TERRAVISION

INTELLIGENT EXPLORATION

SURVEYING FOR OIL SANDS AND SHALLOW OIL
UP TO 500m DEPTH




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 500m”

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 500m using a 48MW 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

VALUE PROPOSITION

Mapping (Production Surveying):

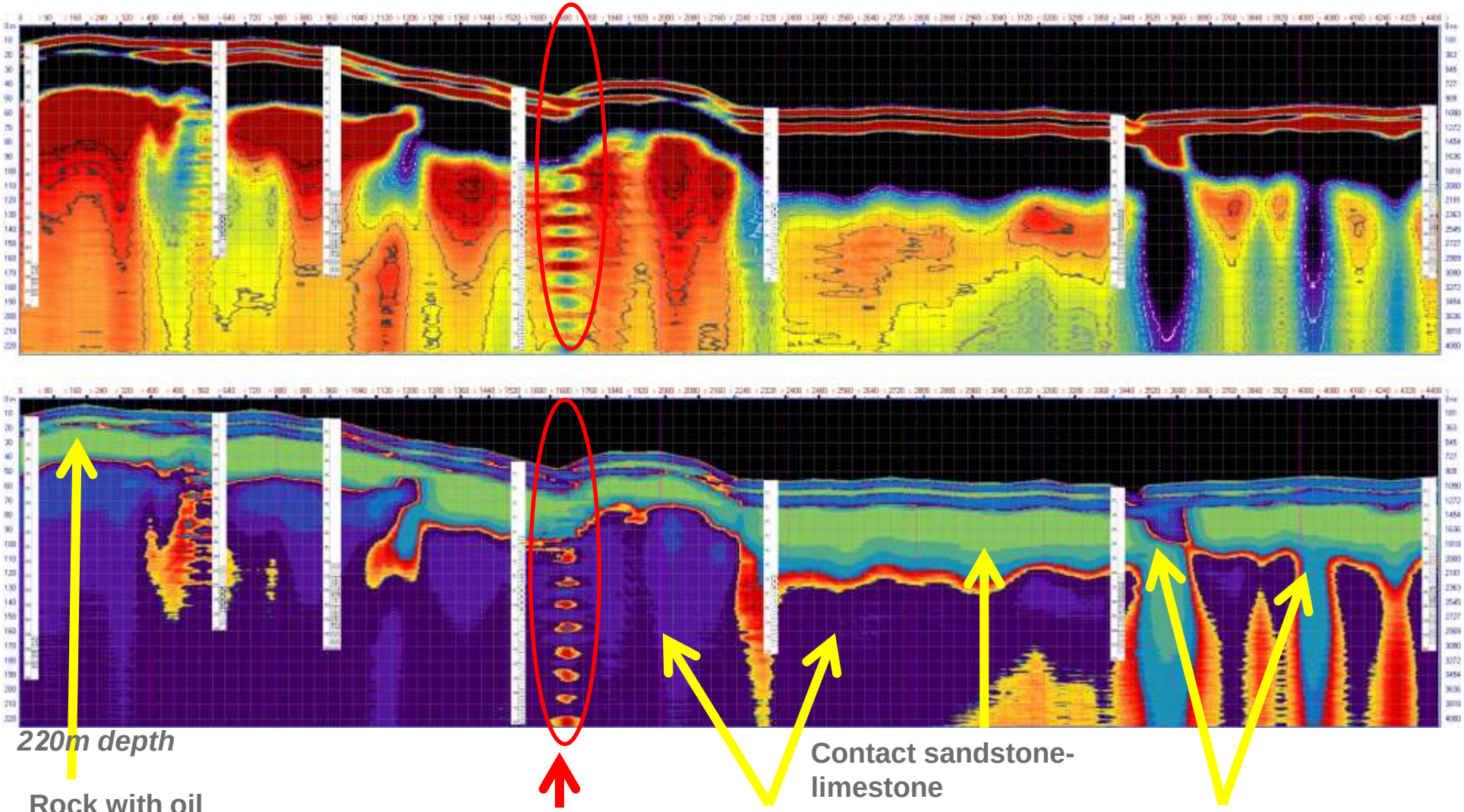
- Terravision Radar can survey and currently operates on mine sites to deliver comprehensive analysis, which allow for detailed verification, structure mapping, and mine planning.
- Surveying over Water: Terravision Radar is able to map deposition on the subsurface of rivers, flooded or iced-over areas.

Exploration:

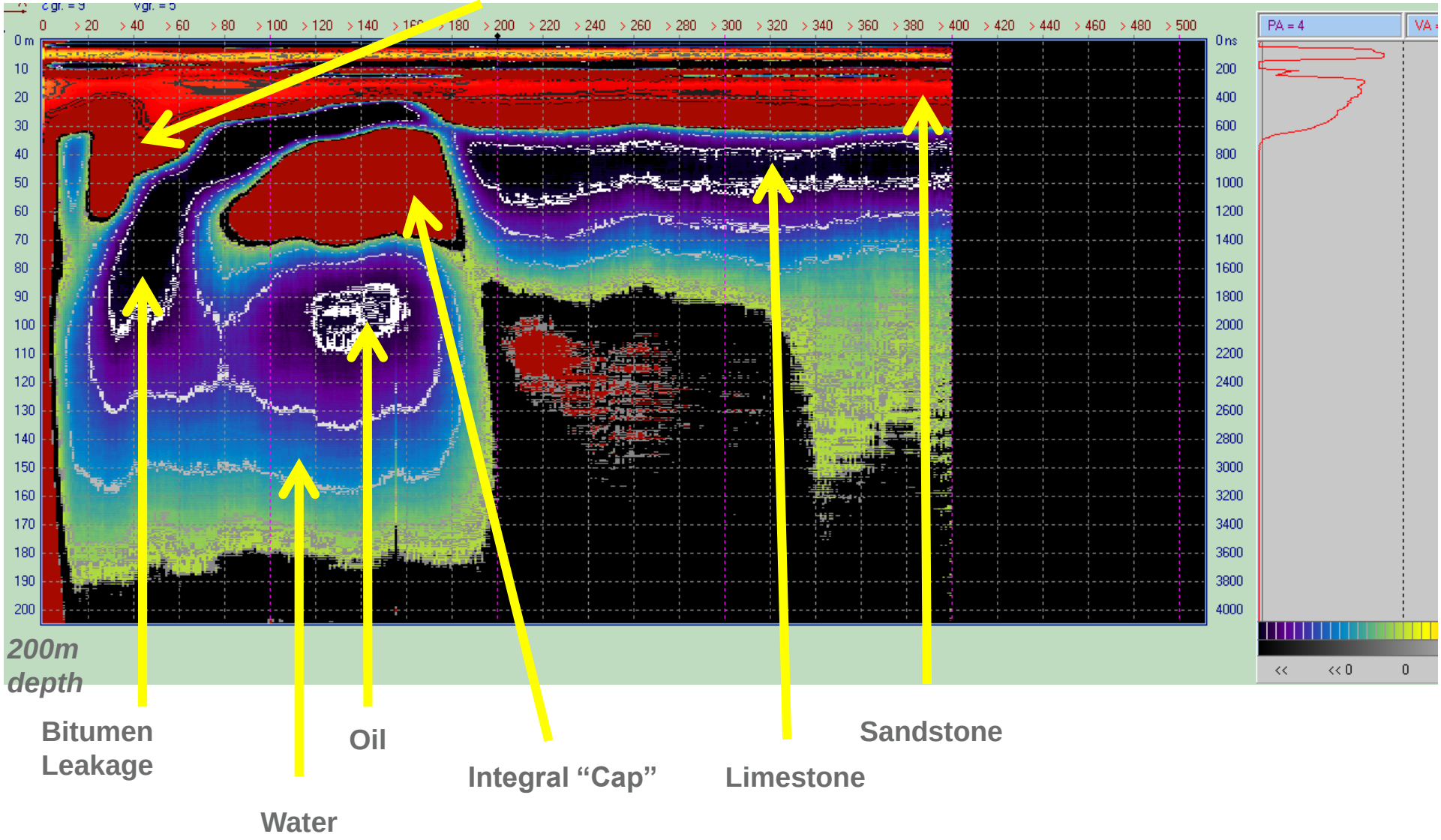
- The survey can cover previously unexplored ground as part of initial exploration work.
- We can offer cost savings, aid drill hole planning and interrogation by targeting, and delineating resources.

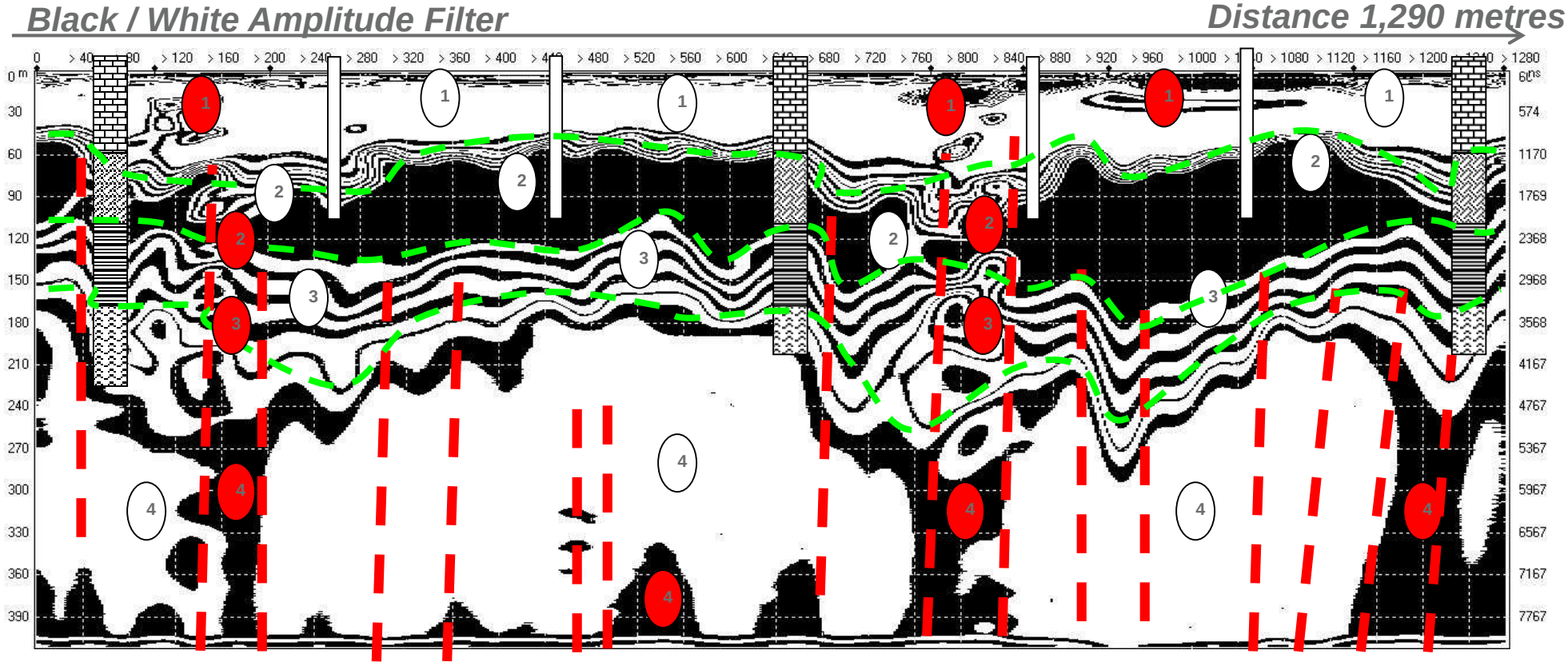
OIL SANDS

The white markers are drill hole locations (with lithology) Sandstone / limestone geology



OIL SANDS


Fractured “cap”
200m depth
Bitumen Leakage
Water
Oil
Integral “Cap”
Limestone
Sandstone



(1) Limestone & mudstone (depth 0-60m) seen the whole length of the profile. There are areas with modified electro-physical features, which are marked red

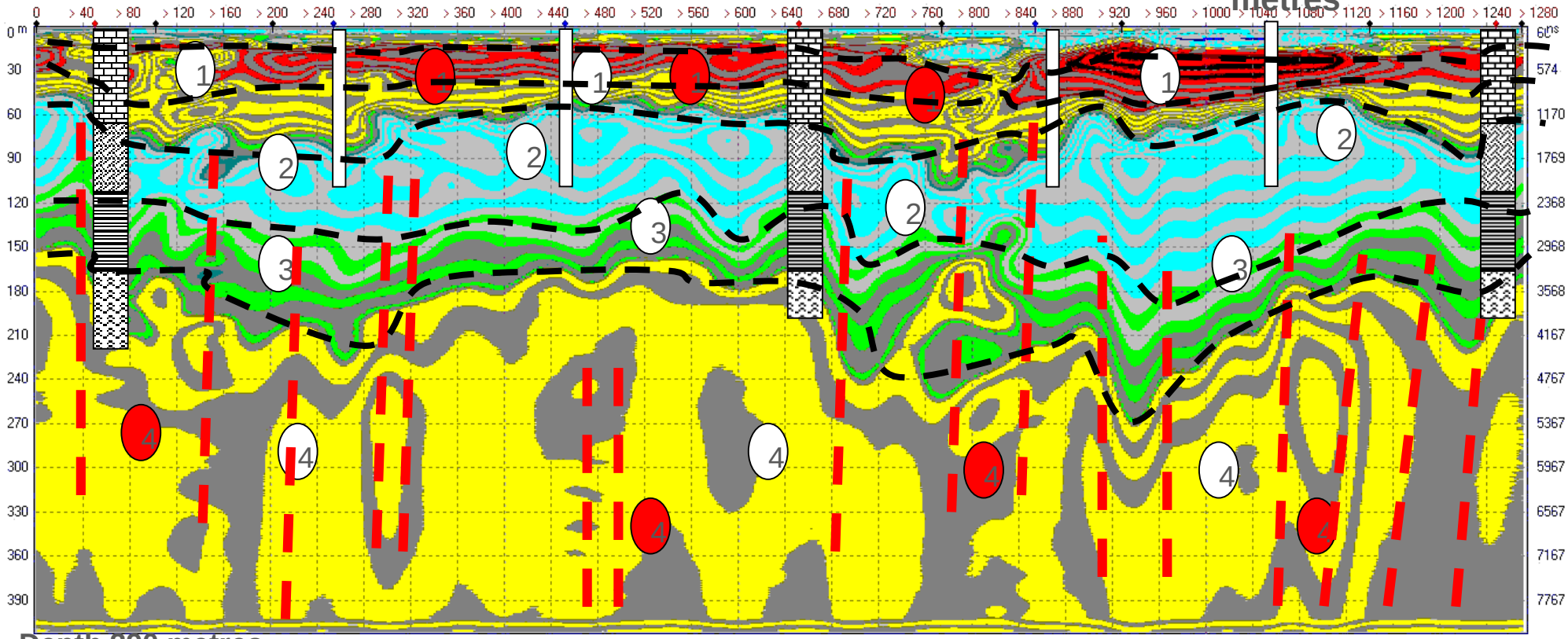
(2) Sandstone, siltstone, mudstone layer (depth 60-110m) There are anomalous areas in the shape of flexures (subsidence) at 60-200m, 650-800m, 1100-120m which are marked red.

(3) Sandstone layer (depth 110-170m) There are anomalous areas with vertical violations, marked with red.

Metamorphic shale, quartz micaceous layer (170-400m) There are areas of breaks and crushing, which are marked with red dotted lines and red marks.

Differentiation by colour 32 gradations - Amplitude Filter

Distance 1,280 metres



Depth 390 metres

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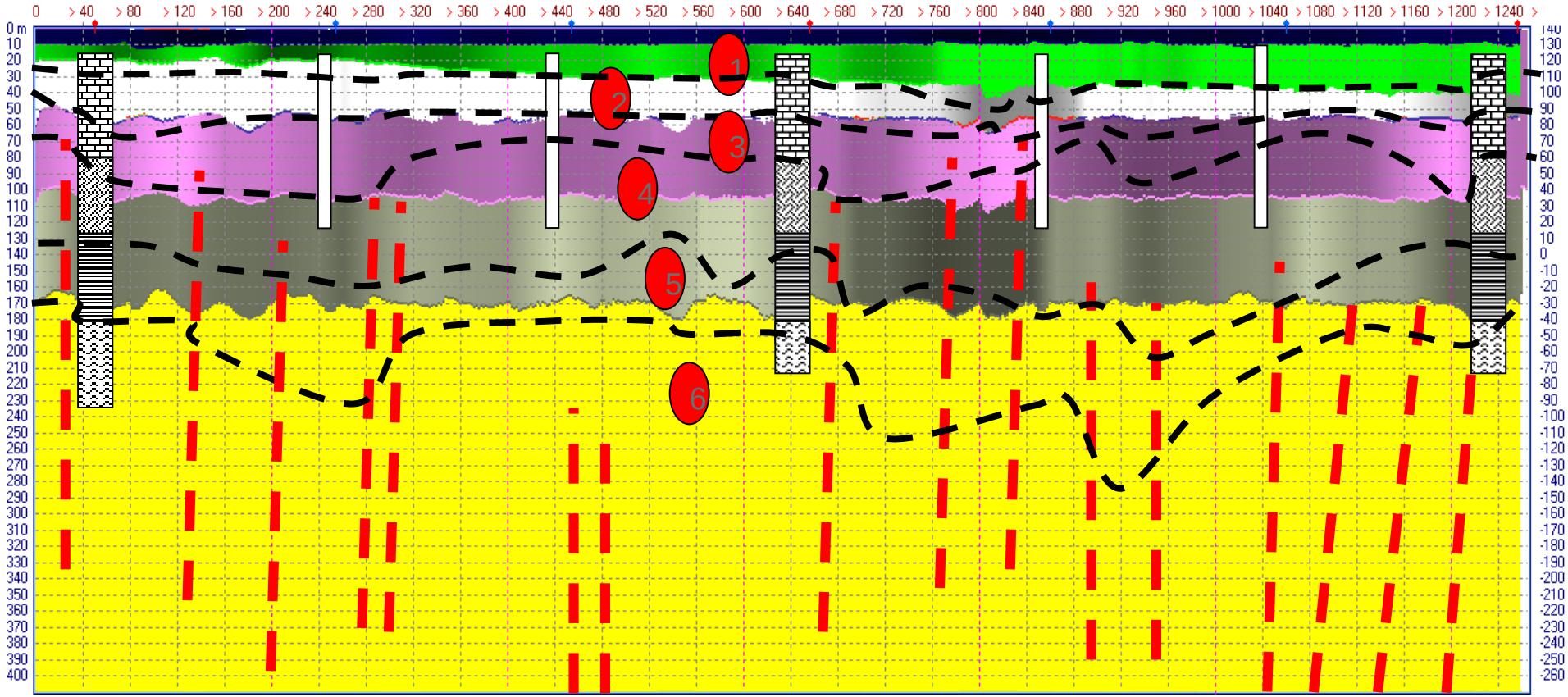
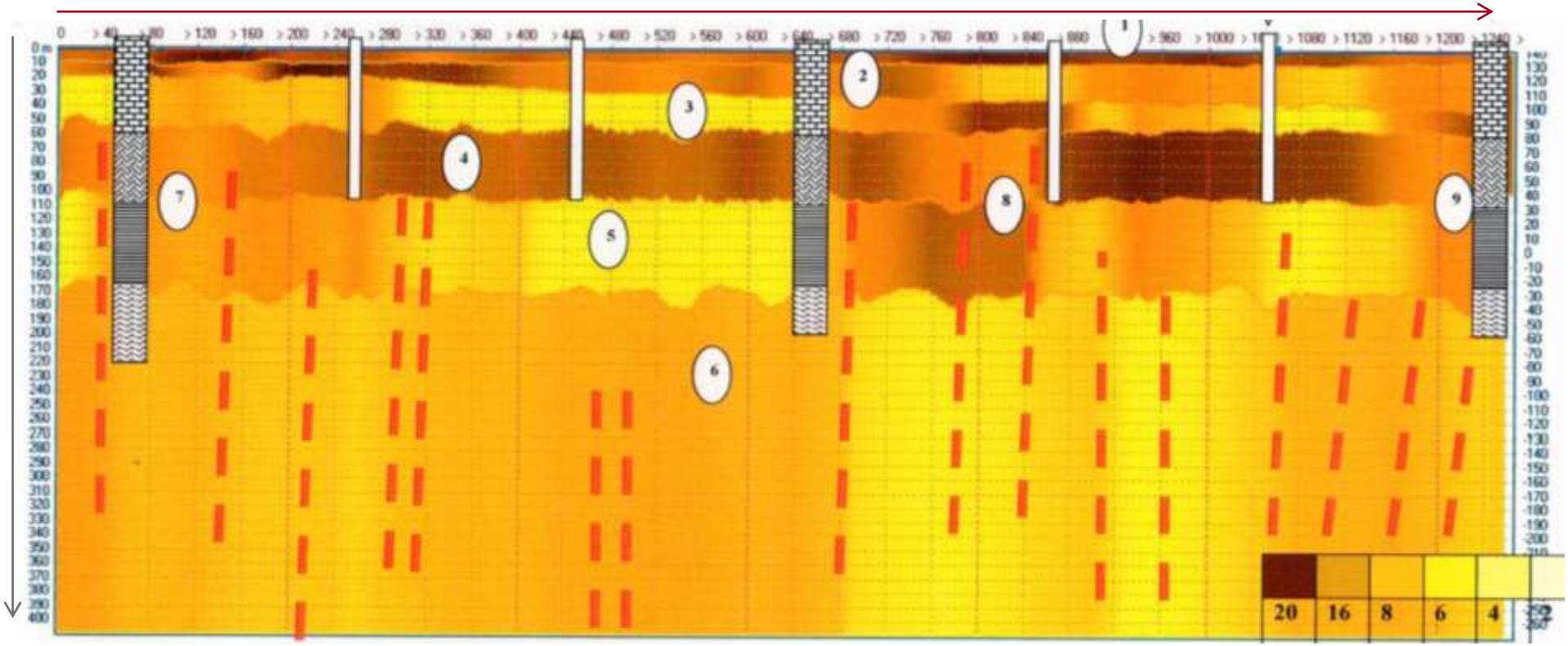
(4) Metamorphic shale, quartz micaceous layer (170-400m) There are areas of breaks and crushing, which are marked with red dotted lines and red marks.



Layer 1 to 5: Devonian system, upper echelon
Layer 1,2: Domannikoviy horizon from 0m to 20m>40m is observed across the whole profile.
Layer 3: An upper layer of the Sargaevskiy horizon.
Layer 4: Producing layer of the Sargaevskiy horizon from 56m to 105m
Layer 5: . Tyumanskiy horizon from 105m to 170m is observed across the whole profile.
Layer 6: Proterosoic system, upper tier is observed from 180m to 400m
Anomalies are observed in all layers. These occur due to an increase or decrease in the dielectric permittivity, zones 7,8,9.

Faults



400 metre Depth

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– – – – – Faults

CONCLUSION

The comparison of the electromagnetic survey with the provided geological data leads to the establishment of a correlation of the geophysical boundaries seen.

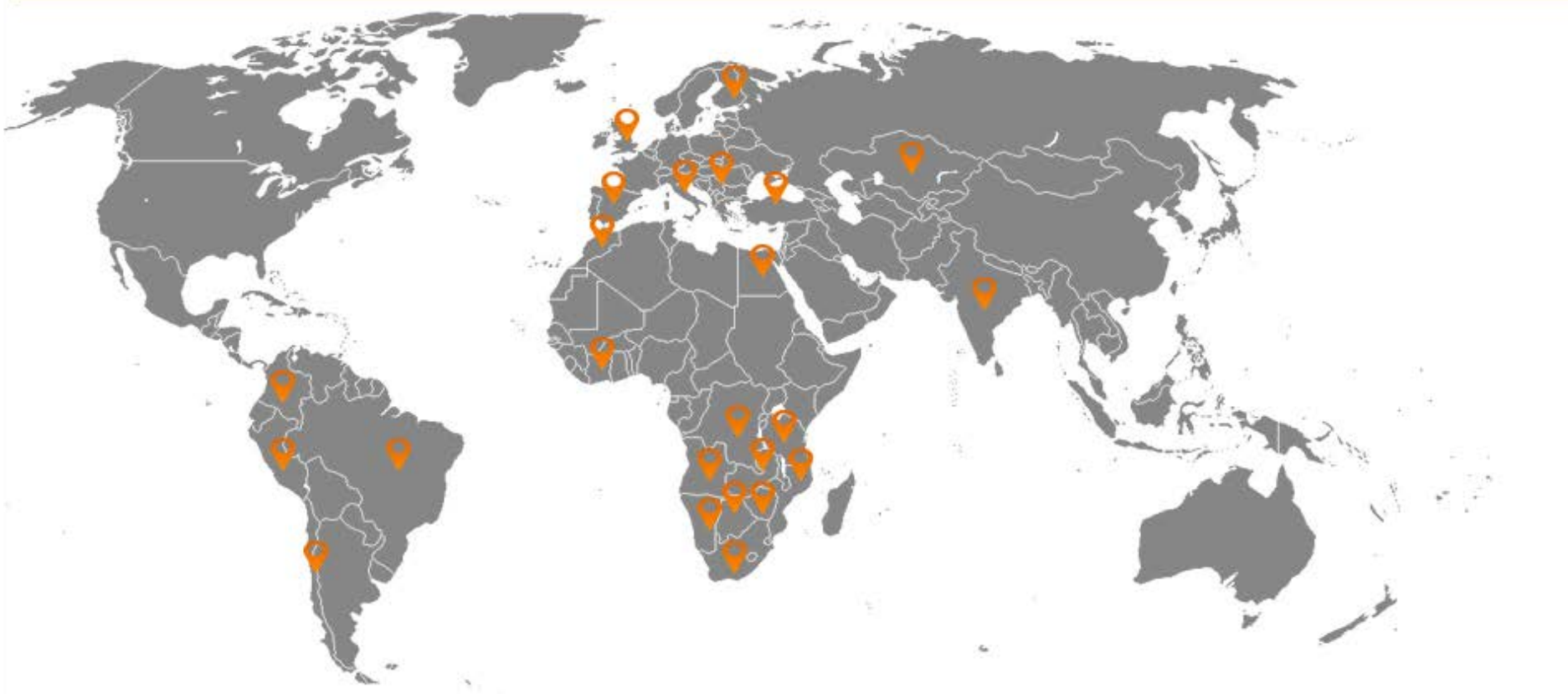
After a more thorough analysis and comparison of the production rate of the hydrocarbons with the established anomalies (structural vertical discrepancies, increased layer capacities, deflections) it was possible to establish a proportional relationship between the eletro-physical parameters and the concentration of hydrocarbons.

Increased production rate of hydrocarbons is observed in wells confined in areas with fractures and in local inhomogeneities in the base of the layer.

The Terravision-Radar survey was conducted with high power deeply penetrating pulsed radar, and is able to reach depths of 500m, allowing for more productive operations when working with deposits of this kind.

With the use of areal filming, additional algorithmic filters, construction of 3D models and horizontal profiles, the quality of the data will improve. This will allow us to pinpoint the locations of increased fracturing and porosity with high degree of accuracy.

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

TERRAVISION RADAR CONTACTS

Sergei Markov
Director

Skype: sergei.markov
Email: sergei.markov@terravisionradar.com

Charlie Williams
Director

Skype: cevwilliams

Email: charlie.williams@terravisionradar.com

Victoria Howarth
Geological Consultant

Skype: vfhowarth
Email: victoria.howarth@terravisionradar.com




Website: **www.terravisionradar.com**

Email: **Info@terravisionradar.com**

TECHNICAL SPECIFICATIONS

TECHNOLOGY OVERVIEW

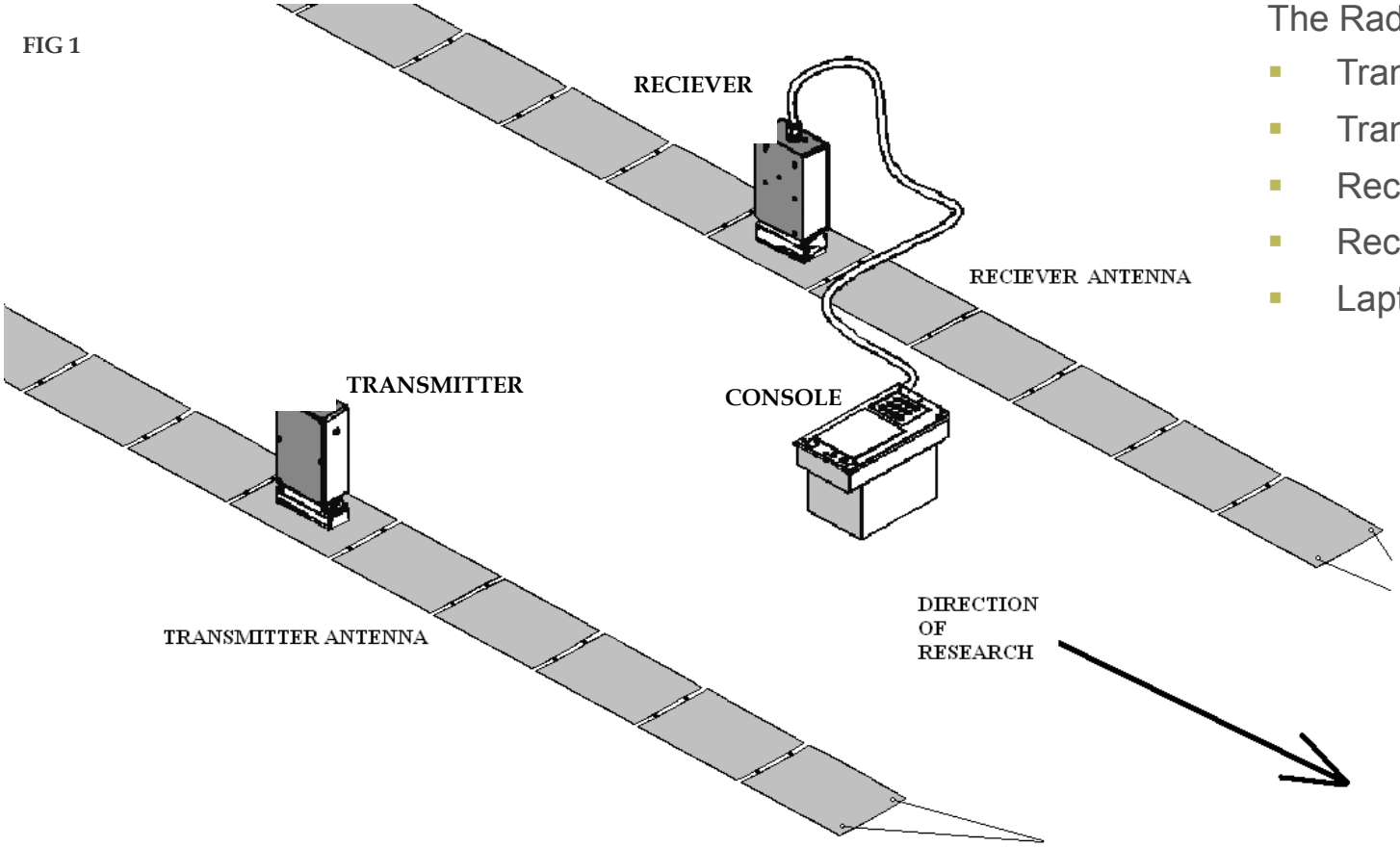
- The company uses a 4th generation Ground Penetrating Radar system.
- The radar scheme has been completely revised: pulse transmitter power has been increased by a minimum of 100,000 times, and the stroboscopic transformation replaced to direct detection of signal.
- The antennas used by Terravision-Radar 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 console's
- Fig 1 Below: displays a typical radar setup

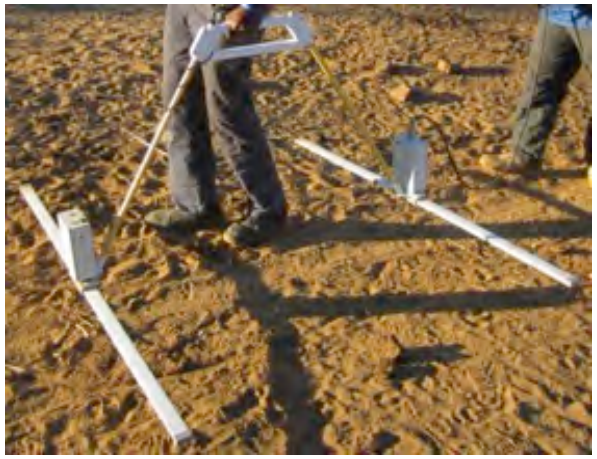


The Radar is configured as follows:

- 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



- **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

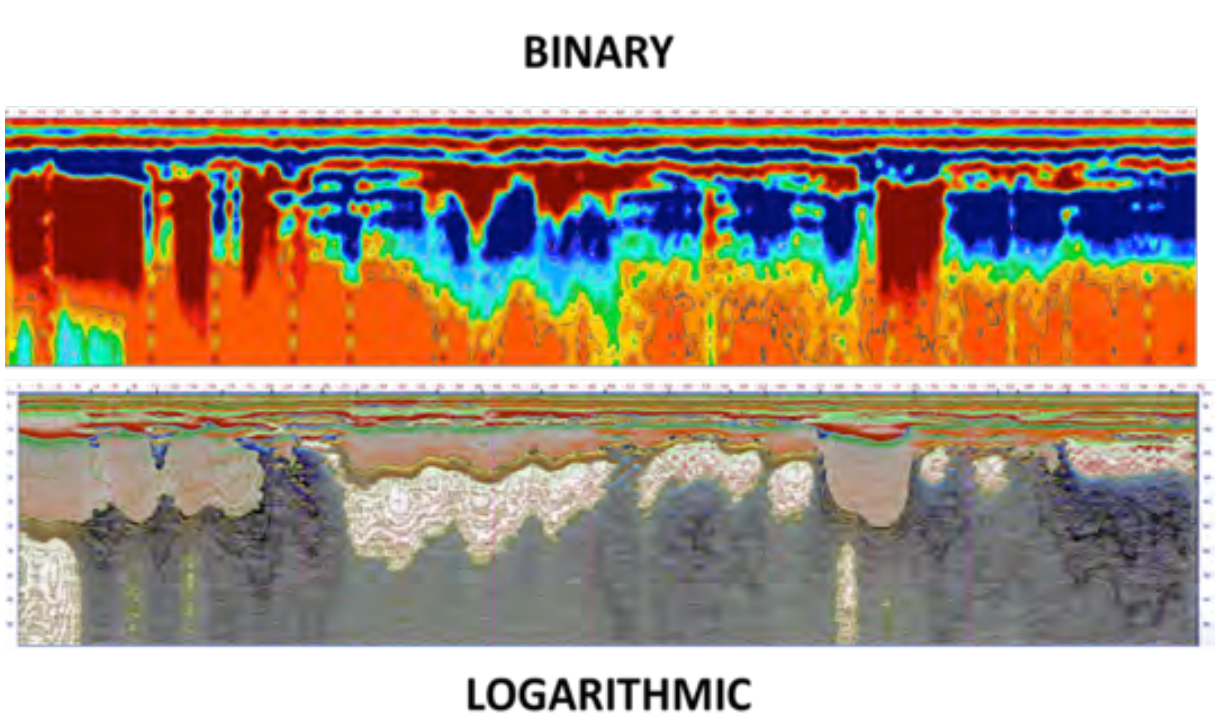
The Radar in Action – 10m and 3m antenna array manually pulled over the target.

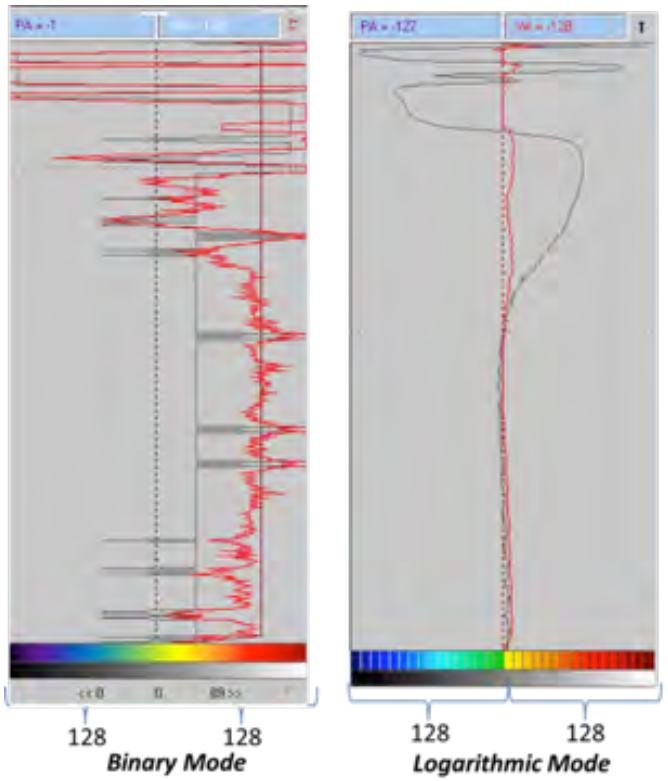
Real time location of anomalies/channels

Instant download to locate features of interest.

The light weight, highly portable system is set up on the survey area. Depending on the geological conditions, Terravisions operator adjusts the settings of the device and programs the radar to fire automated regular shots, once every half second or one second. The radar can be pulled either manually, by hand or mechanically behind a 4x4/ATV across the surface.

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.

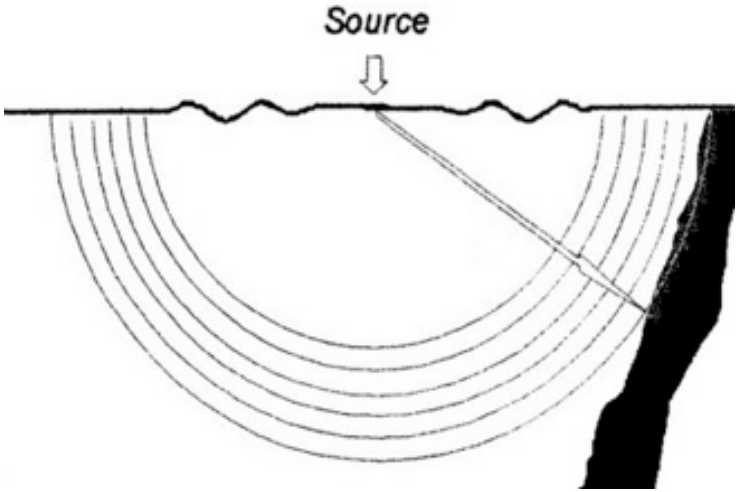


Fig 6 (Left): *Capturing Structural Detail*

- 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 large ore bodies, and well defined structure. we may take a shot every one metre.

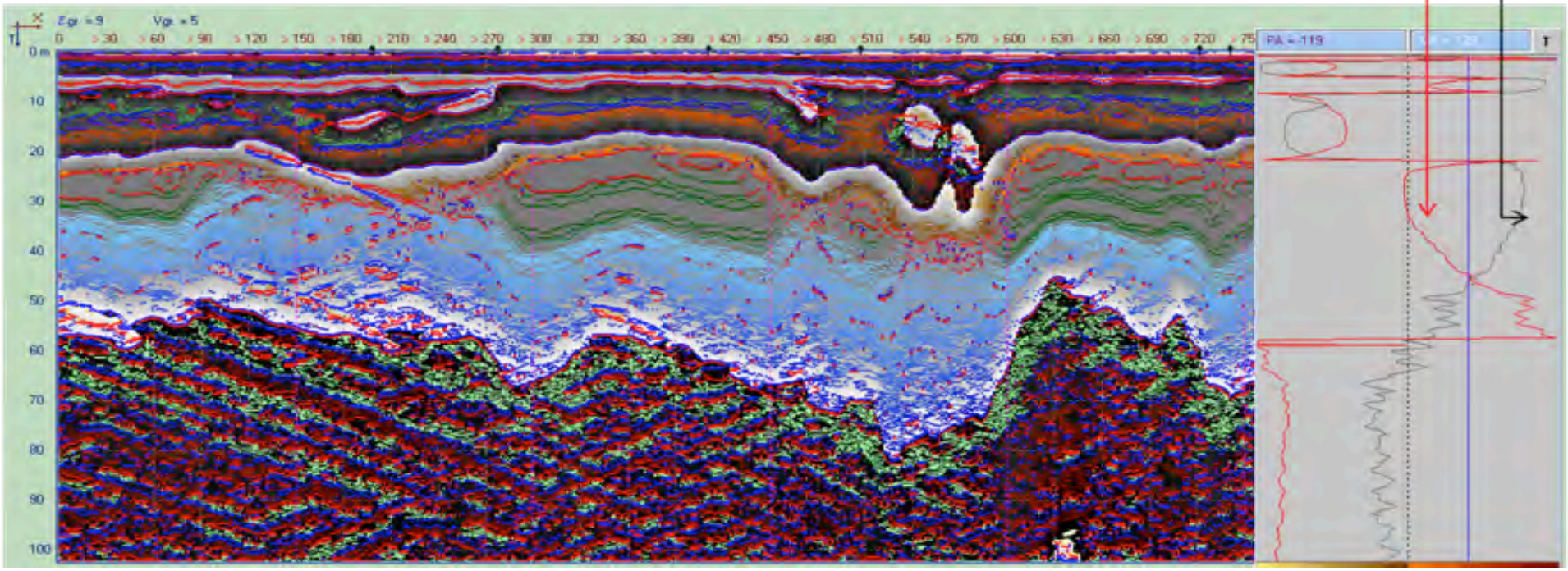
Fig 7 (above): *“Shot” spacing*

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



Above: A coal seam is shown over sandstone bedrock.

- 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.