TERRAVISION

INTELLIGENT EXPLORATION

SURVEYING FOR IRON ORE
TERRAVISION RADAR PRESENTATION

WWW.TERRAVISIONRADAR.COM

ABOUT TERRAVISION

- Terravision Radar is an industry leading ground surveying exploration company, that uses **GPR*deep*** innovative geophysical technologies.

- Resource mapping to date completed on: Gold, Diamond, Rubies, Alluvials, Coal, Iron Ore, Copper, Tin, Limestone and Kimberlites.

- Terravision Radar surveys & currently operates on mine sites to deliver comprehensive analysis, which allows for detailed verification, structure mapping, and mine planning.

- 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.

"Unrivalled clarity and speed up to depths of 200m"

TECHNOLOGY OVERVEIW

- Terravision Radar also known as **GPR*deep*** is a ground-scanning device, which verifies and investigates the presence of mineral resources and geological features, with unrivalled clarity and speed up to a **depth of 200m using a 20MW mono pulse transmitter.**

- The **GPR*deep*** Radar technology is derived from a requirement of the Russian space program to scan for water on Mars.

- Existing ground penetrating radar technologies traditionally penetrate to 25 meters in conducive conditions. **GPR*deep*** is consistently effective to depths of up to 500m, in a diverse range of environments.

- **GPR*deep*** 6m antennas in parallel configuration

WHY TERRAVISION RADAR?

Advantages of GPR*deep*:

- **GPR*deep*** can penetrate to **depths of up to 500m**
- Versatile and highly portable
- **GPR*deep*** has 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: Terravision Radar can collect up to 4km of line profile a day.

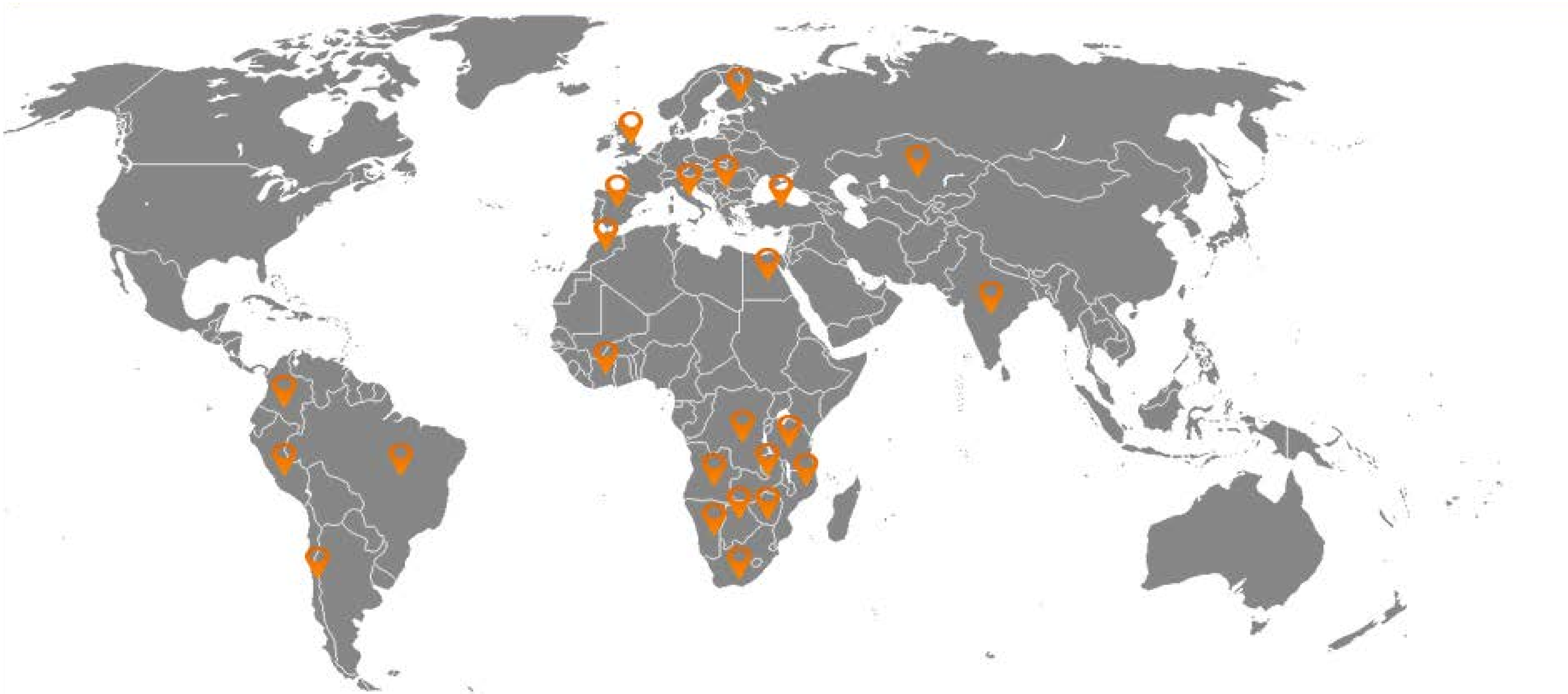
Terravision Radar delivers financial savings to our clients through:

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

We can accurately locate:

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

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

RioTinto

srk consulting

NEWCREST MINING LIMITED

De Beers

IRONVELD

TETRA TECH

ALEXKOR

RESERVOIR MINERALS

TARMAC A CRH COMPANY

UIT UNDERGROUND IMAGING TECHNOLOGIES

LAFARGE TARMAC

BARRICK

SUSTAMINING

SEVENTH FRAMEWORK PROGRAMME

AMATHEON AGRI

KeatonEnergy

African Consolidated Resources Plc

BUSHVELD MINERALS

COAL of AFRICA LIMITED

pangolin DIAMONDS CORP

Prospect Resources

British Gypsum SAINT-GOBAIN

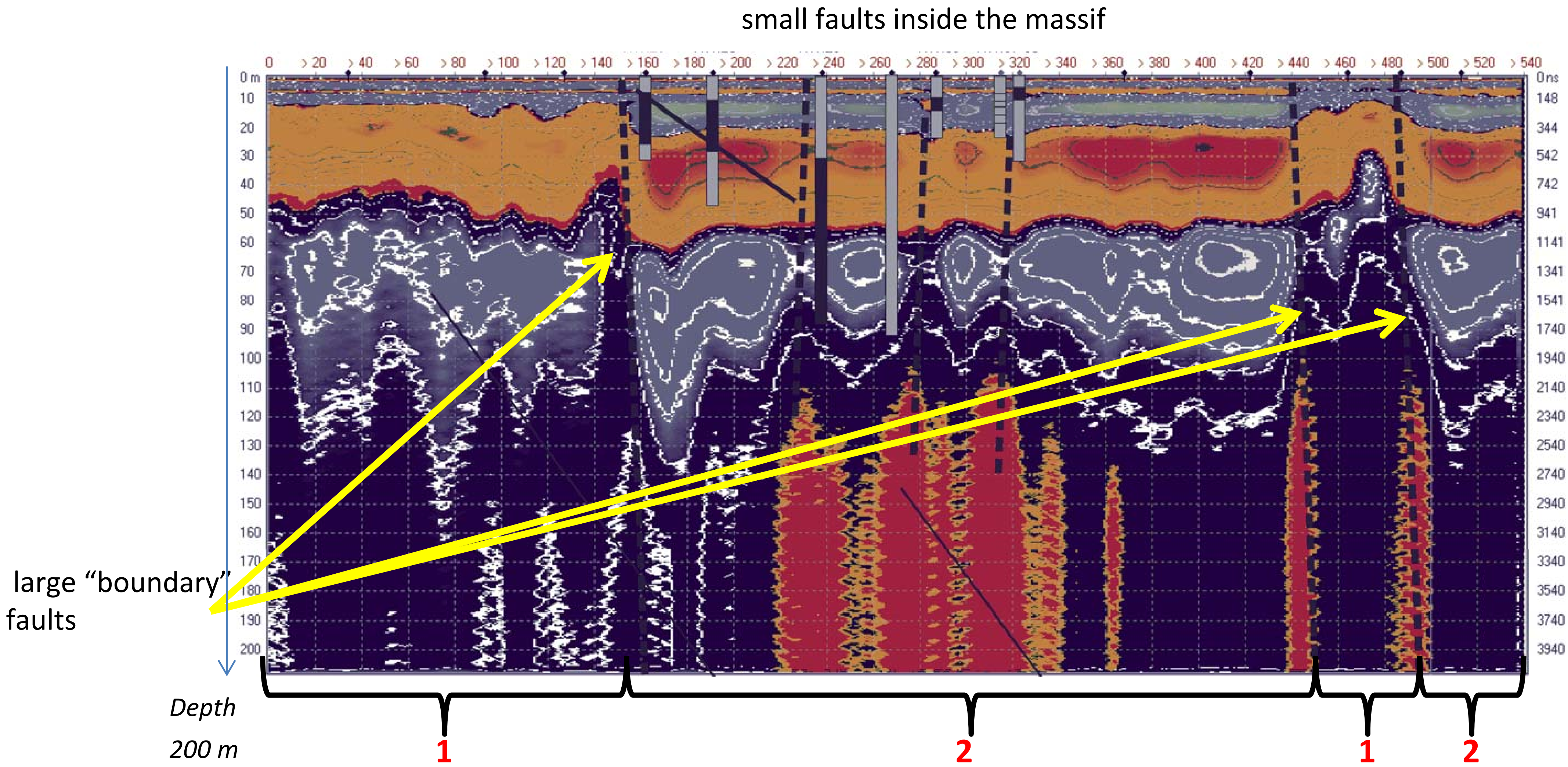
KASBAH RESOURCES

Morupule Coal Mine Seam to Energy

Knight Piésold CONSULTING

CASE STUDY 1: Magnetite, South Africa

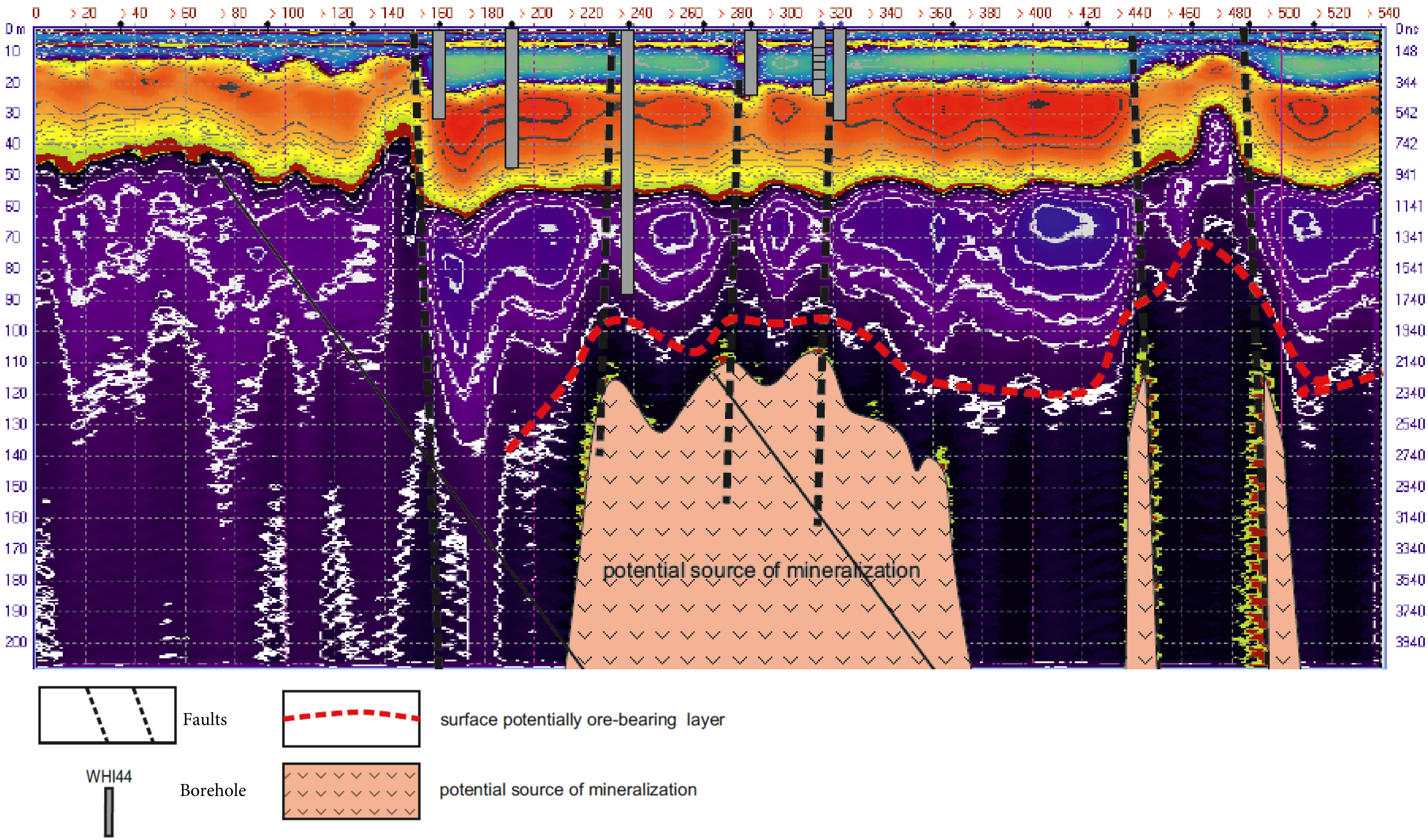
The objective was to map structures



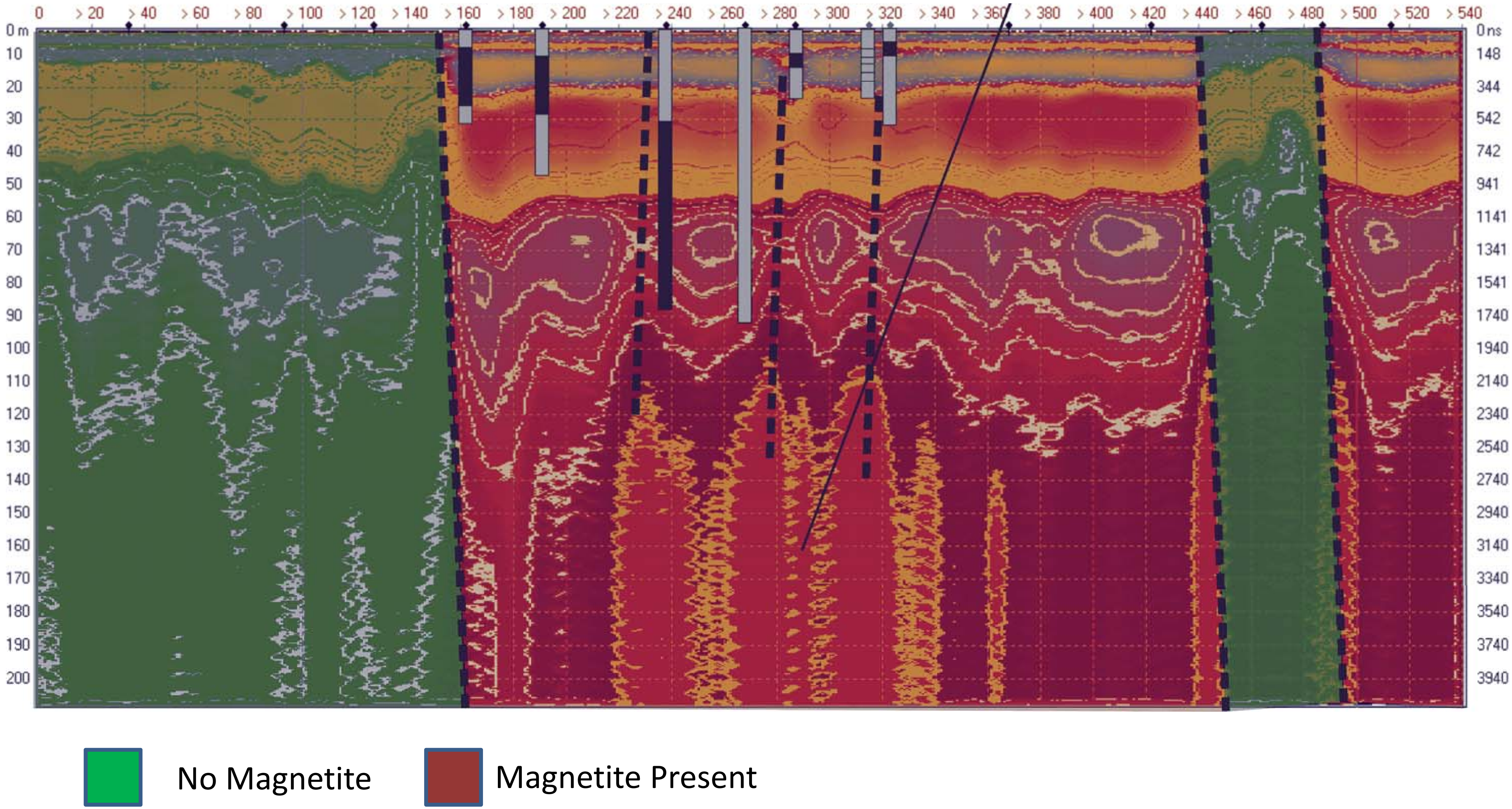
1 - Massif without magnetite

2 – Massif with magnetite

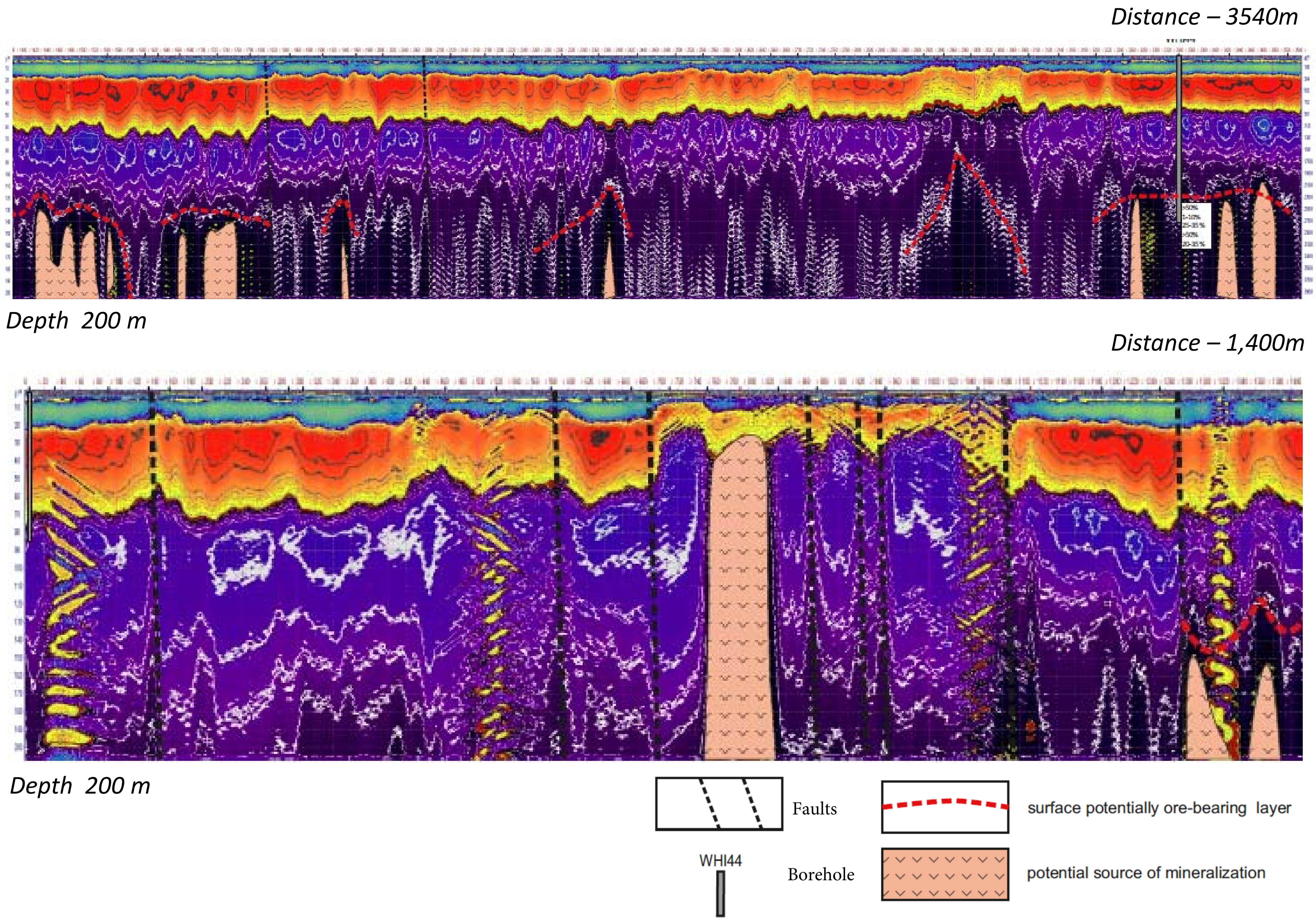
Schematic outlining anomalies interpreted as potential mineralised zones



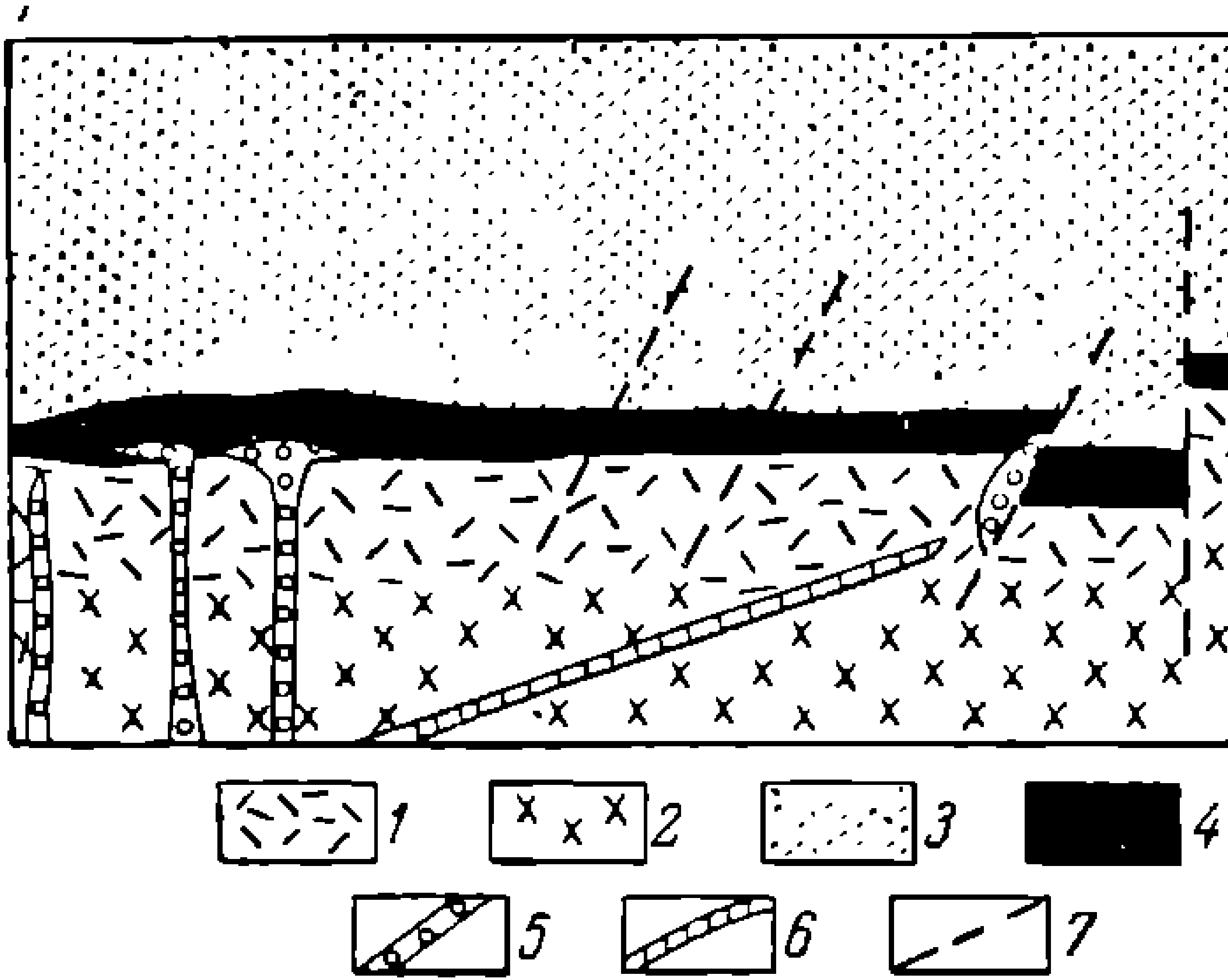
Pre existing drillholes superimposed on the section show the client should extend drilling to reach the massif.



Further survey lines with limited/no borehole data indicates drilling and sampling targets



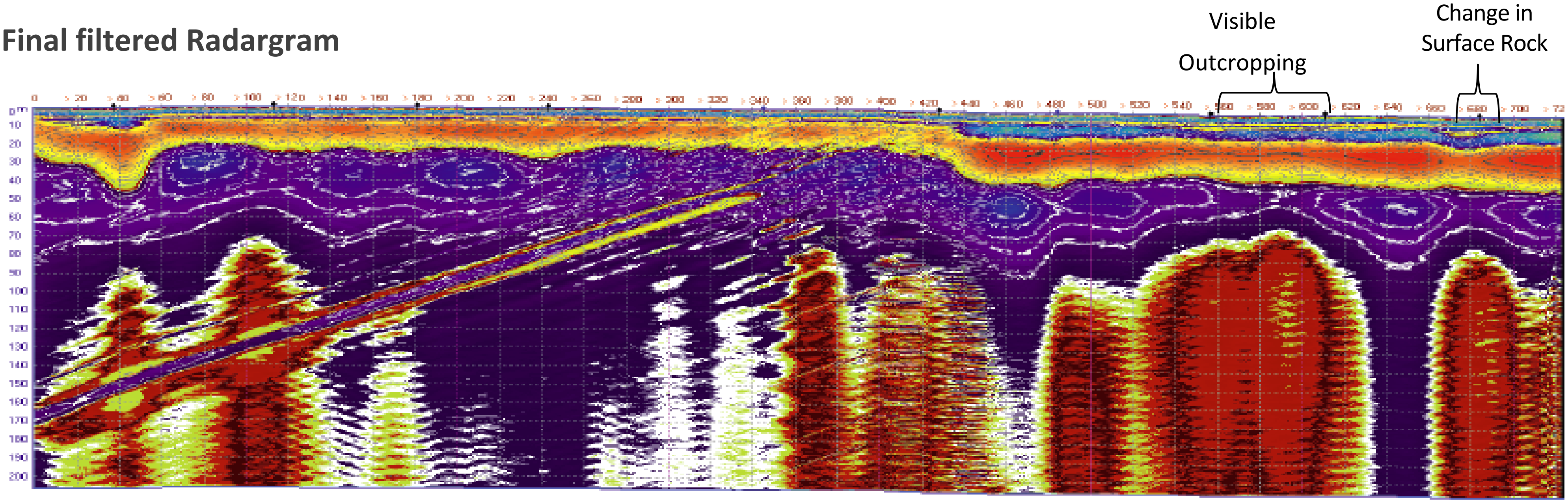
This is a similar model or example



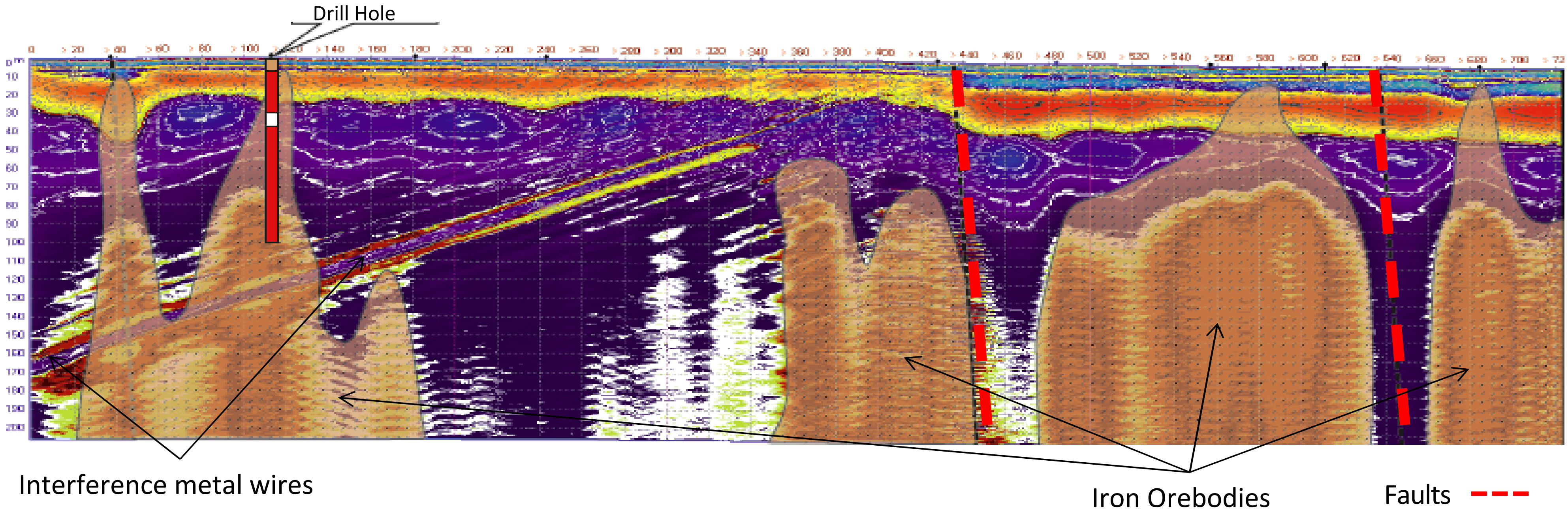
1. Syenite Porphory
2. Clear Syenite
3. Quartz Porphory
4. Ore (T+Fe)
5. Granite Porphory
6. Granophire
7. Downthrow Structure

CASE STUDY 2: Haematite, South Africa

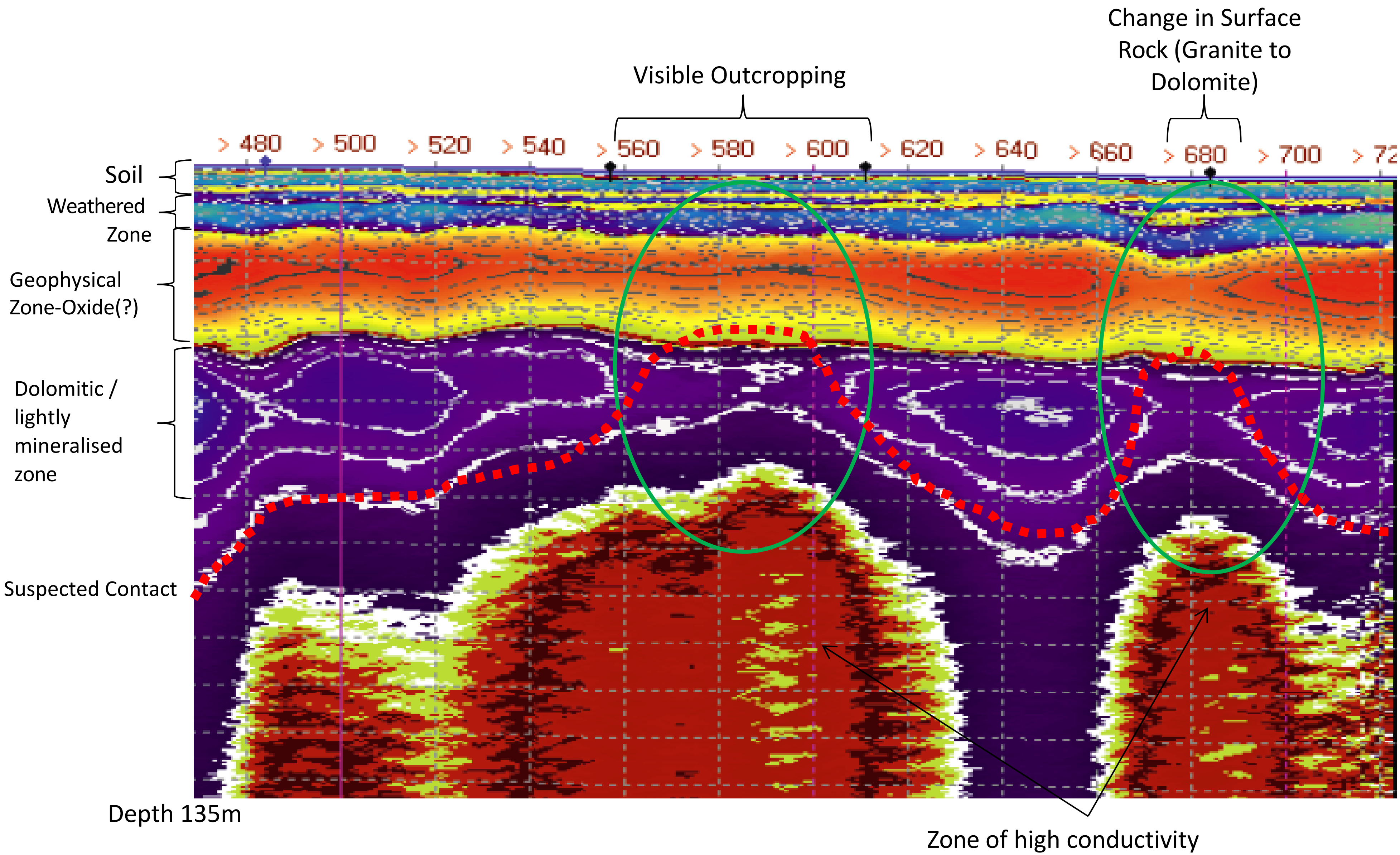
Final filtered Radargram



Schematic overlay of Iron Orebodies



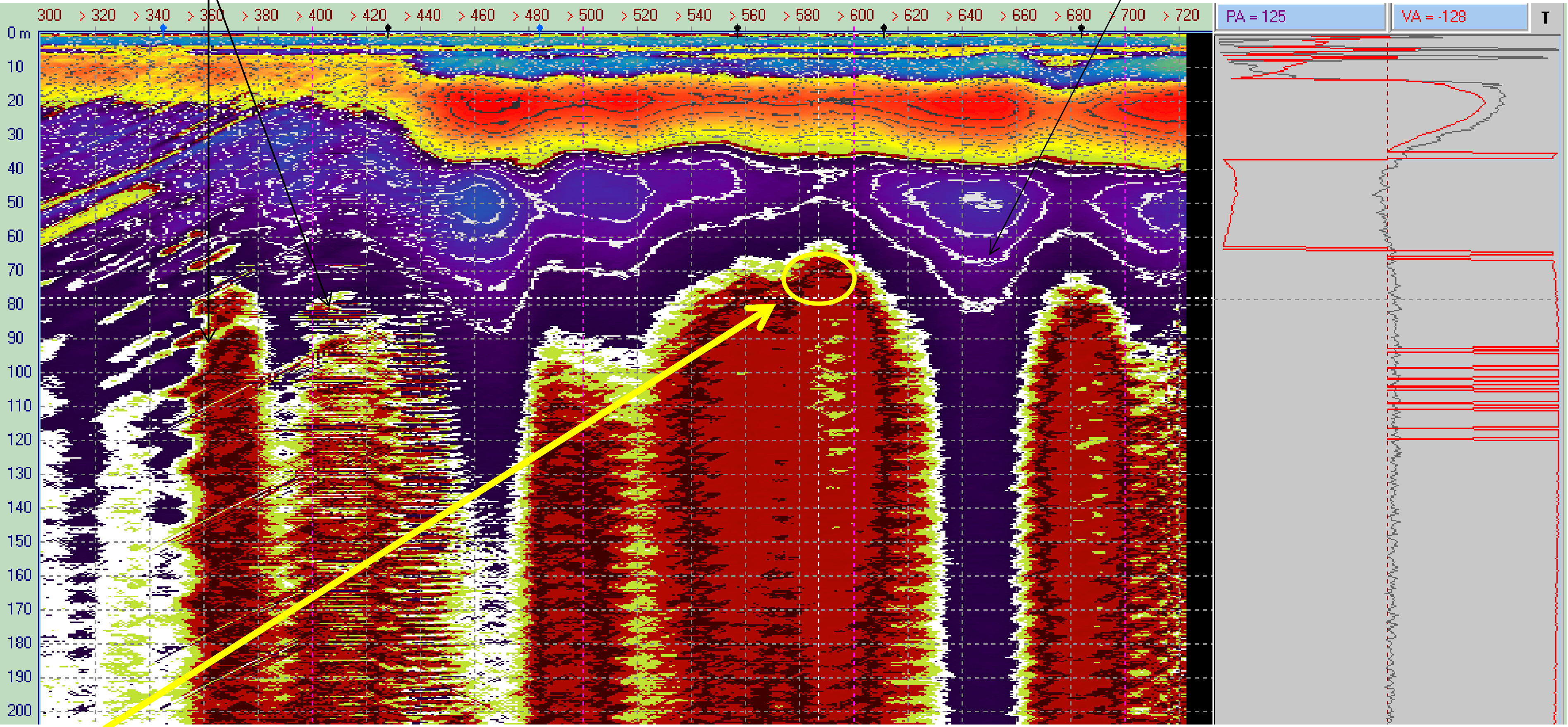
Anomalous geophysical signal symbolised in yellow/red interpreted as oxide zones. The yellow zones are thought to represent zones of greater iron content



At the point of interrogation we see the behaviour of the signal on the Radargram. Within the orebody, we see high conductivity analogous with high metal content.

Zone is slightly distorted by noise from metal fence

White lines show geophysical borders, helps us to define structure; in this case, there is clearly a fault



Point of interrogation

CASE STUDY 3: Iron Ore, Mine Gol-a-Gohar, Iran

Gol-e-Gohar Quarry is located in a mountainous region of Iran, near the town of Kerman and the city Sabjon. Magnetite ore is produced, the depth of the ore body is 70m. The pit depth is 120m.

The economic resource is concentrated within the larger system of tectonic and structural faults that originate from the north-west to south-east, and the cycle adjacent to them, being a system of smaller faults running from south-west to north-east.

This type of skarn deposit originated via the development of contact-metasomatic changes associated with the introduction of the magma body in the tectonic systems.

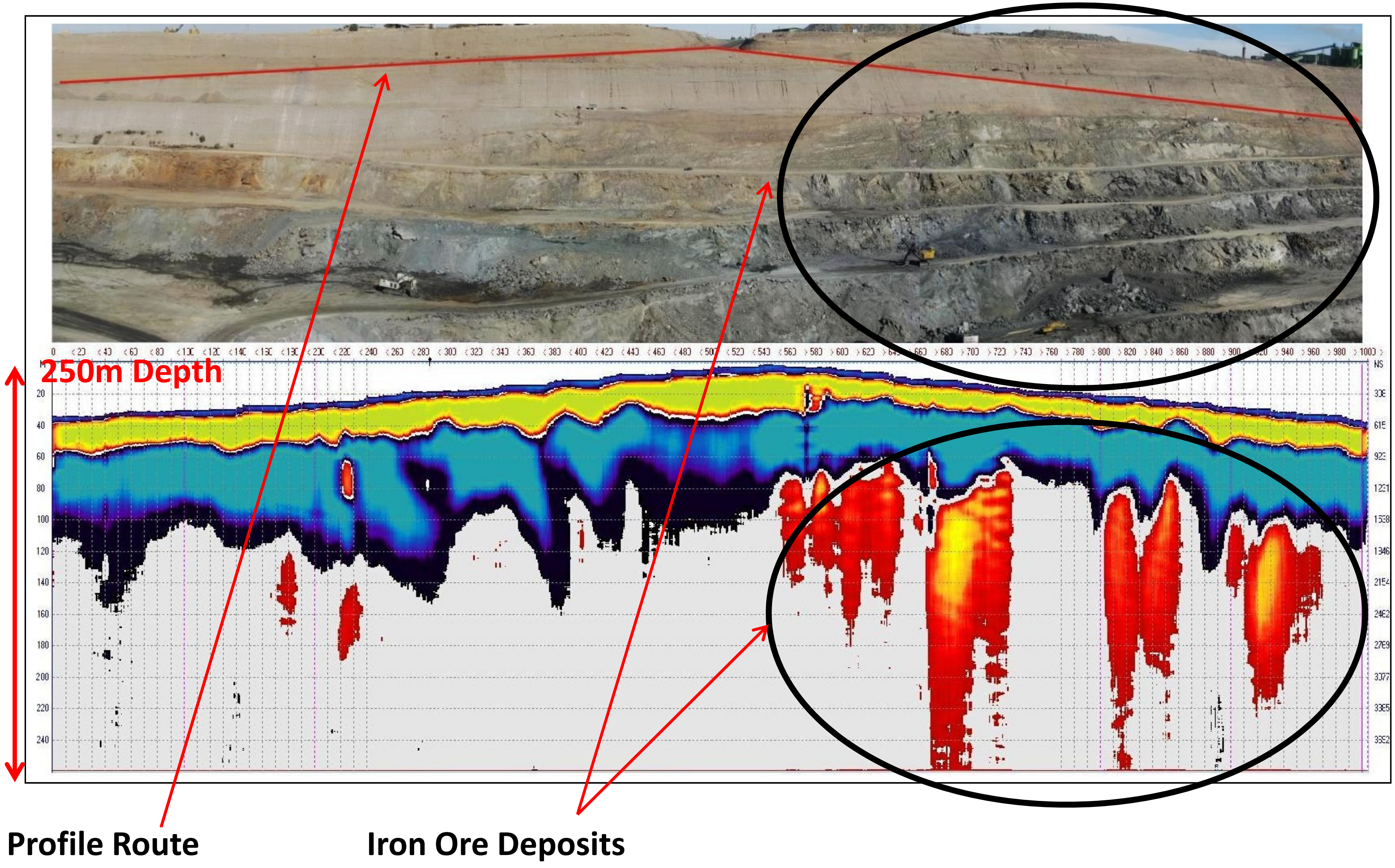
The survey scanned to 220 m depth. Project geologists assisted the team locate the ore-bearing rock.

The profile crossed the main faults and passed over the ore rock mass and ended at the edge of the pit, where the MSZ is pinched.

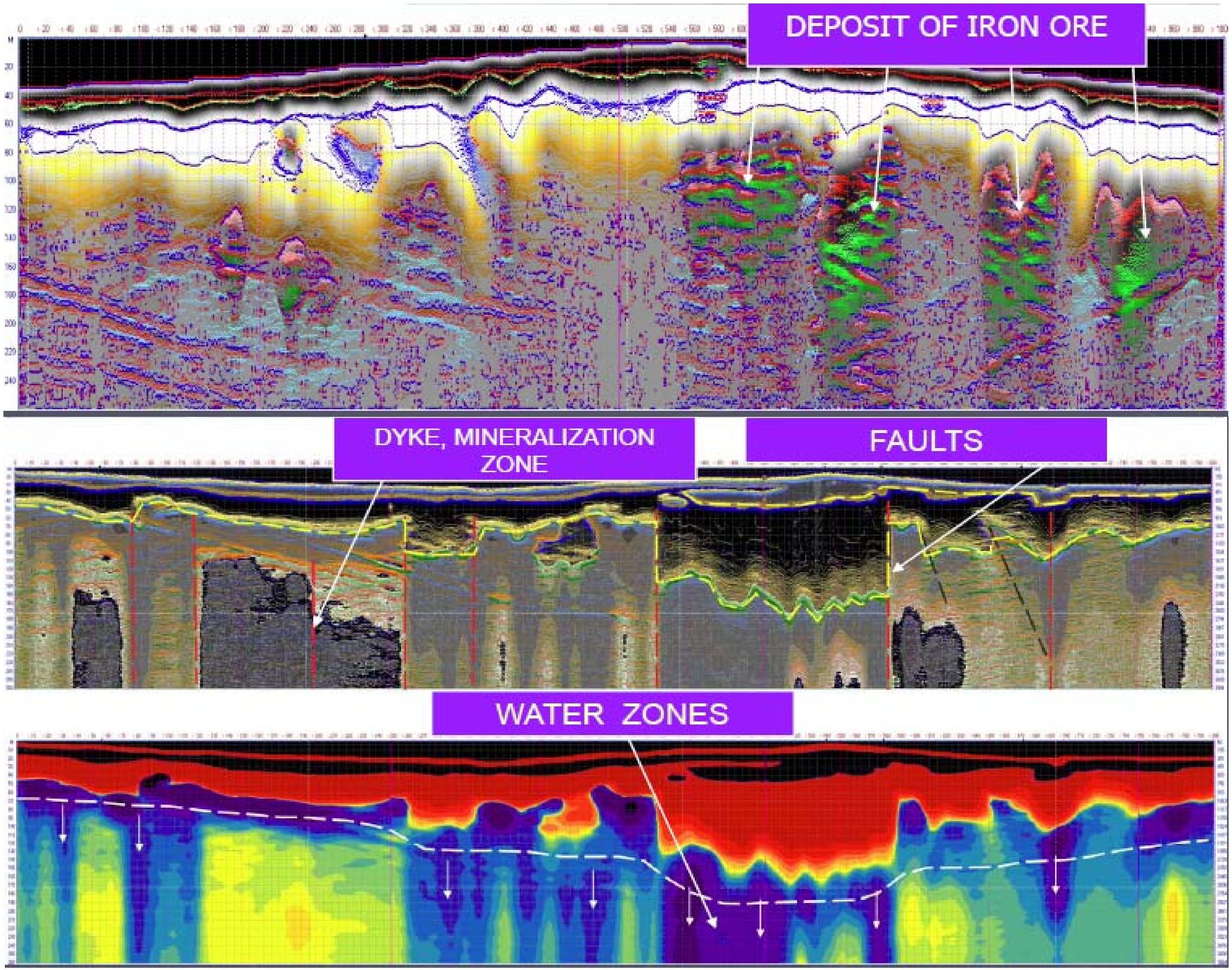
As a result of processing , the GPR profiles revealed anomalies that correspond to the massifs of rocks with increasing concentrations of magnetite ore.

The data was consistent with the geological data obtained from drilling.

Profile along the top of the quarry identifies anomalous zones in the signal which correspond to iron ore in the quarry benches.



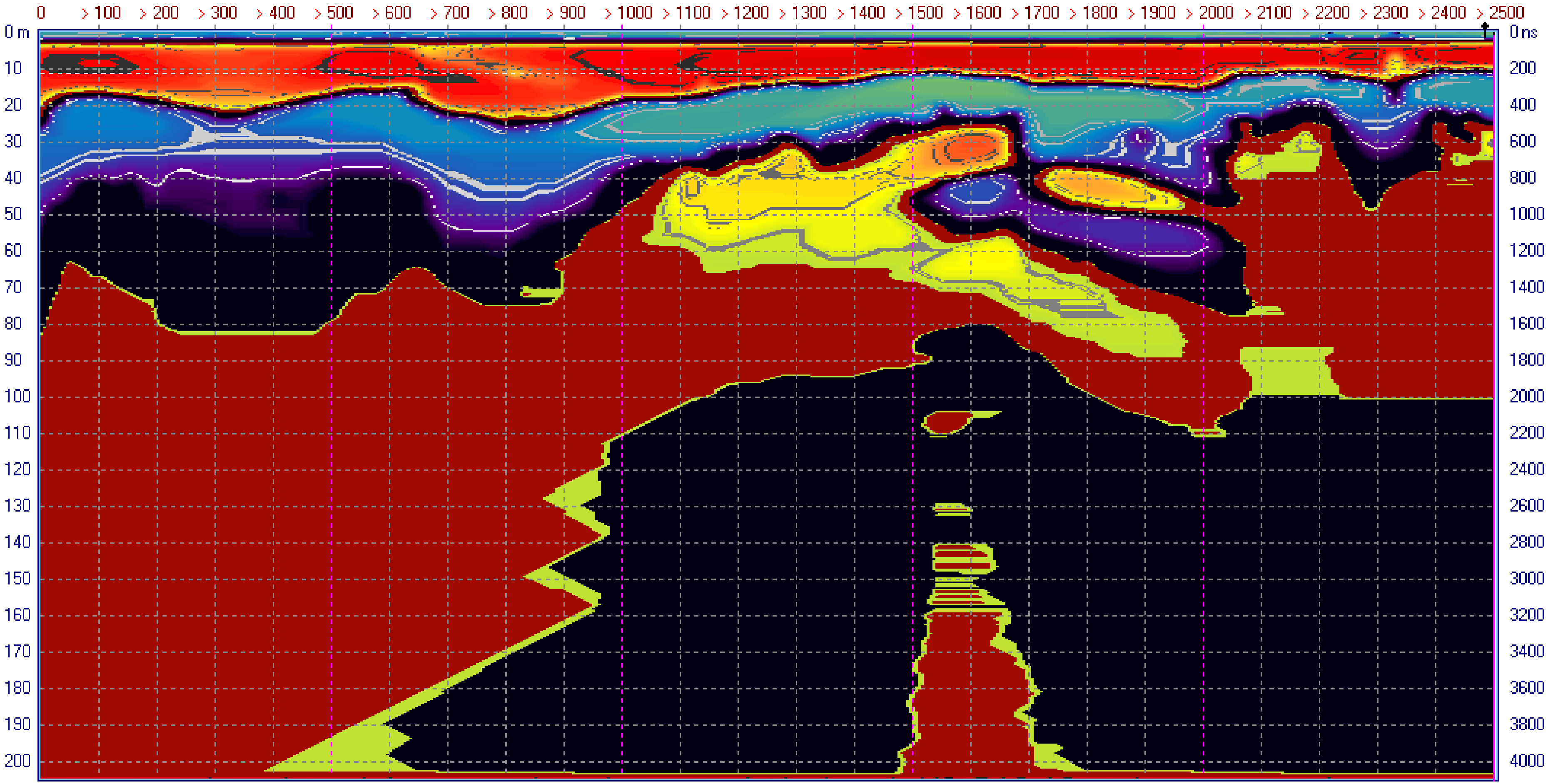
FILTERING This slide shows the same profile in three different filters, highlighting the key features the client requires to see:



(1) Iron Ore mineralisation

(2) Tectonic influences

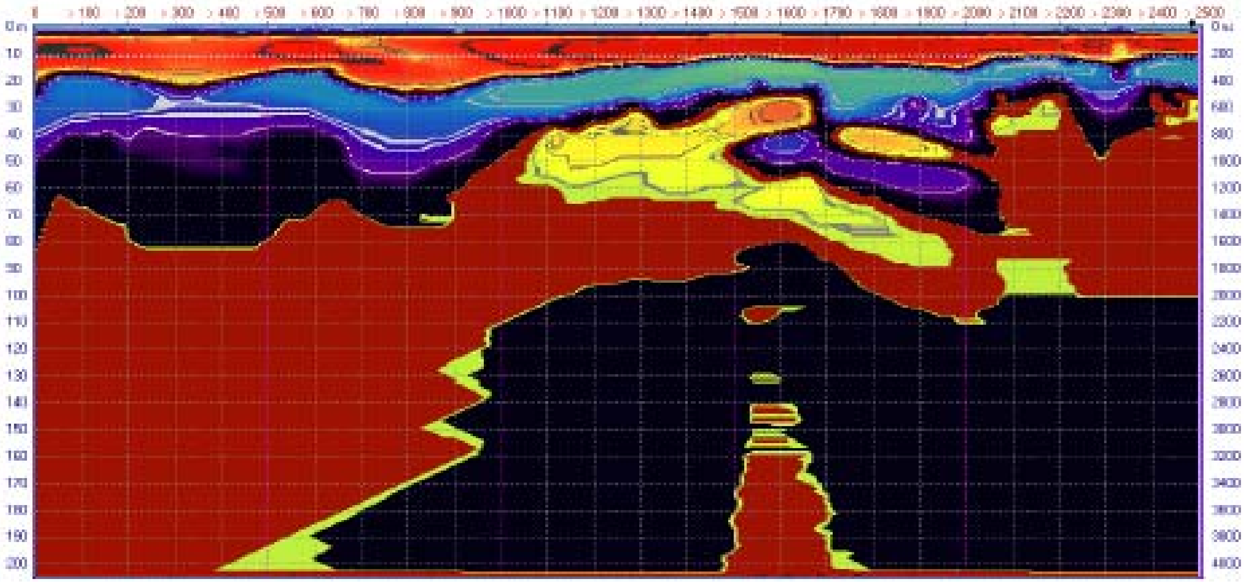
(3) Water

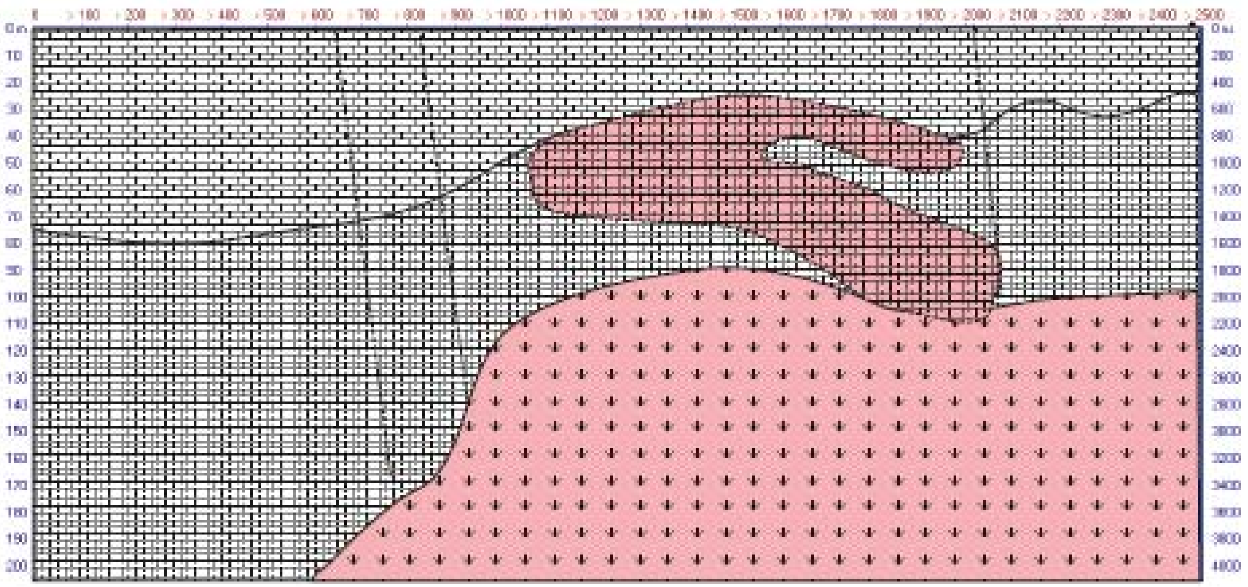


The profile was made along the surface of limestone and dolomitized limestone, shown on the radarogramme as the blue-black and red colors. A strongmagma formation (black) can be seen In the carboniferous rocks. In the upper part of the section at the contact of the intrusion and the carbonate rocks occurred the formation of skarn magnetite-hematite structure (yellow). Probably ferrugination occurred in the system of cracks formed during uplift of the intrusion and subsequent implementation of hydrothermal flows.

CASE STUDY 4: Skarn magnetite-haematite structure

The survey was conducted across carboniferous limestone and dolomitised limestone. These units are represented on the Radargramme in blue and red colors. A magma intrusion (black) can be seen in the carboniferous rocks. The skarn magnetite-hematite structure formed in the upper part of the section at the contact of the intrusion and the carbonate rocks (yellow). It is believed ferrugination occurred in the system of cracks formed during uplift of the intrusion and subsequent implementation of hydrothermal flows.





limestones

dolomites

ferruginated dolomitized limestones

intrusive

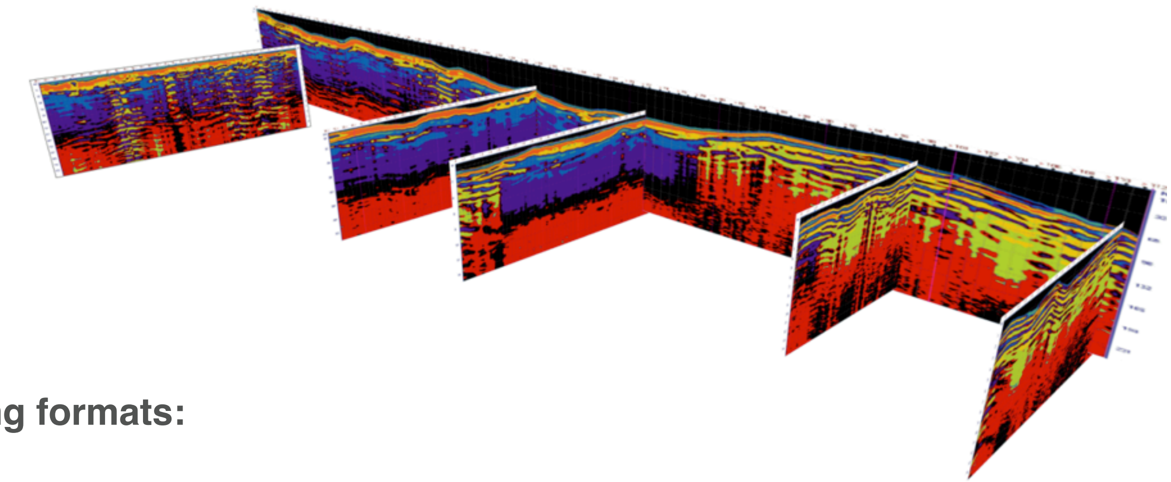
fault

RADARGRAM FORMATTS & REPORTING

Report Writing: On completion of the data collection, the end result of the Terravision Radar service is a written report.

Reports contain the following:

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



Analysed data is provided in the following formats:

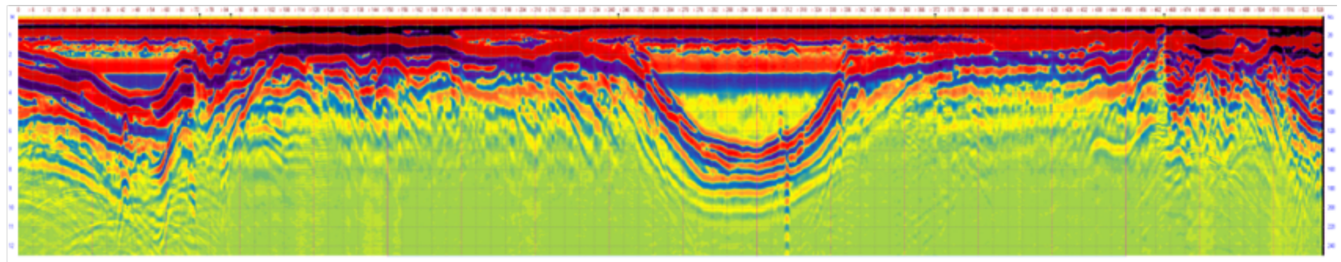
- RAW file
- TXT file
- Filtered (Radargram will be provided as standard)
- 3D Model where appropriate
- Other formats available upon request

RADARGRAM FORMATTS & REPORTING

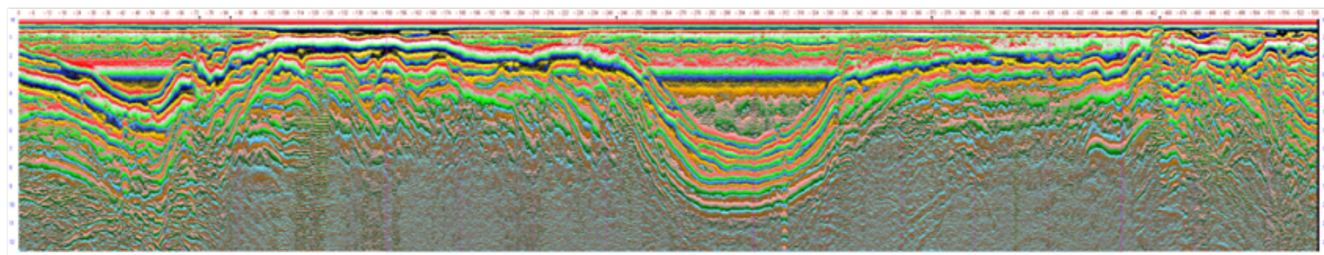
- ***Product to client***: Profiles are shown in one of three settings

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:

Waveform mode



Waveform derivative mode



Binary mode

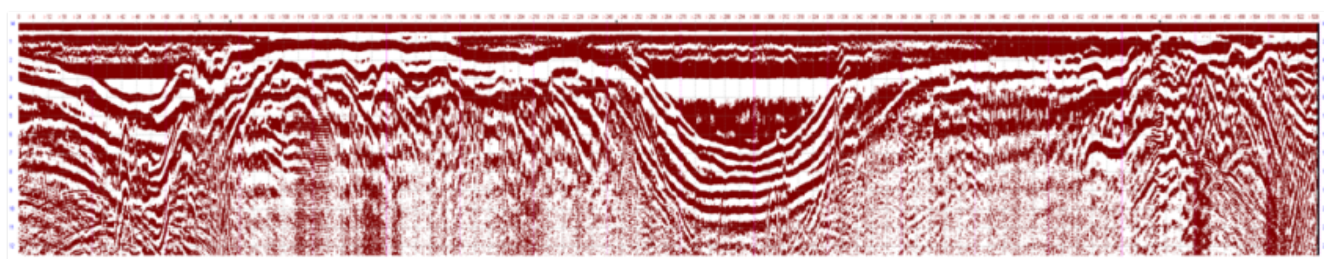


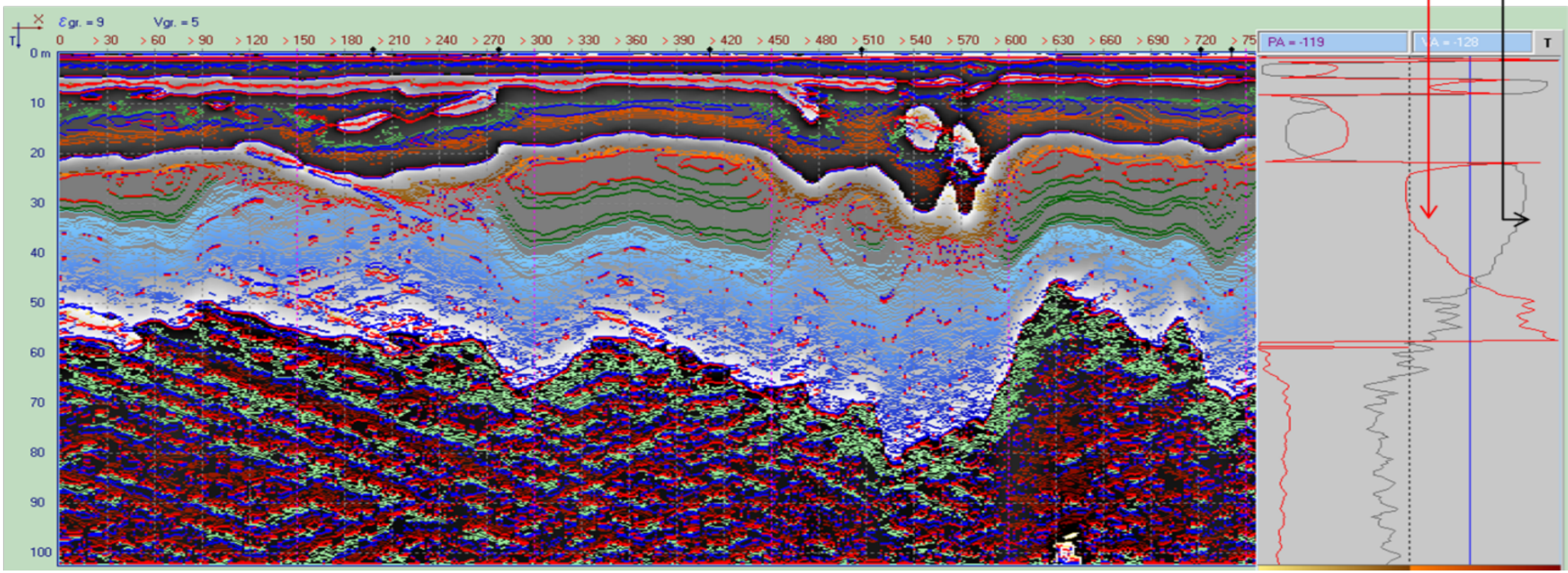
Fig 8 (above): *Waveform mode of representation*

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.

TERRAVISION RADAR CONTACTS

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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.

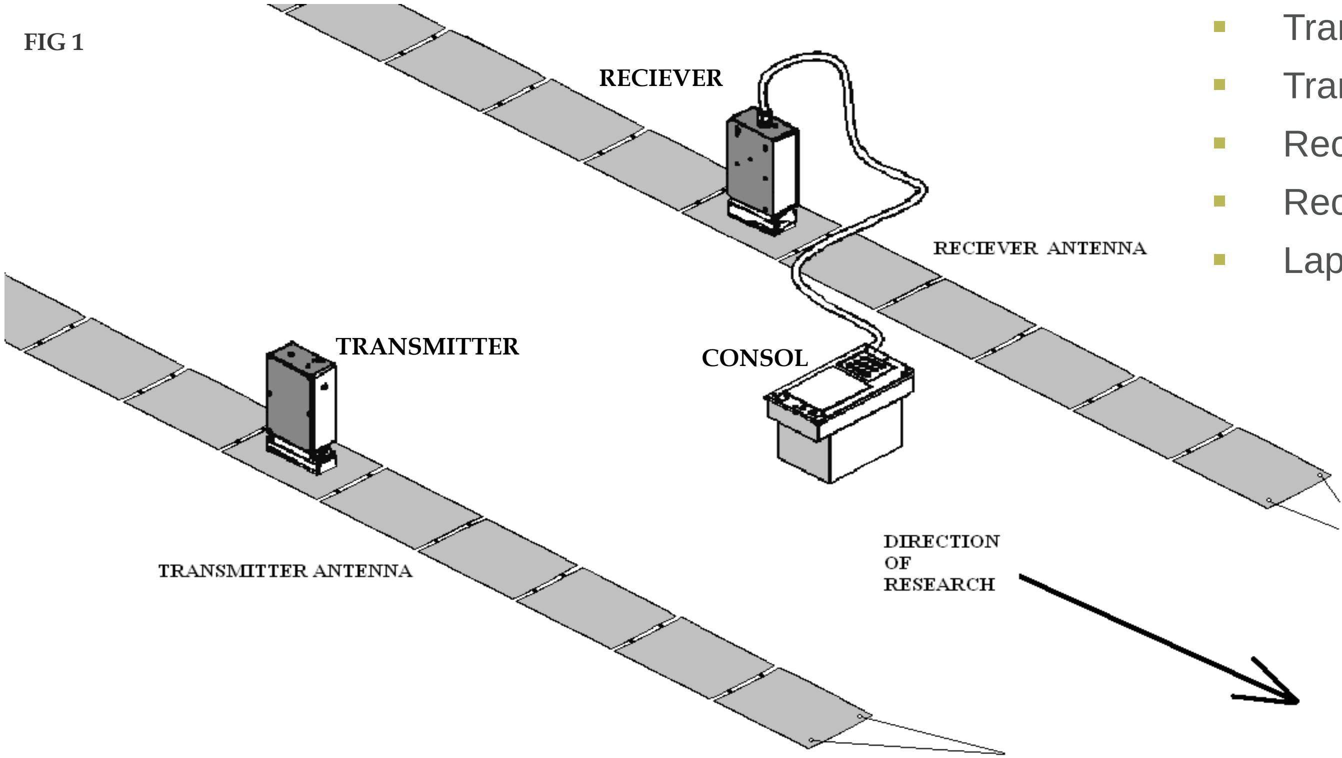
Technical Parameters

- 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

FIG 1



The Radar is configured as follows:

- Transmitting Antenna
- Transmitter
- Receiver
- Receiving Console
- Laptop with proprietary software

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

RADAR CONFIGURATION

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

- Real Time Display
- Download data to Laptop in minutes

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

- **<u>Penetration to 45m</u>**
- 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.

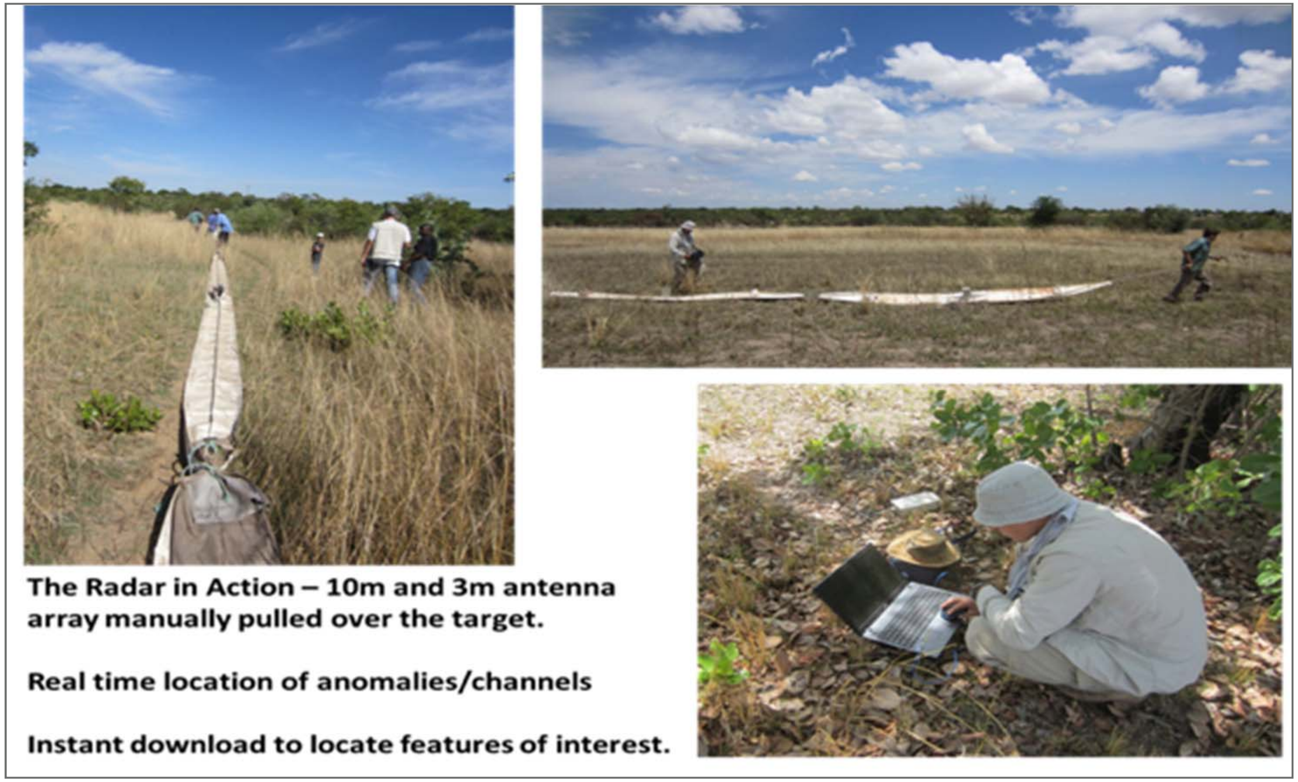
DATA ACQUISITION

- 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.

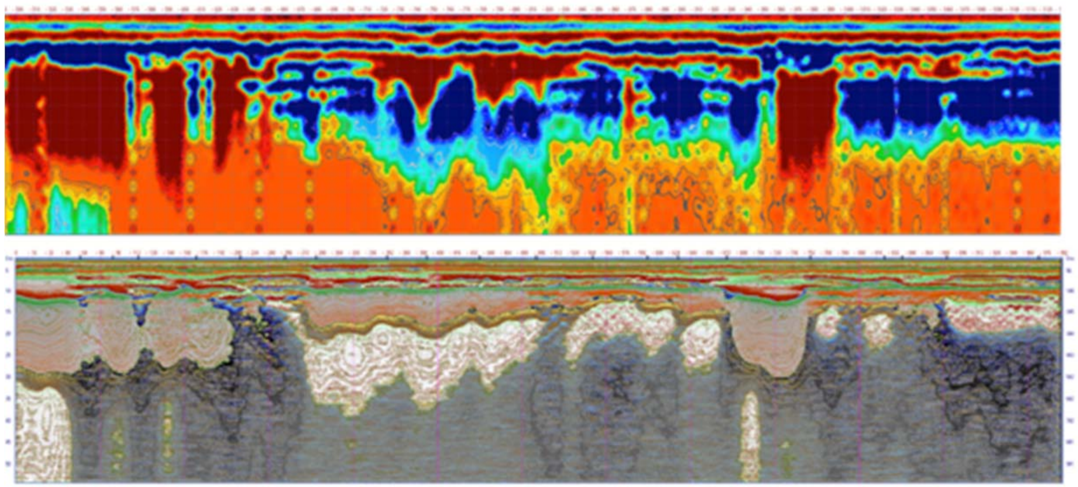
DATA ACQUISITION – THE RADAR IN ACTION



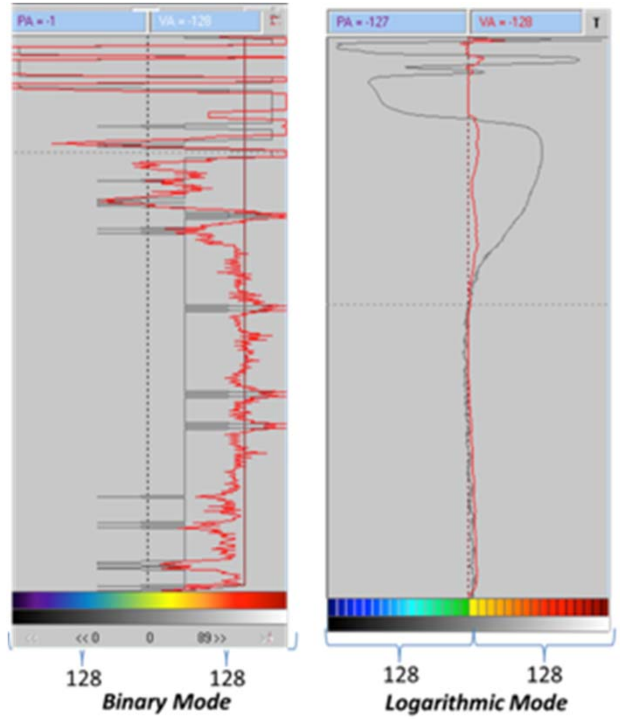
- The spacing of the "radar – shots" taken along the profile is chosen according to the required scale of the target objects.
- For small objects (pipes, cables, small voids etc), shots may be taken every 20 cm to 30cm, for shallow geological surveys (e.g. alluvial deposits) spacing may be 50-100 cm.

DATA ACQUISTION - technical

BINARY



LOGARITHMIC



- 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 ACQUISTION – 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 ACQUISTION – 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).

IDNETIFYING 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.

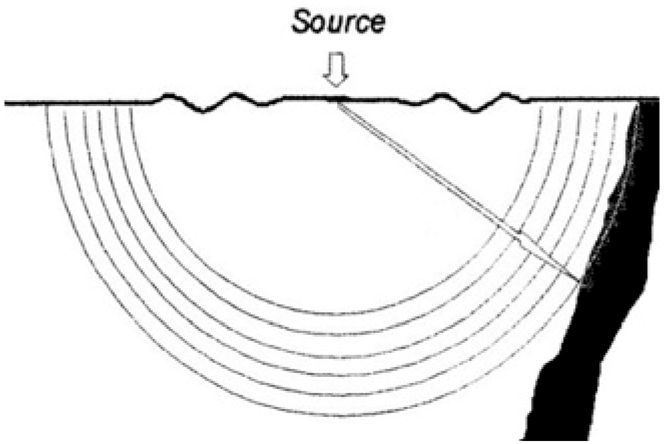


Fig 6 (Left): *Capturing Structural Detail*

- 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.

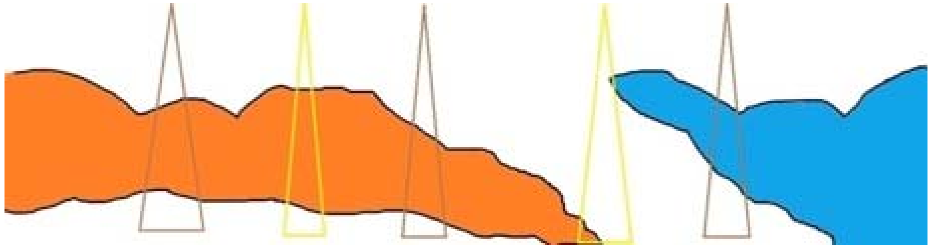


Fig 7 (above): *“Shot” spacing*

ANALYSIS

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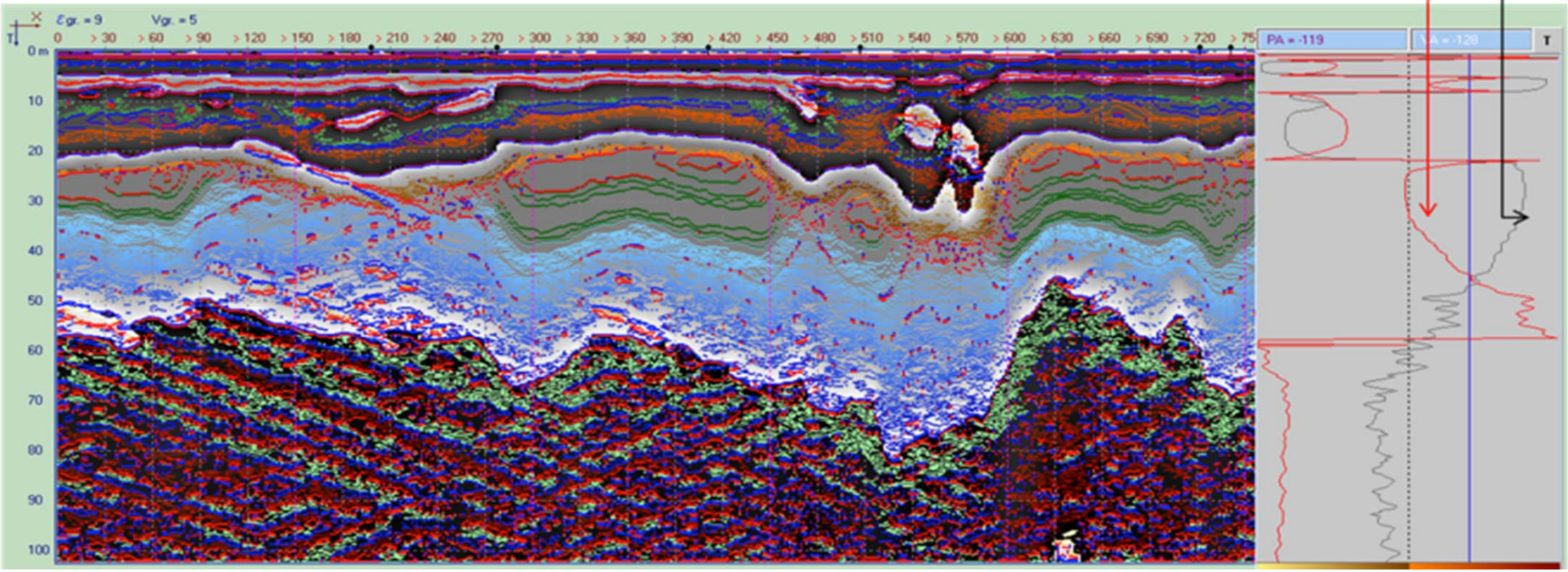

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DATA ACQUISITION – PRODUCTION & CALIBRATION

- ***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/ddbG9Ivf0sw

- 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, Terravison 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.