GEOTEK

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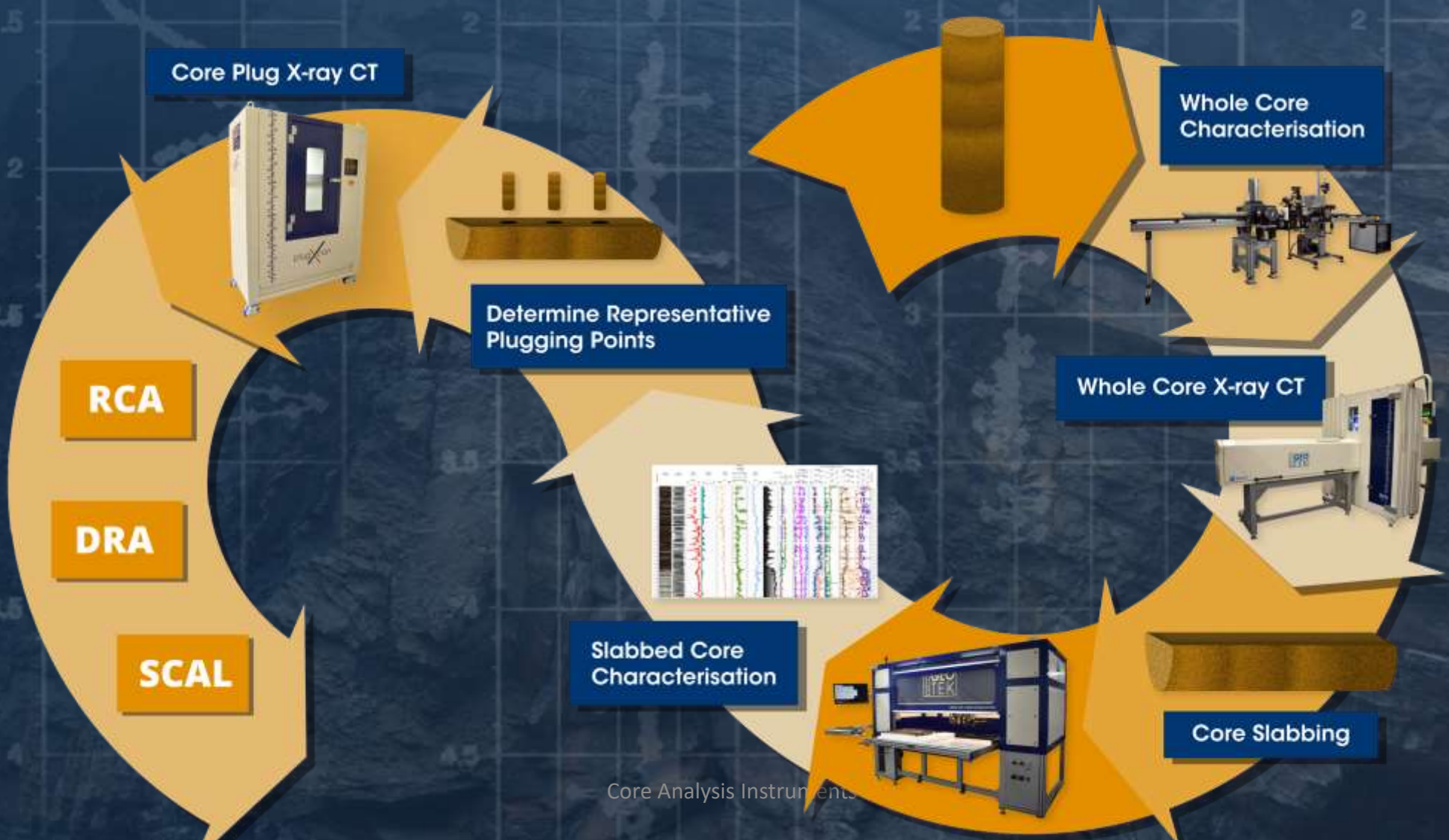
Why are Core Analysis Instruments Required?

- **Core is** the **crucial** ground truthing required for many geoscience applications and therefore you can't afford NOT to core
- **Core is** often destructively tested and only **partially utilized/tested** over areas of interest and so what are we missing?
- **Core is expensive** to acquire and test and can take many weeks to months to complete

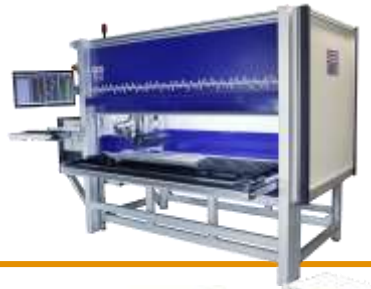
Geoscientists and Engineers need to:

*To **maximize data recovery** from every core…In a **time and cost efficient** manner*

Core Workflow



Geotek Core Analysis Instrumentation

Standard Multi-Sensor Core Logger (**MSCL-S**)	• Accepts nearly any form of core material • Most flexible with respect to sensor arrangement • Continuous core logging	
XZ Multi-Sensor Core Logger (**MSCL-XZ and MSCL-XZXRF**)	• Bench-top core logging platform • Surface core measurements • Main use for split or slabbed core samples	
XYZ Multi-Sensor Core Logger (**MSCL-XYZ and MSCL-XYZXRF**)	• Multiple core workstation • Accepts core boxes • Surface core measurements • Main use for split or slabbed core samples	
X-ray CT Machines (**XCT, RXCT, VXCT, PXCAN**)	• Accepts nearly any form of core material • High resolution (35 microns to 250 microns) • Cabinet-based systems	

Available Sensor Technology for MSCL Systems

Sensor	Compatible MSCL System
Attenuated Gamma Density and Porosity	MSCL-S
P-wave Transducers	MSCL-S
Non-Contact Electrical Resistivity	MSCL-S
Magnetic Susceptibility (loop* or point)**	MSCL-S* **, MSCL-XZ**, MSCL-XYZ**
Spectral and Total Natural Gamma	MSCL-S
Color Spectrophotometer	MSCL-S, MSCL-XZ, MSCL-XYZ
Olympus Vanta XRF	MSCL-S, MSCL-XZ, MSCL-XYZ
He-flushed Geotek XRF	MSCL-XZ, MSCL-XYZ
VIS and VNIR/SWIR Point Sensor	MSCL-S, MSCL-XZ, MSCL-XYZ
SpecCam 4 VNIR/SWIR Hyperspectral Camera	MSCL-S, MSCL-XZ, MSCL-XYZ
Geotek linescan camera Visible and UV	MSCL-S, MSCL-XZ, MSCL-XYZ

- **Multiple** sensors can be installed onto one MSCL system
- MSCL systems are **modular** and sensors can be added or removed as required
- MSCL systems can be **upgraded** with sensor technology in the future

MSCL-S with 9 sensors incl. XRF

Mobile Containerised Laboratories

- Often drillsites and/or core repositories are in remote locations, and it is difficult and expensive to move core **– So take the logging to the core**
- MSCL equipment can be installed into either **20ft** or **40ft self-contained laboratories, or in trailers**
- **Ruggedized** equipment and laboratories that are **field-proven**
- **Field data acquisition** for instant feedback to geologist's or engineers allowing them to make informed scientific or operational decisions in near-real time





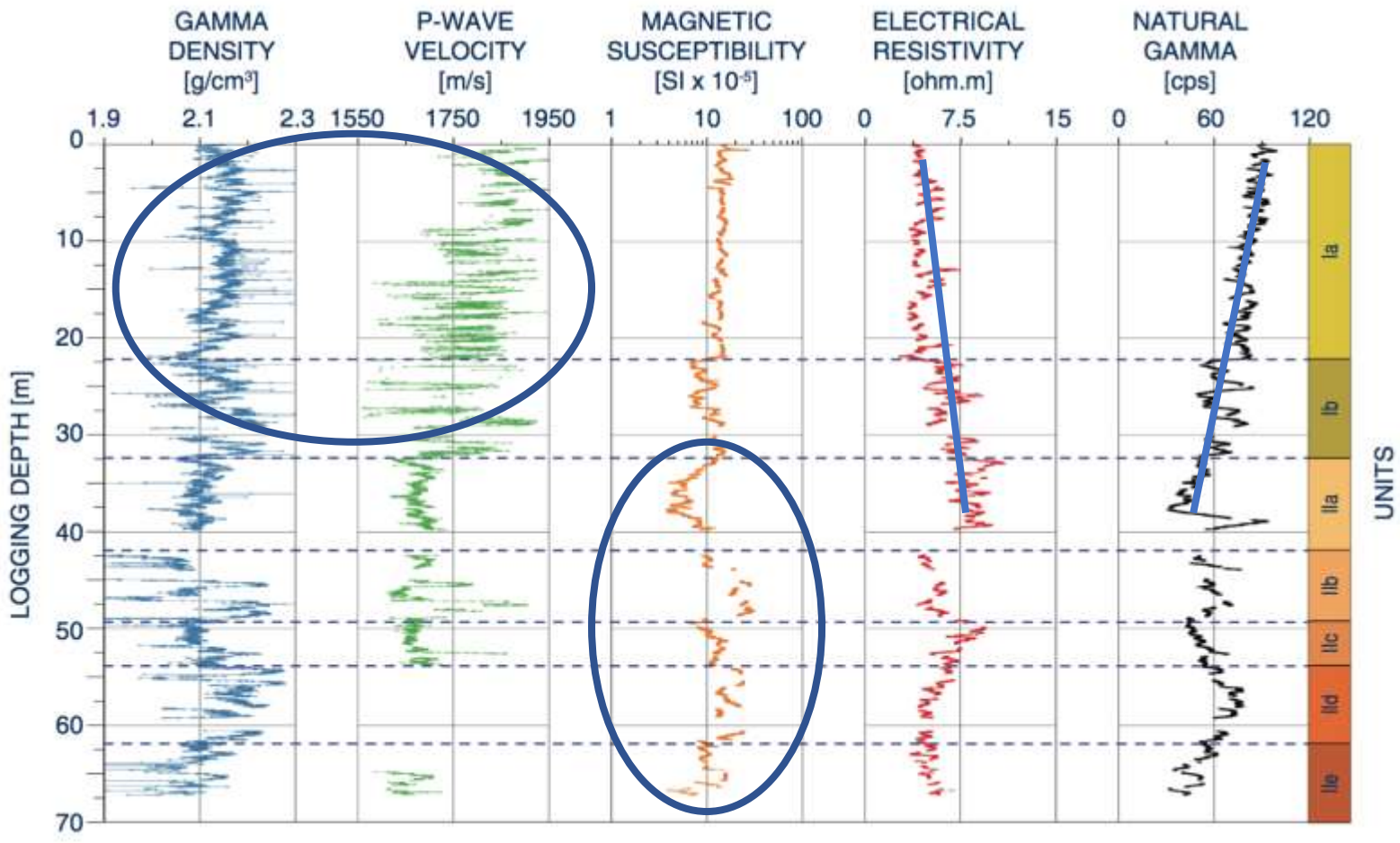
MSCL-S: Standard Multi-Sensor Core Logger

- Flexible geometry for **whole and split cores**
- Capable of logging **lined and unlined cores**
- **Automated** and **Simple** software control
- Cores are pushed passed sensors
- **Multiple sensors** (up to 9) can be installed
- Depth co-registration of data
- Data are collected **simultaneously**
- Variable acquisition resolution

Provision of continuous high resolution physical and geochemical stratigraphy

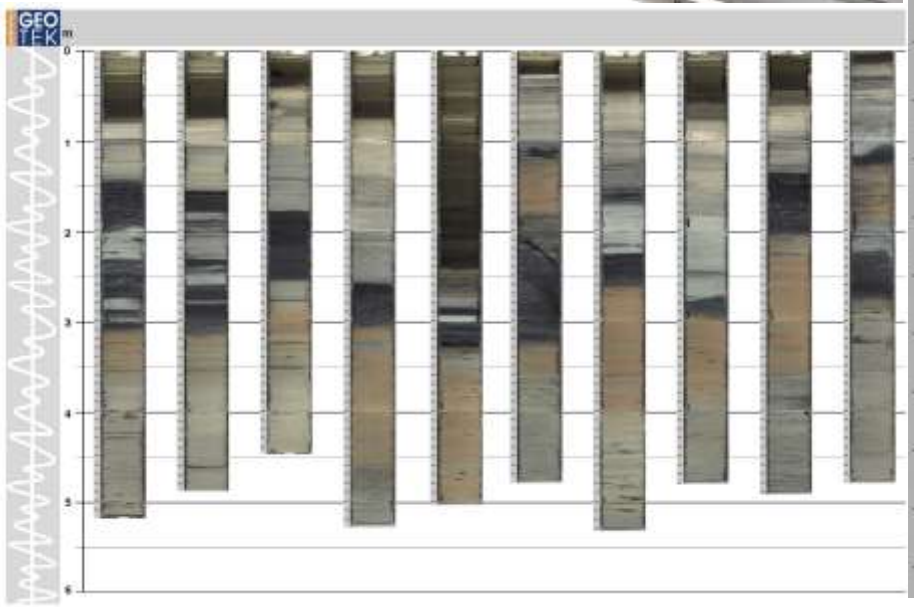
Case Study: Sediment Core, ONDRAF/NIRAS, Belgium
10 mm Multi-Parameter Stratigraphy Acquired using a MSCL-S

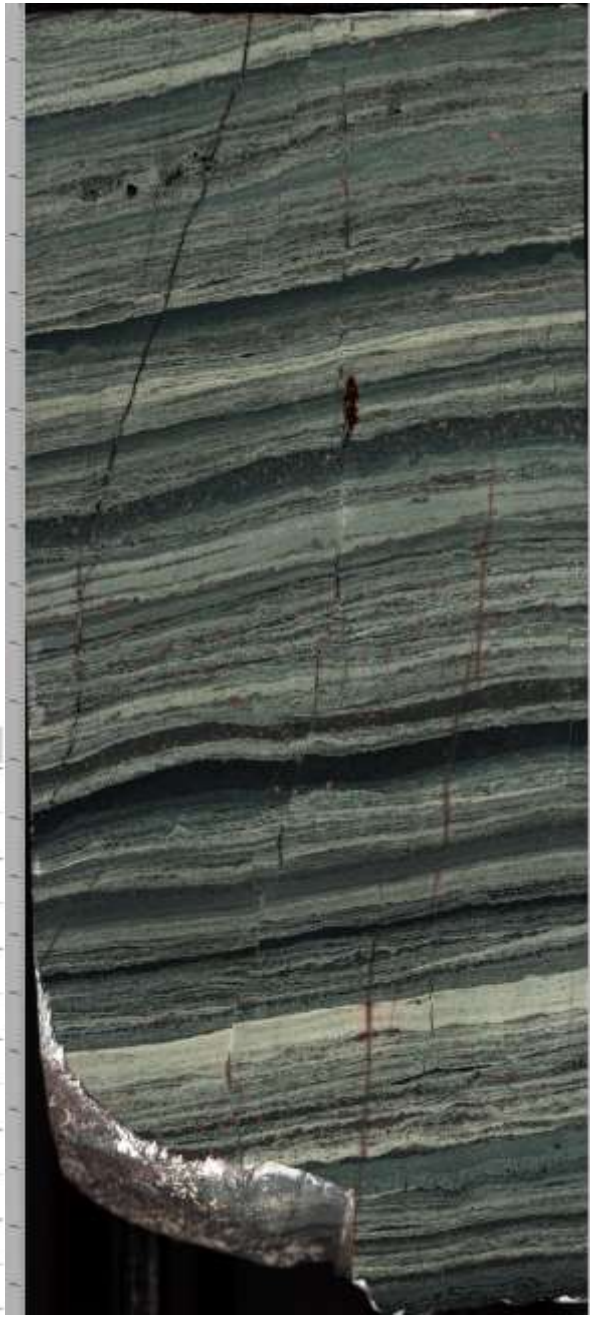
- Whole plastic lined unconsolidated sediment cores
- Sediments are a **clay transitioning to a underlying sand/silt/clay** sequence
- Natural gamma and electrical resistivity show **fining upwards sequence** from 0 m to 40 m
- Erratic gamma density and P-wave velocity profiles from 0 m to 32 m from **authigenic precipitates**
- Magnetic susceptibility and density highlight changes in **sediment lithologies** below 40 m



Core Imaging System Geoscan V

- **Linescan** Imaging from the Geoscan V
- Can integrated with all MSCL systems
- **True colour** separation
- **Calibrated** measurements
- Automated **ruler**
- Excellent images from **wet cores** with **cross polarisation**
- High resolution (20 to 100 microns per pixel)
- **Fast** (1 minutes 40 seconds per 1m)
- **Automated** Focus and Aperture for Easy Set-Up

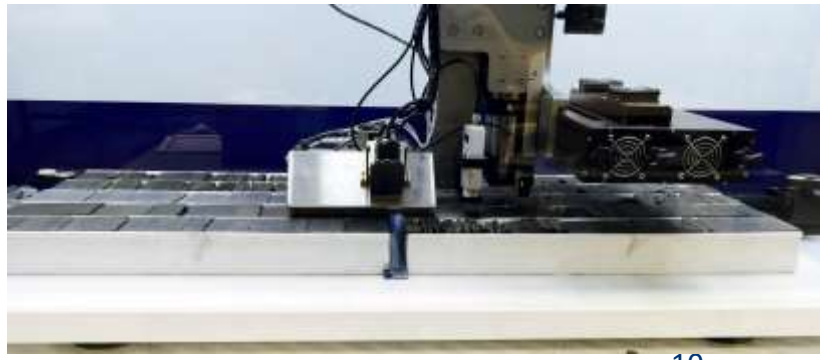




MSCL-XYZ: Core Workstation

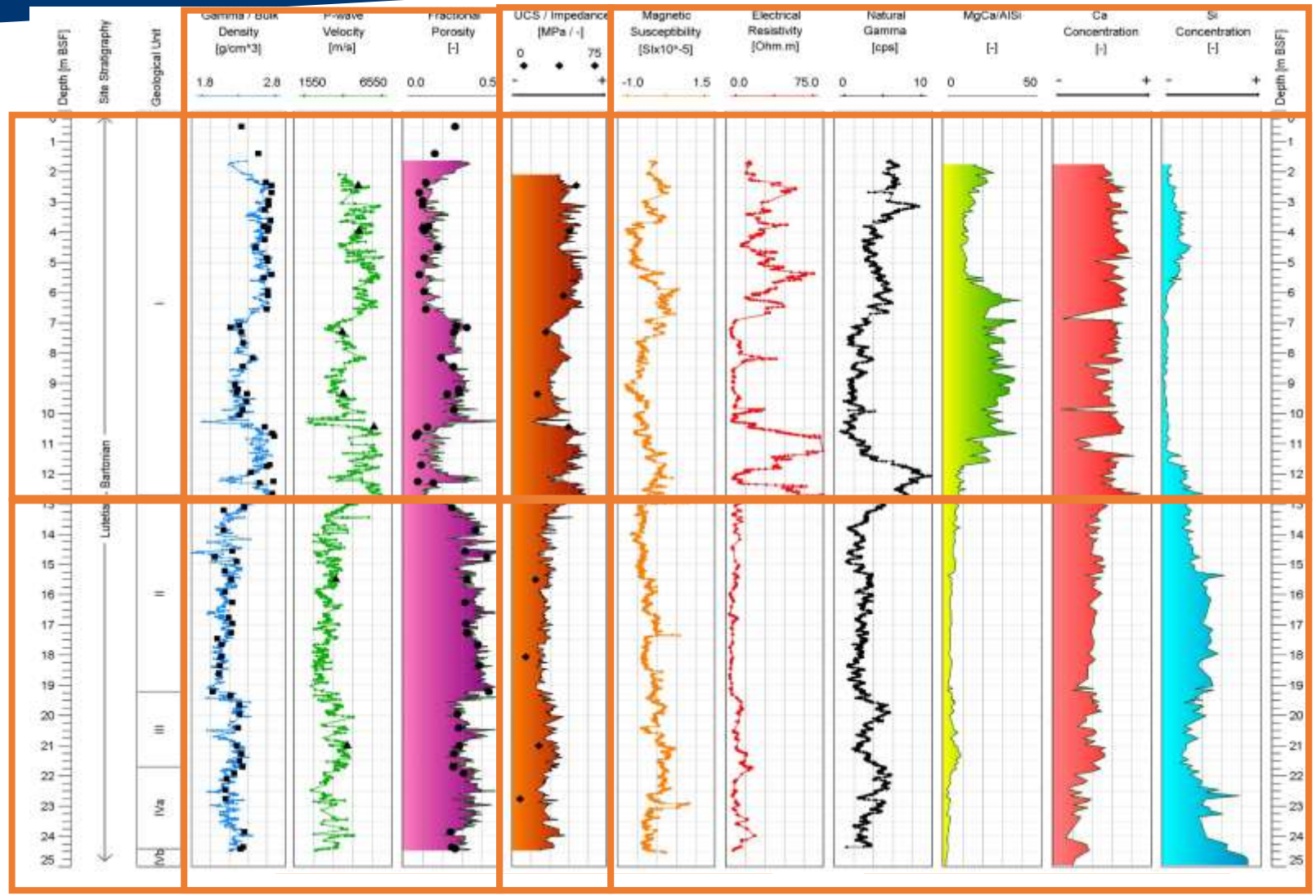
- **Integrated core workstation for large core laboratories and core volumes**
- **Multiple core sections or certain core boxes can be loaded into the system**
- Data are **depth coregistered** and acquired **simultaneously**
- **Sensors move** over the core surface
- Can include **Hyperspectral Core Imaging** and **XRF** measurements

An integrated imaging and spectroscopy core analysis workstation for mineralogical and chemostratigraphical studies



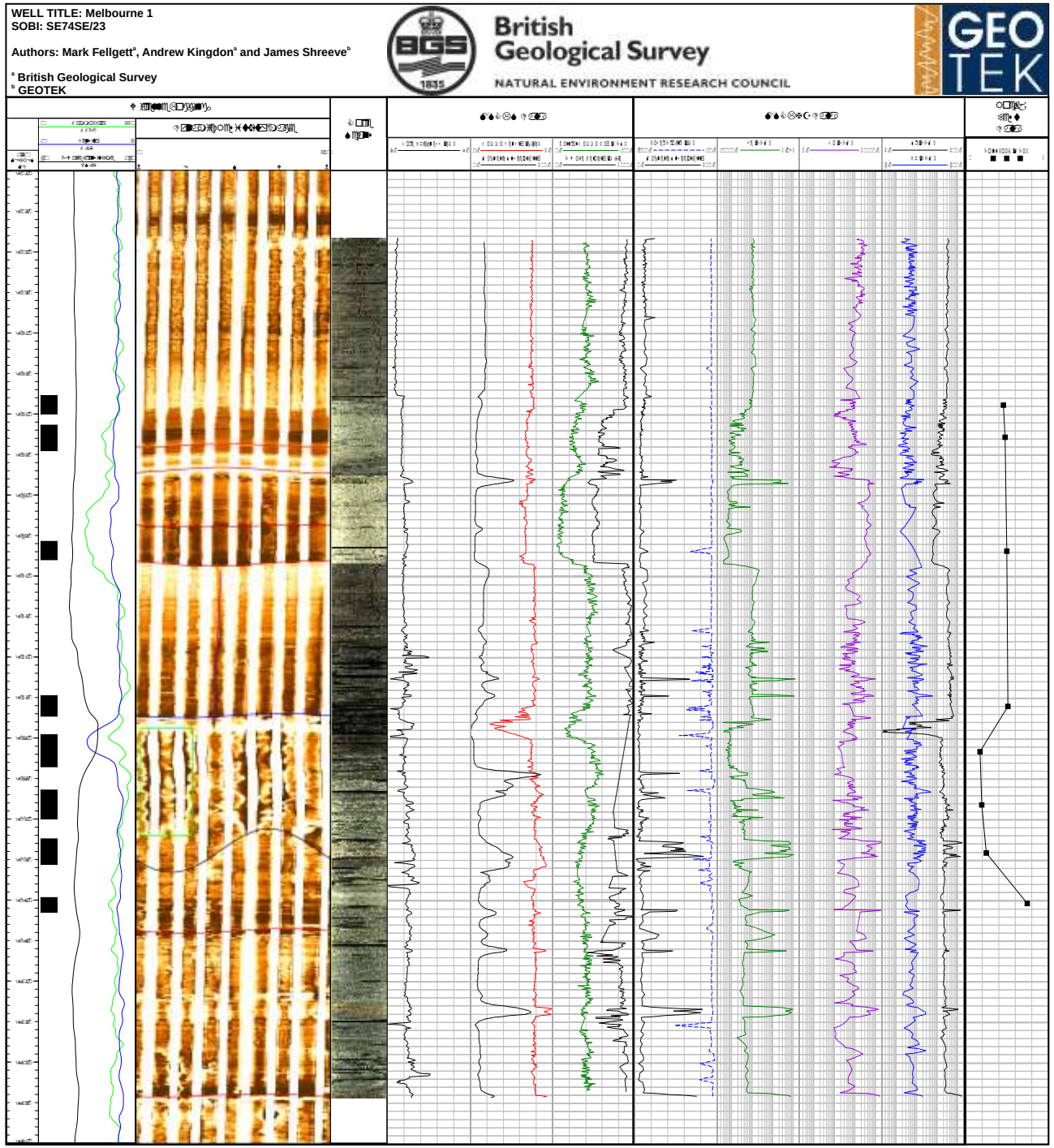
Case Study: Rock Core, Shreeve *et al*., 2017
10 mm Multi-Parameter Stratigraphy Acquired using a MSCL-S and MSCL-XZXRF

- Whole exposed rock cores
- Rocks are well to partially cemented **calc-arenites to dolomites**
- **Strong correlation** between laboratory and MSCL data
- Strong, dense dolomite surficial layer with high CaMg/SiAl ratios that can be **traced across the site**
- Strong link between **rock strength and MSCL properties**
- Gave the ability to **untangle complex relationship** between strength, physical properties and chemistry



Downhole vs Downcore

- The MSCL data is able to resolve finer scale detail compared to the downhole log
- The MSCL data can be used to depth correct the core depths
- The combination of geochemistry and physical properties suggests that borehole breakout is not a function of stratigraphy
- X-ray CT data actually shows small scale fractures within the samples within the breakout zone suggesting a existing structural weakness
- Data from Kingdon et al., 2016



VNIR and SWIR Hyperspectral Camera Semi-Quantitative Mineralogical Maps

High resolution very near infrared (**VNIR**) and short wavelength infrared (**SWIR**) **hyperspectral camera - SpecCam 4**

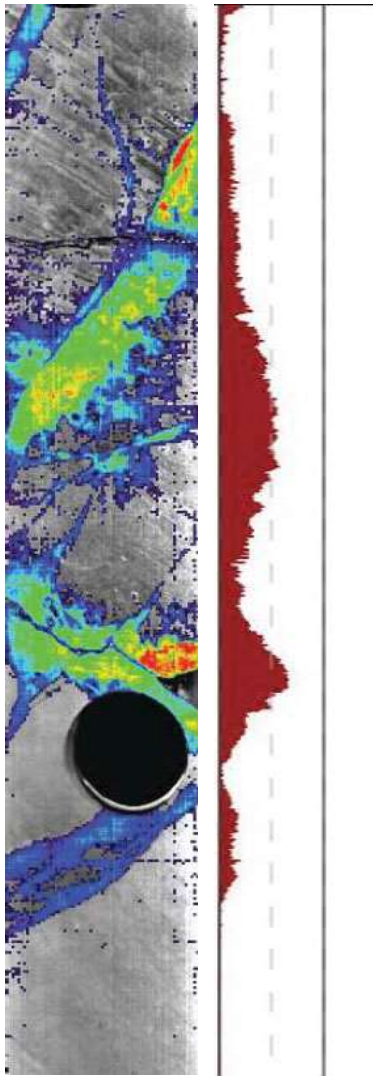
Hyperspectral MSCL can include:
XRF, Mag. Sus., or ASD

Interpretation software **identifies**, **semi-quantifies** to produce **mineral profiles or maps**:

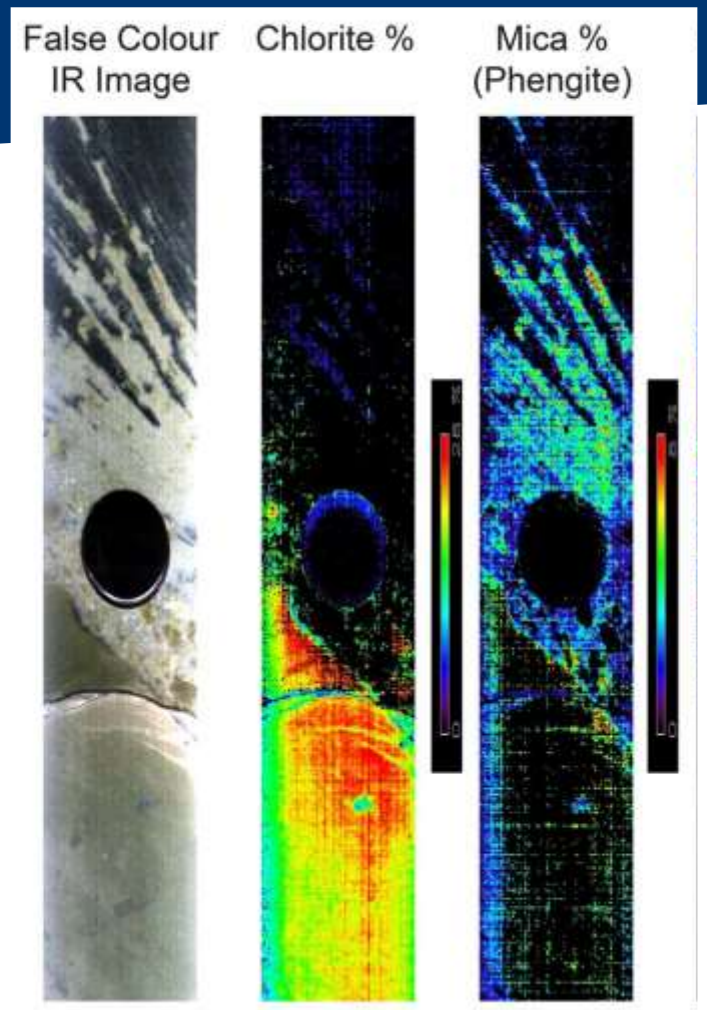
- Specific mineral types
- Mineral chemistry
- Zones of mineral alteration
- Liquid and sold hydrocarbons
- Contaminants

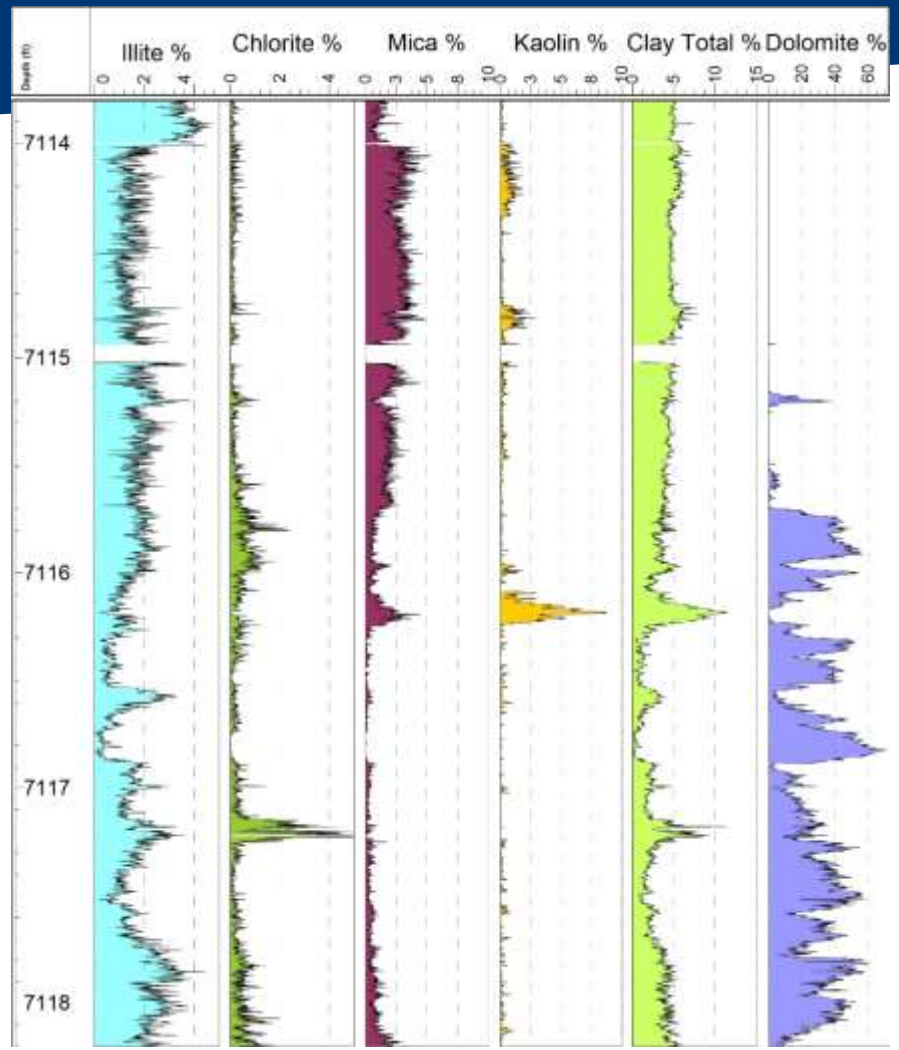
- Spectral range offered 400 nm to 2500 nm
- Electronically controlled wavelength separation for superior spectral resolution
- Continuous coverage high image resolution is (0.5 mm x 0.5 mm)
- Accurate % data derived for the minerals

Semi-Quantitative Mineral Maps and Log Profiles



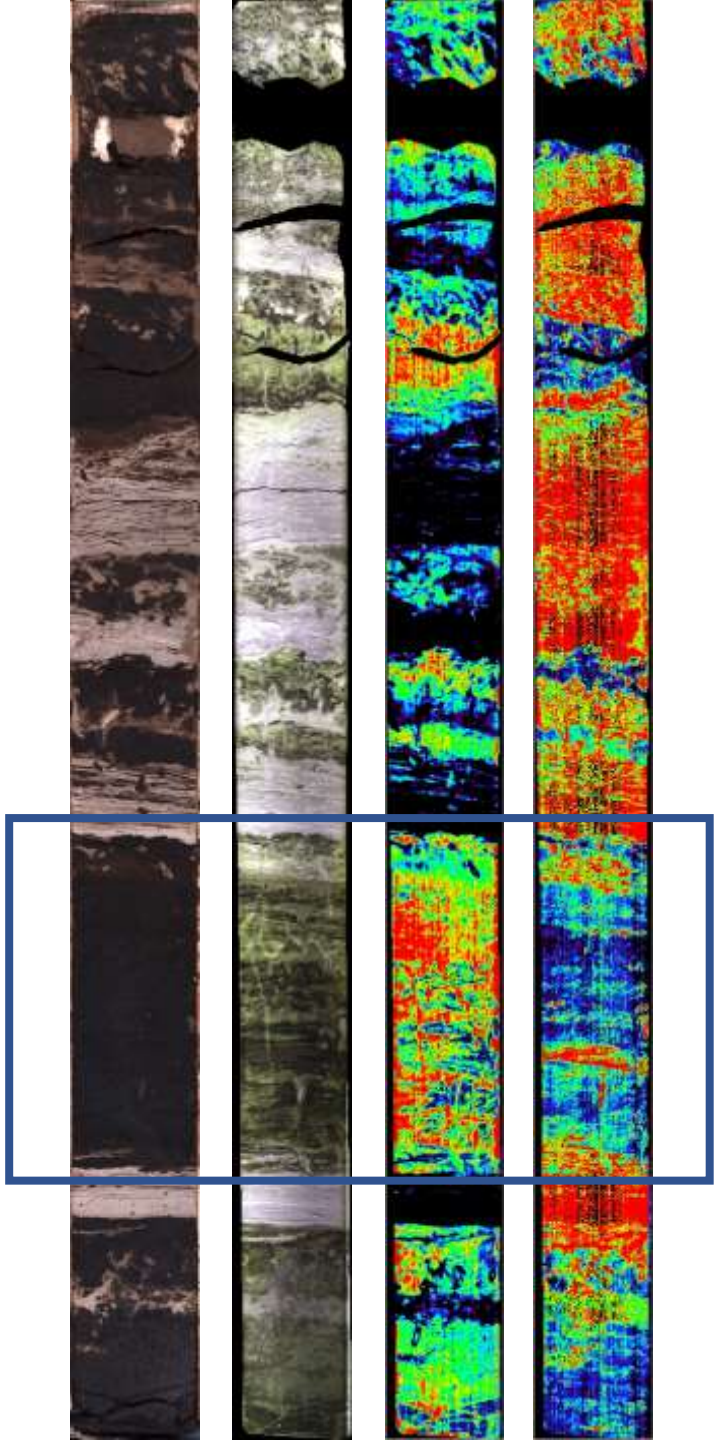
Hyperspectral VNIR/SWIR MSCL Technology



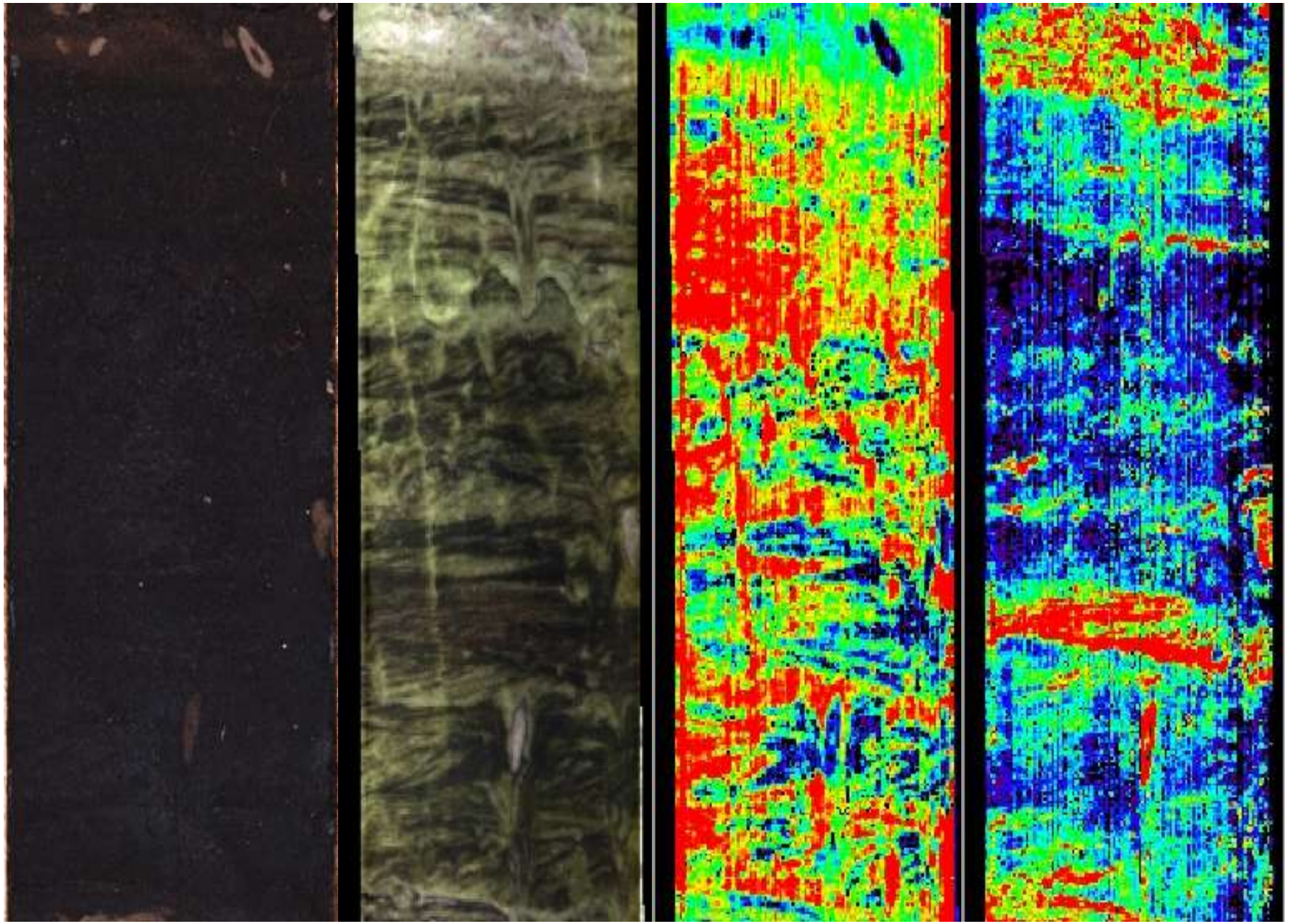


Multi-Sensor Core Scanning with a unique integration of mineralogy, elemental abundance and physical properties

- **Identification of minerals and their polymorphs**
- **Identification of mineral assemblages**
- **Clay crystallinity**
- **Mineral abundances (%) calculated, which are comparable to other analytical methods**



VIS False Colour HC Comp. Total Clay



Geotek X-ray CT System Product Range For Industry and Academia

ScoutXcan	X-ray CT (XCT)	Vertical X-ray CT (VXCT)	Rotating X-ray CT (RXCT	PlugXcan
2D Radiography and Laminography	Horizontal Rotating Core	Vertical Rotating Core	Horizontal Stationary Core	Core Plug and Sidewall Core Scanning
				

Geotek's versatile X-ray product range provides valuable high resolution **2D and 3D** X-ray images from **whole and split** core samples. The Geotek product range system are **affordable and practical instruments** ideal for geological and Industrial research laboratories.

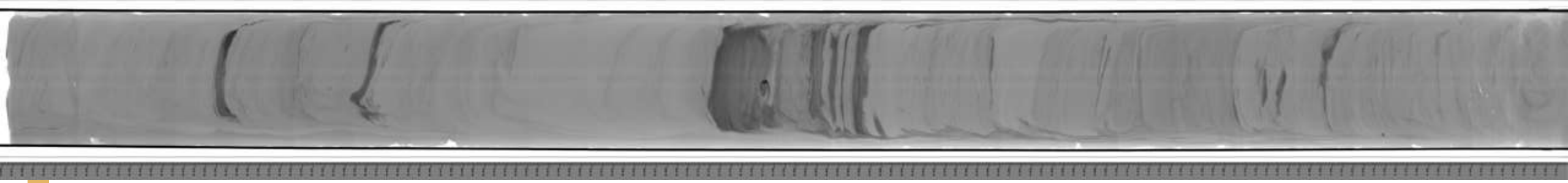
XCT

- **Mobile system perfect for container labs**
- **Flexible adapters** for easy core location and handling
- Cores are **rotated horizontally**
- Samples up to 1.5 m can be scanned at **resolutions between 30 µm and 300 µm**
- **Perfect for whole core 3D CT and Split Core 2D X-ray radiography/laminography**

RXCT

- **Perfect for whole, split, broken, small or irregular shaped core**
- Flexible adapters for easy core location and handling
- Cores are **stationary and X-ray gantry rotates**

- Samples up to 1.5 m can be scanned at **resolutions between 30 µm and 300 µm**
- **Perfect for whole 3D CT and 2D X-ray radiography/laminography**



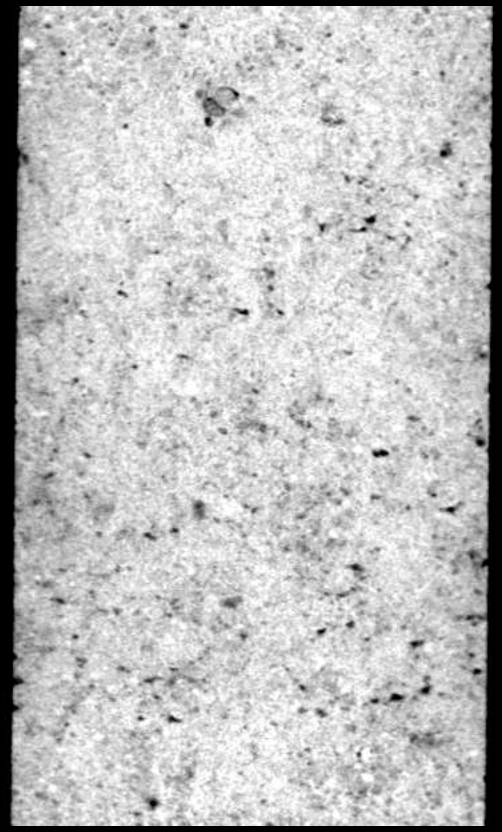
plugXcan: CORE PLUG SCREENING THE WAY IT SHOULD BE!

Scan up to **100 core plugs per day!**

Intelligent workflows for **faster CT deliverables**

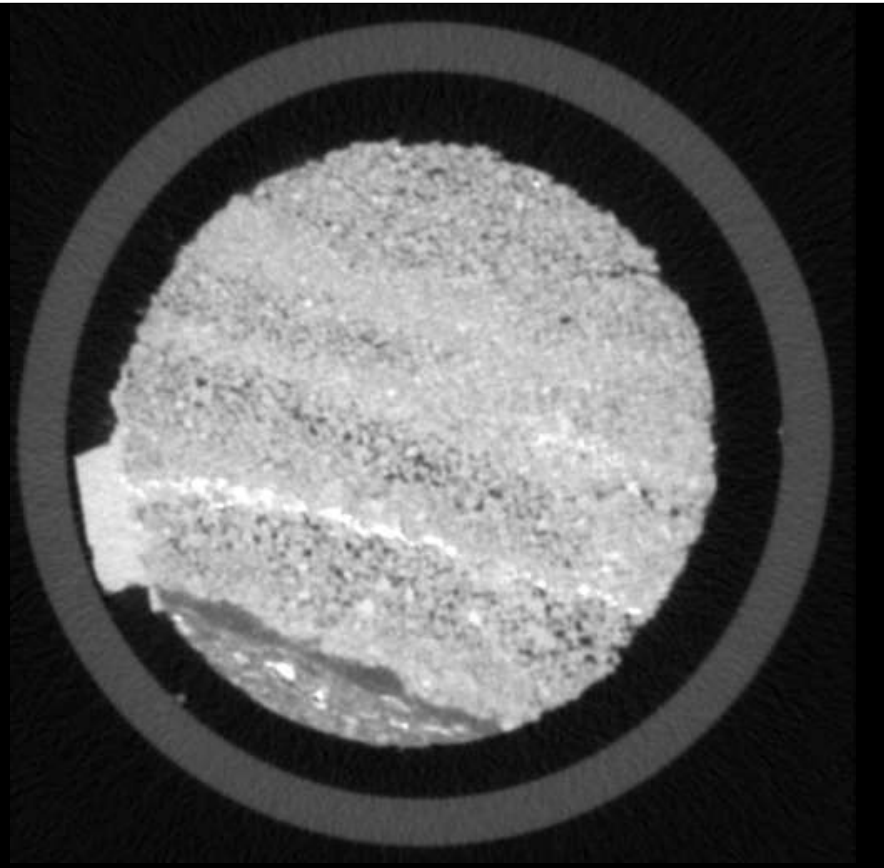
plugXcan: RESOLVE MORE

Medical CT
300µm x 625µm



100µm x 100µm

Medical CT
300µm x 625µm



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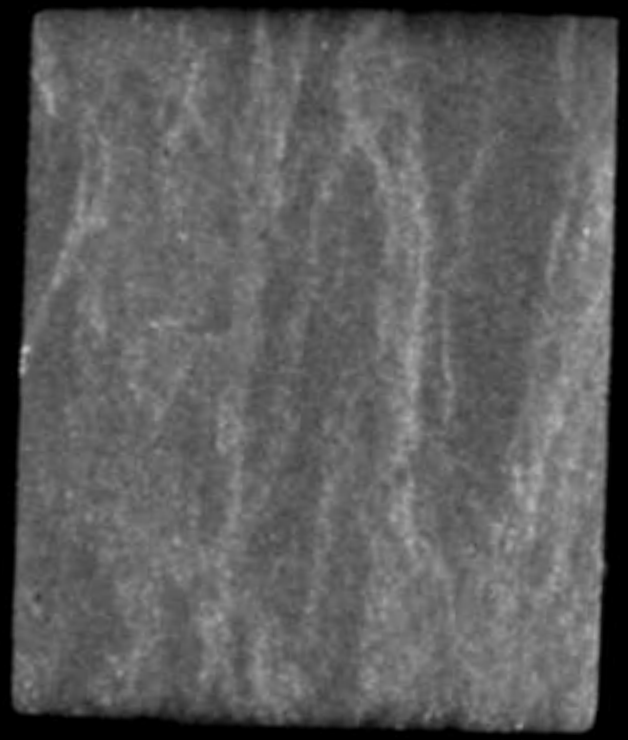

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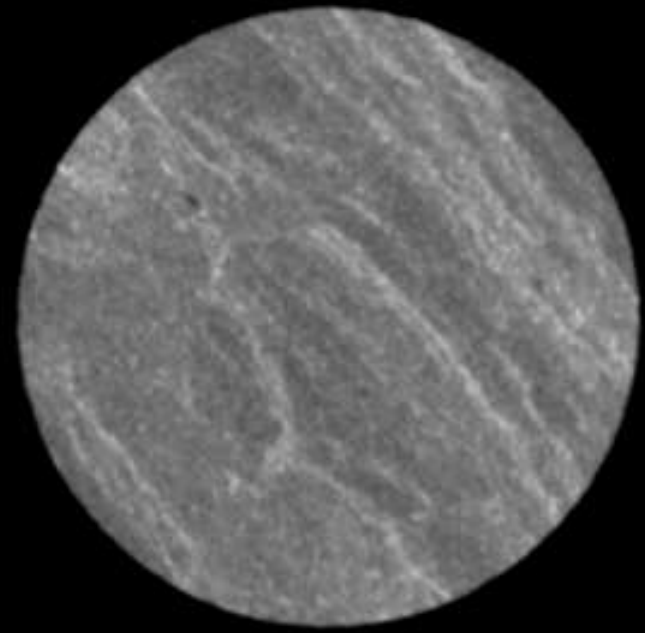

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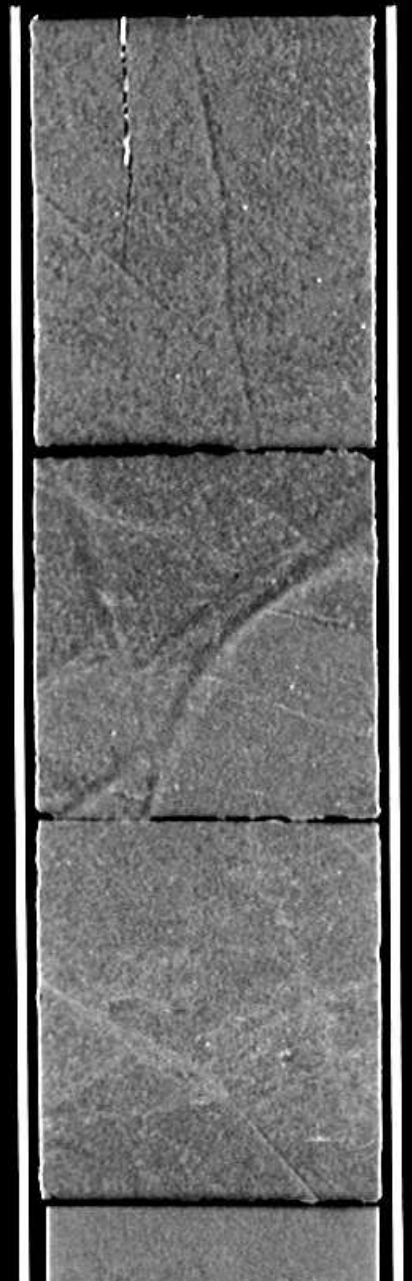
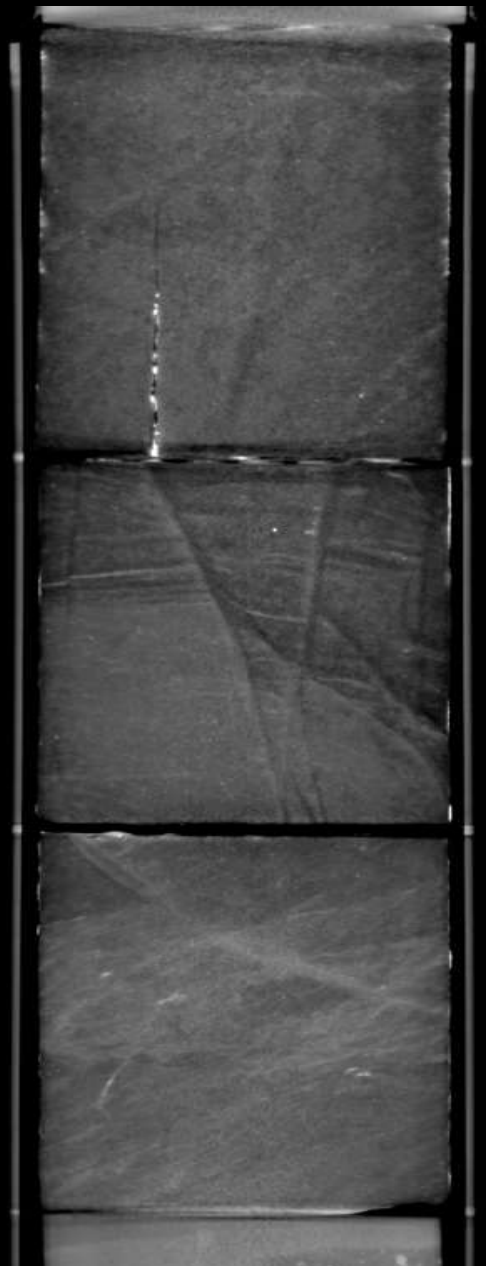
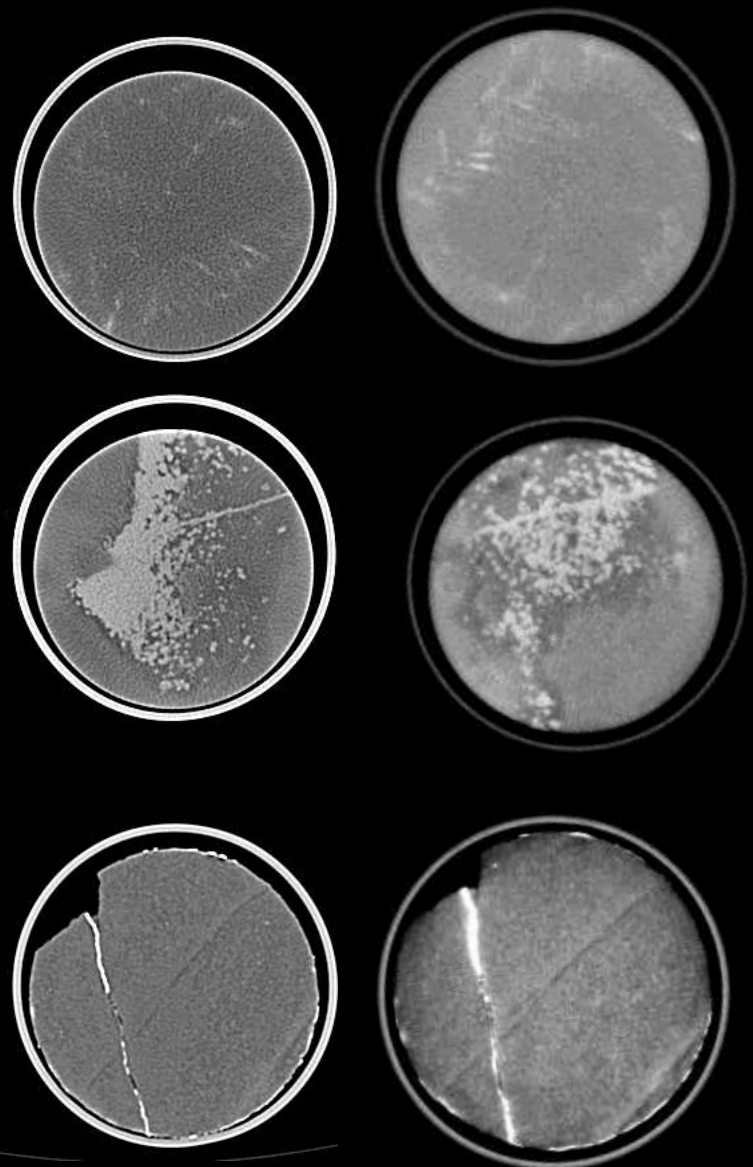


Geotek CT
250µm x 250µm



Medical CT
300µm x 625µm

Geotek CT
250µm x 250µm



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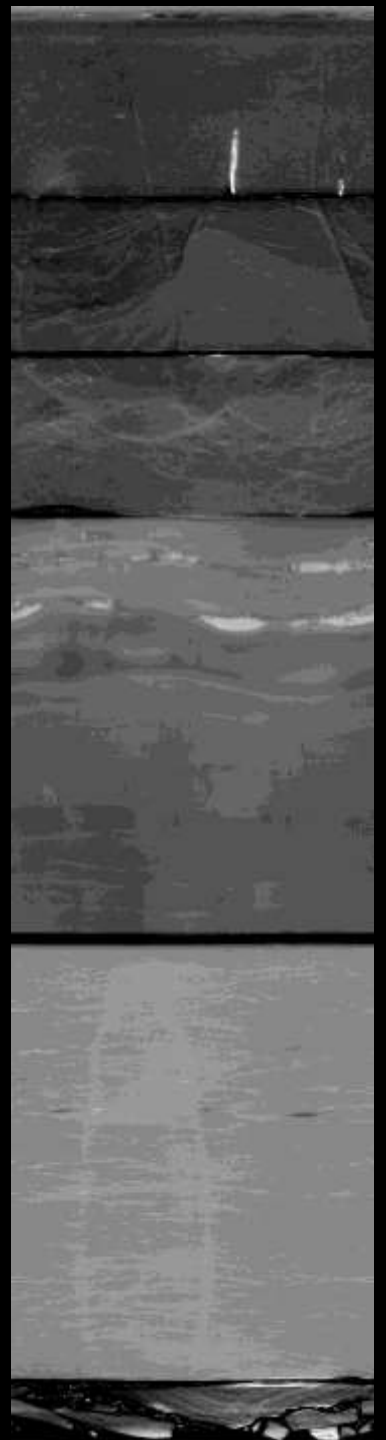

Summary

Multi-Sensor Core Logger (MSCL) instruments to **non-destructively** acquire continuous **physical and geochemical** parameters from mineral exploration drill cores

X-ray CT product range that offers the **flexibility** required for geoscience **research and industry**

Time is of the essence – scan the core at the drillsite with mobile core labs

What more can we learn? – scan cores at the repository and rescue lost data from archived core