

TERRAVISION

INTELLIGENT EXPLORATION

COAL



ABOUT TERRAVISION

- Terravision Radar is a ground-scanning device, which verifies and investigates the presence of mineral resources, geological and hydrogeological features, with unrivalled clarity and speed up to a depth of 200m.
- Existing ground penetrating radar technologies traditionally only penetrate to 25 meters in conducive conditions.
- The Radar technology is derived from a requirement of the Russian space program to scan for water on Mars.
- Our Radar is a leading technological tool, where, with minimum cost, information can be obtained about the geological structure of the section and prospective areas identified with real time speed.



WHY TERRAVISION RADAR?

Advantages of Terravision

- Technology to penetrate to **depths of up to 250m**
- Versatile and highly portable
- More powerful - 100,000 times the power of traditional GPR
- Our surveys enable drilling and trenching to be targeted more efficiently
- Localised and light operational footprint
- Minimal impact on the environment and surrounding operations
- Speed of data collection: acquisition of up to 4km of line surveyed profiles a day.

FINANCIAL ADVANTAGE

Delivers financial savings to the client:

- Low cost & accurate resource targeting
- Verification of drill hole data
- ***Reduced drilling expenditure***
- Real time data processing and analysis
- Improved mine planning

TERRAVISION can accurately locate:

- Faults & Voids
- Bedrock Contact & Ore Bodies
- Alluvial Horizons & Oxidised Zones

COAL SPECIFIC – ADVANTAGES IN EXPLORATION

Traditional methods of seismic combining with drilling in early stages of resource identification can be replaced with Radar and less drilling:

- with an overall decrease in expenditure
- improving on the required level of accuracy and quality of data
- no comprising on quantifying resource estimates
- faster acquisition with real time display
- reduction in initial drilling to define edges of payable coal with respect to thickness

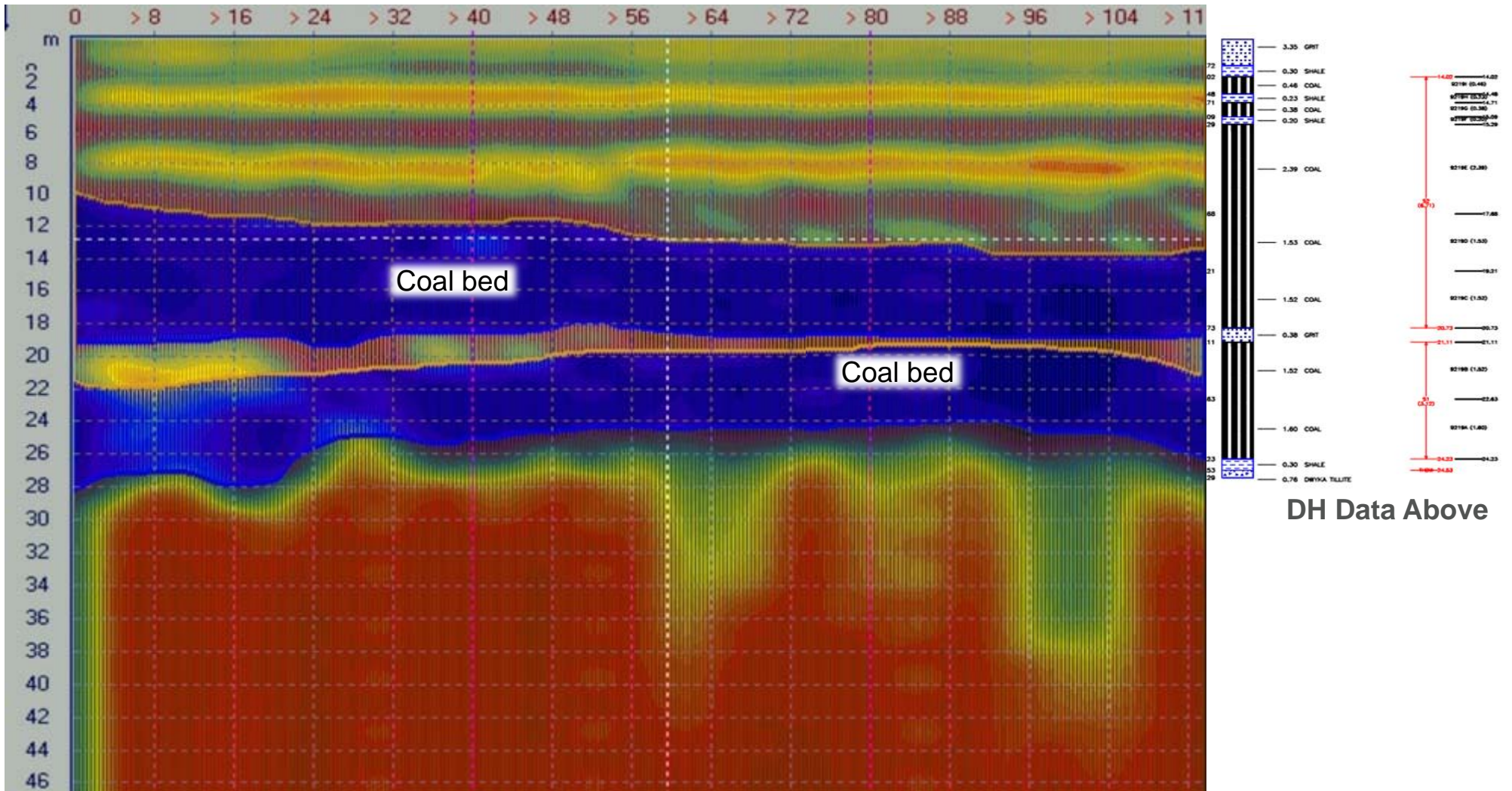
Acquisition of new ground via Joint Ventures:

- rapid assessment of the resource potential of potential new ground
- reduction in initial drilling to confirm coal thickness
- discard or proceed with JV

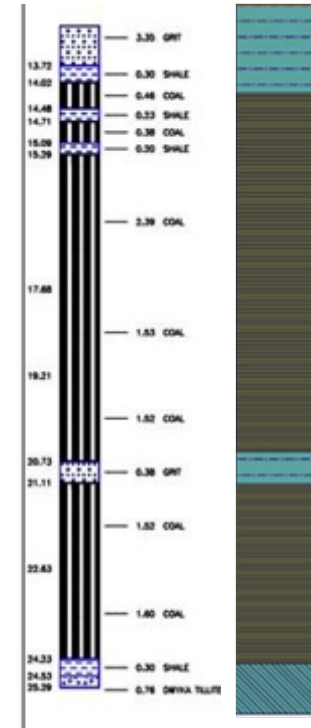
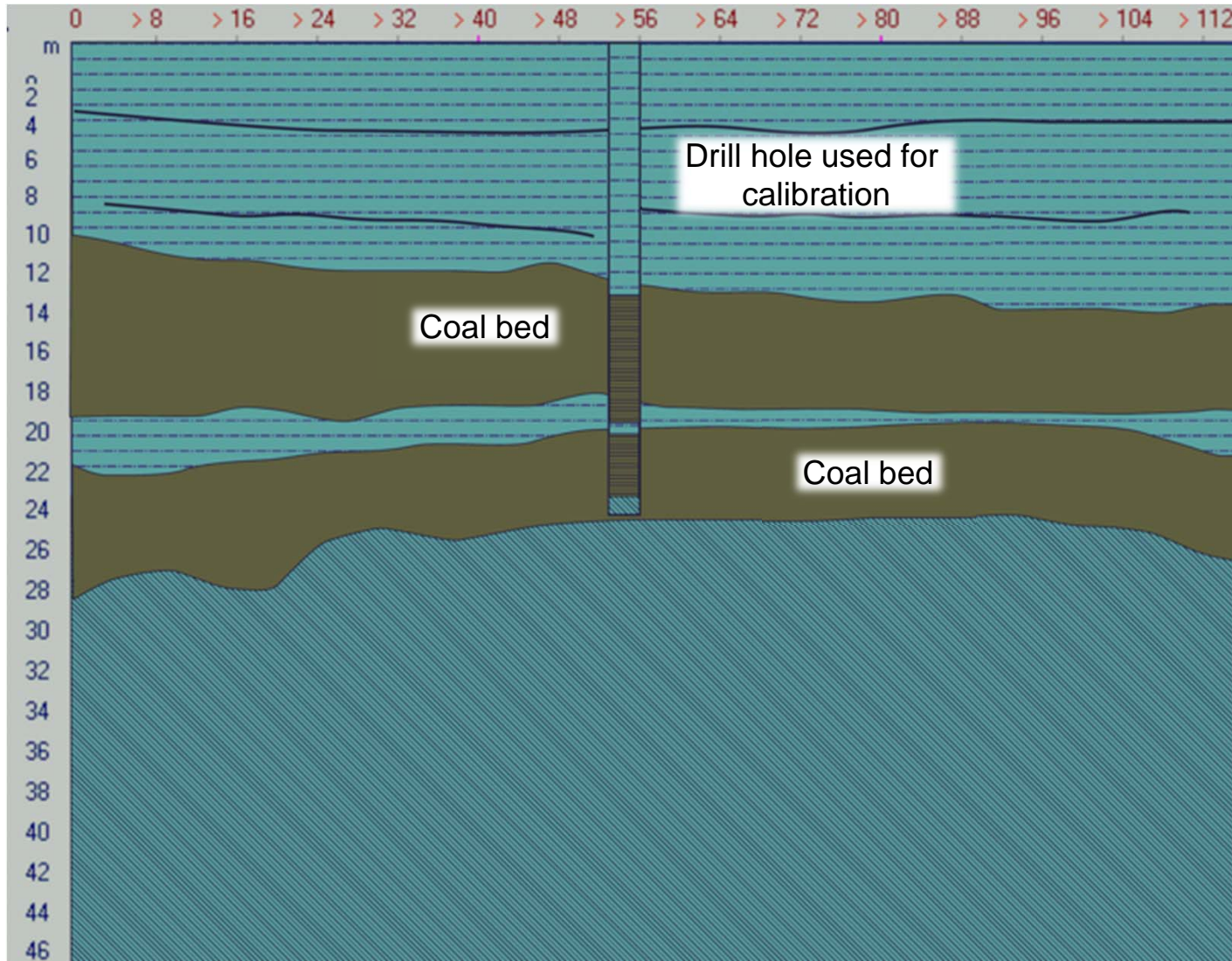
Cost Analysis:

- Terravision can provide a detailed costing for a comparative survey to illustrate the potential savings upon obtaining past expenditure details on the traditional survey methods of seismic and drilling.

COAL RADARGRAM EXAMPLE # 1

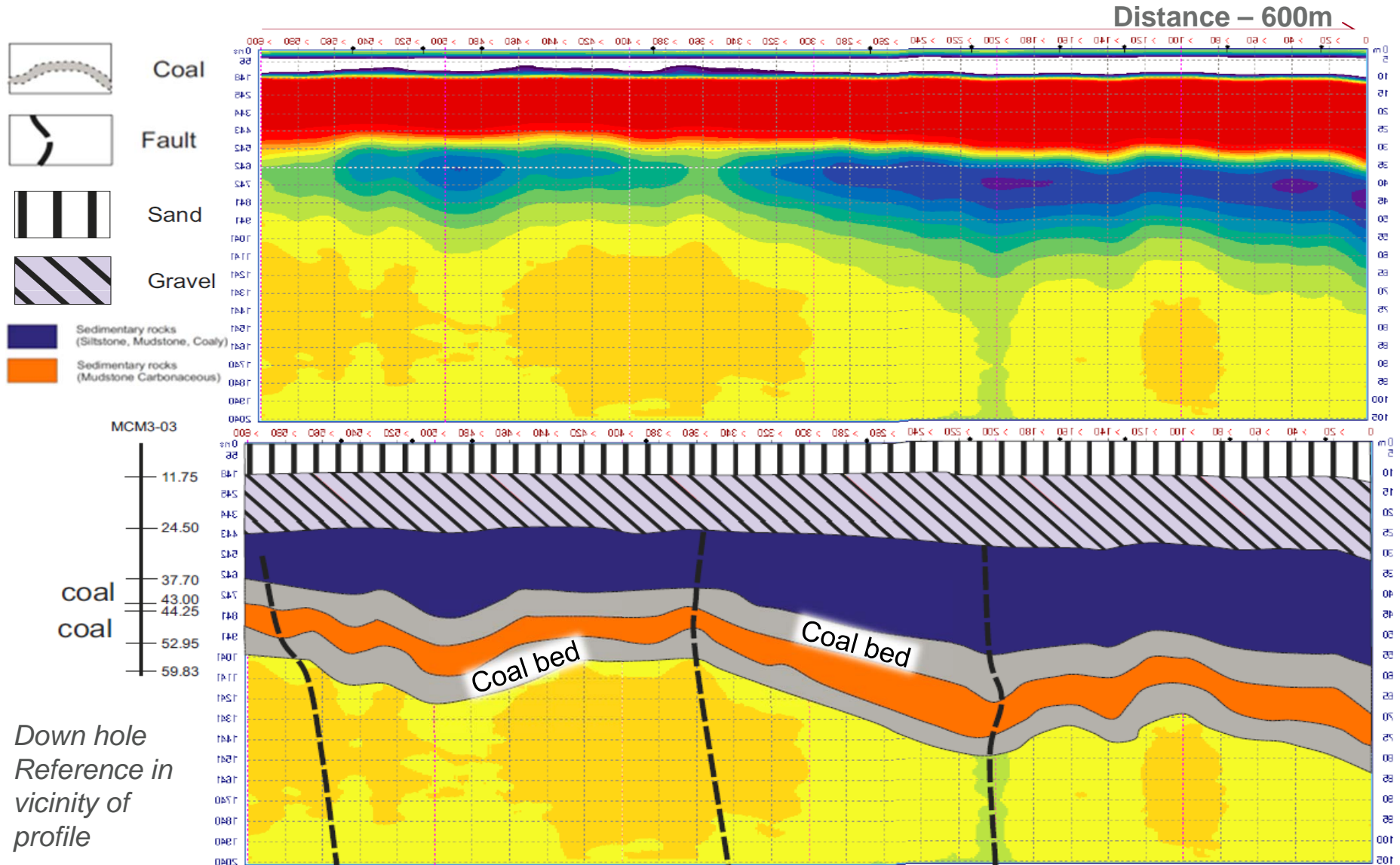


COAL SCHEMATIC EXAMPLE # 1

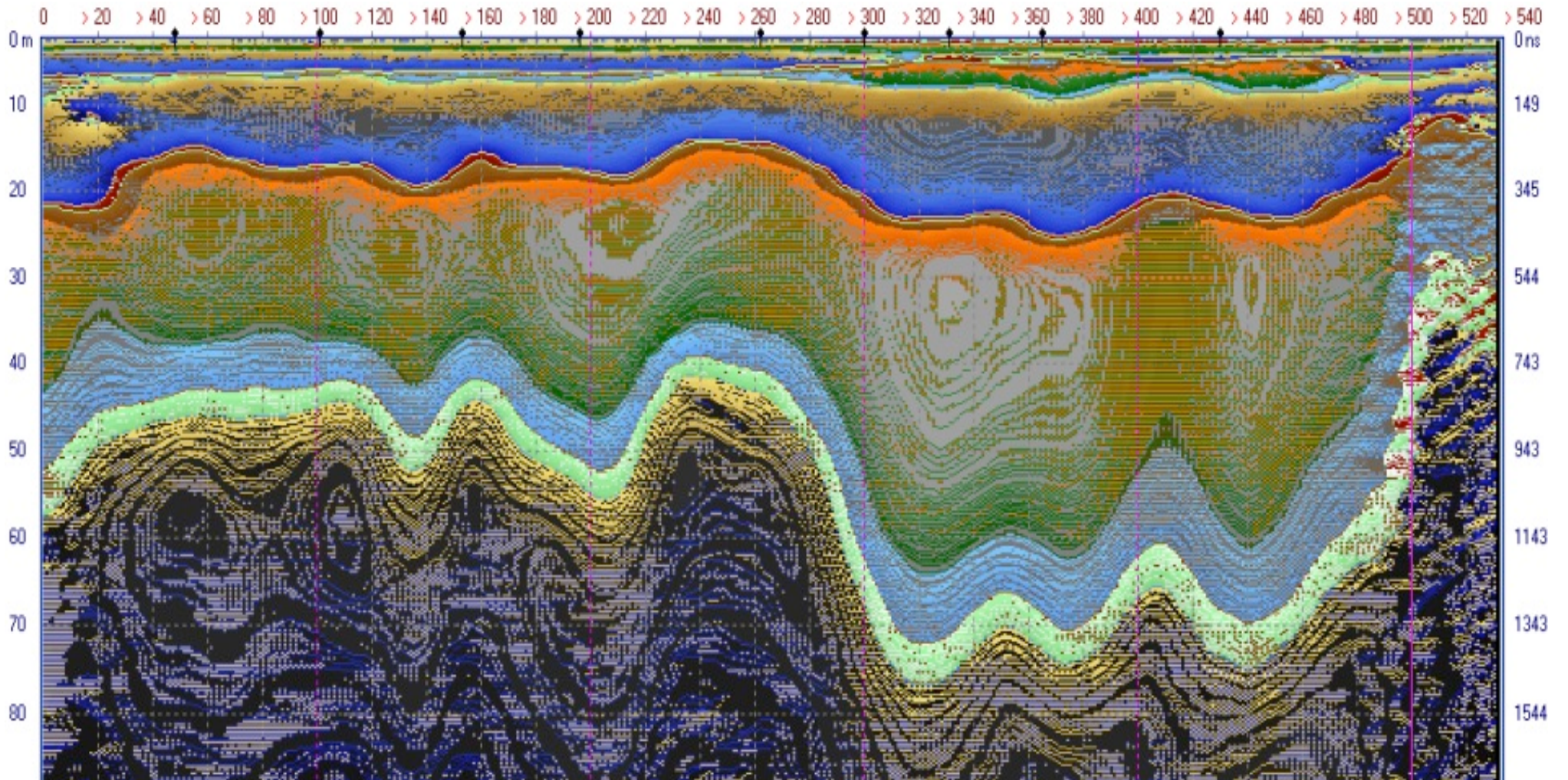


Schematic Representation of Radargram on previous page

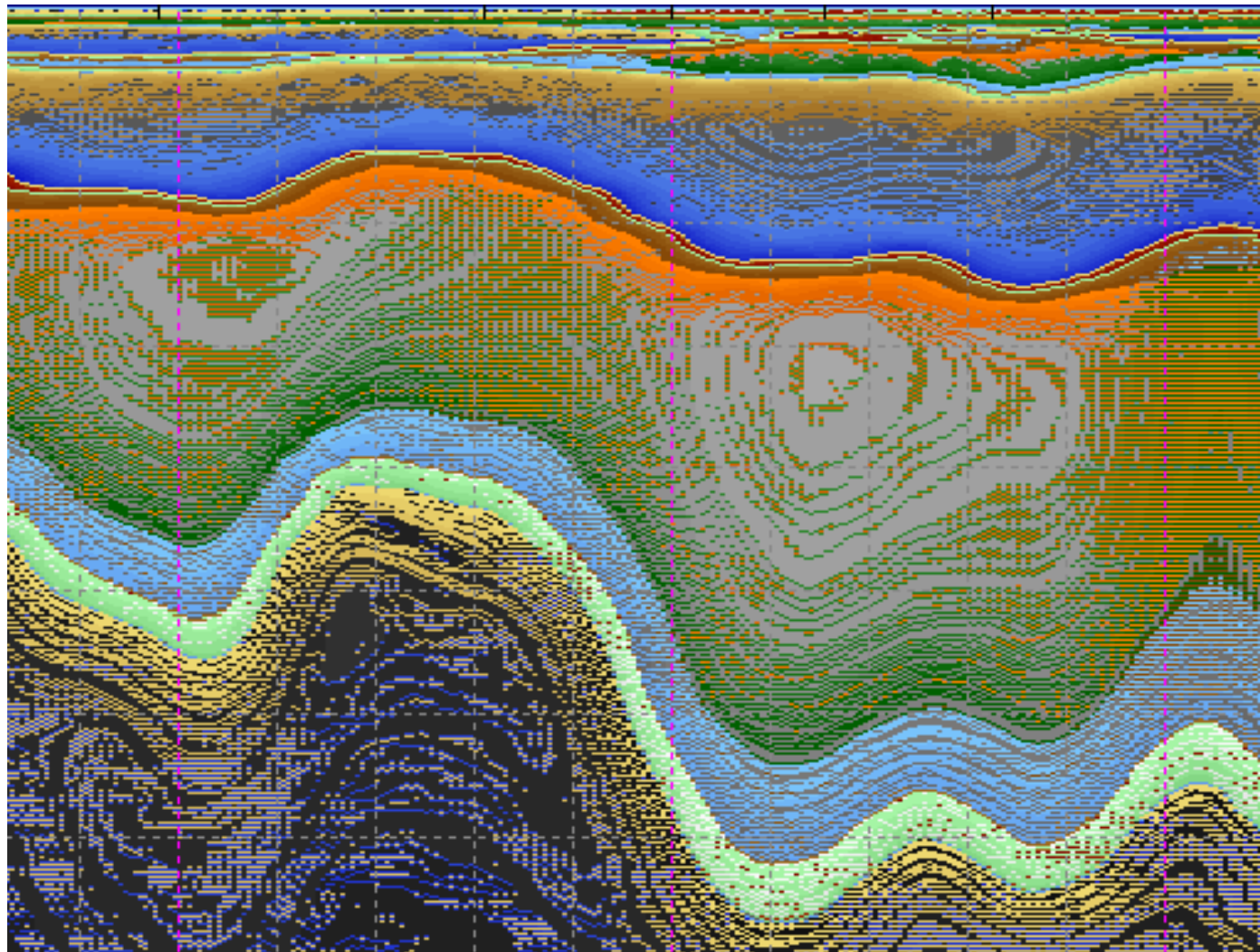
COAL RADARGRAM EXAMPLE # 2



COAL RADARGRAM EXAMPLE # 3 (COMPLETE PROFILE)



COAL RADARGRAM EXAMPLE # 3 (SECTION)



Sandstone / shale mix

Shale

*Coal Layer 2 – Thermal
Coal*

*Coal Layer 3 – Coking
Coal*

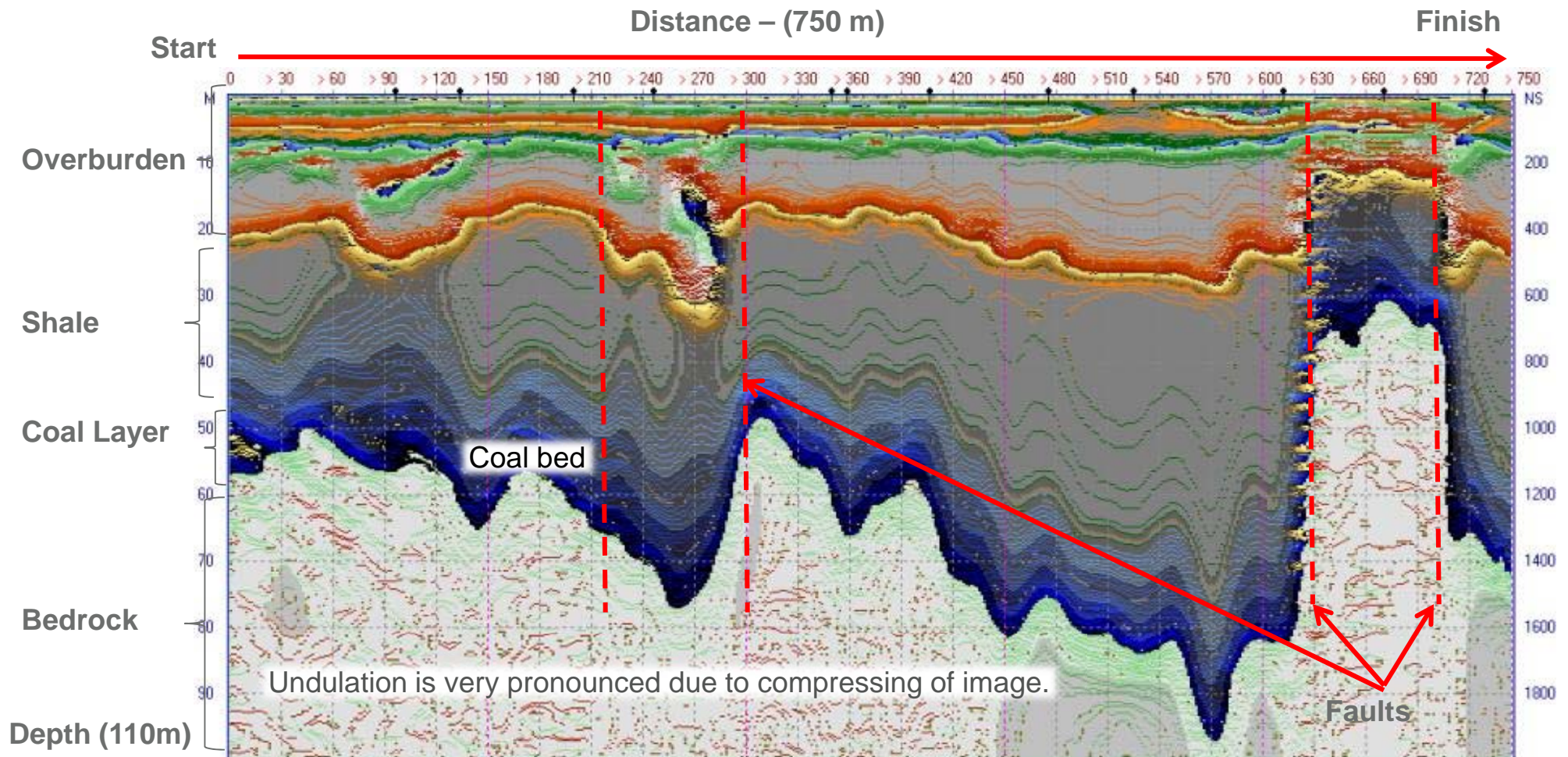
Sandstone Bedrock

COAL CASE STUDY #1 – AFRICA



COAL CASE STUDY # 1 – AFRICA

Radargram below displays the Overburden, Shale and Coal Layers, contact with Bedrock and Faulting. The profile is 750m in length and took 30 mins to collect and 4 hours to process. The profile was taken from the coal pit wall (previous slide) – so calibration was possible from visual observation.

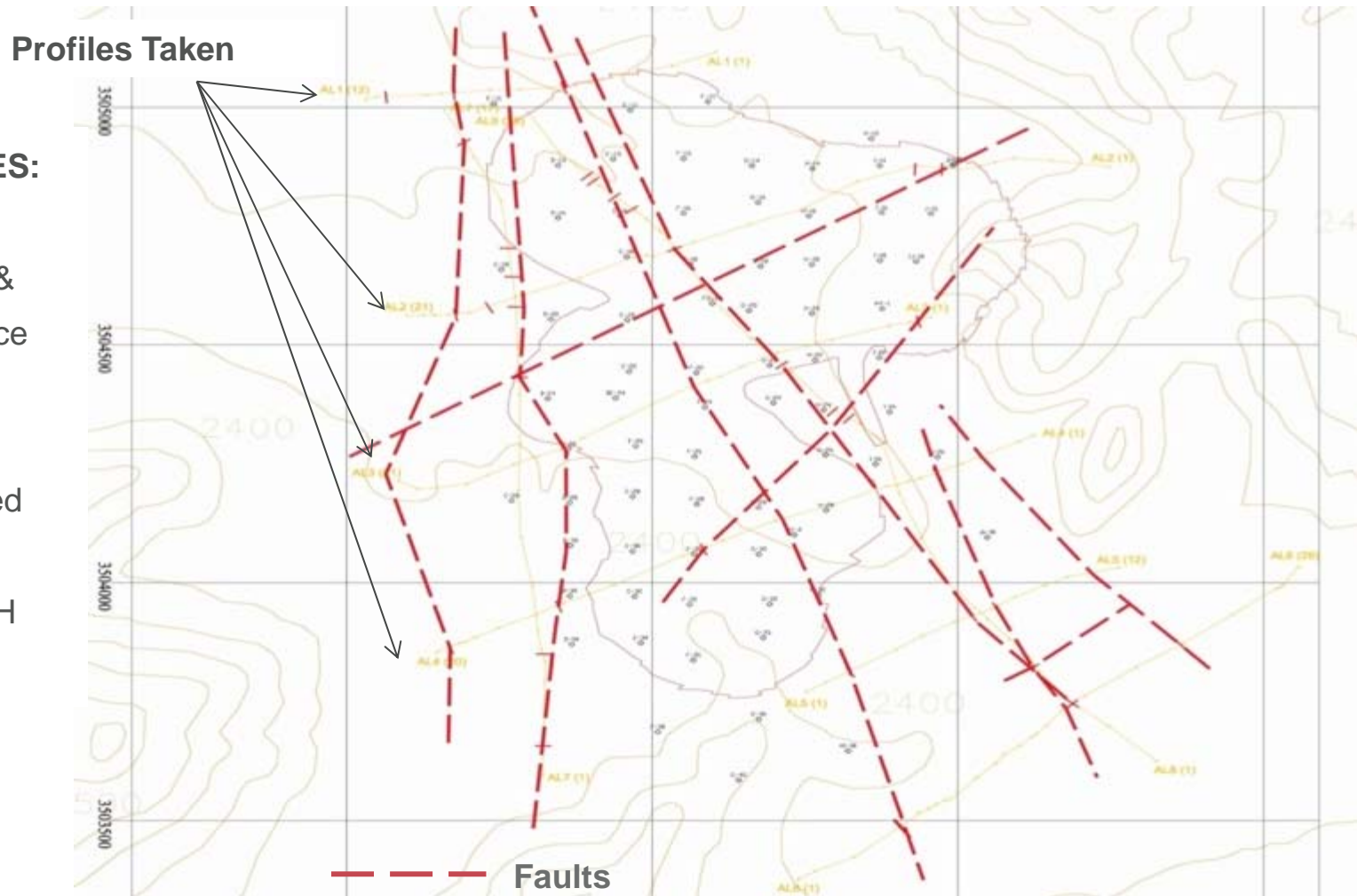


COAL CASE STUDY #1 – AFRICA

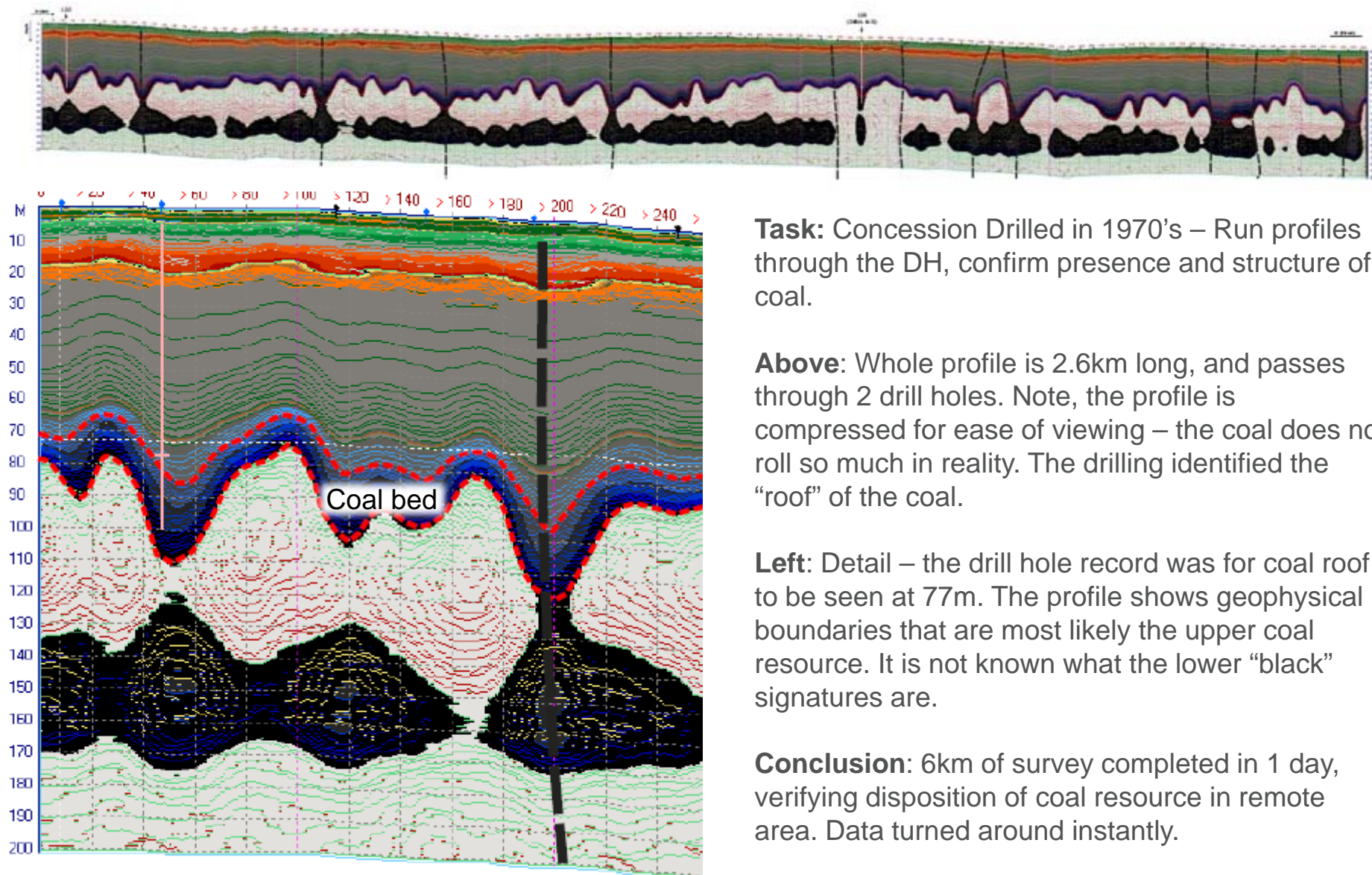
To survey the heavily faulted zone to position fault locations and the coal seams.

SURVEY OBJECTIVES:

1. Estimate volume & location of resource
2. Assist client with planning a targeted drilling program & reduce the # of DH required.



COAL CASE STUDY # 2 – AFRICA



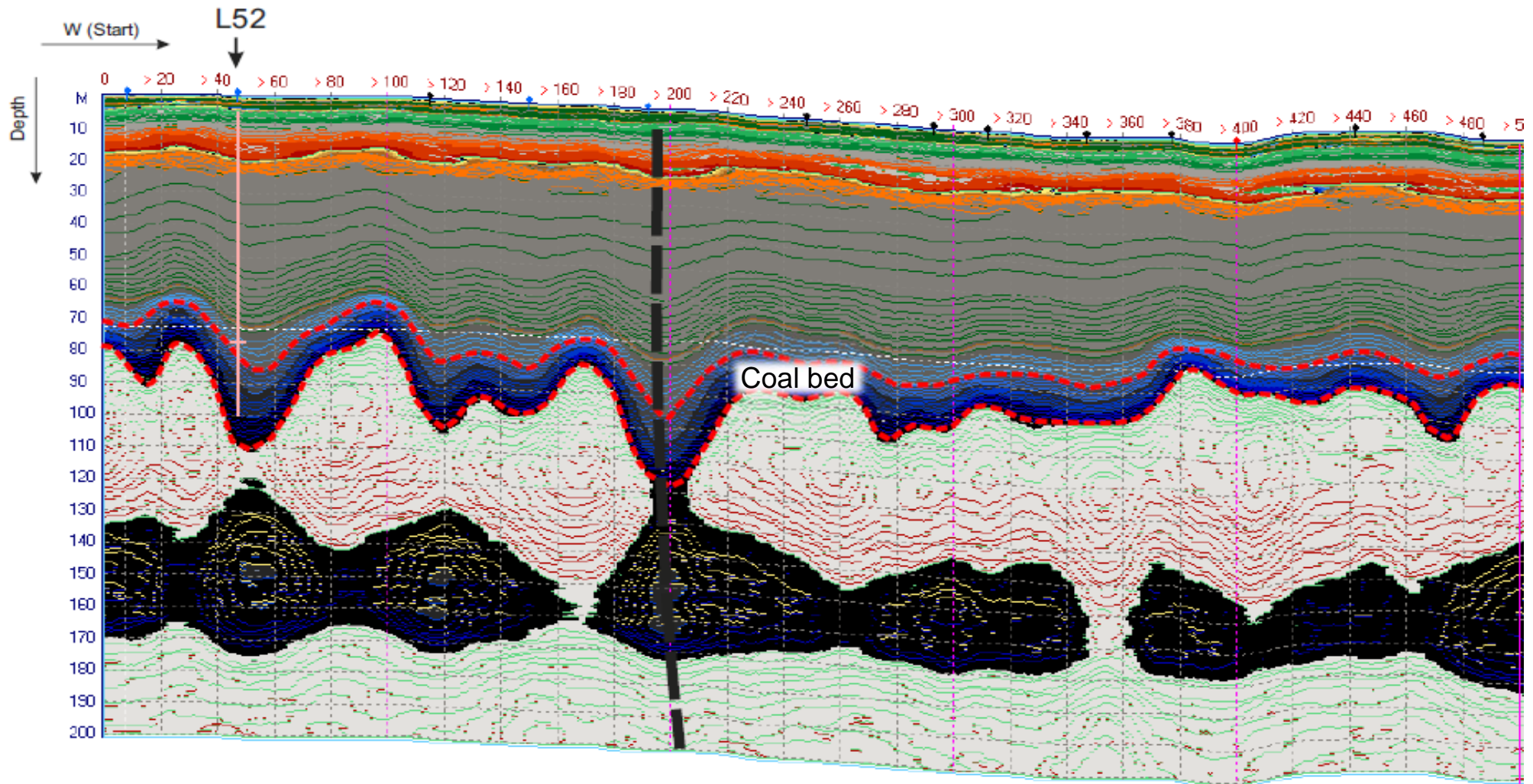
Task: Concession Drilled in 1970's – Run profiles through the DH, confirm presence and structure of coal.

Above: Whole profile is 2.6km long, and passes through 2 drill holes. Note, the profile is compressed for ease of viewing – the coal does not roll so much in reality. The drilling identified the “roof” of the coal.

Left: Detail – the drill hole record was for coal roof to be seen at 77m. The profile shows geophysical boundaries that are most likely the upper coal resource. It is not known what the lower “black” signatures are.

Conclusion: 6km of survey completed in 1 day, verifying disposition of coal resource in remote area. Data turned around instantly.

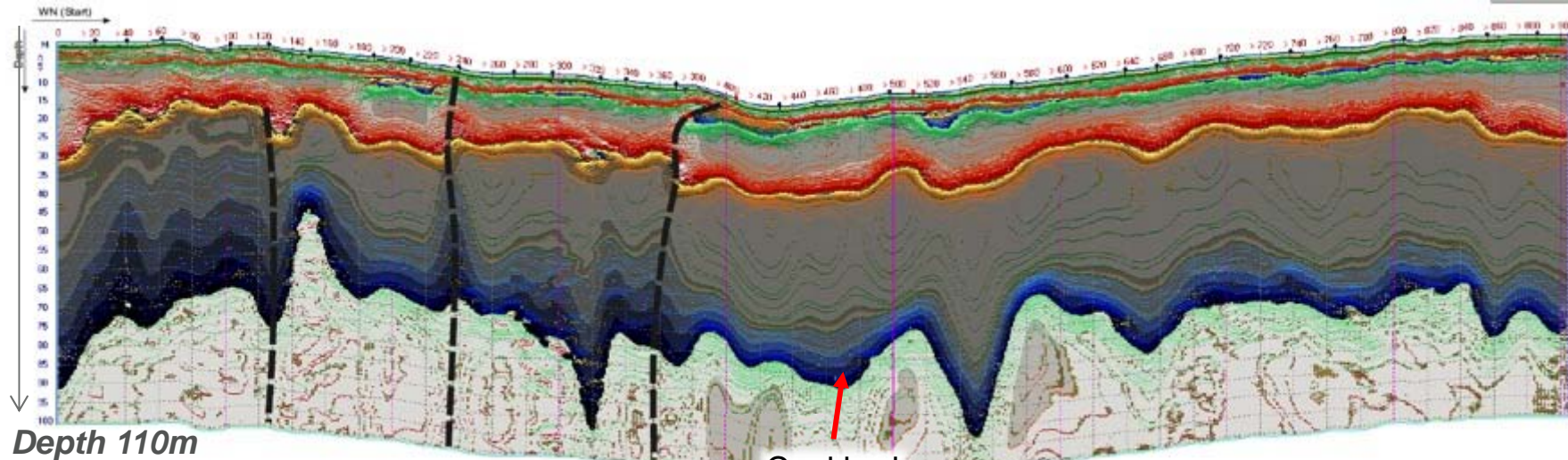
COAL CASE STUDY # 2 – AFRICA



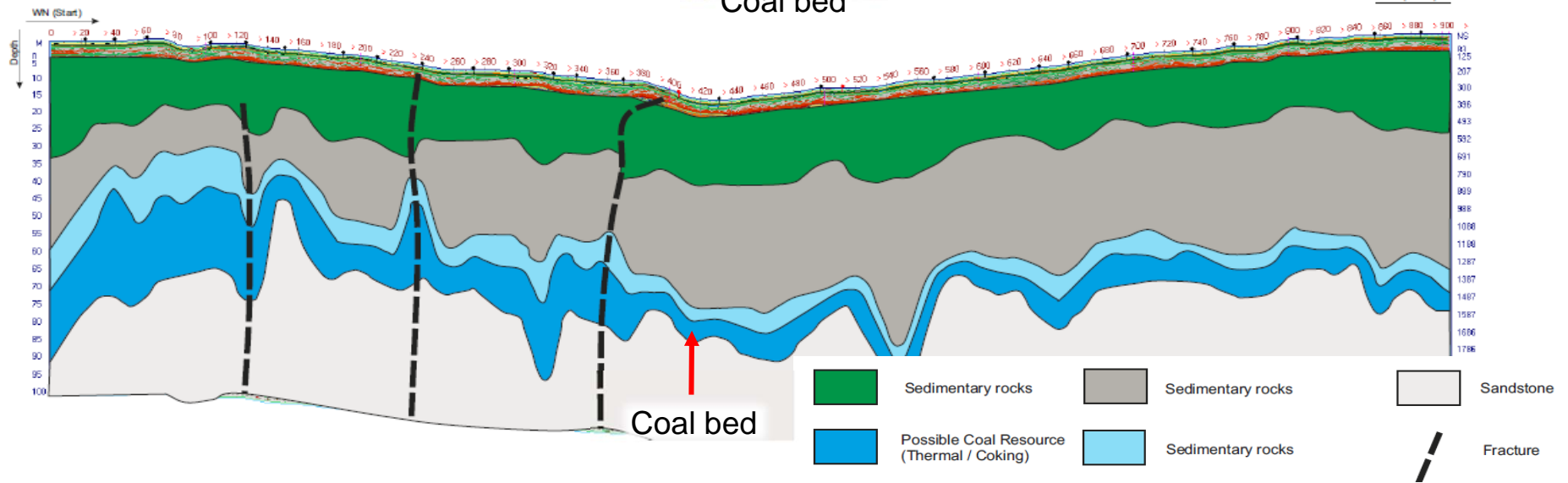
Existing Drill Hole Data Showing “roof” of coal bed

COAL CASE STUDY # 2 – AFRICA

Distance 900m



Coal bed



Coal bed

RADARGRAM FORMATS & REPORTING

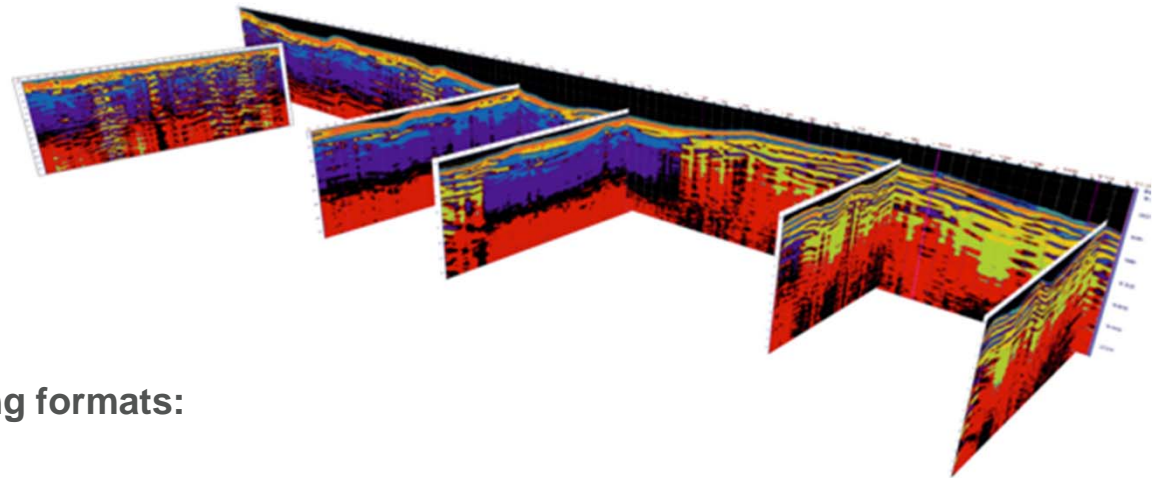
DELIVERABLES :

Reports contain the following:

- Analysed geophysical data
- Radargrams displaying the data
- Relevant geo referencing
- Summary & recommendations

Analysed data is provided in the following formats:

- RAW file
- TXT file
- Filtered (Radargram will be provided as standard)
- 3D Model where appropriate
- Other formats available upon request



RADARGRAM FORMATS & REPORTING

- **Product to client.** Profiles are shown in one of three settings

Consequent waveforms form a radar image of the subsurface medium (cross-section). Such type of data is very common for processing, there are two main modes of its representation:

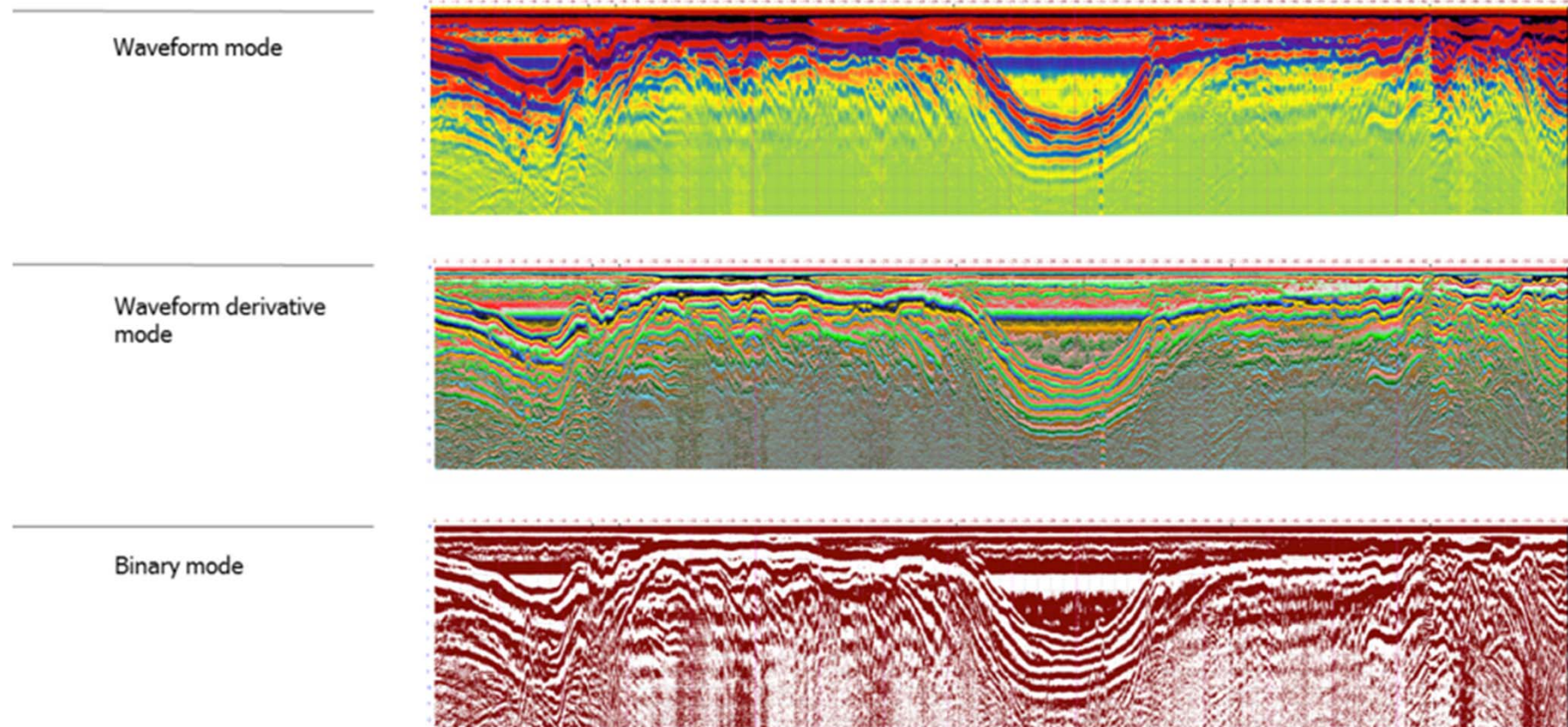
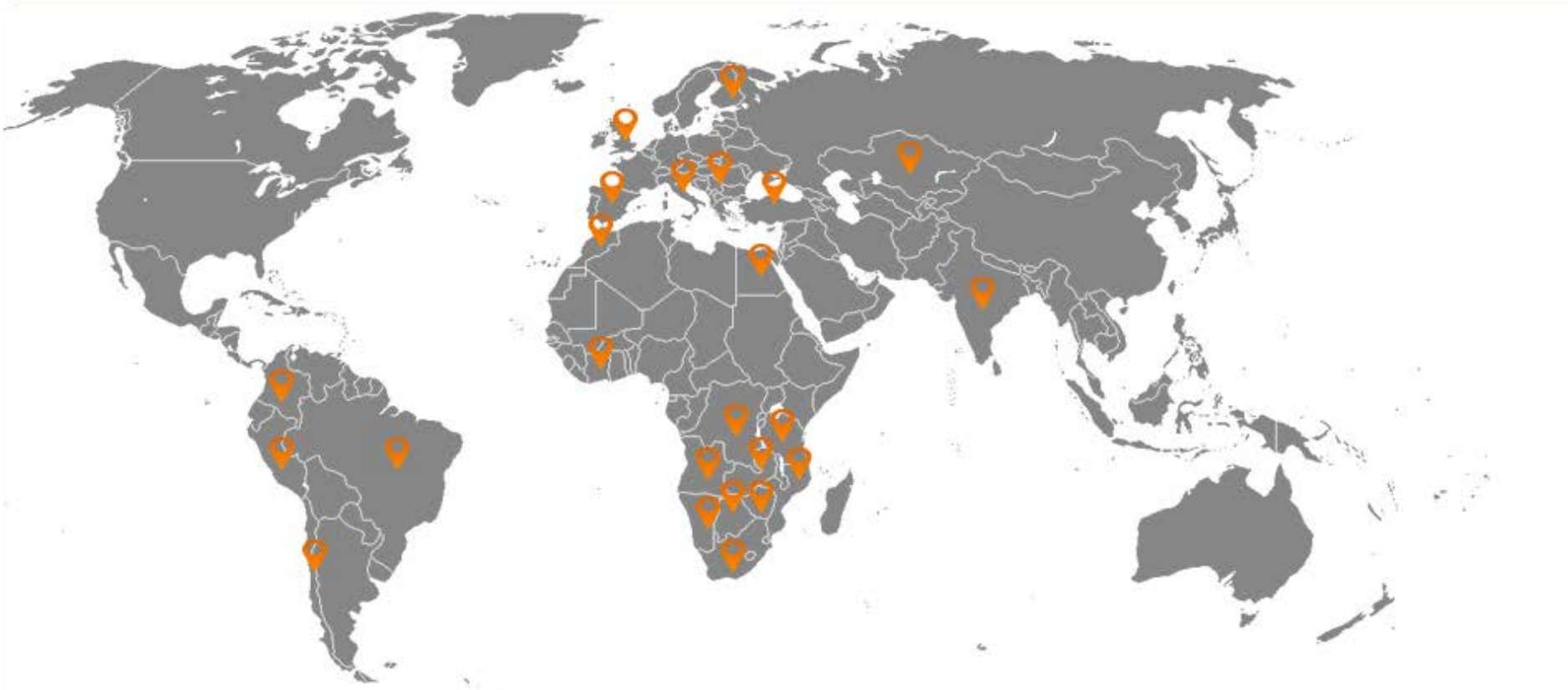


Fig 8 (above): *Waveform mode of representation*

OPERATIONS AND CLIENTS



Terravision Radar is working with industry leading mining majors and governments, through to junior exploration companies across Africa, Asia, South America and Europe.

OPERATIONS AND CLIENTS



DIAMONDS CORP



Prospect Resources



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TECHNICAL SPECIFICATIONS

TECHNOLOGY OVERVIEW

- The company uses a 4th generation Ground Penetrating Radar system.
- The radar scheme has been completely revised: pulse transmitter power has been increased by a minimum of 100,000 times, and the stroboscopic transformation replaced to direct detection of signal.
- The antennas used by Terravision-Radar use RC-loaded dipoles. This ensures the exclusion of interference in the received signal that suppresses weak signals, whilst also permitting the reception of strong signals.

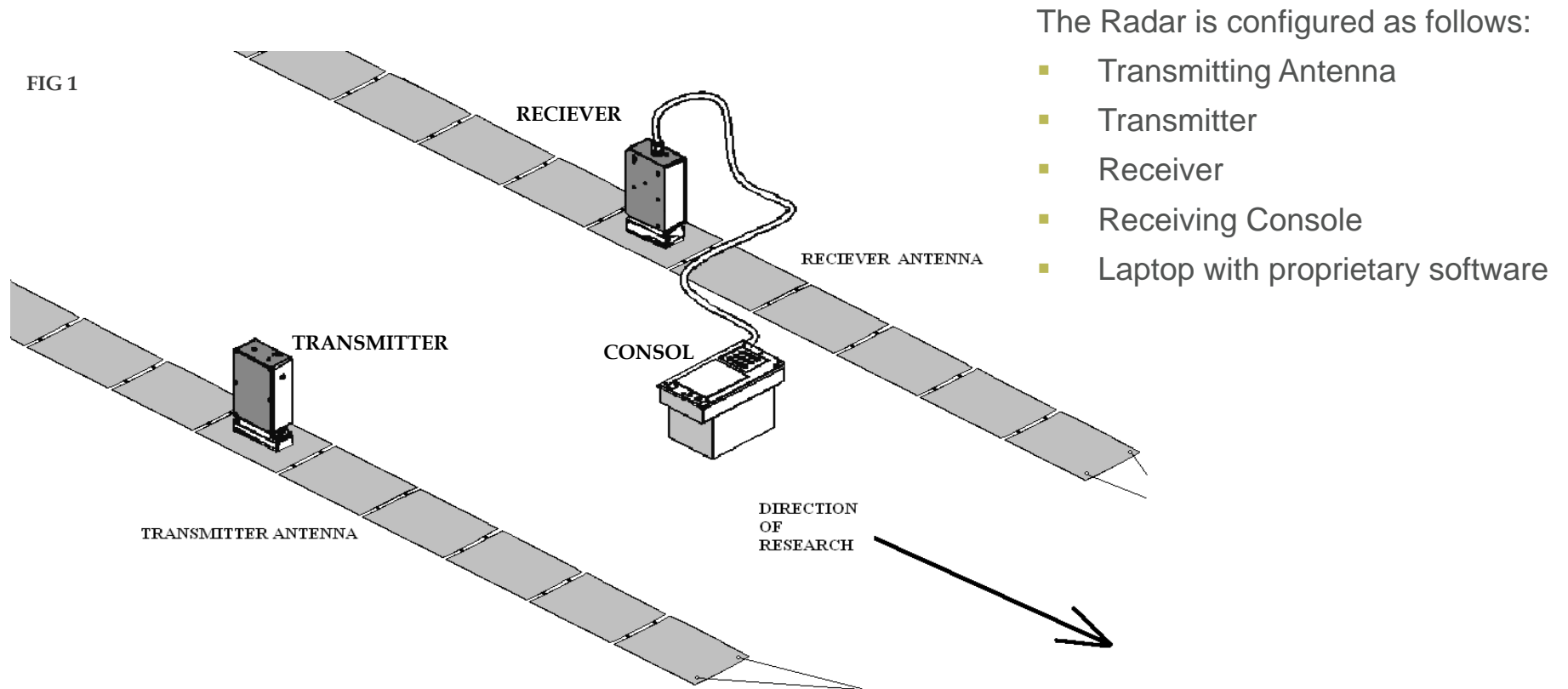
- The transmitter uses a high-pressure hydrogen discharge, and the transmitter operates in stand-alone mode without synchronization.
- This avoids the requirement for connecting lines which also introduce strong interference from the transmitter.

Technical Parameters

- The capacity of the EM transmitter is either 1, 10, 20, or 48MW Megawatt
- Working frequency range (MHz) 1-50
- Number of samples per scan (ns) 512, 1024, 2048, 4096, 8192
- Antennas can be 1m, 1.5m, 3m, 6m, 10m and 15m

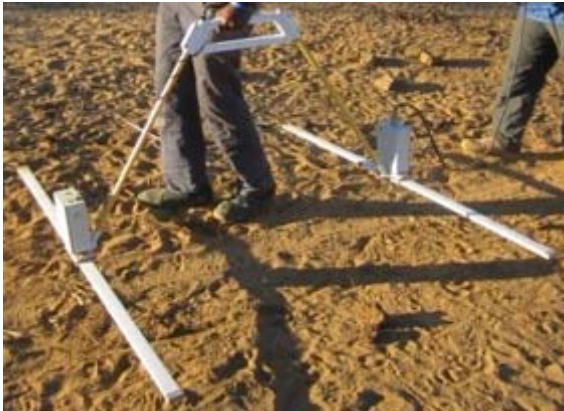
RADAR CONFIGURATION

- The Radar uses different sized antennas, transmitters, receivers and consoles
- Fig 1 Below: displays a typical radar setup



Scanning to different depths or achieving certain resolutions, requires the same configuration, with component parts changed to suit the target and objective.

RADAR CONFIGURATION



- **Penetration to 15m**
- 1 & 1.5 Meter Antennas
- 1 MW High-Feq Transmitter
- High Resolution



- Real Time Display
- Download data to Laptop in minutes



- **Penetration to 200m**
- 6/10/15 Meter Antennas
- 20 MW High-Feq Transmitter
- High Resolution



- **Penetration to 45m**
- 3 Meter Antennas
- 1 MW Low -Feq Transmitter
- High Resolution

REQUIREMENTS FROM THE CLIENT FOR DATA ACQUISITION

- **Requirement for Geo-Support:** It is important to have a fully qualified and experienced geologist on site. Surface mapping will also augment the radar survey.
- **Requirement for Casual Labour:** Casual-labour clearance teams and manual pulling assistance is required. Larger antennas require more manpower. 1 man can pull a 6m antenna, 2 men for a 10 or 15m antenna.
- **Requirement for a Surveyor with DGPS:** A surveyor with a DGPS should be provided, as the Radar has “real time” reporting – where structures are identified, real time marking can be achieved.



DATA ACQUISITION



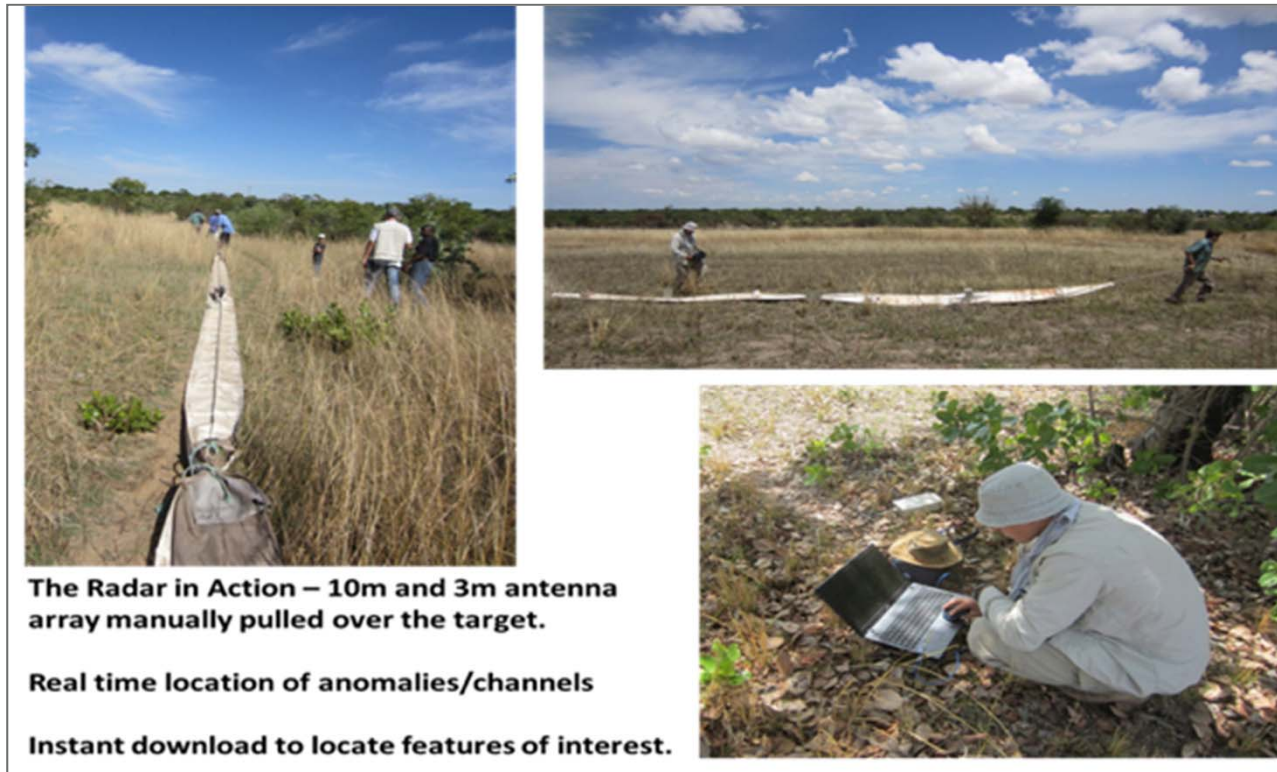
- The antennas require to be flush with the surface – highest performance achieved on machine prepared grids / lines.
- The use of 4x4 vehicles as the “tow” vehicle is the preferred approach but not essential with the 4 x 4 in low range travelling at a “crawl” at @ 1km per hr
- The operator sets the radar to fire automated regular shots such as once every half second or one second.

Fig 2 (Left): Pictures of well cleared profile lines

- Above & Right: the device is pulled along well cleared profile lines.
- The lightweight, highly portable system allows for rapid mobilization and deployment.
- The Radar is towed either by hand, behind a 4x4 or quad bike.

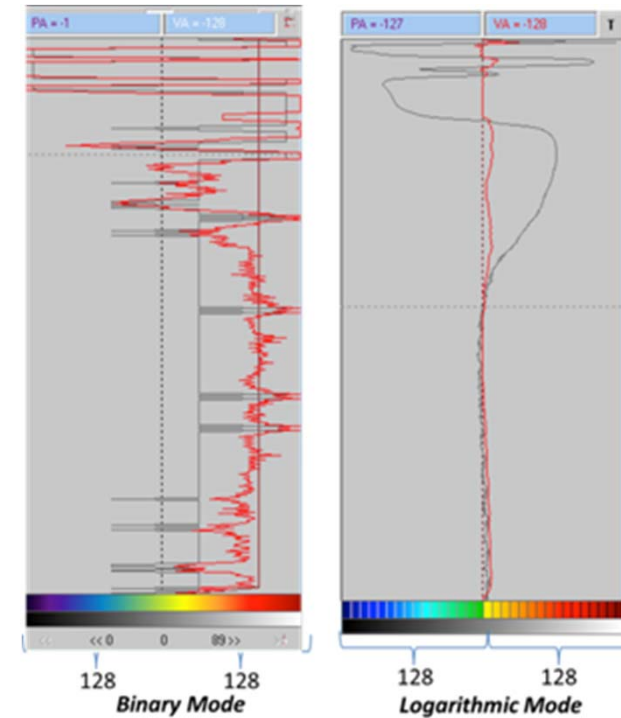
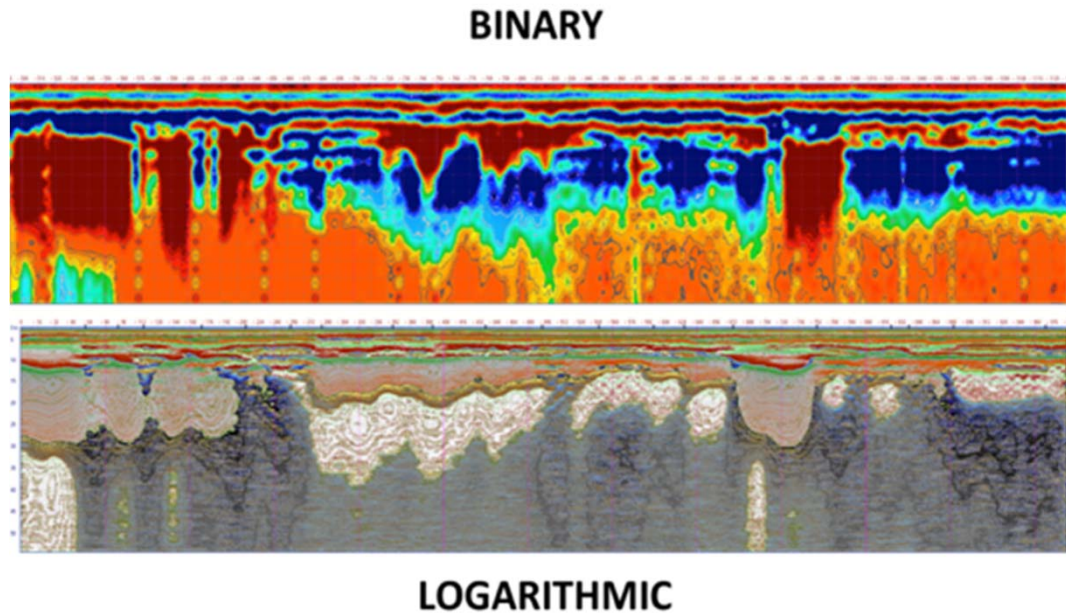


DATA ACQUISITION – THE RADAR IN ACTION



- The spacing of the “radar – shots” taken along the profile is chosen according to the required scale of the target objects.
- For small objects (pipes, cables, small voids etc), shots may be taken every 20 cm to 30cm, for shallow geological surveys (e.g. alluvial deposits) spacing may be 50-100 cm.

DATA ACQUISITION - technical



- The radar can be set to “automatic” when dragged behind a 4x4 or quadbike. The timing of the shots depends on what mode the system is set to. Binary is quick (1 shot every half second), logarithmic delivers more detailed data and has a longer “calculation time (one shot every second).
- **Fig 3&4 (above):** *Recording of the EM wave, showing different parameters - binary is a “quick method” using just one pulse of energy, Logarithmic uses many pulses to determine more detail.*

DATA ACQUISITION – technical continued

- At each measurement point, the arrival time of the signal is recorded from the geological boundaries. The profile 'Radargram' is formed in real time on the operators console LCD screen in the form of a binary plot depicting radar return time of the subsurface reflections.
- The EM wave travel times, depending on the reflector depth and propagation velocity, vary along the profile giving a picture of subsurface layered structure.



- **Fig 5 (above):** *The operators' console displays the wave form (right side) and the build up of the profile (left side) Experienced operators can therefore recognize features such as voids, as the EM wave travels faster in voids than in the surrounding material.*

DATA ACQUISITION – technical continued

- Results of the survey, including the wave-forms for each point/”shot” in the survey (every 10cm to 110cm – depending on the objective), are stored in the console memory, which can then be instantly downloaded into a normal laptop computer for instant review.
- This “real-time” capability means that the operator can “mark” features of interest as the profile is taken. Therefore a Differential GPS (DGPS) operator should be onhand, walking with the operator, to mark points of interest. This allows the client to mark the features on his own software for subsequent actions to be accurately delivered (drilling etc).



IDENTIFYING STRUCTURE & “SHOT” SPACING

- Vertical structure, we see this – as the diagram below attempts to portray. We do see vertical structure quite well because we get the signal reflection not only from horizontal boundaries.

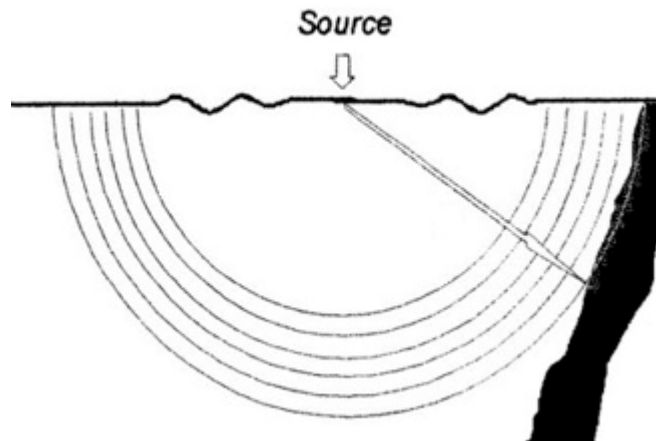


Fig 6 (Left): *Capturing Structural Detail*

- The Radar operator can either manually operate the “firing switch” or it can be set to automatic. Shot spacing is determined by the clients objective, and the speed of the traverse. Where we have competent horizontal coal layers we may take a shot every 1.5m.

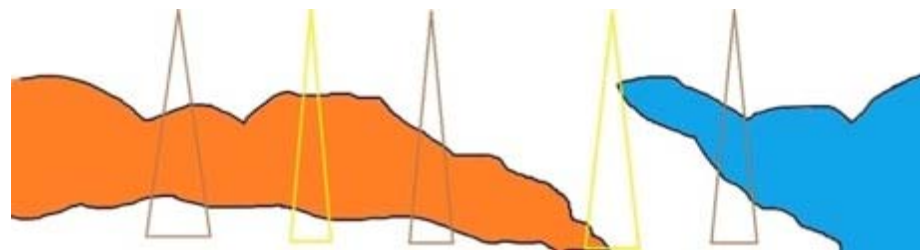


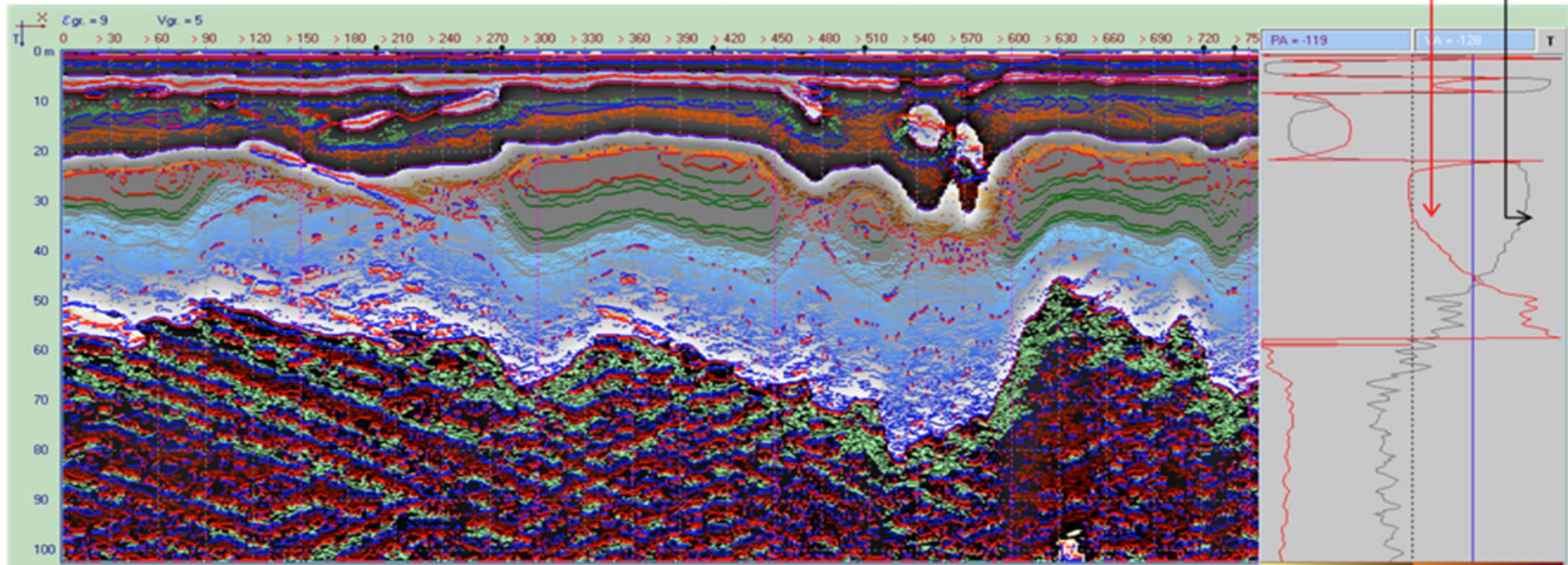
Fig 7 (above): *“Shot” spacing*

ANALYSIS

How is the filtering process conducted?

Black line – original data.

Red Line – Data adjusted with algorithmic filter that pushes the signal out over a rainbow of colours



- Data is collected and downloaded onto a laptop for analysis on proprietary software. Typically taking 12hrs to fully analyse 1km line of data.
- Preliminary analysis on the laptop can be conducted immediately in the field to check data quality and features of interest.
- The final report will be delivered no later than 21 days following the completion of data collection.

DATA ACQUISITION – PRODUCTION & CALIBRATION

- **Rate of Collection:** We assume that by “manual” data collection, we will generate between 2.5km to 3.5km of line kilometres per day on land. A video example can be seen at (a) <http://youtu.be/JXEiahFUaww> and (b) <http://youtu.be/ddbG9lvf0sw>
- This is an arbitrary calculation, and when surveying for voids, it may be necessary to have a much greater “shot concentration” – i.e. more shots over shorter distances, so that several shots pass through each void. Factors such as definition and detail required, size of target features, and antenna/transmitter arrays all define the speed.
- **Adaptable Planning:** As mentioned above, Terravision sees features in real time, and can instantly download data to obtain an initial analysis. Often the client will amend the profile plan due to Terravision’s immediate ability to understand the geological conditions, or due to topographical/ vegetational obstructions. Liaison with the project geologist is essential, and mutual collaboration is required.
- **Calibration:** Where possible, the profiles should pass through a point of reference, such as an augur hole, or drill hole, where the stratigraphy and assay data is known, or perhaps from a visible feature like a pit-face, that enables the “geo-electric” signature in the radargram to be definitively identified. The sub-surface “geo-electric” signature can then be matched along the profile, and recognised in other profiles taken locally where there is no calibration point.