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)
Introduction Geology

[Map of Queensland showing mining locations and geological lines]

Murphy, 2004

glencore.com
Introduction Minalyzer CS

The Minalyzer CS provides:

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

chalmersventures.com
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
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)

The XRF data shows low S and Fe values
Clustering

4 Clusters (yellow/orange/blue/green) based on the ‘heat-maps’ and associated trends

- **Blue**: high values of Al₂O₃, K₂O, SiO₂, TiO₂, 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 $\text{Al}_2\text{O}_3$, $\text{K}_2\text{O}$, $\text{SiO}_2$, $\text{TiO}_2$, $\text{Zr}$)
- **Yellow:** Calcareous Siltstones (high values of $\text{CaO}$)
- **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

- Siltstone
- Shale
- Pyritic Shale (5-20%)
- Pyritic Shale (>20%)
Enhanced geological drill core logging

Siltstone  
Shale  
Pyritic Shale (5-20%)  
Pyritic Shale (>20%)  

South

North

- Shale
- Siltstone
- Pyrite
- Pyritic Shale + Zn & Pb
- Banded + Zn & Pb

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Enhanced geological drill core logging

Signature confirms Stratigraphy Log
Enhanced geological drill core logging

Same signature, but different logging
Enhanced domaining

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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
Thank you

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