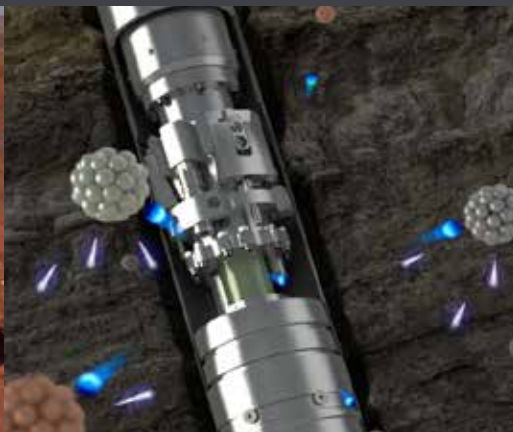


MPC KINETIC



Downhole Assay Services

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MPC KINETIC

At MPC Kinetic we are excited about the future of the mining industry and our place in driving safety and cost-efficient operations through our innovations and can-do attitude.

Our Downhole Assay Service will enable our partner clients to improve the Net Present Value (NPV) of their assets. The technology has the unique ability to provide a rich subsurface dataset cost effectively, and with a step change in safety. With over 750,000 metres across more than 15,000 boreholes assayed to date in the iron ore market, the technology is rapidly maturing to the point of becoming the industry standard for production hole assays.

MPC Kinetic has partnered with specialist neutron instrumentation manufacturer Sodern to bring a holistic and comprehensive system to deliver their **FastGrade™** downhole assay technology to the mining industry; and help our clients maximise the value of their data.

As an organisation, we have been focusing on increasing the amount of automation in our logging platforms to allow safer operation and higher productivity. Our developments in this area are leading us to roll out **OreSight™**, a patent-protected semi-automated logging platform that allows the logging process to take place on blast-pads independent of personnel.

MPC Kinetic has committed to meeting demand for this service, by investing in a new Perth Centre of Excellence which includes manufacturing, technical support and a real-time operations hub.

We look forward to continually improving the value of the service by introducing it to new operations and hope you will choose to partner with MPC Kinetic.



John Smith
Chief Executive Officer



Brenton Armitage
Executive General Manager
Mining Technology

MPC KINETIC



> INTRODUCTION

> APPLICATIONS

Overview

Improved Resource Classification

Efficiency & Recovery Yield

Improved QA/QC Process

Reduced Laboratory Costs

Improved Blasting Performance

Real-time Information

Improved Safety Outcomes

Autonomous Trend

> SPEC SHEET

FastGrade™ 100D

FastGrade™ 170

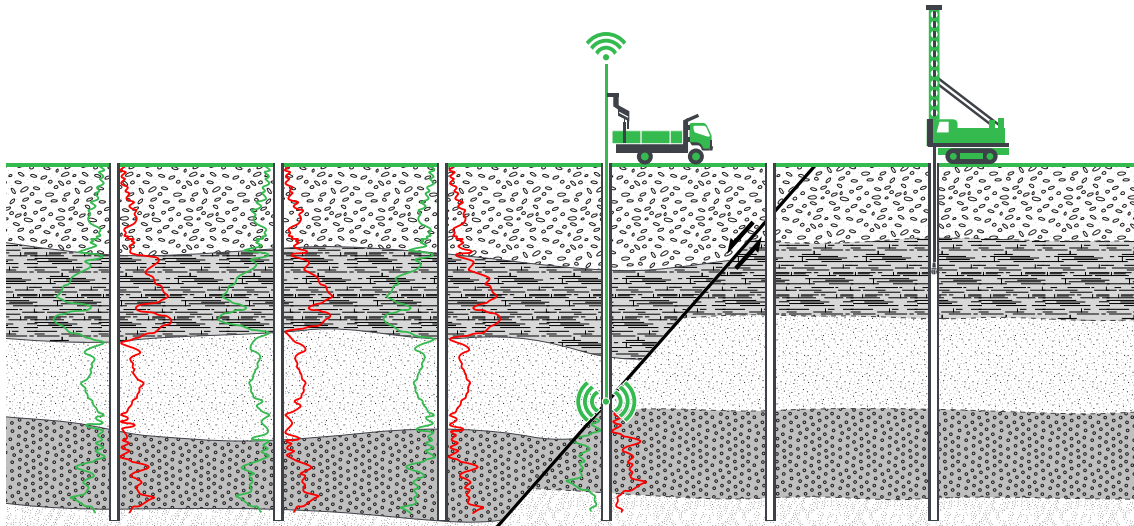
Conventional Assay Vehicle

OreSight™ Assay Vehicle

> TECHNICAL PAPERS

INTRODUCTION

MPC Kinetic has partnered with Sodern to bring downhole assaying to the mining industry. The combination of MPC Kinetic's OreSight™ deployment and operational support technologies with Sodern's FastGrade™ pulsed neutron tools allows the mining industry to gather high resolution, large sample size assay data from their boreholes in a rapid and cost-effective manner.



FastGrade™

Neutrons emitted by the pulsed neutron generator penetrate the surrounding rock and lose their energy when colliding with nuclei. As they penetrate, they initiate different interactions, as fast inelastic collisions or neutron captures that results, nearly instantaneously, in the emission of gamma photons. Each element produces a set of characteristic energies, which is the key to identifying and quantifying them. A high resolution, LaBr scintillating material coupled with a photomultiplier converts the photons into electrical pulses and a fast processing, specialised circuit digitiser sorts and counts them to build their spectrum. At this point a computer can unfold element footprints out of the spectrum to reveal the chemistry 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 characterisation and to minimise the final on-site calibration adjustment.

Sodern leads pulsed neutron technology today

Thanks to over 50 years of experience in neutron technology, Sodern pulsed neutron tubes have been used for a wide range of industrial applications at a low cost of ownership.

The tube lifetime and reliability have been significantly enhanced through a unique combination of ceramic technology and a unique hydrogen isotopes loading process.

Oresight™

MPC Kinetic has used its experience as a leader in mineral logging to develop world leading downhole assay logging vehicles. Our OreSight™ semi-autonomous logging system, provides an ultra-efficient deployment of the FastGrade™ tools on blast-pads. A nominal 50 – 60 holes can be logged in a 12 hour shift with data automatically transferred via 4G to our real-time operations centre – OreSight Central.

Our conventional Downhole Assay platform allows safe and efficient logging for resource development and exploration activities.

Safety

The downhole assaying service removes the need for the collection, handling and transporting of physical samples. The OreSight™ downhole logging platform requires no physical inputs from the operator to perform logging operations and therefore removes the requirement for personnel to be exposed on the blastpad.

The conventional Downhole Assay platform incorporates motorised tool trays and tool handling, thereby removing risks associated with manual handling.

All downhole assay platforms are integrated with the FastGrade™ system which automatically cuts out, should neutrons be detected at surface. All platforms are minesite compliant and fitted with In Vehicle Monitoring Systems, proximity sensors, VHF/UHF radios and EPIRBs.

APPLICATIONS OVERVIEW



Downhole assays have a wide range of applications across the mining process.

From exploration through to production, the methodology can be used to improve safety, efficiency and reduce costs for mining companies.

**Improved
Resource
Classification**

**Efficiency &
Recovery
Yield**

**Improved
QA/QC
Process**

**Reduced
Laboratory
Costs**

**Explosives
Optimisation**

**Real-time
Data
Processing**

**Improved
Safety
Outcomes**

**Autonomous
Trend**

IMPROVED RESOURCE CLASSIFICATION



From exploration to mining, quantifying grade and tonnage of the mineral resource requires an enormous effort. Collection of geochemical data is achieved by drilling to sample the ore body. Traditionally this technique generates a large quantity of physical samples, which can incur significant costs and time in preparation and assay, and is not always effective at characterising thin layers.

The FastGrade™ Pulsed Fast and Thermal Neutron Activation (PFTNA) has been proven through its operations to date to have several advantages over conventional sample-based assays for characterising ore bodies:

- » An in-situ measurement with improved depth accuracy
- » A high and consistent vertical resolution (>20cm)
- » An increased measurement volume of the sample (~80cm diameter)
- » The ability to record data at a high spatial density.

High resolution data can also be integrated to match mining block models to improve 3D mapping and modelling of the orebody and provide inputs for intelligent extract techniques and improved material reconciliation.

EFFICIENCY & RECOVERY YIELD

Improved ore / waste identification and delineation along with the quantification of deleterious elements is key to maximising the value of a mineral resource. The following examples illustrate how the high-resolution data from the FastGrade™ downhole assay data can be used to improve operational minesite performance.

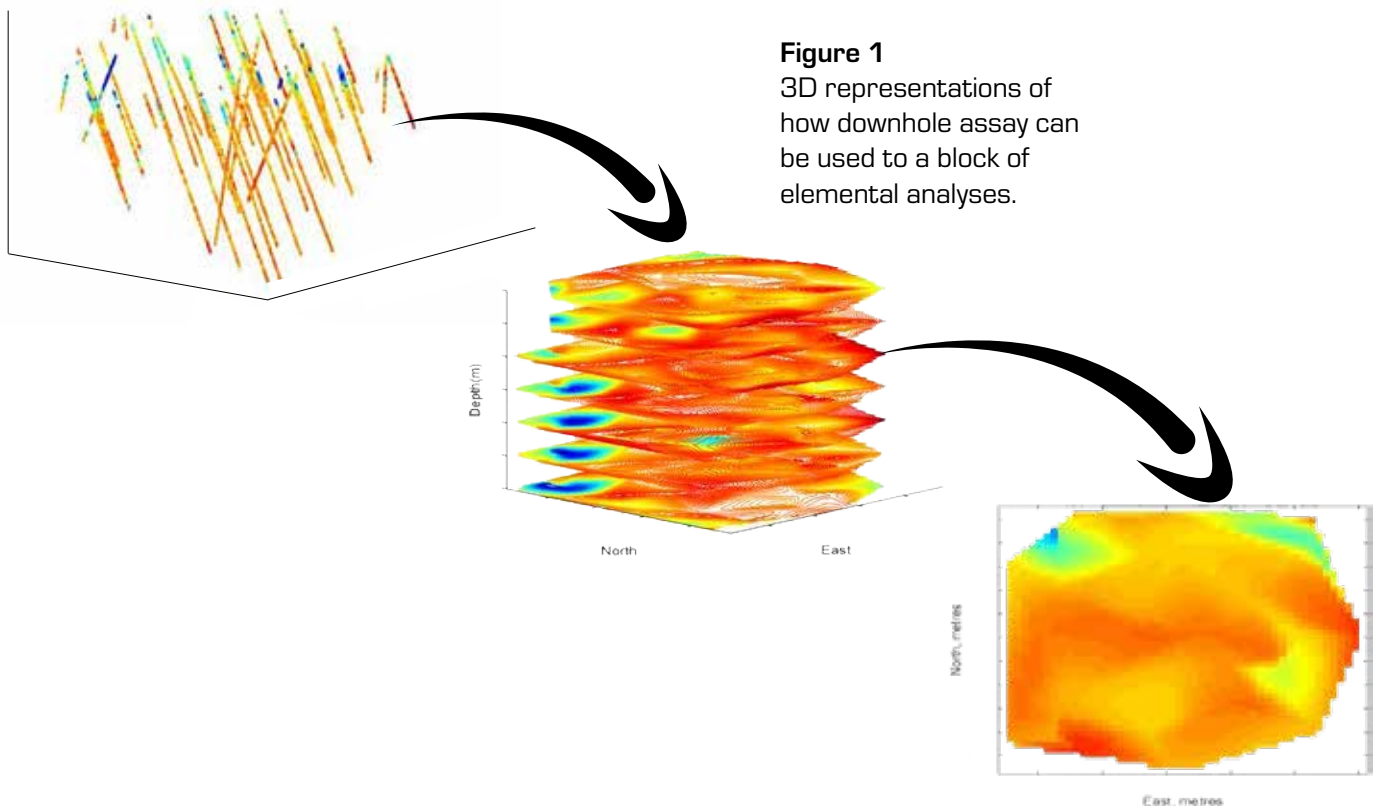


Figure 1
3D representations of how downhole assay can be used to a block of elemental analyses.

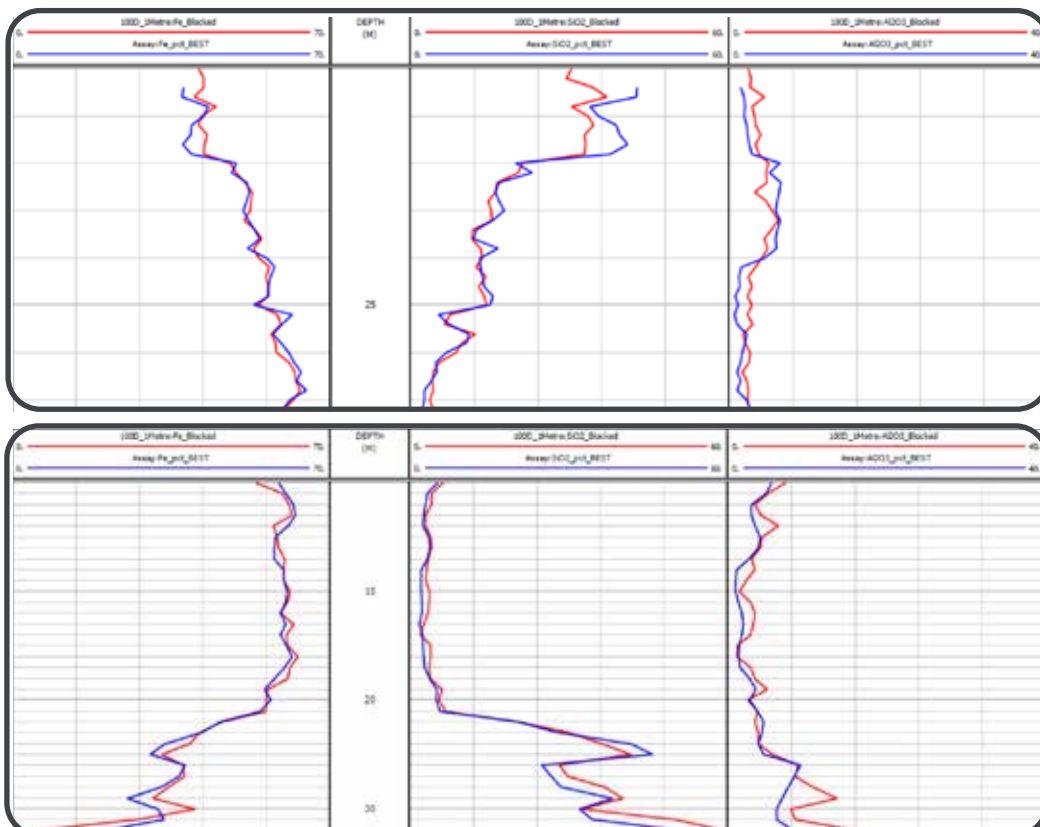


Figure 2
Shows how the downhole assay data can be used to assess bed boundaries, allowing accurate depths based on a sharp bed definition or cut-offs to be applied on a gradational boundary.

Iron Ore Mine

- > Annual extraction - 103.7 Mt
- > Annual Ore production - 25.5 Mt
- > Ore - 56.33% Fe - 24.62%
- > Waste - 46.37% Fe - 75.38%
- > Cut-Off Grade (COG) - 55% Fe
- > Grade distribution extracted from exploration data set
- > 3200 blocks - 15m / 20m / 40m



IMPACT OF RESOURCE ASSESMENT ERROR ON STRIPPING RATIO

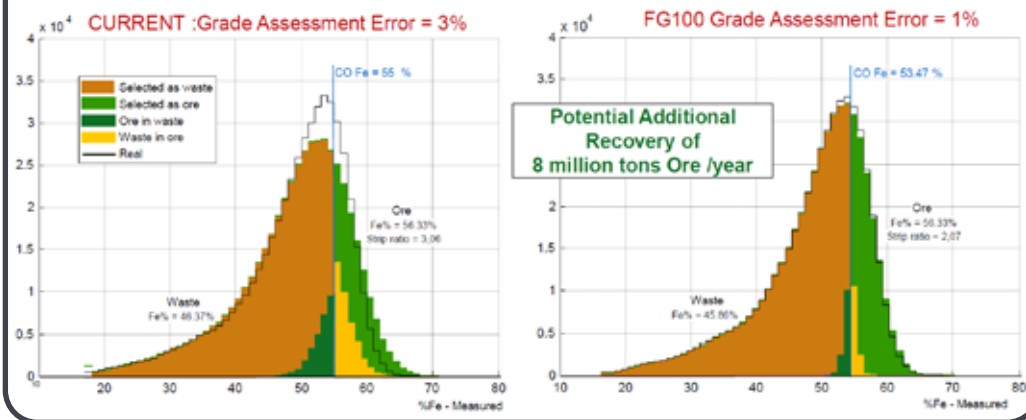


Figure 3

Shows a case study of the financial benefit of using the downhole assay data to reduce grade assessment error from 3% to 1%.

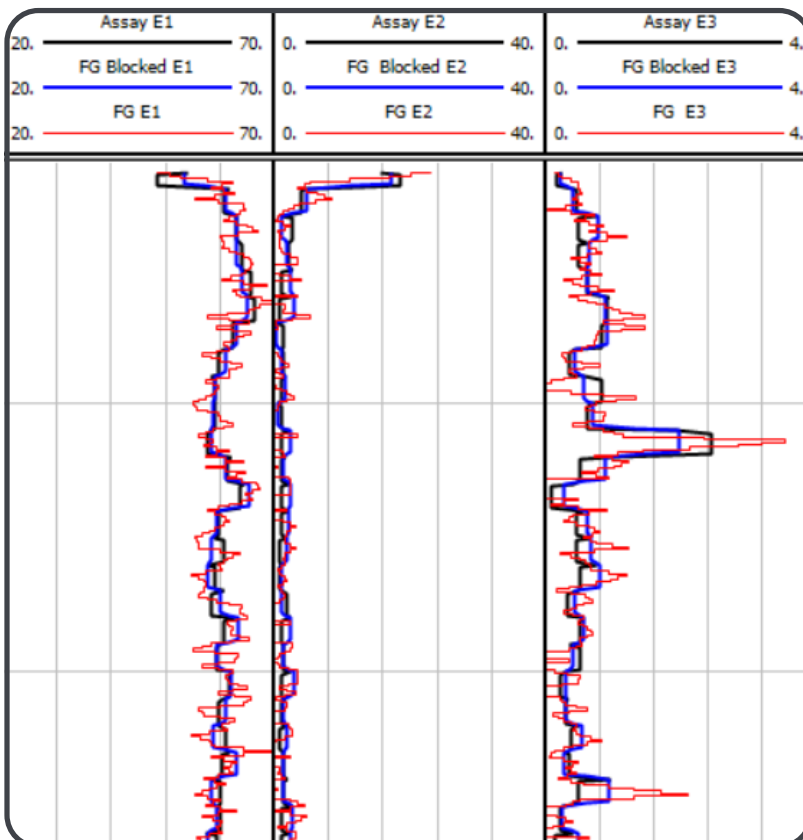


Figure 4

Shows an example of the high resolution and blocked downhole assay data versus the laboratory assays from an RC drilling campaign. The downhole assay data provides the advantage of allowing elemental analysis to be performed at different resolutions in order to populate models and address a variety of production problems.

IMPROVED QA/QC PROCESS



The FastGrade™ downhole assay has numerous advantages over physical samples gathered from the borehole. The technology provides results with a large in-situ sample size (~60 to 80 cm diameter), and high vertical resolution (>20cm) that are not impacted by the same errors typically seen with physical samples.

- » Sampled data is no longer in-situ
- » No core/sample loss is experienced
- » Variations in resolution
- » Natural biases occur in RC and blasthole samples
- » “Depth smearing” of RC and blasthole samples
- » Biases of measurements occur between laboratories
- » Sampling requires manual handling

The FastGrade™ technology provides mining companies with the ability to get high quality assay data from a range of hole types including blast holes and cost-effective reverse circulation drilled holes. This opens up opportunities for reducing drilling costs whilst gathering an improved sub-surface dataset.



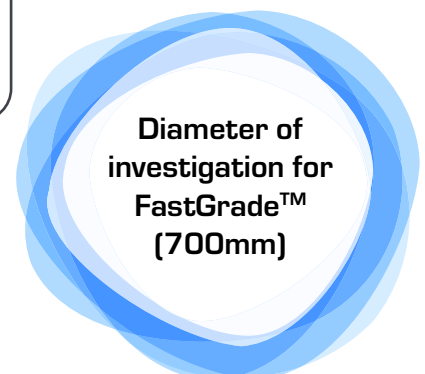
**PQ Core
(122mm)**



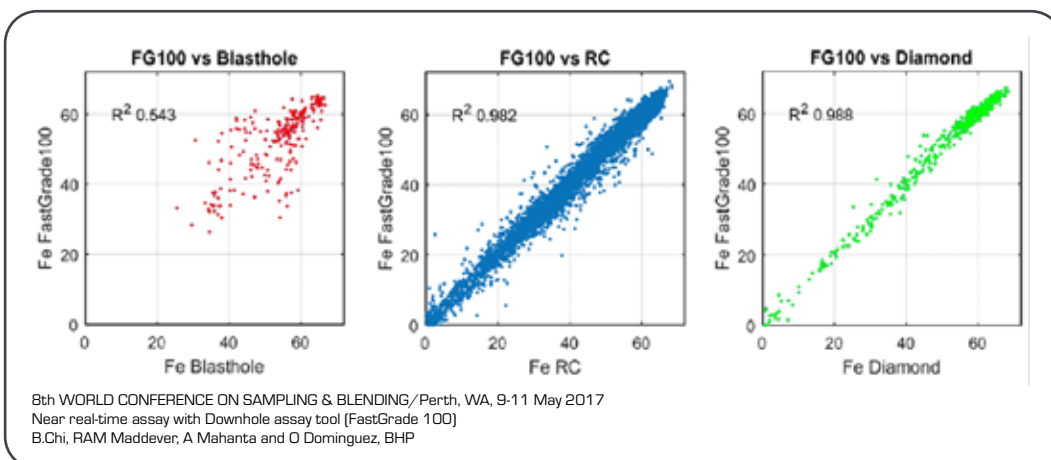
**Typical
RC Hole
(140mm)**



**Nominal
Blast Hole
(220mm)**



**Diameter of
investigation for
FastGrade™
(700mm)**

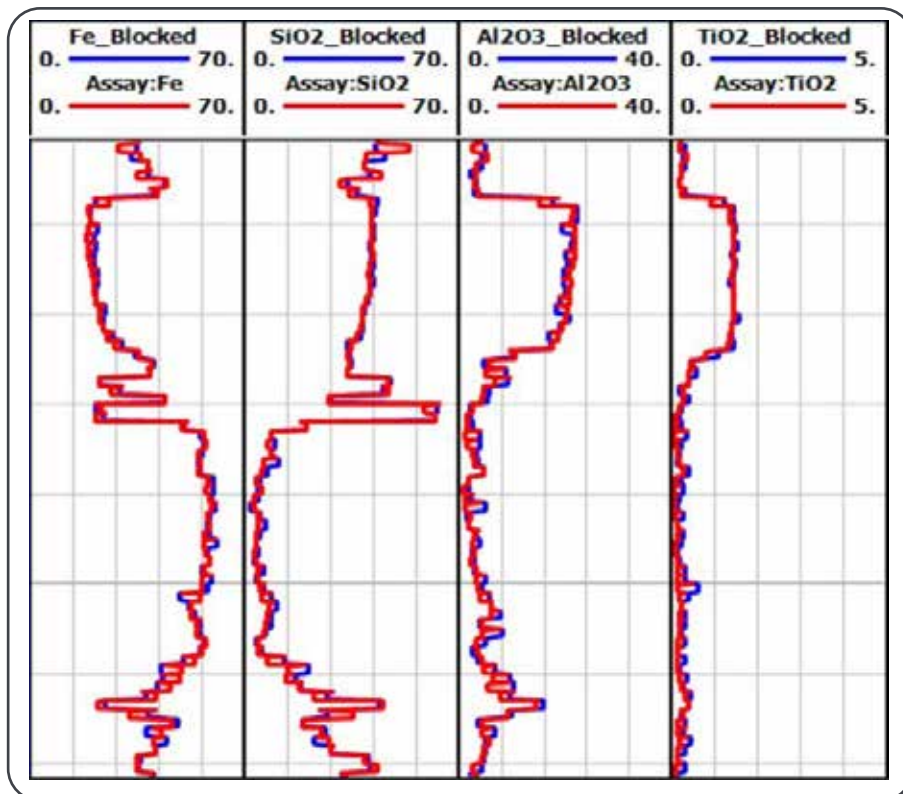




REDUCED LABORATORY COSTS

Depending on the resource type and product, downhole assays can be used as a partial or complete replacement for assaying at various stages of the resource development and mining process.

This leads to a direct reduction of laboratory costs and ancillary costs associated with handling and shipping physical samples. The ability of the tool to gather data in almost all hole types means that the costs associated with twinned core holes as a quality control can also be removed.



FastGrade™
Lab Assay

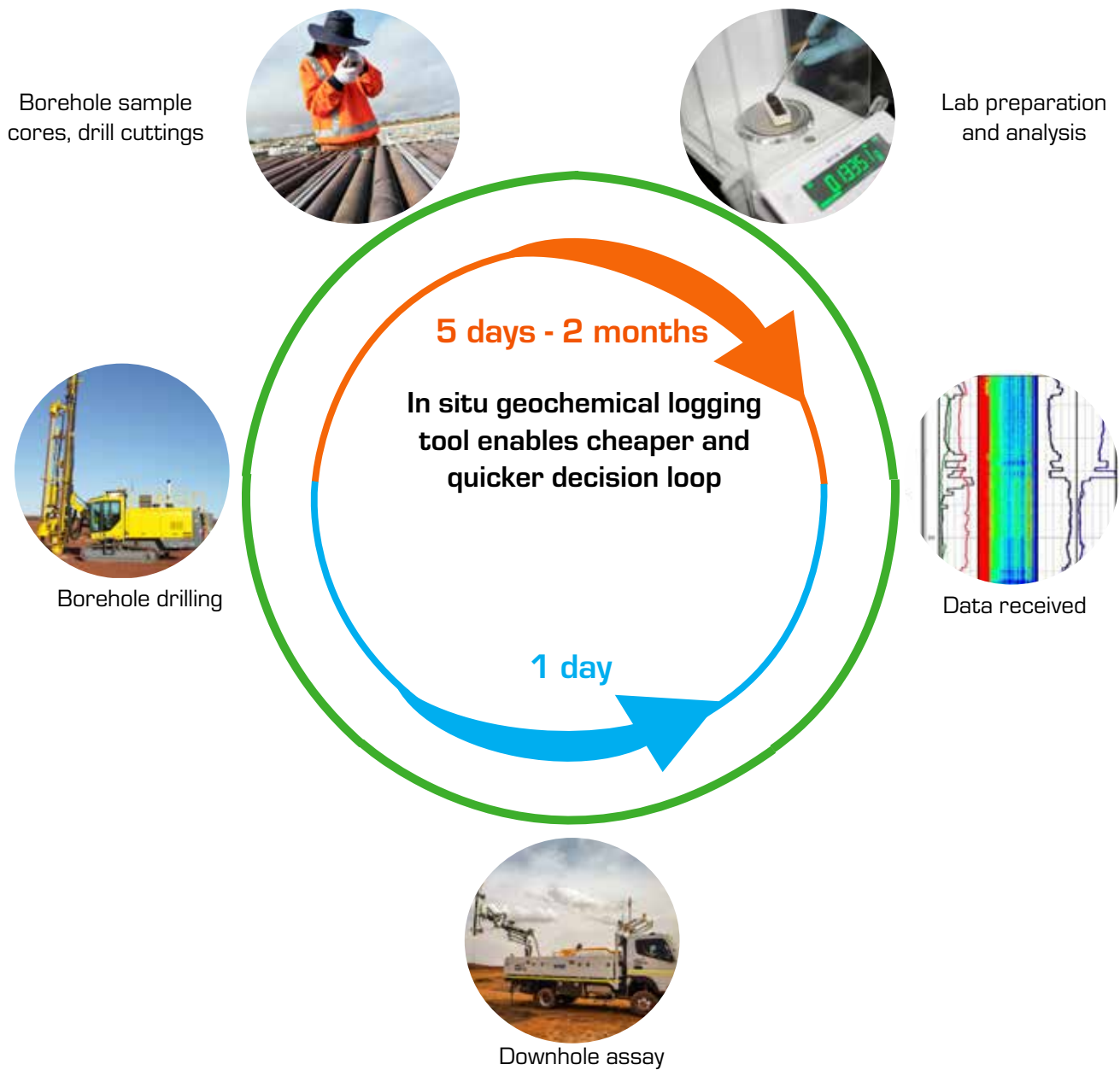
REDUCED EXPLOSIVE COSTS

The FastGrade™ tool can provide a spectral response at a high vertical resolution; allowing explosives to be targeted much more effectively than is the case with one or two physical samples gathered from each blast hole.

The high-resolution data also allows ore waste boundaries to be better defined, and allows the spectral response to be used to identify formation types.

This data can be built into the blasting model, allowing for accurate sequential loading of the blast hole which will maximise the blast performance both by fragmentation and cost effectiveness.

REAL-TIME DATA



Optimisation of resources involves having the necessary data to plan in a timely manner.

MPC Kinetic's downhole assay service allows us to provide assay data in near real-time to our client's IT eco-systems for analysis and operational planning. With the industry moving to 'just in time' mining, near real-time high resolution assays provide clear operational and efficiency advantages by removing the days or weeks it takes to receive bulk samples from the laboratory analyses.

MPC Kinetic downhole assay logging platforms have integrated communication systems that allow all data to be transferred in real-time to the MPC Kinetic Real-time Operations Centre - (OreSight Central) based in our Perth facility.

As the service continues to grow, OreSight Central will allow us to monitor all aspects of the delivery system (*truck, logging infrastructure, FastGrade™ tooling*) and data to ensure we maximise operational availability.

IMPROVED SAFETY



The traditional sampling processes involved in the recovery, packing and transport of physical samples exposes employees to risks and hazards associated with manual handling, working around machinery, exposure to extreme weather, working on the ground in mining pits and driving.

Downhole assaying with the MPC Kinetic deployment systems allows these risks to be reduced or removed by replacing the manual collection and handling of drill samples with a logging probe that makes measurements of the formation in-situ.

Engineering controls on all our downhole assay platforms include:

- » Zero manual handling required through mechanical systems.
- » Automated winch to maximise logging efficiency and remove potential for human error.
- » Automated and manual lock-outs associated with radiation detectors.
- » Air conditioned cabins to reduce operators exposure to dust, noise and the elements.
- » OreSight™ downhole assay units are operated from a driving position – there is no requirement for the operator to be outside the vehicle when working in mining operations.



All MPC Kinetic vehicles are actively monitored with IVMS as standard to ensure that our company wide driving risks are minimised.

AUTONOMOUS TREND

MPC Kinetic understands that the mining industry is adopting technological solutions to further drive production and cost optimisation. Our downhole assay service aligns with these goals by improving safety and productivity.

Both OreSight™ and our conventional downhole assay platforms are fitted with GPS and 4G communications, allowing them to integrate into mine-site asset and machinery tracking systems for safety and monitoring at real-time operations centres. Our data can be sent across our highly secured network in almost real-time to the client from the field and allow it to be incorporated in to programs and models for improved blasting, reduced explosive use, improved blast product / blending, and better waste classification.

MPC Kinetic's real-time operations centre – Oresight Central, maximises the productivity and value of our downhole assay service. The Perth-based centre is allowing us to monitor all facets of the logging platforms and data in real-time. This is a fundamental change from traditional borehole geophysical operations and will enable pro-active improvements to the service, improving value for our clients.

CENTRE OF EXCELLENCE



MPC Kinetic has established a Centre of Excellence for Downhole Assay and Geophysical Logging Operations in Kewdale, Western Australia.

This state-of-the-art facility ensures the company's Mining Technology Division leads the way in the development and introduction of new technologies for the mining industry and the provision of high quality in-situ downhole measurements and advanced data interpretation.

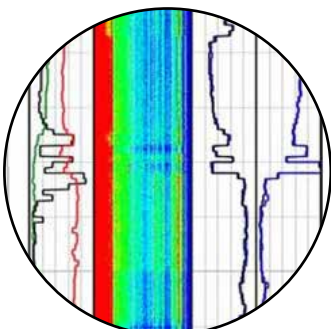


OreSight Central - Real Time Operations Centre

OreSight Central provides 24/7 support, data quality control and monitoring of data distribution to our clients. The secure facility helps maximise the productivity of our service through improved operational efficiency and minimising downtime.

Calibration Facilities

On-site calibration facilities ensure standardised responses of logging tools. A combination of calibration blocks and boreholes enables repeatable, reliable geophysics measurements.



Geophysics and Data Interpretation

Our geophysics team streamlines the processing and delivery of geophysics data and integration of multiple measurements for advanced applications. These include ground stability, fracture mapping, automated stratigraphy, hardness analysis, and moisture estimation. The data interpretation team also work closely with the operations team and supports research and development projects.



Manufacturing

Our best in class manufacturing division has a focus on continuous improvement. It combines a high performing team with a 1500sqm facility designed on the Lean and 5S principles. MPC Kinetic has the capacity to deliver multiple platforms in an efficient timeframe to the highest quality.

Research and Development

A continual focus on research and development keeps MPC Kinetic at the forefront of geophysical logging and provision of the highest quality data. Our deployment and measurement technologies are constantly being improved to increase value for our clients.



Repair and Maintenance

Our dedicated maintenance team can apply real-time machine learning using a series of monitoring systems. This enables our specialised technicians to deliver uninterrupted operational productivity. In addition to providing a robust preventative maintenance system our technicians provide advanced in-field support.

SPECIFICATIONS

FastGrade™ FG100D

Application	In-situ elemental analysis of boreholes
Analytical principle	Pulsed Fast and Thermal Neutron Analysis (PFTNA)
Borehole type	Uncased or chlorine free plastic casing Water filled or dry hole
Measurements and data	
Raw data	Inelastic, capture and activation gamma spectra Natural gamma
Analytical data	Weight percentages after calibration
Other measurements	GPS geolocation, 3 axis accelerometer and 1 axis rotation, 3 axis magnetic field, internal temperature and humidity
Mechanical and Electrical Specifications	
Length	~3.4m
Diameter	101.6mm
Weight	~72kg
IP Index	67
Connection	4 conductor twisted logging cable (Rochester A240185 or similar)
Storage condition	0°C to +30°C protected from the sun and rain
Operational Limits	
Logging speed	Typically 1 – 2 m / min, maximum 8 m/min
Tripping speed	15 m/min
Maximum depth	Max 600m (max 400m below the water table)
Operating temperature	-20°C to 35°C
Maximum water pressure	50 bar
Warm up time (cold boot)	10 minutes
Wake up time (standby)	15 seconds
Minimum logging depth from surface	0.6m
Sensor distance from the bottom of the tool	1.6m
Safety interlocks	Safety and alarm functions with power cut-off based on: Neutron emission at surface – dedicated neutron meter Distance to surface – winch depth meter Tool orientation – dedicated tilt meter
Neutron Emission	
Neutron device	D-T sealed tube – NEM 16 S
Neutron output	Max $5 \cdot 10^7$ n/s
Neutron energy	14 MeV
Neutron emission	Pulsed mode
Detector	
Crystal	Cerium doped lanthanum bromide – LaBr ₃ (Ce) 3" x 4"
Gamma ray energy	0.3 to 10MeV
Spectrum channels	1024
Number of windows	3 for PFTNA, 1 for natural gamma
Gain stabilisation	Yes

FastGrade™ FG170

Application	In-situ elemental analysis of boreholes
Analytical principle	Pulsed Fast and Thermal Neutron Analysis (PFTNA)
Borehole type	Uncased or chlorine free plastic casing Water filled or dry hole
Measurements and data	
Raw data	Inelastic, capture and activation gamma spectra Natural gamma
Analytical data	Weight percentages after calibration
Other measurements	GPS geolocation, 3 axis accelerometer and 1 axis rotation, 3 axis magnetic field, internal temperature and humidity
Mechanical and Electrical Specifications	
Length	~2.2m
Diameter	174mm
Weight	~72-90kg (barrel material dependant)
IP Index	67
Connection	4 conductor twisted logging cable (Rochester A240185 or similar)
Storage condition	0°C to +30°C protected from the sun and rain
Operational Limits	
Logging speed	Typically 1 - 2 m / min, maximum 4 m/min
Tripping speed	15 m/min
Maximum depth	Max 600m (max 50m below the water table)
Operating temperature	-20°C to 35°C
Maximum water pressure	5 bar
Warm up time (cold boot)	10 minutes
Wake up time (standby)	15 seconds
Minimum logging depth from surface	0.6m
Sensor distance from the bottom of the tool	0.5m
Safety interlocks	Safety and alarm functions with power cut-off based on: Neutron emission at surface - dedicated neutron meter Distance to surface - winch depth meter Tool orientation - dedicated tilt meter
Neutron Emission	
Neutron device	D-T sealed tube - NEM 16 LLS
Neutron output	Max 5.10^7 n/s
Neutron energy	14 MeV
Neutron emission	Pulsed mode
Detector	
Crystal	Cerium doped lanthanum bromide - LaBr ₃ (Ce) 5" x 2.5"
Gamma ray energy	0.3 to 10MeV
Spectrum channels	1024
Number of windows	3 for PFTNA, 1 for natural gamma
Gain stabilisation	Yes

CONVENTIONAL

Based on the latest MPC Kinetic geophysical logging platform, our Conventional downhole assay logging platform combines the latest safety features with the flexibility to allow logging in exploration and resource development areas. The powered tool tray allows the tool to be run in to hole with no lifting on the part of the operator. Additional tooling can be carried and run making the platform particularly useful for providing services on remote sites.



Vehicle	Conventional Downhole Assay Platform
Width	2200 mm
Height	3250 mm (approx. 4200 to top of antennae and flags)
Length	6,500 mm
Nominal Weight	6,400 kg
Front approach angle	33 degrees
Rear departure angle	20.7 degrees
Fuel	Diesel
Probe deployment	
Maximum wireline length	600m
Speed range	0.0 - 25.0 m/min
Speed regulation	≤ 0.1 m/min
Operational Limitations	The vehicle can be fitted with an aftermarket track system for operating in steep terrain. All limitations are for the standard platform configuration.
Maximum traverse angle - across contour	<10 degrees, otherwise subject to a risk assessment
Maximum incline angle - traversing (pitch straight up or down slope)	20 degrees
Maximum incline angle - logging (pitch straight up or down slope)	10 degrees, otherwise subject to a risk assessment
WLL Boom Assembly	200 kg
Features	
<ul style="list-style-type: none"> » Customised logging system compatible with Sodern's FastGrade™ Logging system » Dedicated climate-controlled cabin for operator and acquisition equipment » Electric winch motor and control » Temperature regulated tool storage » Manual handling free tool deployment and storage » Near real-time data transfer (subject to 4G availability or other suitable means) » Compliant with all Australian maximum allowed radiation exposure requirements 	



The MPC Kinetic OreSight™ downhole assay solution is the latest generation of logging platform. The automated logging platform is fully integrated with the FastGrade™ logging tool, allowing for maximum efficiency and safety. The vehicle is fully road legal to allow easy movement between sites and blast-pads, allowing for maximum “up time” and reducing resources and planning to move the service between operational areas.

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 degrees
Rear departure angle	20.7 degrees
Fuel	Diesel
Probe deployment	
Maximum wireline length	600m
Speed range	0.0 - 25.0 m/min
Speed regulation	≤ 0.1 m/min
Nominal cycle time (12m holes @ 4 m/min logging speed)	8.12 minutes
Operational Limitations	The vehicle can be fitted with an aftermarket track system for operating in steep terrain. All limitations are for the standard platform configuration.
Maximum traverse angle – across contour	<10 degrees, otherwise subject to a risk assessment
Maximum incline angle - traversing (pitch straight up or down slope)	20 degrees
Maximum incline angle - logging (pitch straight up or down slope)	10 degrees, otherwise subject to a risk assessment
Features	
<ul style="list-style-type: none"> » 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 immobilisation 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 » Compliant with all Australian maximum allowed radiation exposure requirements 	

TECHNICAL PAPERS

A number of articles and peer reviewed technical papers have been written on the subject of downhole assaying technology, particularly **FastGrade™** technology for the mining industry.

Please contact us for copies of the following technical papers and articles:

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., Rossiter, H., & Armitage, B., (2019). 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.

Market, J., Robinson, D., Jeanneau, P., Rossiter, H., (2019). Downhole assays in the Pilbara. Iron Ore Conference, Perth, Australia.

Jeanneau, P., Flahaut, V., Maddever, R.A.M., (2017). Iron ore benefits from neutron pulsed geochemical tools, Iron Ore Conference, Perth, Australia, 24-26 July 2017.

Chi, B., Maddever, R. A. M., Mahanta, A., and Dominguez, O., (2017). Near real-time assay with downhole assay tool (FastGrade™ 100). Eighth World Conference on Sampling and Blending (Vol. 1, pp. 137 – 144). Perth: AUSIMM.

Smith, C.P., Jeanneau, P., Maddever, R.A.M., Fraser, S.J., Rogic, A. Lofgren, M.K., Flahaut, V. (2015). PFTNA logging tools and their contributions to in-situ elemental analysis of mineral boreholes. TOS Forum, 2015 (5), 157.

<https://doi.org/10.1255/tosf.54>





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