Determination of spectra characteristics of laterite drill-core for «on line-on site» real-time automated mineralogy detection

Laure CAPAR¹, Anne BOURGUIGNON¹, Cédric DUEE¹, Xavier BOURRAT¹, Stéphane CHEVREL¹, Valérie LAPERCHE¹, Nicolas MAUBEC¹, Sébastien MONTECH¹, Beate ORBERGER²,³, Anne SALAÜN², Céline RODRIGUEZ²

¹BRGM, 3 Avenue Claude Guillemin, BP36009, 45060 Orléans Cedex 2 - France
²ERAMET, ERAMET RESEARCH, 1 Avenue Albert Einstein, 78190 Trappes – France
³GEOPS – Université Paris Sud, Université Paris Saclay, Bâtiment 304, 91405 Orsay, Cedex - France
SOLSA PROJECT

SOLSA PROJECT IS:

• AN INNOVATIVE PROJECT FOR SUSTAINABLE EXPLOITATION TECHNOLOGIES

• DEVELOPED IN A RESPONSIBLE MINING CONTEXT

• TO DEVELOP A BENCHMARKING ON-LINE-ON-MINE-REAL-TIME ANALYSIS

• A BOREHOLE COUPLED WITH AUTOMATED MINERALOGY & CHEMISTRY

SOLSA IS ASSOCIATED WITH ROYAL EIJKELKAMP (NL) TO DEVELOP THE DRILLING SYSTEM TO DRILL AT A SPEED OF 60 TO 80 METERS/DAY

SOLSA HAS RECEIVED FUNDING FROM THE EUROPEAN UNION’S HORIZON 2020 RESEARCH AND INNOVATION PROGRAM UNDER GRANT AGREEMENT N° 689868

SOLSA PROJECT: www.solsa-mining.eu
SOLSA PROJECT

9 PARTNERS – 4 COUNTRIES

SOLSA PROJECT: www.solsa-mining.eu
OBJECTIVES

A QUICK MINERALOGICAL IDENTIFICATION OF SITE DRILLS CORES

TO DEVELOP NEW OR IMPROVED SUSTAINABLE EXPLORATION TECHNOLOGIES WITH

• HIGHLY-EFFICIENT
• COST-EFFECTIVE
• A PORTABLE SYSTEM IN MOST GEOLOGICAL AND ENVIRONMENTAL CONTEXTS
• IN A RESPONSIBLE MINING CONTEXT

On-site mineral identification
The conveyor must be able to adapt to all applications and all types of rocks in the future.

(modified after Maëstracci, 2017)
STUDY AND DATA

THE CHALLENGE IS TO ADDRESS MIXTURES OF HARD AND SOFT ROCKS

Hyperspectral cameras VNIR, SWIR

LATERITIC DRILL- CORES

INFLUENCE OF SURFACE ROUGHNESS EFFECT ON VISIBLE TO SHORT WAVE INFRARED SPECTRAL RANGE
DATA

4 DIFFERENT ROCK SAMPLES

BRECCIA

SANDSTONES

GRANITE

PERIDOTITE
5 surface states for solid cores:

- as-drilled
- as-cut
- Polished @6µm
- Polished @0.25µm
- Powdered
DATA

- as-drilled
- as-cut
  - 4 samples at 5 stages of surface roughness
- Polished @6µm
- Polished @0.25µm
- Powder

<table>
<thead>
<tr>
<th>Sandstone</th>
<th>Grey granite</th>
<th>Breccia</th>
<th>Peridotite</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Sandstone Image" /></td>
<td><img src="image2.png" alt="Grey granite Image" /></td>
<td><img src="image3.png" alt="Breccia Image" /></td>
<td><img src="image4.png" alt="Peridotite Image" /></td>
</tr>
</tbody>
</table>

4 samples at 5 stages of surface roughness
MEASUREMENTS

Reflectance spectra acquired with: ASD Fieldspec 3® spectroradiometer

Contract probe: sampling surface 1.76cm²
Wavelength: 350 – 2500 nanometers
RESULTS

BRECCIA

Breccia as-drilled
Breccia as-cut
Breccia polished 6 µm
Breccia polished 0.25 µm
Breccia powder

Characteristic absorption zone

Wavelength (nm)
RESULTS

SANDSTONE

Characteristic absorption zone

Sandstone as-drilled
Sandstone as-cut
Sandstone polished 6 µm
Sandstone polished 0.25 µm
Sandstone powder

- Continuum Removed
- Wavelength (nm)

0.6
0.7
0.8
0.9
1.0

500 1000 1500 2000 2500

RESULTS

SANDSTONE

Characteristic absorption zone

Sandstone as-drilled
Sandstone as-cut
Sandstone polished 6 µm
Sandstone polished 0.25 µm
Sandstone powder

- Continuum Removed
- Wavelength (nm)
RESULTS

GRANITE

Granite as-drilled
Granite as-cut
Granite polished 6 µm
Granite polished 0.25 µm
Granite powder

Characteristic absorption zone
RESULTS

PERIDOTITE

Characteristic absorption zone

Peridotite as-drilled
Peridotite as-cut
Peridotite polished 6 \( \mu m \)
Peridotite polished 0.25 \( \mu m \)
Peridotite powder

6 \( \mu m \) and 0.25 \( \mu m \) are superimposed
CONCLUSIONS

The roughness of sample has an influence on intensity of the absorption peaks

As-cut and polished give the best results:
- Not the most economical
- Not easiest to implement for the ON-LINE-ON-MINE-REAL-TIME automated mineralogy detection

Tests show that as-drilled sample make it possible to obtain exploitable spectra
SAVE TIME on ON-LINE-ON-MINE-REAL-TIME
The tests were carried out on different samples so measurements for a rock type were not taken on the same sample.

To have more precise measurements, the test will be performed on a single sample by type of rock which will be cut then polished and then reduced to powder.

The same study have been carried out with others measurement systems: handheld X-Ray Fluorescence, Raman Spectroscopy. The results will be presented in Society of Geology Applied Congress in Quebec in August 2017.

THANK YOU FOR YOU ATTENTION