

# INFRARED SPECTROSCOPY

## INFRARED SPECTRAL ANALYSIS AND MACHINE LEARNING

As an exploration project transitions to a mining project, one of the most expensive stages from an analytical perspective is process and mine development and, to a lesser degree, mine production. Many of the geochemical, mineralogical, or physical tests at these stages are costly, thus fewer domain samples are analysed. Assays become poor proxies for metallurgical characteristics in a block model.

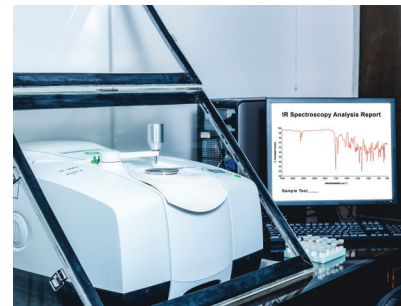
Through its Metals and Minerals division, Bureau Veritas has incorporated into its processes the development and application of spectral services, which includes Fourier transform infrared spectrometry (FTIR) and ASD spectroscopy in a pressed pellet, finalised in the combination of the spectra and interpreted through Machine Learning mathematical models.

Bureau Veritas' Minerals spectral service (VNIR to TIR) plus machine learning can help to optimise resource development by predicting properties that are difficult, costly, or time-consuming to measure. The spectral analysis and Machine Learning service is the appropriate tool for the Digitalisation of Mining Planning, obtaining high benefits in the analysis and evaluation of minerals, as well as for the performance of the process.

This analytical technology measures light absorbed by a sample in the infrared (IR) region of the light spectrum [spectral range of VNIRSWIR- LWIR-TIR (0.35 to 26.5  $\mu\text{m}$ )]. It is the appropriate tool for the Digitalisation of Mining Planning, obtaining high benefits in the analysis and evaluation of minerals, as well as for the performance of the process.

The development of the BV Prediction application allows you to obtain a fingerprint of each of your samples and predict future processing conditions, metallurgical parameters, mineralogical parameters, chemical properties and physical properties. As this technology covers a large wavelength range, it can predict a diverse range of mineralogical and metallurgical parameters.

Bureau Veritas has successfully completed bauxite, iron ore, base metals, precious metals, and porphyry copper spectral programmes. Our service can predict mineralogy, physical properties, ore processing properties, ore classification, geochemistry, and more.



# INFRARED SPECTROSCOPY



CYCLE	SCOPE OF WORK	ANALYSIS TYPE	ANALYSIS COST	ANALYSIS VOLUMES
Exploration ▼	Geo Assay Mineralogy Ore Characterisation	Low Detection Levels Pathfinder	INNOVATION 	Scoping Samples Field Analysis Routine Laboratory Samples
Resource Development ▼	Geo Assay Process Scoping Geomet Studies	Accurate Quantitative Analysis JORC and 43-101 Reporting		Target Samples Routine Laboratory Samples
Process and Mine Development ▼	Feasibility Studies Pilot Plant Product Testing	Mineralogy Recovery Concentrates		Project Samples Research Analysis Proxies
Production ▼	Process Optimisation Product Quality Grade Control Geomet Programmes	Tailored Methods for Operations Metal Accounting Transactions		On-Site Lab Fast Turnaround High Accuracy (Trade)

## WHY PERFORM SPECTRAL ANALYSIS AND MACHINE LEARNING?

- Low cost analysis - rapid spectral collection
- No additional sample preparation is required
- Get a complete picture of the mine from routine laboratory samples
- Create a digital mine log for the future

## PREDICT:

- Future processing conditions
- Metallurgical parameters
- Mineralogical parameters
- Chemistry
- Physical properties

## USE MACHINE LEARNING TO:

- Identify the relationships between spectral characteristics and critical variables
- Discover and capture associations and patterns within spectrums
- Learn and predict

# INFRARED SPECTROSCOPY



## **BUREAU VERITAS' SPECTRAL ANALYSIS PLUS MACHINE LEARNING WORKFLOW INVOLVES:**

- Normal sample preparation methods are used to produce a dried pulp
- The IR spectra are collected without any additional preparation. There are no digests, fusions or other processes required
- Collection of fingerprint IR spectra on a calibration set from a given mineral deposit
- Data analytics and Machine Learning processes are used to build a custom predictive model
- The model is validated with spectra from known samples from the same deposit, then deployed to the laboratory for predictions on routine samples

## **HYLOGGER (VNIR AND SWIR) SPECTROMETRY**

The Hylogger system can be used on core or rock chips for the qualitative determination of an extensive list of minerals including Fe oxides, AIOH group minerals, sulphates, FeOH group, MgOH group, and carbonates

### **Application of VNIR and SWIR analysis**

- + Alteration vectoring
- + Lithocap investigations
- + Geometallurgy applications

### **Benefits:**

- + Cost effective mineralogy
- + Little sample preparation required  
(analysis can be conducted on core, or chips)
- + Non-destructive
- + Easy set-up, on-site application
- + Hylogger spectra interpretation service is available



**BUREAU  
VERITAS**

For more information:  
[Contact.africa@bureauveritas.com](mailto:Contact.africa@bureauveritas.com)

Shaping a World of Trust

[www.bureauveritas.africa](http://www.bureauveritas.africa)