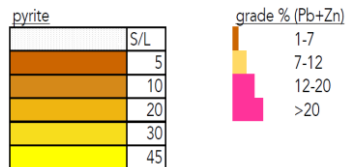
[minalogger.com](http://minalogger.com)



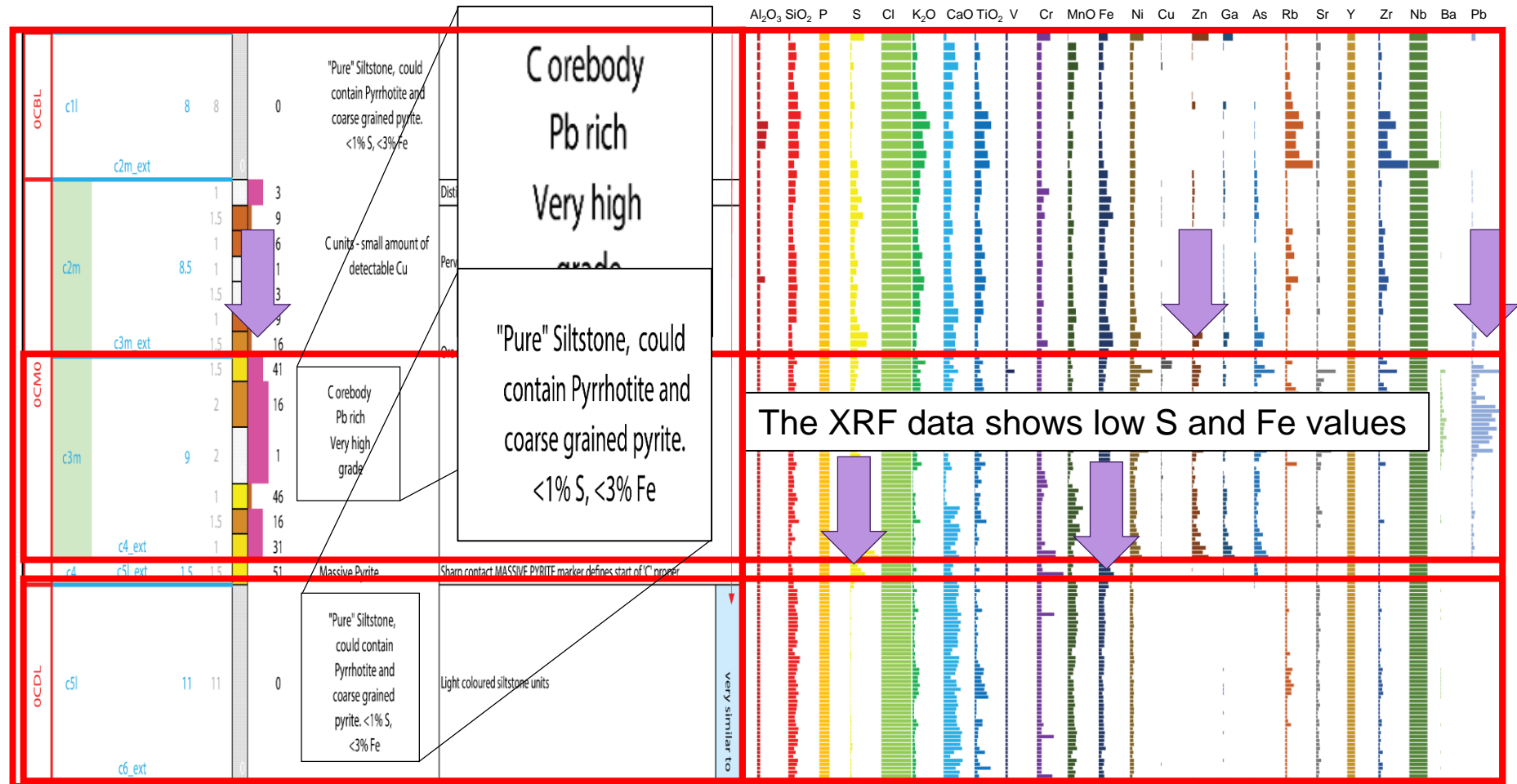
# Cleaning of the data

- Example of Stratigraphy Log and XRF Scan

- The log includes important geological information

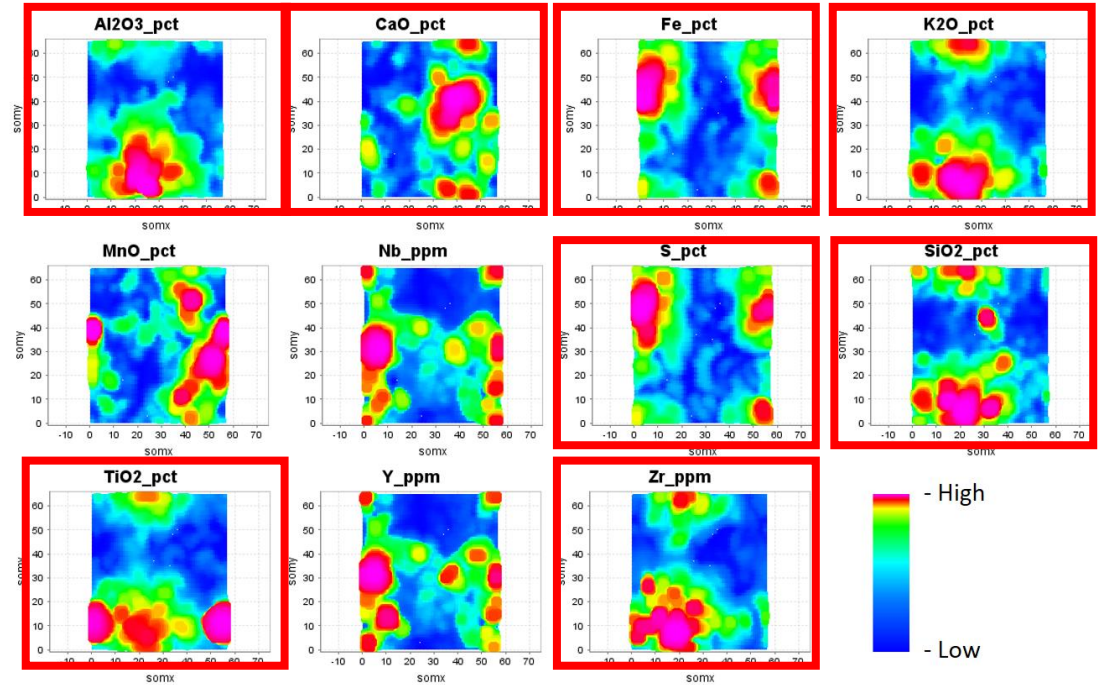
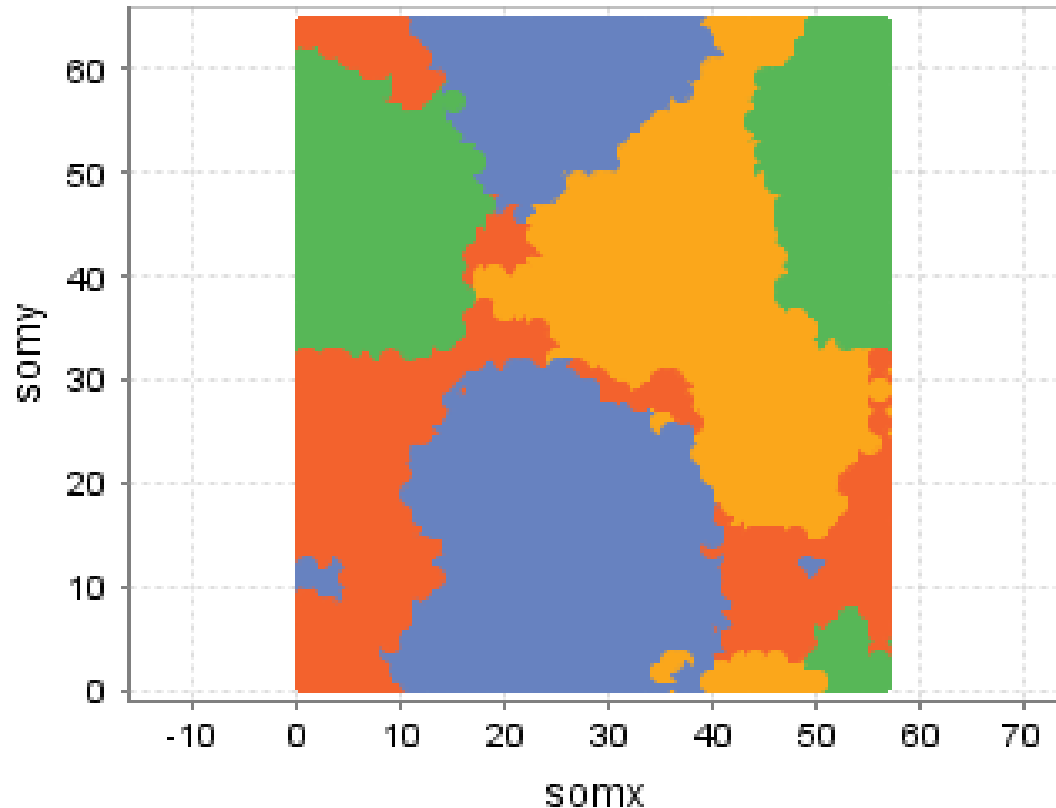


- XRF data is presented in bars for each cell (high value = long bar)



# Clustering

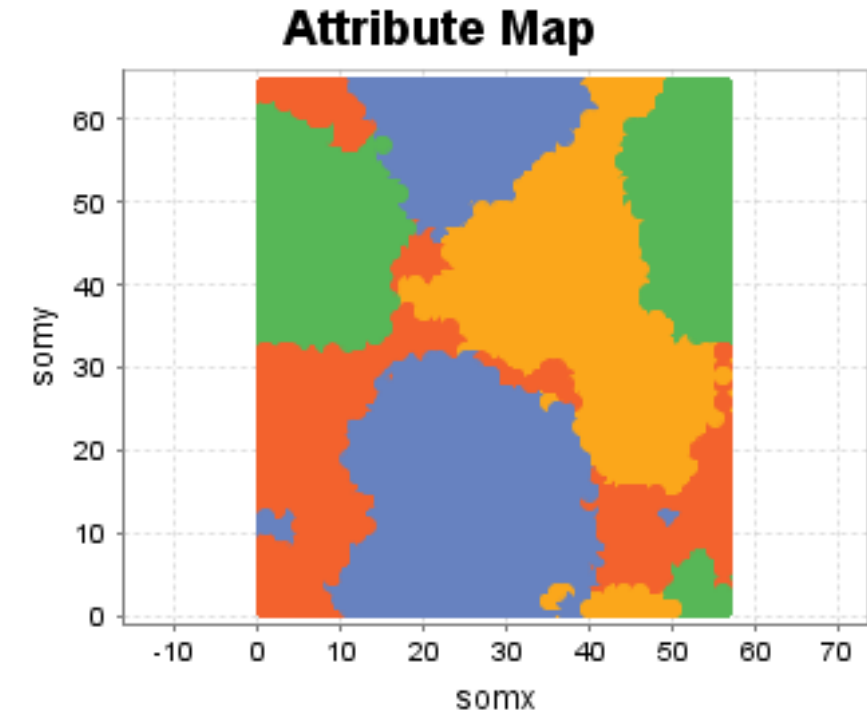
## Attribute Map



- **4 Clusters** (yellow/orange/blue/green) based on the 'heat-maps' and associated trends
- *Blue*: high values of Al<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>, Zr
- *Green*: high values of Fe and S
- *Yellow*: high values of CaO
- *Orange*: Traces of all major elements/oxides

# Rocktype classification

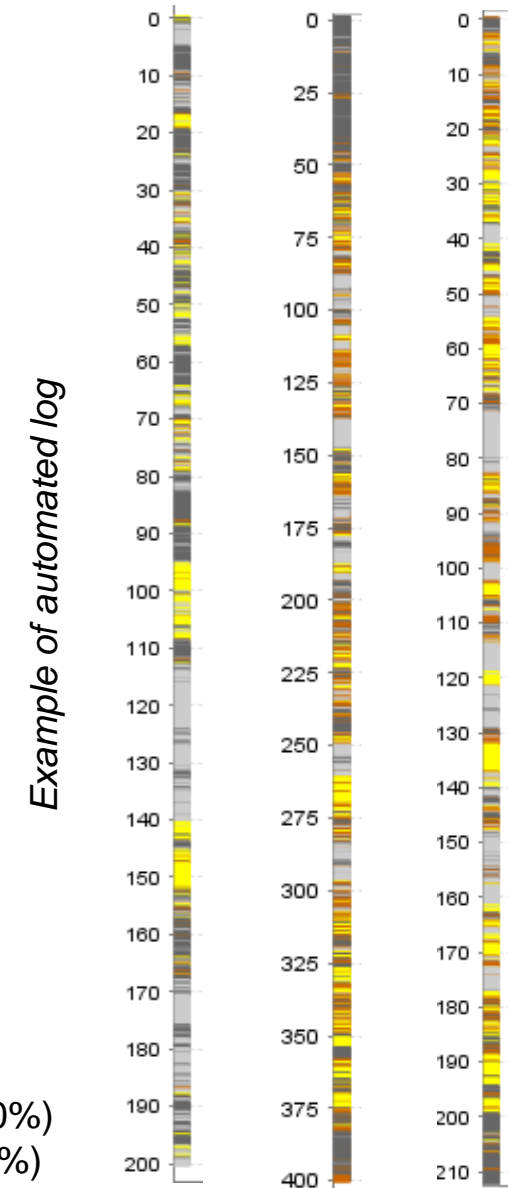
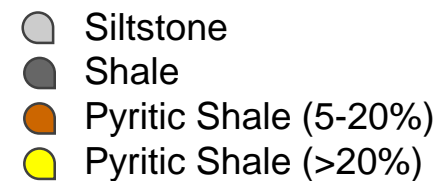
- *Blue*: Shales (high values of  $\text{Al}_2\text{O}_3$ ,  $\text{K}_2\text{O}$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ , Zr)
- *Yellow*: Calcareous Siltstones (high values of CaO)
- *Green*: Pyrite (high values of Fe and S)
- *Orange*: Mixture of lithologies (traces of all elements/oxides)
- The Pyrite-rich layers can be further distinguished
  - high content (>20% Pyrites)
  - low content (5-20% Pyrites)
- The samples in the orange cluster were associated with adjacent clusters



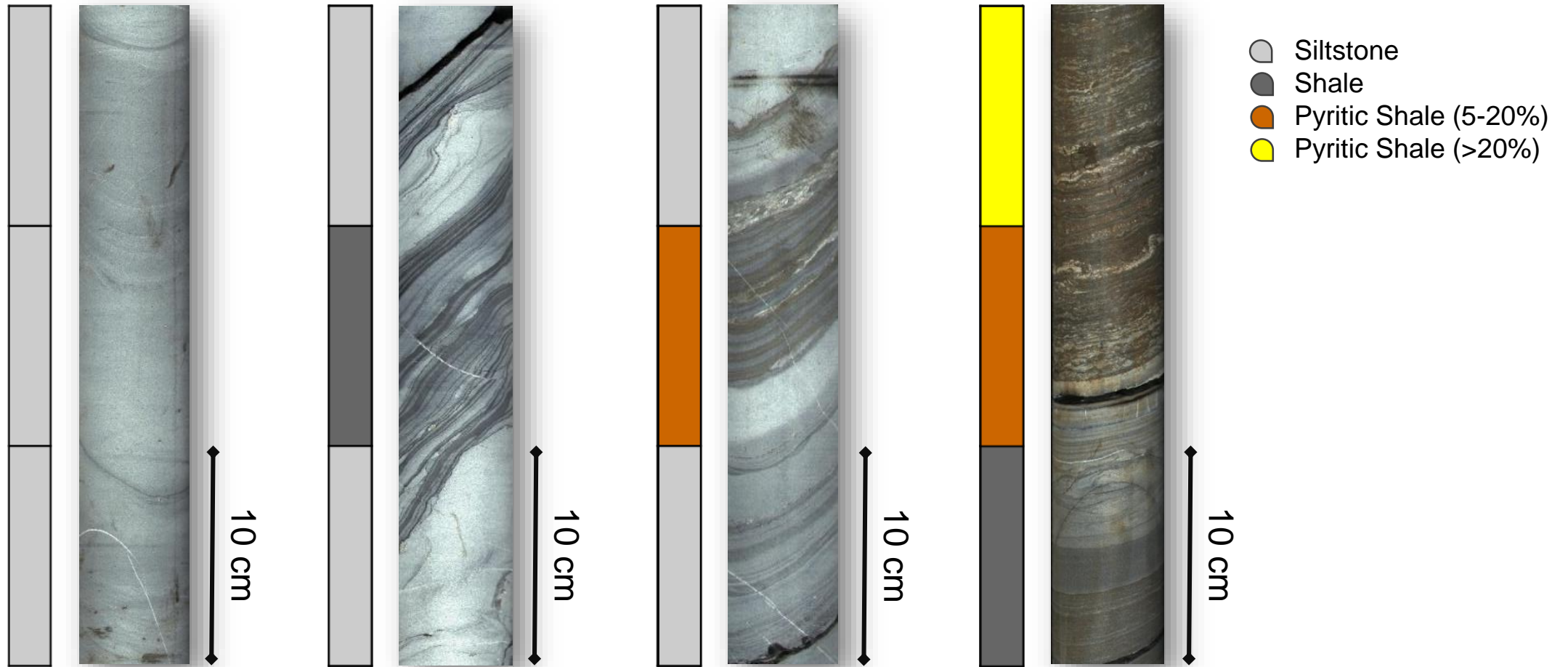


# Automated drill core logging

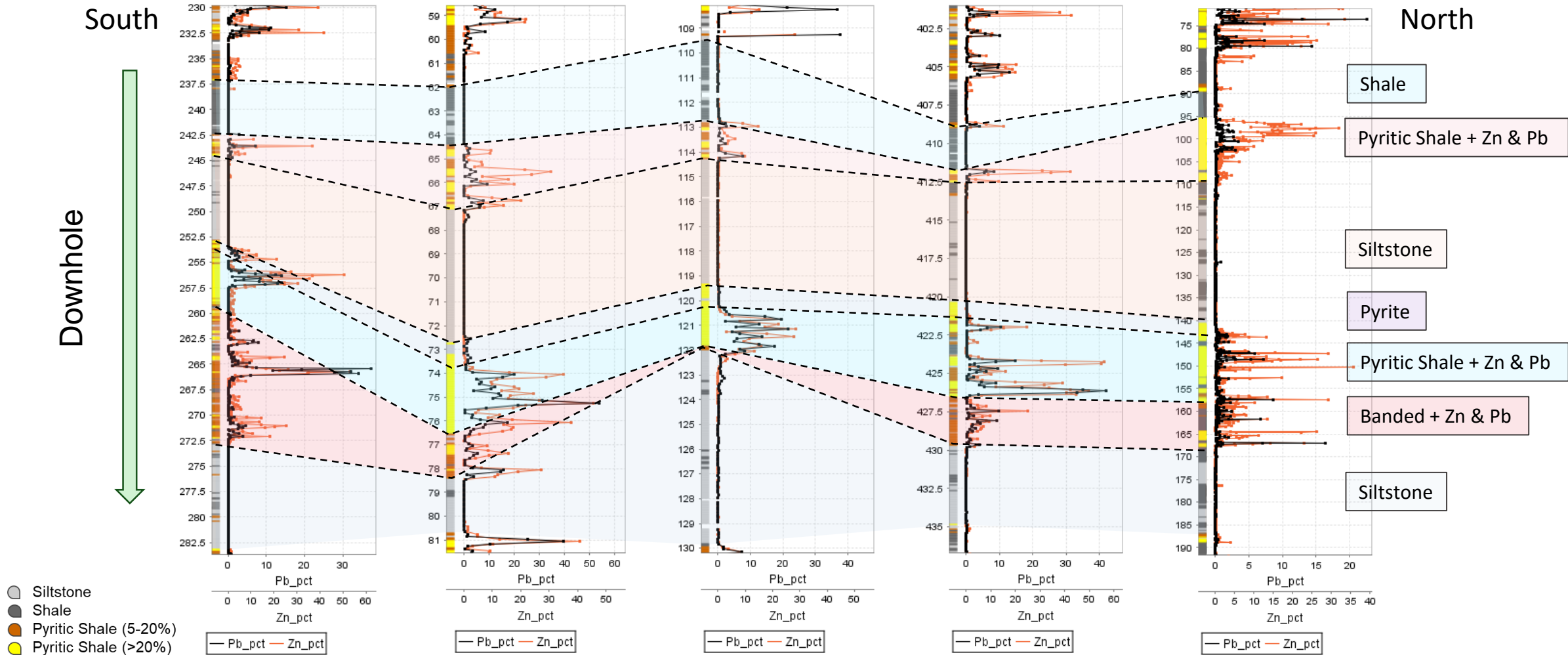
- Automated detection of 4 host-rock lithologies
  - ✓ Calcareous Siltstones (light grey)
  - ✓ Shales (dark grey)
  - ✓ Pyritic shale (5-20% Pyrite) (brown)
  - ✓ Pyritic shale (>20% Pyrite) (yellow)
- Consistent interpretation of the data
- Interpretation based on actual scanned XRF data and correlation between elements/oxides



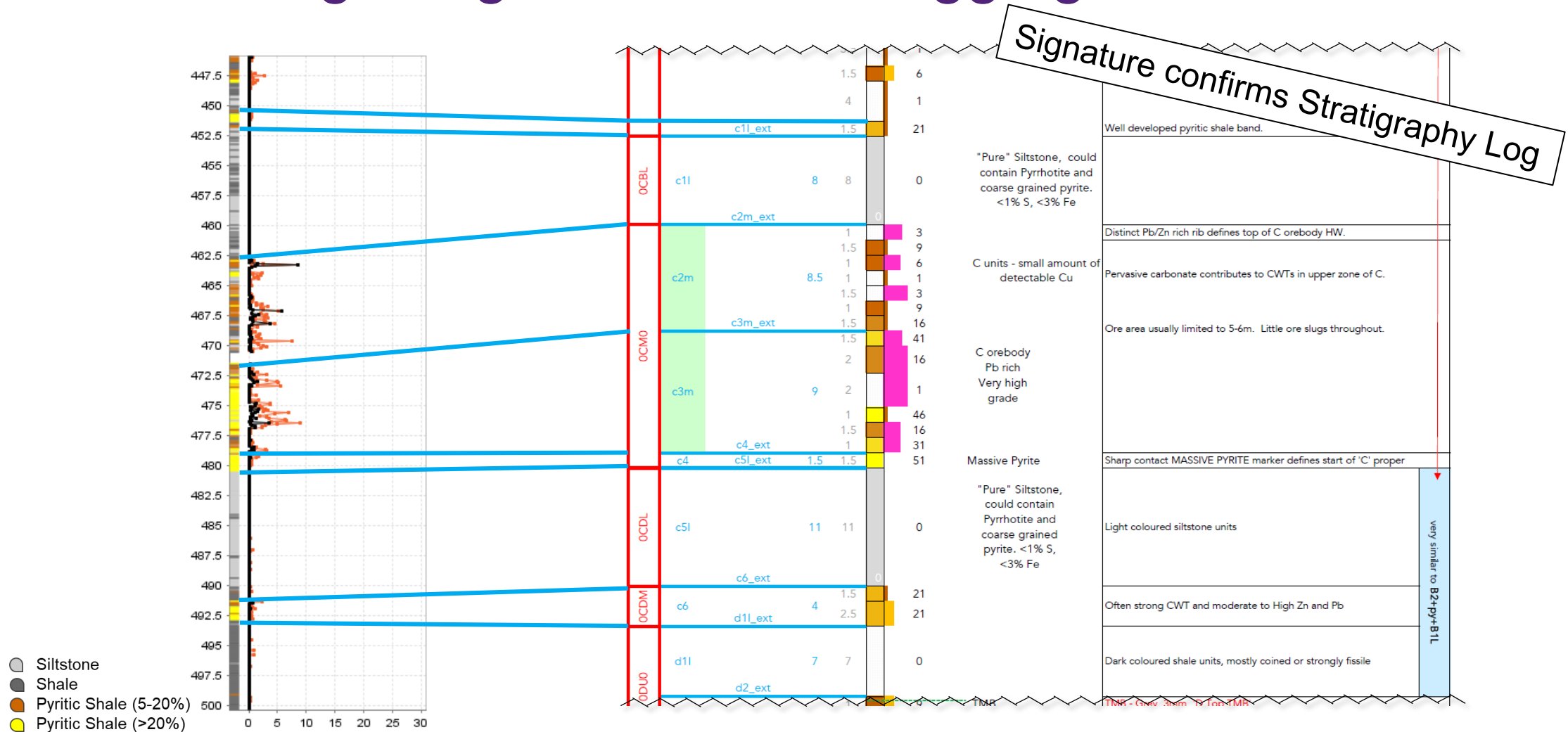
# Automated detection of host-rock lithologies



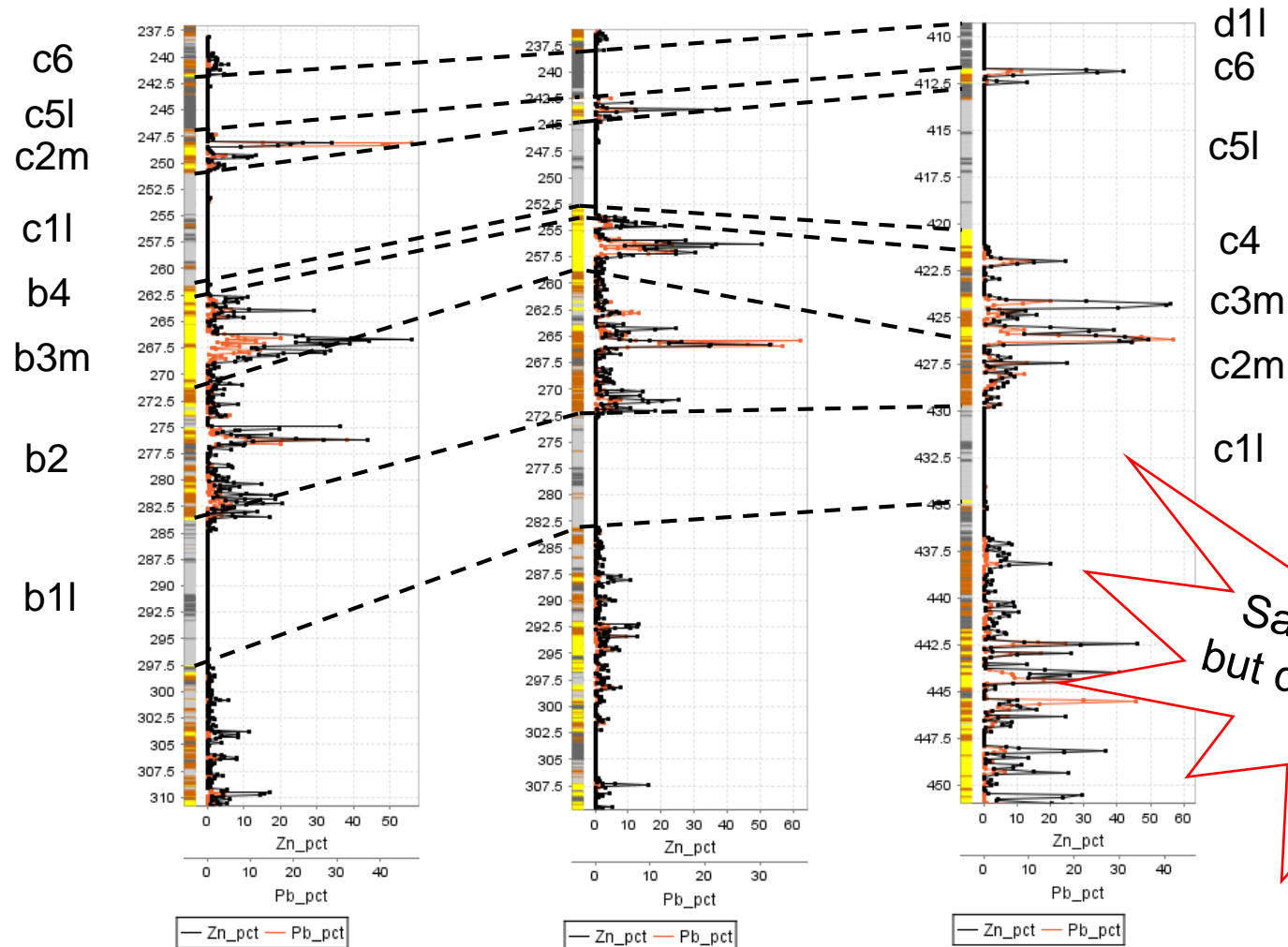
# Enhanced geological drill core logging



# Enhanced geological drill core logging

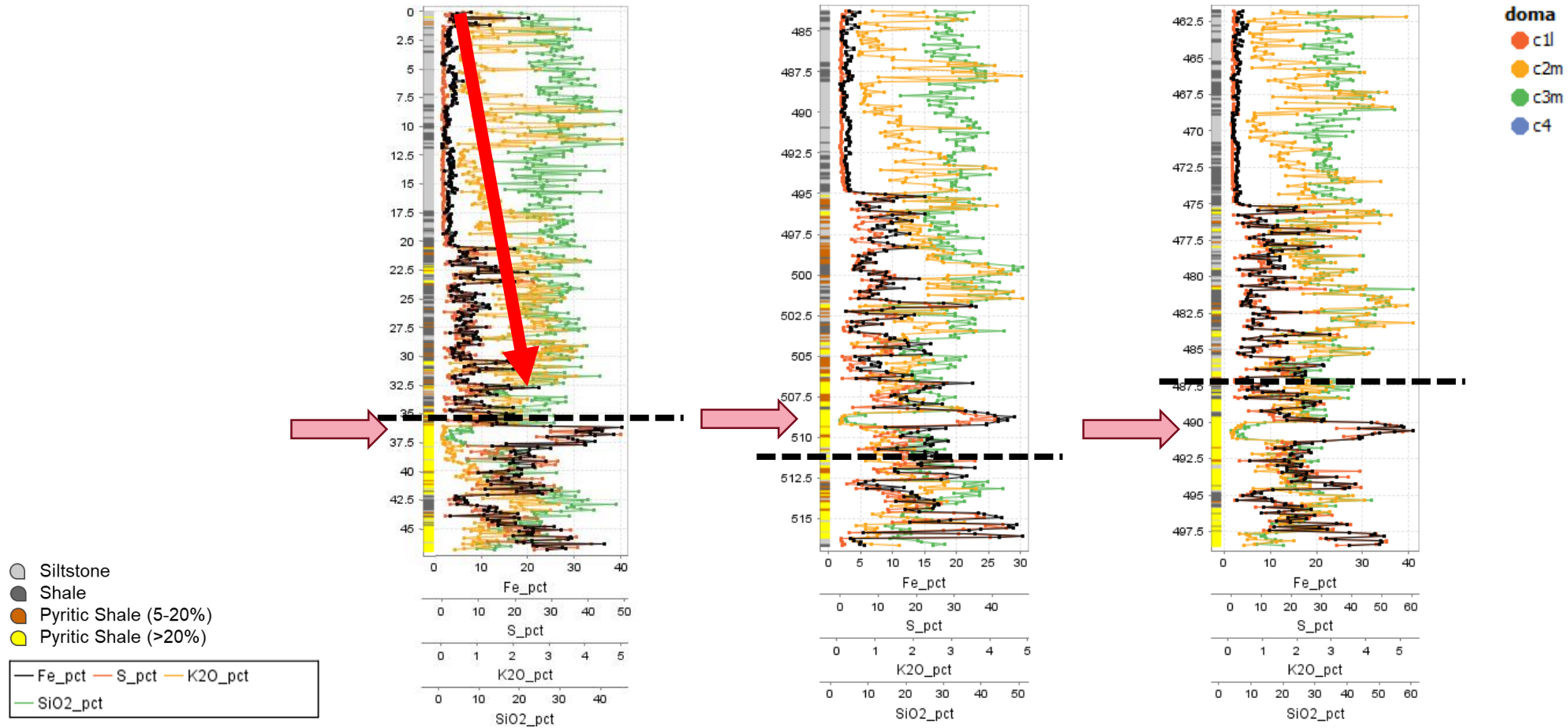


# Enhanced geological drill core logging





# Enhanced domaining



# Outcome

- Enhanced geological drill core logging
  - *Rocktype classification and domaining*
- Consistent interpretation of the data
  - *Interpretation based on actual scanned XRF data*
- Enhanced detection of domain boundaries
  - *Based on geochemical signatures and rocktype recognition*
- Implications to mining
  - *Potentially saving time and costs*



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AUSTRALIA

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# Thank you

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