This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

SOLSA PROJECT

8/1/2020 - Deliverable D 9.3 – REPORT - PUBLIC

Conferences and papers

This deliverable refers to the task 9.3, "Conferences" and task 9.5 "Workshops" (all partners).
The leader of WP9 is Eramet.

Summary report

This deliverable falls into the category "public".

It corresponds to the inventory of communications and posters made about the project SOLSA. Most of the members of the Consortium attended a list of conferences and events where they made presentations and dissemination, met main actors in similar business and researches and got ideas that led to the improvement of the prototype SOLSA.

In total, **39 papers were presented at international conferences**, 5 workshops were led, 4 dissemination events (booths…) and SOLSA clustered at 3 events with other H2020 and EIT-KIC projects: (RT-Mining: H2020-INNOLOG-PAIRED-X: EIT-KIC).

The different supports of communication are presented in this report. The list of published papers is given in deliverable D 9.2 Publications.

They correspond to:

1- Communication materials
   a. Logos
   b. Flyers and posters
   c. Website
2- Conferences and presentations
3- Movies

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1- COMMUNICATION MATERIAL

a) Logo

A logo has been designed which will be located on the prototype, representing the 3 modules DRILL, ID and SOFTWARE combined to form the expert system.

SOLSA Expert System

SOLSA Expert System

b) Flyers and posters

The posters presented in the following pages.

Note that the one designed by Maria Secchi et al. received the Best Poster Presentation Award.


GeoRaman2018

GeoRaman International Science Advisory Committee

is pleased to assign to

Maria Secchi

the Best Poster Presentation Award

with communication entitled:

"Characterization of Ni leterites using a combined approach"

XIII GeoRaman International Conference

Catania 10-14 June 2018

The Conference Chair

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

Characterization of Ni laterites using a combined approach

M. Secchi,[1] M. Zanatta,[2] E. Borovin,[1] M. Bortolotti,[1] A. Kumar,[2] A. Sanson,[3] Y. El Mendili,[4] D. Chateigner,[4] B. Orberger,[5,6] M. Le Guen,[5] S. Gialanella,[1] G. Mariotto,[2] M. Montagna,[7] L. Lutterotti[1]

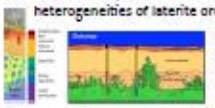
[1]University of Trento, Dept. of Industrial Engineering, via Sommarive 9, 38123 Trento, Italy, [2]University of Verona, Dept. of Computer Science, Verona, Italy, [3]University of Padua, Dept. of Physics, Padova, Italy, [4]Normandie Université, CRISMAT-ENSICAEN, UMR CNRS 6508, Université de Caen Normandie, Caen, France, [5]ERAMET-RESEARCH-SLN, Trappes, France, [6]GEOPS, Université Paris Sud, Orsay Cedex, France, [7]University of Trento, Dept. of Physics, Trento, Italy

INTRODUCTION

The increase in the global request of critical raw materials leads to the development of new extraction techniques and the mineral processing optimization[1]. Within the mining cycle, the exploration stage is crucial to obtain reliable information within a short time.

Usual approach

For Ni extraction, an intensive exploration drilling needs to be carried out, due to the high variability and heterogeneities of laterite ore.



Flexible techniques are typically used, like IR-based techniques, X-rays fluorescence, and hyperspectral imaging.

But none of these methods is capable to provide a fully satisfactory response (complexity of mineral ores). In this regard, the effective multi-analytical approaches are usually conducted in structured laboratories on selected samples, due to the strong time/costs constraints.

Alternative solution

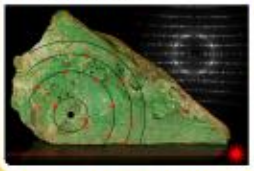
Multi-analytical approach using an on-site instrument for data collection, mineralogical and chemical analysis.

SOLSA project
http://www.solsa-mining.eu/

Automatic expert system coupling sonic drilling, profilometer, hyperspectral imaging, and a combination of Raman spectroscopy (RS), X-ray fluorescence (XRF), and X-ray diffraction (XRD).

The base principles of the RS-XRF-XRD cooperative approach will be discussed and applied to specific test samples, showing the potential and the novelty of the method[2,3].

METHODS



Combined analysis:

1 XRF
- elemental analysis ($m>m_{tot}$)
- full-pattern fit (Maud[4])
- selection among possible phases in databases for RS and XRD

2 RS
- phase identification via comparison with reference (RRUFF[5])
- starting guess for XRD

3 XRD
- phase identification via iterative search-match procedure (COD[6])
- simultaneous full-pattern fit of XRD and XRF

Quantitative estimation of volume fraction of each component

1 XRF → RS → 2 XRD → 3

LabRam Aramis
- focal length 450 mm
- λ=785 nm
- 600 grooves/mm
- 50X LWD (5 μm)
- resol. ~3 cm⁻¹

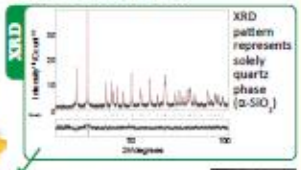
LabRam HR
- focal length 800 mm
- λ= 633 nm
- 600 grooves/mm
- 80X LWD (3 μm)
- resol. ~1.5 cm⁻¹

Inel Equinox 3500
- Mo microfocus source
- Amptek X-123 SDD
- irradiated area: 6x0.2 mm²

Rigaku DMAX III
- Bragg-Brentano geometry
- 2 kW Cu source
- scintillation counter + graphite monochromator
- 2Θ step: 0.02 deg
- irradiated area: 8x4 mm²

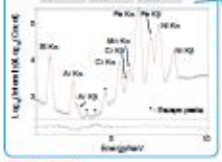
Case study 1: SILICEOUS BRECCIA (SB)

a rock originated form hydrofracturing of ultramafic rocks, mainly composed by quartz



?

Fe! no Fe!



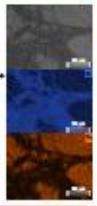
RS: iron detected by XRF due to iron oxide inclusions, confirmed by SEM and EDXS.

+

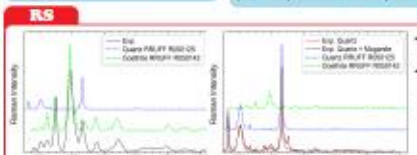
XRD: Fe concentration probably below the detection limit (~3 wt.%).

+

XRF gives thus an upper limit of the goethite presence (~5 wt.%), assuming that all the iron (3.1 wt.%) is related to this phase.



RS



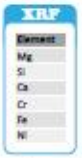
- Dominant phase:
  - quartz (α-SiO_2).
- Minor contribution:
  - moganite (quartz polymorph)
  - goethite (FeO(OH))
  - hematite (α-Fe_2O_3).

WARNING
use of Raman databases: different resolutions vs automatic software

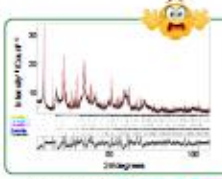
Cs 2: SERPENTINIZED HARZBURGITE (HG)

dark green peridotite, coarsed to medium grained, mainly composed by orthopyroxene, olivine, and serpentine

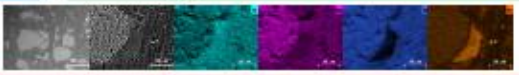
XRF



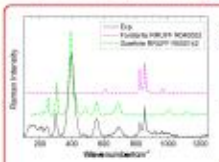
XRD



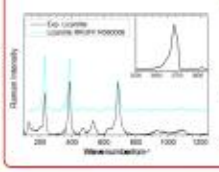
- Complex microstructure.
- Main constituent:
  - lizardite ($Mg_3Si_2O_5(OH)_4$) with various microstructure features:
    - t, turbostratically disordered
    - h, highly crystalline
    - n, nano-crystalline phase.
- RS is crucial to select the phases for fitting.



RS



- Complex system (multi-phases spectra).
- Most common phases:
  - forsterite (Mg_2SiO_4)
  - lizardite ($Mg_3Si_2O_5(OH)_4$)
  - inclusions of goethite (FeO(OH)).
- Small amount: enstatite ($MgSiO_3$), magnesiochromite ($MgCr_2O_4$), talc ($H_2Mg_3(SiO_3)_4$), quartz (SiO_2), cowlesite (zeolite; $CaAl_2Si_3O_{10}\cdot 3H_2O$), dwornikite ($(Ni,Fe)(SiO_3)(H_2O)$).



- Serpentine group polymorphs (lizardite, chrysotile, antigorite, polygonal serpentine): similar Raman spectra for low wavenumber vibrational modes.
- Difference: OH streching band shape (sensitive to local geometry of the crystalline layers).
- Lizardite fingerprints[7]: intense peak at 3685 cm^{-1}, shoulder at ~3700 cm^{-1}.

WARNING
Multi-phases spectrum + possible presence of polymorphic compounds = non-trivial automatization of the phase identification!

The information from RS, XRF and XRD are **all fundamental** to achieve a reliable phase identification.

From the **combination of all** these techniques: lizardite (76.5%), forsterite (15.8%), enstatite (7.7%).

CONCLUSIONS

- ✓ Case study 1: demonstration of powerful of each experimental technique, where XRD and XRF can give quantitative results, whereas Raman spectroscopy can give information also on very local inclusions.
- ✓ Case study 2: typical case in which the separate use of the single experimental techniques can fail in the sample characterization, while the combination of XRF, XRD and Raman analyses allows to obtain quantitative results even on very complex systems.
- ✓ The automotization of this combined approach is a big challenge: this is the main aim of the SOLSA expert system, which is a work in progress.

ACKNOWLEDGMENTS

The authors thank all the SOLSA partners for the collaboration. This work has been developed within the SOLSA project (www.solsa-mining.eu) founded by the European Commission through EU-H2020 Raw Materials, Project SCS-11d-689868.

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maria.secchi@unitn.it

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

Highlighting of nickel using the hyperspectral signal of minerals originating from New Caledonia lateritic profiles

Duée Cédric[1], Da Silva Alves Anthony[1], Maubec Nicolas[1], Blaineau Pierre-Gilles[1], Orberger Beate[2-3], Bui Thanh[2], Pillière Henry[4], Bourrat Xavier[1], Le Guen Monique[2]

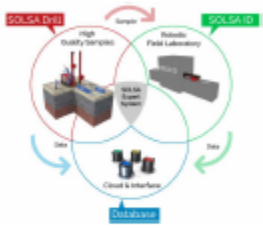
[1]BRGM, 3 avenue Claude Guillemin, 45060 ORLEANS Cedex 2, France (Cédric DUFF: c.duee@brgm.fr)
[2]ERAMET-ER-SLN, 1 avenue Albert Einstein, 78190 TRAPPES, France
[3]GEOPS-Université Paris Sud, Bât 504, 91405 ORSAY Cedex, France
[4]INEL-Thermo Fisher Scientific, 71 rue d'Orléans, 45410 Artenay, France

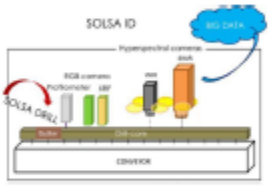
CONTEXT

The SOLSA project (www.solsa-mining.eu) aims to develop an on-line-on-mine expert system coupling sonic drilling, chemical and mineralogical analyses and data treatment. In a first place, this expert system is planned for lateritic profiles of New Caledonia, known to hold nickel. The latter is found in two forms in these profiles. First, nickel can be adsorbed on the surface or inserted in the structure of goethite (α-FeOOH) present in the limonites and saprolites. Second, Ni may substitute Mg in different silicates of saprolite, like in garnierite, known to be nickel-rich and corresponding to a mixture of phyllosilicates usually occurring as vein or porosity filling.

The SOLSA system will combine several analytical techniques, such as XRD, XRF, Raman spectroscopy, RGB or hyperspectral, and the data collected will be compared to an internal library in order to identify the several minerals present in the lateritic profiles. Therefore, the elaboration of a comprehensive library, taking into account the influence of chemistry on the different signals, is mandatory.

Thus, our study focuses on the evolution of the hyperspectral signal (400-2500 nm) with the quantity of nickel for Ni-bearing silicates present in the lateritic profile.





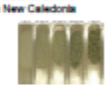
Samples and Techniques

Samples

4 Olivines (4 tint of green)

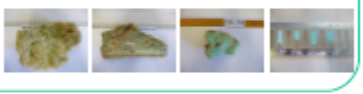
O1 and O2 are from Unknown locations
O3 is an Industrial Olivine
O4 is from New Caledonia

O1 : crushed and sieved at different grain sizes



4 Garnierites (from New Caledonia)

Garnierite powders are obtained by separation from the rocks and sieved at different grain sizes



Analyses

Attenuated Total Reflectance InfraRed spectroscopy: Bruker Tensor 27, 375-4000 cm-1, 4cm-1

Hyperspectral VNIR-SWIR spectroscopy: Specim FX10 (VNIR 400-1000 nm) and SWIR (1000-2500 nm)

Electron Probe MicroAnalysis: Cameca SX-FIVE, WDS 5 detectors

Raman spectroscopy: Renishaw InVia, 514, 633, 785 nm lasers

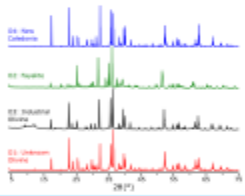
X-Ray Diffraction: D8 Bruker Advance, Cu tube, 4-75°, 0.03°/step

Results

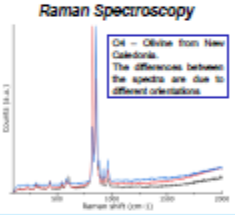
Olivines

Identification

XRD



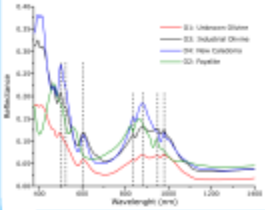
Raman Spectroscopy



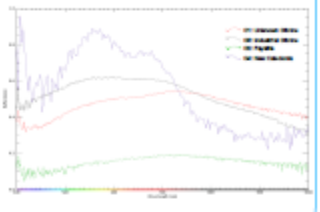
According to XRD, **O2 is a fayalite** (Fe-pole of olivine), **O1, O3 and O4 are more similar to forsterite** (Mg-rich olivine), which is confirmed by Raman spectroscopy (example of the New Caledonian olivine, O4).
The composition obtained from EPMA, confirms the fayalite composition for O2, gives 0.1-0.2 wt.% NiO for the samples, except for that of **New Caledonia (O4)** with a rate between **0.2 and 0.7 wt.% NiO.**

Hyperspectral

ATR InfraRed Spectroscopy



Visible-Near InfraRed Spectroscopy

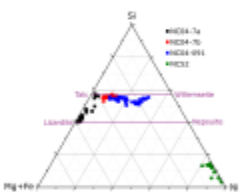


ATR (Attenuated Total Reflectance) InfraRed Spectroscopy (Laboratory) shows that Fayalite spectrum is shifted toward lower wavelengths, which is related to the Mg/Fe ratio. The three other olivines don't show this shift, but a difference of reflectance is clearly visible and is related to the quantity of NiO. This behavior is retrieved on the VNIR spectrum.

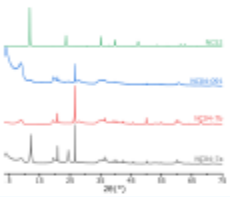
Garnierites

Identification

EPMA



XRD



EPMA analyses highlight **4 different compositions** for the samples. NC04-7a garnierite has a composition near to the Si-Mg+Fe binary with few Nickel. NC04-7b and NC04-091 are part of the Talc-Willemseite solid solution ($Mg_3Si_4O_{10}(OH)_2$-$Ni_3Si_4O_{10}(OH)_2$). The NC52 sample is not a garnierite, the composition and the XRD powder pattern indicate **takovite** $Ni_6Al_2(CO_3OH)(OH)_{16}.4H_2O$.

Hyperspectral

VNIR : Takovite (NC52) barely discernable from garnierites. Similar spectrum slightly shifted toward lower wavelengths.

SWIR : Necessary to differentiate takovite from garnierite (characterized by the bands in the 1390 nm region).

4 bands in the 1390 nm region related to the Mg-Ni substitution:
1384 nm : Mg_3OH stretching 1389 nm : Mg_2NiOH stretching
1395 nm : $MgNi_2OH$ stretching 1403 nm : Ni_3OH stretching

Conclusion

This study highlights that nickel can influence InfraRed spectra in different manners. For olivines, the increase of Ni content induces an increase of reflectance. In the case of garnierite, the increase of nickel is related to a modification of the bands in the 1390 nm region, corresponding to the stretching of $Mg_3Ni_{3-x}OH$. Moreover, SWIR (such as XRD) also permits to distinguish takovite from garnierite, since their VNIR spectra are quite similar. This last point highlights the importance of combining the techniques, which is one of the objectives of the SOLSA project.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

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2014 Raw Material EIP-RM Commitment - EIP 2015

SOLSA

SC5-11d-2015 - 689868

HORIZON 2020

An innovative Expert System for Sustainable Exploration Technology & Geomodels

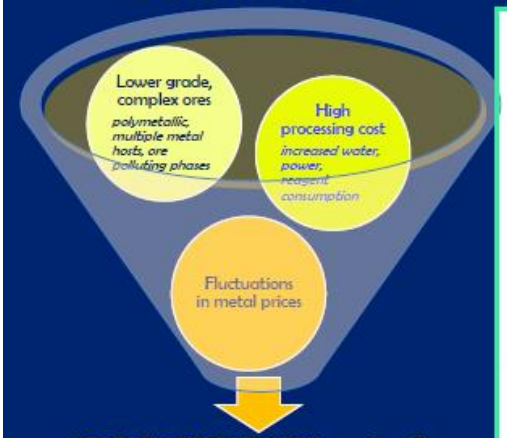
2016 - 2020

SONIC DRILLING COUPLED WITH AUTOMATED MINERALOGY & CHEMISTRY

ON MINE - ON LINE - REAL TIME

European Mining and Metallurgical Industries need to secure the Metal Supply for our markets while minimizing environmental impact. SOLSA provides a breakthrough in combining drilling and analytical technologies. It will optimize exploration, resource and reserve estimates, mining and anticipate process dysfunction.

CHALLENGES



COST-TIME REDUCTION on mine sites
Tracer development for exploration & processing
Optimizing resource and reserve estimates

EXPERT SYSTEM

Innovations in Sonic Drill ⇔ Robotized-automated semiquantitative drill core logging

- ❑ Geographic Coordinates
- ❑ Coherent complete drill core
- ❑ Innovative drill core box
- ❑ Fast drilling
- ❑ Monitoring While Drilling

- ❑ Reliable, validated mineralogical, textural & chemical data (XRF-XRD-FTIR-RAMAN-IMAGING)
- ❑ Based on intelligent Big Analogue Data mining & easy-to-use software
- ❑ Connect Drill core parameters to logged data => Up-grading the scientific open database (COD) for industrial purpose

2 Prototypes will be validated !

CONSORTIUM

Nine transdisciplinary partners from 4 countries design and construct the expert system: 1 large and 2 small companies, 1 government organisation, 5 universities and 1 research institute.

GLOBAL BENEFITS

SOLSA pushes Europe in front

Total budget : 9.8 M€

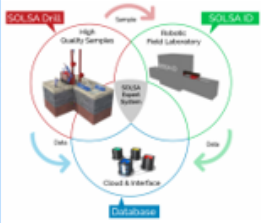
solsaproject@erametgroup.com

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

Combined mineralogy and chemistry on drill-cores: challenging for on-line-real-time analyses

SOLSA Consortium

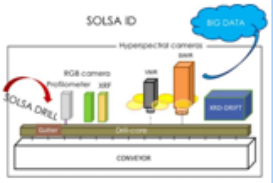
BRGM, 3 avenue Claude Guillemin, 45060 ORLEANS Cedex 2, France
ERAMET-ER-SLN, 1 avenue Albert Einstein, 78190 TRAPPES, France
GEOPS-Université Paris Sud, Bât.504, 91405 ORSAY Cedex, France
Normandie Université, CRISMAT-ENSICAEN, UMR CNRS 6508, Université de Caen Normandie, 14050 Caen, France
ThermoFisher Scientific - INEL, 71 rue d'Orléans, 45410 Artenay, France
University of Verona, 37134 Verona, Italy
University of Trento, 38123 Trento, Italy
University of Padua, 35131 Padova, Italy
Eijkelkamp, Ultmast 8, 6987 ER Giesbeek, The Netherlands
Vilnius University Institute of Biotechnology, 10223 Vilnius, Lietuva, Lithuania



CONTEXT

The SOLSA project aims to create an innovative on-line-on-mine-real-time expert system, combining sonic drilling and mineralogical and chemical analyses. Ideally, this combination, highly demanded by mining and metallurgical companies, will speed up exploration, mining and processing, as it provides textural, mineralogical and chemical data to define geometallurgical key parameters for optimizing beneficiation.

In order to evaluate the instrumental parameters for the SOLSA expert system, portable and laboratory analyses were performed on 4 samples with contrasting lithologies. Among the several techniques integrated on the system, this study focuses on hyperspectral spectroscopy, Raman spectroscopy and X-Ray Fluorescence (XRF). More precisely, the aim of this study is to evaluate the possible risks for erroneous analyses or loss of information due to the surface roughness of the samples.



Samples and Techniques

Preparation of squared samples from 4 cores

Diamond drilled

Siliceous Breccia — Serpentinized Harzburgite (Peridotite)

Sonic drilled

Sandstone — Granite

Surface state of the samples

As drilled
Cut
Polished at 6 µm
Polished at 0.25 µm
Powdered < 80 µm

Analyses

Handheld instruments

Portable X-Ray Fluorescence: ThermoFisher NITON XL3t 980 GOLDD (mining mode, analytical window : 3 mm, 3 filters, 5 analyses)

Portable InfraRed spectroscopy (hyperspectral): ASD Fieldspec 3 (350-2500 nm (VNIR-SWIR), resolution: 3 to 10 nm, area = 1.76 cm²)

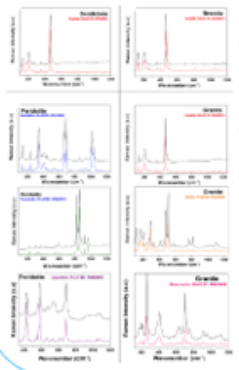
Laboratory instruments

Raman spectroscopy: Thermo Scientific DXR (532 nm laser, 1 mW, spot size 0.8 µm, integration time 120 s)

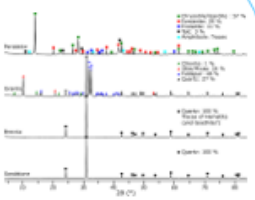
X-Ray Diffraction: Siemens D5000, Co tube, 4-84°, 0.03°/step

Results

Raman spectroscopy



X-Ray Diffraction

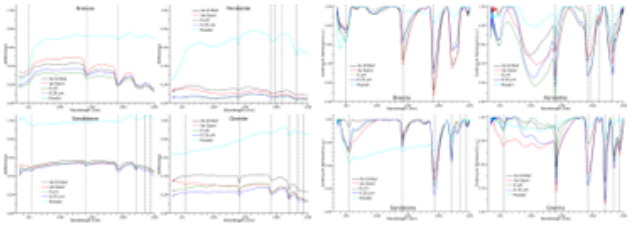


Raman spectroscopy **confirms and completes** the mineralogy proposed by XRD

No effect of the surface state on the Raman signal has been evidenced (not shown)

Hyperspectral spectroscopy

Reflectance — **Continuum removed**



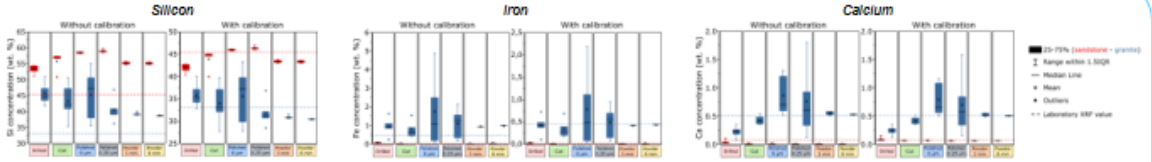
Around 1420 and 1920 nm : **Water** molecules

Breccia: **Goethite** at 500 nm, **Quartz** undetectable in this range — Peridotite: presence of **Serpentine**
Sandstone: presence of **Illite or Montmorillonite** — Granite: presence of **Illite**

Polishing **decreases the reflectance**, but **increases the peak intensities** (except for Breccia). However, sufficient information can be obtained from the samples as drilled.

Handheld X-Ray Fluorescence (Sandstone and Granite)

Silicon — **Iron** — **Calcium**



Comparison with laboratory XRF (dashed lines) → Using the internal calibration of the Niton (Figures "Without calibration") highlights a difference between our results and actual concentrations. **Performing a calibration on the whole range of expected concentrations with our own set of references is mandatory** (see Figures "With calibration")

Mineralogy has an impact on the XRF results. Sandstone (homogeneous sample) presents a good accuracy of results. Granite (heterogeneous sample) is characterized by an important scattering of the results → **Necessity to gather a large quantity of results on the same sample**

Surface state has an impact on XRF results, either on the scattering of the results, or on their accuracy, or both.
The presence of air between the surface of the samples and the spectrometer induces a loss of data, which results in erroneous concentrations.

Conclusion

This study highlights the importance of coupling analytical methods to perform a comprehensive characterization of the cores with the SOLSA expert system. Indeed, each method completes the results obtained by another. According to these results, a good characterization of the drill cores can be obtained on the samples as drilled, requiring no particular pretreatment. However, the results obtained by XRF must be used as indicators of the presence (qualitative) of an element and not as quantitative results.

References

Hall G.E.M., Pagé L., Bonham-Carter G.F., Quality Control Assessment of Portable XRF Analysers: Development of Standard Operating Procedures, Performance on Variable Media and Recommended Uses - Phase II, report, 2012.

Hu B, Chen S, Hu J, Xia F, Xu J, Li Y, et al., Application of portable XRF and VNIR sensors for rapid assessment of soil heavy metal pollution. PLoS ONE 12(2), 2017

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

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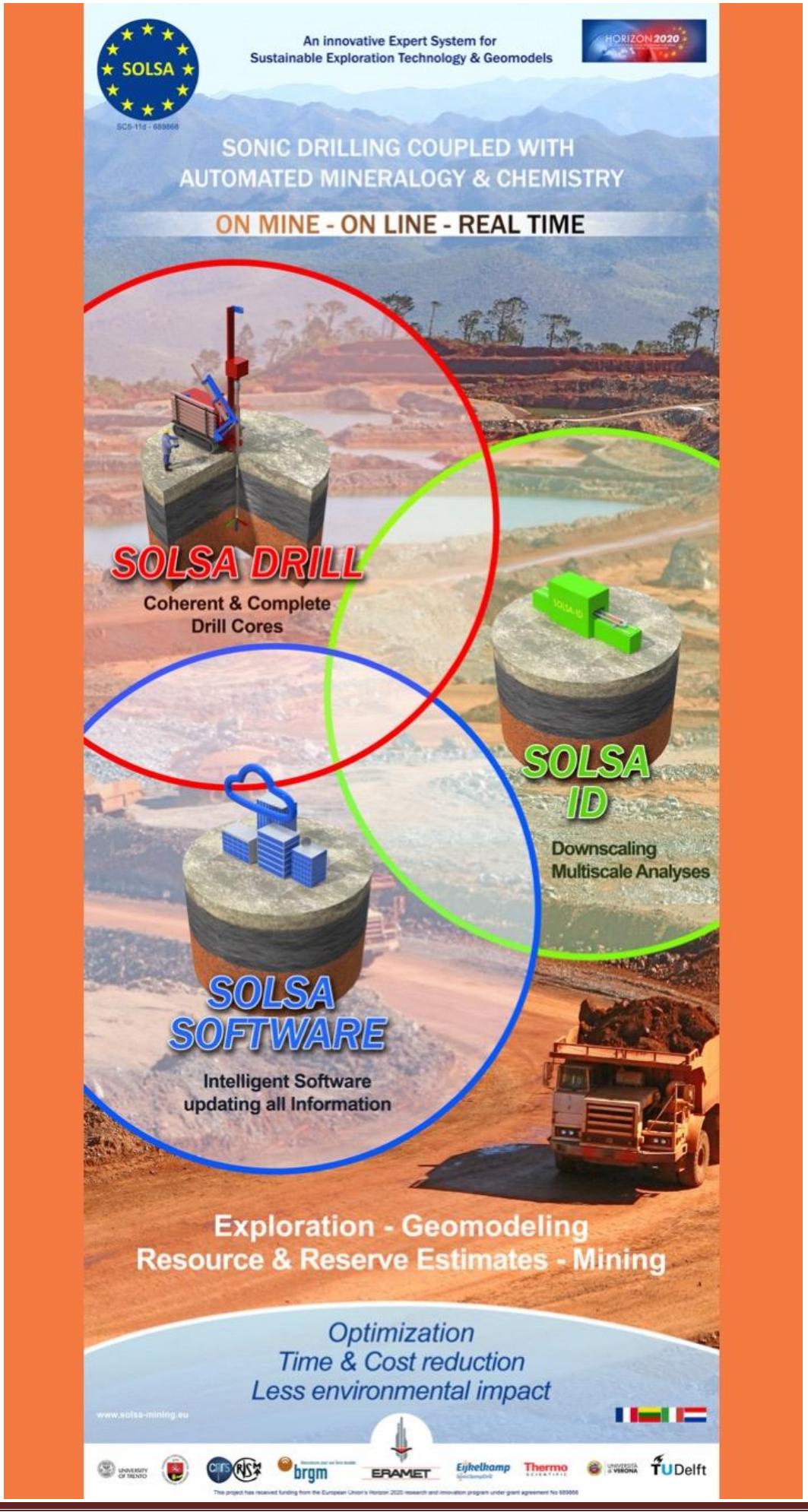

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c) Website

The SOLSA website (www.solsa-mining.eu) is regularly up-dated by the webmaster Thanh Bui and then by Christophe BESSIN (Eramet).

"News" announces all international events, where consortium members present SOLSA results.

When allowed by the publisher, publications can be downloaded from this website.

2- CONFERENCES AND PRESENTATIONS

a) Diverse events

TWORE Days at Royal Eijkelkamp, Giesbeek, The Netherlands, September 29 and 30, 2017; Presentation: "SOLSA/ Future Drill", Marco Lichtenberg, Technical Manager.

Short Course on African Metallogeny (SGA-SEG-IUGS-INP-FHB-Univ. FHB-UNESCO-IRD-KIT, Université Paris Saclay), Yamoussoukrou, Ivory Coast, 28/10- 1/11 2019: Gold deposit: From Exploration to Mining. Lecture (3h): B. Orberger: Sonic drilling and On-line-real-time geometallurgy for efficient mining.

EUROPEAN INNOVATION HUB, 25-26 September, Brussels
B. Orberger presented Market Strategy related to WP8.
http://ec.europa.eu/research/ridays/pdf/ec_rtd_eu-ri-days-hub-programme_draft_2019.pdf

b) Conferences and presentations made by members of SOLSA Consortium

Actually, 39 papers were presented at international conferences. They are listed in the table below and grouped according to the 3 periods of the project. At now, 8 presentations took place during the 1st period of the project, 23 during the second period and 8 during the third period.

1st period: Feb 2016 – July 2017

(1) SciDataCon 2016, 11-13 Sept. 2016, Denver, USA - The Crystallography Open Database – New Perspectives.

Saulius Grazulis, Andrius Merkys, Antanas Vaitkus, Armel Le Bail, Daniel Chateigner, Henry Pilliere, Robert T. Downs, Luca Lutterotti, Peter Moeck, Peter Murray-Rust, Miguel, Quiros Olozabal, Werner Kaminsky

(2**) GFSV : Groupe Français de Spectroscopie Vibrationnelle (GFSV)**, annual meeting 2016 -

D. Chateigner, L. Lutterotti, S. Gascoin,

http://www.ecole.ensicaen.fr/~chateign/danielc/slides/Chateigner_slides_GFAC2016.pdf

(3) **GFSV (Groupe Français de Spectroscopie Vibrationnelle),** 27-30 June 2017, Le Mans, France - Combined Analysis extended to Raman and IR spectroscopies: SOLSA EU Project. Chateigner et al

(4) **GFA 2017** (Groupe Français des Argiles), 22-24 May 2017, Aix-Marseille, France - Caractérisations minéralogiques et cristallochimiques d'argiles nickélifères par DRX, Raman et couplage MEB-Raman.

Nicolas Maubec, Pierre Gilles Blaineau, Anthony Da Silva Alves, Cedric Duee, Xavier Bourrat, Beate Orberger, Monique Le Guen, Anne Salaün, Celine Rodriguez

(5) **AMAM-ICAM** (International Conference on Applied Mineralogy and Advances Materials), 5-9 June 2017, Bari, ITALY - Coupled Mineralogy and Chemistry on drill core samples: benchmarking on-line-real-time analyses. Scientific Research abstracts, V. 6, p70, ISSN 2464-9147 (online). Applied Mineralogy & Advanced Materials, AMAM-ICAM.

Beate Orberger, Cedric Duée, Nicolas Maubec, Valérie Laperche, Laure Capar, Anne Bouruignon, Xavier Bourrat, Yassine El Mendili , Stephanie Gascoin, Daniel Chateigner, Celine Rodriguez, Anne Salaün, Monique Le Guen, Gino Mariotto,

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Marco Giarola, Arun Kumar, Nicola Daldasso, Marco Zanatta, Luca Lutterotti, Evegny Borovin, Mauro Bortolotti, Maria Secchi, Maurizio Montagna, Henry Pillière, Thomas Lefevre, Fons Eijkelkamp, Harm Nolte, Peter Koert, Saulius Grazulis, Fabien Trotet, Mohamed Kadar, Karen Devaux.

(6) **AMAM-ICAM** (International Conference on Applied Mineralogy and Advances Materials), 5-9 June 2017, Bari, ITALY - Combined Raman and EDXS analysis on drill core samples. Scientific Research abstracts, V. 6, p53, ISSN 2464-9147 (online). (Poster presentation : Arun Kumar, Marco Giarola, Nicola Daldasso, Marco Zanatta, Gino Mariotto, Andrea Sanson, Maurizio Montagna, Maria Secchi, Evgeny Borovin, Mauro Bortolotti, Stefano Gianella, Luca Lutterotti, Beate Orberger, Monique Le Guen, Anne Salaün, Celine Rodriguez, Cedric Duée, Nicolas Maubec, and Xavier Bourrat.

(7) **GISR 2017** (Italian meeting on Raman spectroscopies and non-linear optical effects), 7-9 June 7-9 2017, Trieste, ITALY. Expert mineralogical investigations using a combined approach (Oral presentation).

Maria Secchi, Marco Zanatta, Evgeny Borovin, Mauro Bortolotti, Arun Kumar, Marco Giarola, Andrea Sanson, Anne Salaün, Céline Rodriguez, Monique Le Guen, Beate Orberger, Nicola Daldosso, Stefano Gialanella, Gino Mariotto, Maurizio Montagna, Luca Lutterotti.

(8) **International Remote Sensing Conference**, July 2017, Houston, USA –

Determination of spectra characteristics of laterite drill-core for "on line-on site" real-time automated mineralogy detection. Capar, A., Bourguignon, C. Duée, X. Bourrat, S. Chevrel, V. Laperche, N. Maubec, S. Montech, B. Orberger, C. Rodriguez, A. Salaün

2nd period: August 2017 – January 2019

(9) **SGA 2017 (Mineral Resources to Discover)**, 19-23 August 2017, Quebec, CANADA - Combined mineralogy and chemistry on drill cores: challenging for on-line-real-time analyses.

Duée, C., Orberger, B., Maubec, N., Laperche, V., Capar, L., Bourguignon, A., Bourrat, X., El Mendili Y., Gascoin, S., Chateigner, D., Rodriguez, C., Salaün, A., Le Guen, M., Mariotto, G., Giarola, M., Kumar, A., Daldasso, N., Zanatta, M., Lutterotti, L., Borovin, E., Bortolotti, M., Secchi, M., Montagna, M., Pillière, H., Lefevre, T., Eijkelkamp, F., Nolte, H., Koert, P., Grazulis, S., Trotet, F., Kadar, M., Devaux, K.

(10**) SGA 2017**, 7-9 June 7-9 2017, Trieste, ITALY. The importance of high quality drill cores for geometallurgy (Oral presentation). Orberger, B., Eijkelkamp, F. and Le Guen, M.

(11) **IUCr 2017** (24th Congress and General Assembly of The International Union of Crystallography), 21-28 August 2017, Hyderabad, India – Crystallography Open Database for teaching. Saulius Gražulis; Andrius Merkys; Antanas Vaitkus

(12**) IUCr 2017** (24th Congress and General Assembly of The International Union of Crystallography), 21-28 August 2017, Hyderabad, India – The use of interconnected open data for material identification. Antanas Vaitkus; Andrius Merkys; Yassine El Mendili; Saulius Gražulis.

(13) **RTM Conference on Innovation on Raw Materials,** 10-11 Oct. 2017, Amsterdam, NL, 10-11 Oct. 2017. Proceedings of real Time Mining International Raw material extraction Innovation Conference, Wagner Digitaldruck und Medien GmbH, ISBN 978-3-938390-41-2, p. 13. (Oral presentation). Le Guen, M., Orberger, B. SOLSA: a revolution in combined sonic drilling and on-line-on-mine-real-time analyses..

(14) **RTM Conference on Innovation on Raw Materials,** 10-11 oct. 2017, Amsterdam. Wagner Digitaldruck und Medien GmbH, ISBN 978-3-938390-41-2, p. 21. (Oral presentation). Challenges in coupled on-line-on-min-real-time mineralogical and chemical analyses on drill cores. Duée, C., Orberger, B., Maubec, N., Bourrat, X., El Mendili, Y., Gascoin, S., Chateigner, Le Guen, M., Salaün, A., Rodriguez, C., Laperche, V., Capar, L., Bourguignon, A., Eijkelkamp, F., Kadar, M., Trotet, F.

(15) RTM **Conference on Innovation on Raw Materials.** 10th-11th October 2017, Wagner Digitaldruck und Medien GmbH, ISBN 978-3-938390-41-2, p. 44-45. Oral Pres.). 3D Imaging on heterogeneous surfaces on laterite drill core materials. Pillière, H., Lefèvre, T, Harang, D., Orberger, B., Bui, T., Duée, C., Maubec, N, Bourrat, X., El Mendili, Y., Chateigner, D., Gascoin, S, Le Guen, M., Salaün, A., Rodriguez,, C, Le Guen, M., Salaün, A., Rodriguez,, C Kumar, A., Daldosso, N., Zanatta, M., Speghini, A., Sanson, A., Lutterotti, L., Borovin, E., Bortolotti, M., Secchi, M., Montagna, M., Gražulis, S, Trotet, F., Kadar, M., Devaux, K.

(16) **RTM Conference on Innovation on Raw Materials,** 10th-11th October 2017, Wagner Digitaldruck und Medien GmbH,

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

ISBN 978-3-938390-41-2, p. 141-142.
Efficient long-term open-access data archiving in mining industries.
Gražulis, S., Merkys, A., Vaitkus, A., Duée, C., Maubec, N., Laperche, V., Capar, L., Bourguignon, A., Bourrat, X., El Mendili, Y., Chateigner, D., Gascoin, S., Le Guen, M., Salaün, A., Rodriguez,, C ., Kumar, A., Daldosso, N., Zanatta, M., Speghini, A., Sanson, A., Lutterotti, L., Borovin, E., Bortolotti, M., Secchi, M., Montagna, M., Orberger, B., Le Guen, M., Salaün, A., Rodriguez,, C., Trotet, F., Kadar, M., Devaux, K., Bui, T., Pillière, H., Lefèvre, T., Eijkelkamp, F., Nolte, H., Koert, P.

(17**) International workshop Geochemical cycle of Ni, Co and Sc**: from mining exploration to ecotoxicity. October 17-19, Nancy, France.

Genin, JM, Orberger, B., Maubec, N., Duée, C., Bourrat, X., Blaineau, P.G., da Silva Alves, A. (2017). International workshop Geochemical cycle of Ni, Co and Sc: from mining exploration to ecotoxicity.

(18) **International workshop Geochemical cycle of Ni, Co and Sc**: from mining exploration to ecotoxicity. October 17-19, Nancy, France. Duée, C., da Silva Alves, A., Maubec, N., Blaineau, P.G., Orberger, B., Bui, T., Pillière, H., Bourrat, X., Le Guen, M. (2017). International workshop Geochemical cycle of Ni, Co and Sc: from mining exploration to ecotoxicity. October 17-19, Nancy, France, p. 114 (POSTER presentation). Mineralogical and crystallochemical characterizations of Ni-bearing clays: highlighting of Nickel using hyperspectral signal of minerals originating from New Caledonia lateritic profiles.

(19) International workshop Geochemical cycle of Ni, Co and Sc: from mining exploration to ecotoxicity. October 17-19, Nancy, France. Maubec, N., Blaineau, P.G., Duée, C., da Silva Alves, A., Orberger, B., Bourrat, X. (2017). International workshop Geochemical cycle of Ni, Co and Sc: from mining exploration to ecotoxicity. October 17-19, Nancy, France, p. 115 (POSTER presentation). Mineralogical and crystallochemical characterization of Ni-bearing clays.

(20) **RTM Conference on Innovation on Raw Materials,** 10th-11th October 2017D.

Chateigner, L. Lutterotti, S. Gascoin, Y. El Mendili : https://cfcl2017.sciencesconf.org/data/pages/CFCL2017_livret_2.pdfhttp://www.ecole.ensicaen.fr/~chateign/danielc/slides/Chateigner_slides_CFCL2017.pdf.

(21) **GFSV Annual meeting**

http://www.ecole.ensicaen.fr/~chateign/danielc/slides/Chateigner_slides_GFSV2017.pdf

(22) EUG, Vienna, April 2018.

T. Bui, B. Orberger, S. B. Blancher, A. Mohammad-Djafari, H. Pilliere, A., X. Bourrat, N. Maubec, T., C. Rodriguez, A. Vaitkus, S. Grazulis, C. Duée, D. Harang, T. Wallmach, Y. El Mendili, D. Chateigner, M. Buxton, M. Le Guen: MINERAL IDENTIFICATION USING A NEW HYPERSPECTRAL LIBRARY AND SPARSE UNMIXING TECHNIQUES (session: "close sensing") (Pico presentation). EGU General Assembly Conference Abstracts, 2018, vol. 20, p. 18279.

(23) AIMS, International Conference Mines of the Future, RWTH Aachen, Germany, 25-27 Mai 2018.

H. Eijkelkamp, F. Eijkelkamp, H. Nolte, P. Koert, J. van den Broeke, B. Orberger, M. Le Guen, M.W. Buxton: Sonic Coring Coupled with on-site automated material characterization (Oral presentation)

(24) GeoRaman Conference, Catania, Italy, June 2018.

Secchi M., Zanatta M., Borovin E., Bortolotti M., Kumar A., Sanson A., Orberger B., Gialanella S., Mariotto G., Montagna M., Lutterotti L., Le Guen M.: Ni laterites characterization using a combined approach (Poster presentation).

EMRS 2018 - Symposium L, Strasbourg (France), June 18-22, 2018.

(25) GeoRaman Conference, Catania, Italy, June 2018.

A. Kumar, M. Zanatta, Y. Kostikov, G.D. Nessim, G. Mariotto: Carbon nanotubes synthesis using natural limonite laterite as catalyst source, (Oral presentation)

(26) ICARSS, Valencia, Spain, July 2018.

Bui, T., Orberger, B., Blancher, S.B., Mohamed-Djafari, A., Pillière, H., Salaün, A., Bourrat, X., Maubec, N., Lefèvre, T., Rodirguez, C., Vaitkus, A., Grazulis, S., Duée, C., Harang, D., Wallmach, T., El Mendili, Y., Chateigner, D., Buxton, M., Le Guen, M. 2018. Building a hyperspectral library and its incorporation into sparse unmixing for mineral identification, IGARSS 2018-2018 IEEE International Geoscience and Remote Sensing Symposium, 2018, pp. 4261–4264.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

(27) IMA, Melbourne, Australia, August 2018.

T. Bui, B. Orberger, S. Blancher, A. Mohammad-Djafari, S. Gražulis, Y. el Mendili, D. Chateigner, H. Pilliere, N. Maubec, T. Lefevre, X. Bourrat, C. Rodriguez, C. Duée, D. Harang, T. Wallmach, M. Le Guen. A new Hyperspectral library connected to SOLSA OPEN DATA Bases for on-line-real time analyses on Ni laterites and Bauxites. (Oral presentation).

(28) IMA, Melbourne, Australia, August 2018.

H. Eijkelkamp, F. Eijkelkamp, H. Nolte, P. Koert, B. Orberger, M. Le Guen, M. T. Buxton. Sonic Drilling in subsurface ore deposits: an efficient sampling tool to increase metal production (Oral presentation)

(29) IMA, Melbourne, Australia, August 2018.

Y. El Mendili, A. Vaitkus, D. Chateigner, S. Gascoin, S. Petit, A. Merkys, S. Gražulis, H. Pilliere, B. Beccard, M. Zanatta, M. Secchi, G. Mariotto, A. Kumar, L. Lutteroti, E. Borovin, T. Bui, B. Orberger, M. Le Guen. The SOLSA project: Combined techniques and databases for mineral identification (Oral presentation).

(30) SMART Mining Conference, Denver, Feb. 2019.

A. KANZARI, C. RODRIGUEZ, B. ORBERGER, A. PRUDHOMME, T. BUI, S. DELCHINI, A. EL MENDILI, T. LEFEVRE, H. PILLIERE, A. VAITKUS, A. MERKYS, S. GRAZULIS, A. BOURGUIGNON, L. CAPAR, N. MAUBEC, M. LE GUEN. The SOLSA Sonic On Line drilling and Sampling Analysis » project for on-line-on-mine-real-time analyses: Key parameters definition and Field tests on a Bauxite mine in Southern France

(31) SMART Mining Conference, Denver, Feb. 2019.

Orberger, B., Eijkelkamp, H., Nolte, H., Koert, P., Bucklandt, M., Le Guen, M.: SONIC DRILLING FOR SMART EXPLORATION AND MINING. Presented by A. Kanzari

3rd period: February 2019 – January 2020

(32) RTM MINING Demonstration day and International conference, March, Freiberg, Germany. Le Guen, M., Orberger, B.: SOLSA-FIELD TESTS: indispensable for reaching SOLSA Goals

(33) RTM MINING Demonstration day and International conference, March, Freiberg, Germany. Delchini, S., Bui, T., El Mendili, A., Orberger, B.: Moisture effect on hyperspectral analyses tested on bauxites and Ni-laterites samples.

(34) SGA Biannual Meeting, Glasgow, August 2019

Bui T., Thomas Lefevre, Orberger B., El Mendili Y., Ali Mohammad-Djafari, Sylvain Delchini, Henry Pilliere, Simon B. Blancher, Aisha Kanzari, Xavier Bourrat, Daniel Chateigner, Mike Buxton, Monique Le Guen (2019). SOLSA HIMIP – A software for Hyperspectral Image Manipulation, Interpretation and Processing.

(35) SGA Biannual Meeting, Glasgow, August 2019

Maubec, N., Blaineau, PG, Duée, C., Da Silva Alves, A., Bourrat, X., Wille, G., Orberger, B., Le Guen, M., Villanova-de-Benavent, C. (2019): Garnierite characterisation for open data bases for Nickel laterite exploration. International Metallogeny conference: SGA Biannual Meeting, Glasgow, Scotland,

(36) RX-Matière, Nancy 19-22 November 2019

S. Gascoin[1], Y. El Mendili[1], D. Chateigner[1], B. Orberger[2], M. Le Guen[3], H. Pilière[4], L. Lutterotti[5], E. Borovin[5], X. Bourrat[6], S. Delchini[6], et S. Grazulis[7] : Prototype pour analyses combinées DRX – Fluo X - Raman – Projet européen SOLSA H2020.

(37) ITES Conference, Moscow, Russia, october

Delchini, S., El Mendili, A., Bui, T., Lefevre, T., Maestracci, B., Orberger, B., Pillière, H., Bourrat, X., Le Guen, M.: THE SOLSA CORESCANNER: an automatized multifunction analytical tool for on-site core analysis in lateritic environment.

(38) RX-Matière, Nancy 19-22 Novembre 2019

S. Gascoin[1], Y. El Mendili[1], D. Chateigner[1], B. Orberger[2], M. Le Guen[3], H. Pilière[4], L. Lutterotti[5], E. Borovin[5], X. Bourrat[6], S. Delchini[6], et S. Grazulis[7] : Prototype pour analyses combinées DRX – Fluo X - Raman – Projet européen SOLSA H2020.

(39) Raw Material Weeks, Bruxelles, 18-22 November 2019

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 689868

Le Guen, M. and Consortium SOLSA Designing a mobile prototype towards minimizing risk in mining industry. Monday 18/11/19.

c) BOOTHS at Conferences of Fares (2016-2018)

Royal Eijkelkamp, Giesbeek, NL: Mining in Europe, Mai 2016 and 2017, RWTH Aachen, Germany.
SOLSA was presented by Royal Eijkelkamp and the booth was awarded "Best Booth" in 2016.

3- MOVIES

3 movies and 1 teeser have been made with the following goals:

- First tests of SOLSA DRILL on big blocks of fresh peridotites that were sent by SLN from the mine Nepoui to Eijkelkamp's field located at Giesbeek; 1mn 40 seconds.
- Reporting of the field tests for training students and users: 30 mn performed by an internal student of the 3iS school (bachelor level).
- Communication about SOLSA with reference of the field tests: 6 mn, performed by Altitude Production. Sent by "we transfer" to SOLSA's Project Officer.
- Teeser: 48 seconds, made by Altitude Production for diffusion on social network.