OreSight

A highly-automated on-site downhole assay service for the mining industry

Epiroc

Gather accurate, high resolution data from drill holes in near real-time

Discover more about our range of geophysical logging services.

OreSight makes possible in-situ downhole assaying in the mining industry. The combination of Epiroc's OreSight deployment and operational support technologies with Sodern's FastGrade™ has the potential to revolutionize your operation. Pulsed neutron tools enable the gathering of accurate, high-resolution, large sample size assay data from drill holes in a safe, rapid and cost-effective manner.

Reduced manual handling
Traditional sampling processes involved in the recovery, packing and transport of physical samples expose employees numerous risks and hazards. OreSight reduces or removes these risks with in-situ formation measurements. This helps to increase safety on-site.

Automation
Engineering controls on all our downhole assay platforms includes:

- Zero manual handling.
- Automated winch to maximise logging efficiency and removing human error.
- Automated and manual lock-outs associated with radiation detectors.
- Air conditioned cabin to reduce operators exposure to dust, noise and the elements.

OreSight downhole assay units are operated from within the vehicle cabin. There is no requirement for the operator to be outside the vehicle when working in mining operations.
All OreSight vehicles are actively monitored with IVMS as standard to ensure the safety of personnel and reduce driving risks.

Main benefits

Increased safety as people are taken out of the line-of-fire due to reduced manual handling.

Improved geological control thanks to a wealth of high-quality geophysical data.

Boosted efficiency and cost control due to near real-time data, optimized planning, lower lab costs and reduced sampling.

World-beating sophistication

OreSight is an innovative downhole geophysical logging system. Technologically advanced integrated features help to ensure seamless and safe operations. Our semi-autonomous OreSight logging system provides a highly efficient deployment of the FastGrade™ tools on drill patterns. Data is automatically transferred via 4G or WiFi to our real-time operations center.

How is data collected?

Neutrons emitted by the pulsed neutron generator penetrate the surrounding rock. These neutrons lose their energy when colliding with nuclei. During this process, several interactions are initiated including fast inelastic collisions, or neutron captures. This results in an almost instantaneous emission of gamma photons. Each element produces a set of characteristic energies, which is the key to identifying and quantifying them. A high resolution LaBr3 scintillating material, coupled with a photomultiplier, converts the photons into electrical pulses and a circuit digitizer sorts and counts them to build a spectrum. Elemental footprints are calculated from the spectrum to characterise the chemical composition of the formation. FastGrade™ is calibrated using an innovative training technique that aligns spectral variation with rock geochemistry. Digital calibration based on Monte Carlo numerical modelling is used for factory characterization and to minimize final on-site calibration adjustment.

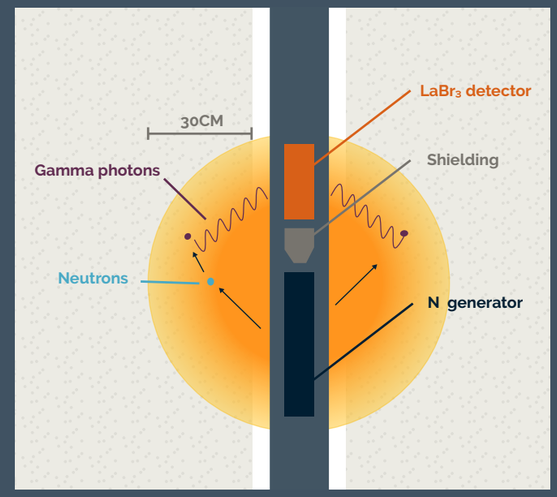
Tool physics

+ Improved resource classifcation.

FastGrade™ Pulsed Fast and Thermal Neutron Activation (PFTNA) has been proven to have several advantages over conventional sample-based assays for orebody characterization.

- In-situ measurement with improved depth accuracy.
- High and consistent vertical resolution.
- Increased measurement volume of the sample.
- Ability to record data at a high spatial density.

High resolution data can also be integrated to match mining block models. This improves 3D mapping and modelling of the orebody and provides inputs for intelligent extraction techniques. It also improves material reconciliation.

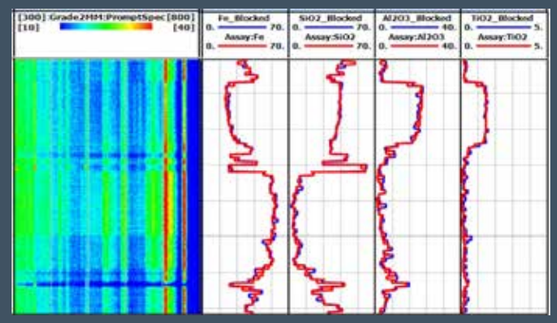


+ Improved QA/QC process

FastGrade™ downhole assay has numerous advantages over physical samples gathered from blastholes. The technology provides results with a large, in-situ sample size, high vertical resolution, that are not impacted by the same errors typically seen with physical samples.

- Sampled data is measured in-situ.
- No core/sample loss is experienced.
- Variations in resolution.
- Measurement not subject to sample bias from drilling method.
- Consistent, selectable sample resolution.
- Not affected by biases between laboratories.
- Eliminates errors associated with traditional sampling methods.

FastGrade™ provides clients with the ability to recover high quality assay data from a range of hole types including blast holes and RC holes. This opens up opportunities for reducing drilling costs whilst gathering an improved sub-surface dataset.



OreSight removes the guesswork

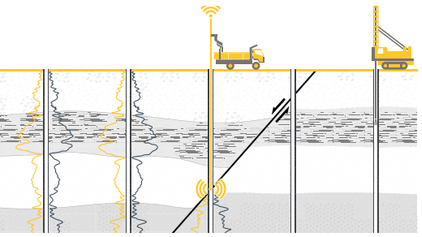
High accuracy FastGrade™ measurements are provided in-situ and on depth, This reduces the reliance on high cost core sampling. OreSight provides clients with a safe, cost effective method of acquiring extremely valuable data and to enhance ore-body knowledge..

+ Unique neutron tubes

Epiroc utilizes pulsed neutron tubes from Sodern in it's range of downhole assay services. Sodern have over 50 years experience in neutron technology. These tubes have a long lifetime and a low cost of ownership thanks to a unique combination of ceramic technology and a hydrogen isotope loading process.

+ Highly mobile

The OreSight vehicle is fully road legal to allow easy movement between sites and drill pads, allowing for maximum up-time. This also helps to reduce the resources and planning required to move the service between operational areas.



+ A proven advantage

FastGrade™ Pulsed Fast and Thermal Neutron Activation (PFTNA) has several advantages over conventional physical sample-based assays for characterizing ore bodies. Measurements are taken on-site in near real-time, at the correct depth and at a high and consistent vertical resolution. The system logs data efficiently and quickly which allows it to record data at a high spatial density. Elements at a low concentration can also be characterized — including thin beds.

Relevant technical publications and articles

Epiroc regularly contributes both articles and peer reviewed technical publications on downhole geophysics. We also regularly present at conferences and mining events. Please contact us if you are interested in us presenting at a relevant technical event or for copies of the following technical publications and articles.

- *Simpson, C., Market, J., (2021)* ***Geophysical blasthole sampling****. AUSIMM Iron Ore 2021, Perth, Australia.*
- *Market, J., Simpson, C., Rossiter, H., Jeanneau, P., (2021)* ***Advances in downhole assay measurements and calibration techniques****. AUSIMM Iron Ore 2021, Perth, Australia.*
- *Rossiter, H., Virani, A., Market, J., Maddever, A., Jeanneau, P., (2020)* ***Using high-efficiency downhole assay to improve the financial performance of open pit copper mining operations.*** *AUSIMM Preconcentration Digital Conference, Online.*
- *Market, J., Robinson, D., Jeanneau, P., Rossiter, H., 2019.* ***Downhole assays in the Pilbara.*** *AUSIMM Iron Ore Conference, Perth, Australia.*
- *Market, J., Rossiter, H., & Armitage, B. (2019, June 15).* ***Advanced Petrophysical Applications for the Australian Mining Industry.*** *Society of Petrophysicists and Well-Log Analysts.*
- *Huw Rossiter, Vincent Flahaut (2018).* ***Downhole Assay: A game changer for the mining industry.*** *AEGC 2018 Conference Handbook.*

Technical specifications

OreSight™

Vehicle	Oresight™
Width	2200 mm
Height	3250 mm (approx. 4200 to top of antennae and flags)
Length	6,500 mm
Nominal Weight	7,150 kg
Front approach angle	33°
Rear departure angle	20°
Fuel	Diesel

Operational Limitations

The vehicle can be fitted with an aftermarket track system for operating in steep terrain. All limitations are for the standard truck configuration.	
Maximum traverse angle – across contour	<10°, otherwise subject to a risk assessment
Maximum incline angle - traversing (pitch straight up or down slope)	20°
Maximum incline angle - logging (pitch straight up or down slope)	5°, otherwise subject to a risk assessment
Maximum incline angle - logging (side to side pitch)	4°

Probe Deployment

Maximum wireline length	600 m
Speed range	0.0 – 12.0 m/min
Speed regulation	≤ 0.1m/min
Nominal cycle time (12m holes @ 4 m/min logging speed)	8.12 minutes

Features

- Integrated and automated system, compatible with Sodern's FastGrade™ Logging system
- Temperature regulated tool storage
- Automated and manual handling free tool deployment and storage
- Vehicle immobilization system (to prevent vehicle movement when logging is in process)
- Near real-time data transfer (subject to 4G availability or other suitable means)
- Dual GPS functionality with the ability to upload hole location files (format dependant)
- Secondary hole location system
- Interlocks to ensure neutron emission is restricted to in hole operations

FastGrade™ FG100D

Application	Geochemical in hole assay, Resource evaluation - Infill assay - Blast Hole assay (Grade Control)
Analytical principle	Pulsed Fast & Thermal Neutron Analysis (PFTNA)
Borehole type	Uncased or chlorine free plastic casing Water filled or dry hole
Borehole min. size	Min 140mm (5.5 in.)

Measurements and data

Ore type		Iron, Nickel, Copper, Bauxite, Limestone, Clay (non exhaustive)
Output data	Raw data	Inelastic, Prompt and Delayed gamma spectra (NG ON) Natural Gamma (NG OFF)
	Analytical results	Geochemistry (elements/oxides) and advanced Proxies (upon calibration) with depths and GPS tags
Recommended logging speed (upward log)		Typical 1-2 m/min - Max 4 m/min
Tripping speed		max. 15 m/min
Max logging depth		max 600 m (2 000 ft) total , max 400 m (1 300 ft) below water table
Min integration time/ depth sampling		6s/10 cm
Vertical resolution		~30-40 cm

Performance Specification

Elements	Fe, Si, Al, Ti, Mn, K, Ni, Cu, Ca, Mg, S, Na, Cl, C, O, H (non exhaustive)
Calibration	In-situ & on-site. Factory pre-calibration

Mechanical and Electrical Specifications

Connection	4 conductor twisted logging cable - type Rochester A240185 or similar
Cable head	Century 112000 or similar
Tool outer diameter	~ 101.6 mm (4 in.) max. OD
Length	3.1 m
Downhole module weight	<70 kg
Downhole module power	240V AC Max 70W
Surface power	<60 W
Standards and codes	EC / WAIO[40]

Environmental specifications

Storage temp.	-20°C to +50°C protected from the sun and rain (+-4°F to +122°F)
Operating temp.	-5°C to +40°C (+23°F to +104°F)
Maximum pressure -water	40 bars (580 PSI)

Operating

Warm up time (cold boot)	10 mins
Recommended sub drill	2 m
Min logging depth from surface	0.2 m
Sensor distance to bottom of the tool	1.6 m
Safety interlock	Safety and alarm functions with power cut-off based on : Neutron emission - dedicated neutron meter Distance to surface - winch depth meter Tool orientation - dedicated tilt meter
Logging mode	Ascent - descent possible
Pre-log inspection	Dummy tool recommended for pre-log inspection according to material type

Neutron Emission

Neutron device	D-T sealed tube – NEM 16 S
Neutron output	Max 5.10^7 n/s
Neutron energy	14 MeV
Neutron emission	Pulsed mode
Typical lifetime	6 000 working hours

Detector

Crystal	Cerium doped lanthanum bromide – LaBr3(Ce) 3" x 4"
Gamma ray energy	Typical 0.5 to 10MeV
Spectrum channels	1 024
Gain stabilisation	Yes

Laptop and software

Model	On request
Software	XNL Logger
Operating system	Windows
Surface to tool communication	VDSL protocol
Others	Built-in GPS geolocation / 3 axis accelerometer and 1 axis rotation / 3 axis magnetic field / Internal temperature and humidity

United in performance. Inspired by innovation.

Performance unites us, innovation inspires us, and commitment drives us to keep moving forward. Count on Epiroc to deliver the solutions you need to succeed today and the technology to lead tomorrow.

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