TERRAVISION

INTELLIGENT EXPLORATION

SURVEYING FOR KIMBERLITES
TERRAVISION RADAR PRESENTATION

WWW.TERRAVISIONRADAR.COM

ABOUT TERRAVISION

- Terravision Radar is a ground scanning device, which verifies and investigates the presence of mineral resources and geological features with unrivalled clarity and speed <200 m depth.

- Resource mapping in 2014 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 p enetrate to 2n meters in conducive condi5ons. 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.

GEOPHYSICS IN DIAMOND EXPLORATION

▪Geophysical methods are particularly useful in diamond exploration. They tend to work well because kimberlite pipes, generally have properties that are different from the surrounding rock, this lithological contrast is what our device is able to identify. Additionally, the data provides guidance on where to position drillholes. At Catoca wide scale airbourne surveys have been used to cover large swaths of the concession, which have identifying a number of anomalies. On a localised scale, Terravisions GPR is used to site and orient a perspective drill hole. Together these two respective surveys should be used to assess the target's size and to model the anomalies to depths of 200m.

Left: the image shows the radar in action, close to a drill rig whilst surveying for intrusives in Botswana 2014.

METHODOLOGY OF
THE RADAR'S ROLE IN KIMBERLITE SURVEYING

Areomag surveys show magnetic anomalies, with no interpretation of what the objects, no detail at depth, nor geometric properties. As a localized tool Terravision has the ability to show the geometric properties of the anomalous ore-body, and is able to understand what the anomaly is by its geological and geophysical properties, enabling classification of the object.

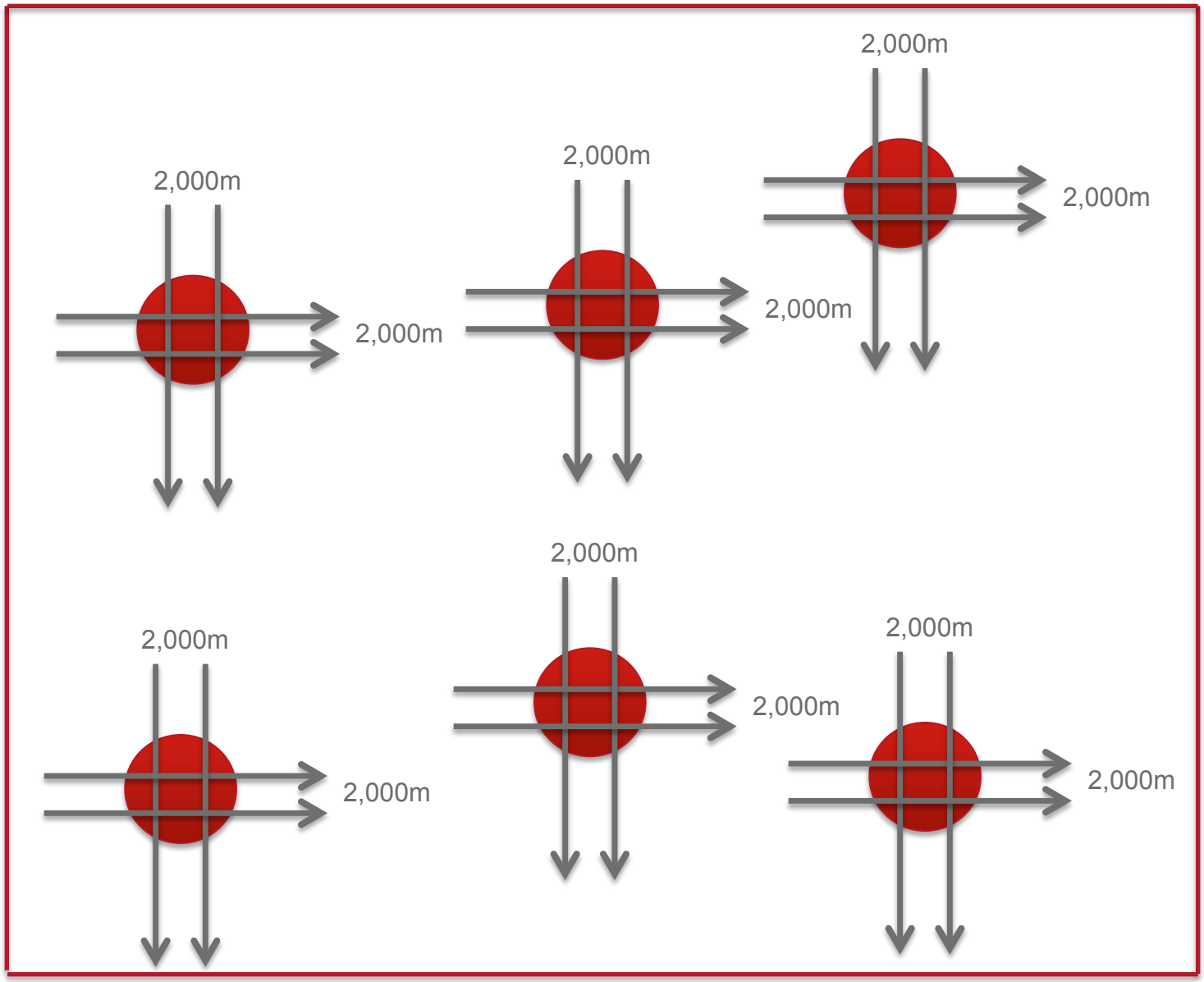
Methodology

- 2-6 profiles are typically taken through the anomaly which delineates the extent of the anomaly

- A model is generated, allowing for a horizontal interrogation of the anomaly (horizontal profiles) down to 200m+ (so we can look across the feature horizontally at 50m, 100m, 150m – any depth to 200m)
- From the horizontal "profiles" we are able to confirm whether the material is a consistent anomaly analogous to a kimberlitic pipe, as opposed to another type of anomaly

- We have experience in identifying kimberlitic structures from known magnetic anomalies, in the Arkhangelsk and the Yakutian kimberlite provinces, and in Zimbabwe and Botswana.

KIMBERLITE CLUSTERS – PROPOSED SURVEY PLAN



Four profile lines will be used when surveying the anomalies. Used in conjunction with drilling the picture of information obtained will be significantly increased.

60Ha per anomaly totals 600,000 sq meters, or 0.6 Sqkm. Each profile line will therefore be 1km long, to ensure the radar moves from the host rock, across the body of the anomaly and again into host rock. The client has selected 20 anomalies to be surveyed.

The image to the left displays the proposed profile plan. The radar should only be used on identified anomalies.

Calibration in the form of a pilot drill hole is important and we request the client has a Geologist present at all times to verify our data.

IMPORTANCE OF LINE SPACING

- The resolution of the geophysical map produced for interpretation is linked to the line separation. Choosing a practical line separation is a balance between an understanding of the possible target sizes, the complexity of the geology as a function of the specific parameter being measured, and the costs of the survey.

- If the line spacing is too wide for the target there is a good chance that the target will be missed or that the target will only have one line going through it; typically we need at least four lines to survey a anomaly confidently. If the geological background is very complex relative, to the target size and the line spacing is too wide it will be difficult to interpret the geophysical data at a sufficient level.

Right: The image with four profile lines, crossing a drilled intrusive.

WHY TERRAVISION RADAR?

Advantages of Terravision

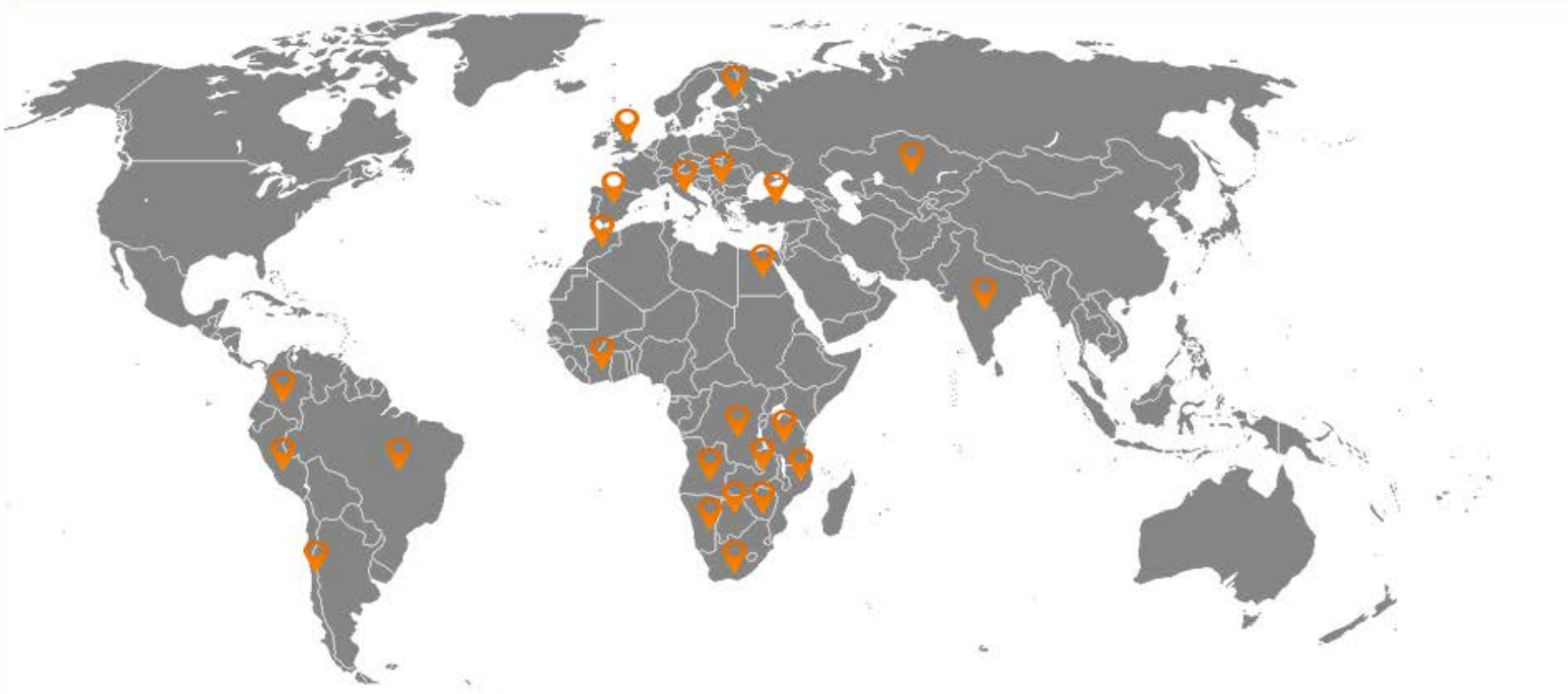
- Technology to penetrate to **depths of up to 200m**
- Versatile and highly portable
- More powerful - 100,000 times the power of traditional GPR
- Our surveys enable drilling and trenching to be targeted more efficiently
- Localised and light operational footprint
- Minimal impact on the environment and surrounding operations
- Speed of data collection: acquisition of up to 4km of line surveyed profiles a day.

FINANCIAL ADVANTAGE

We deliver financial savings:

- Reduction of initial capital required to verify anomalies & check the integrity of intrusive
- Costly methods of Seismic/IP could be replaced using the radar and reduced drilling programme
- Verification of drill hole data
- Reduced drilling expenditure
- Real time data processing and analysis
- Improved accuracy and quality of data
- Real time tracking of intrusive, GPS marking
- Rapid assessment of intrusive structure & depth of overburden

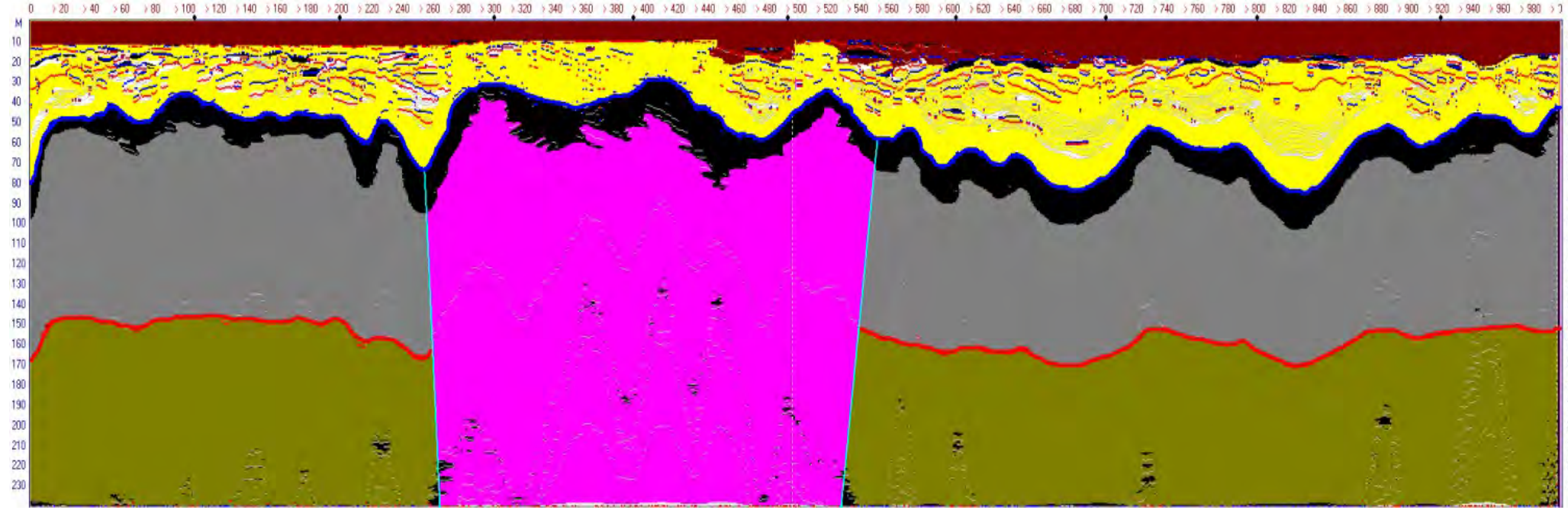
OPERATIONS AND CLIENTS



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

KIMBERLITE MAPPING EXAMPLE 1



Legend:

Brown – Sand;

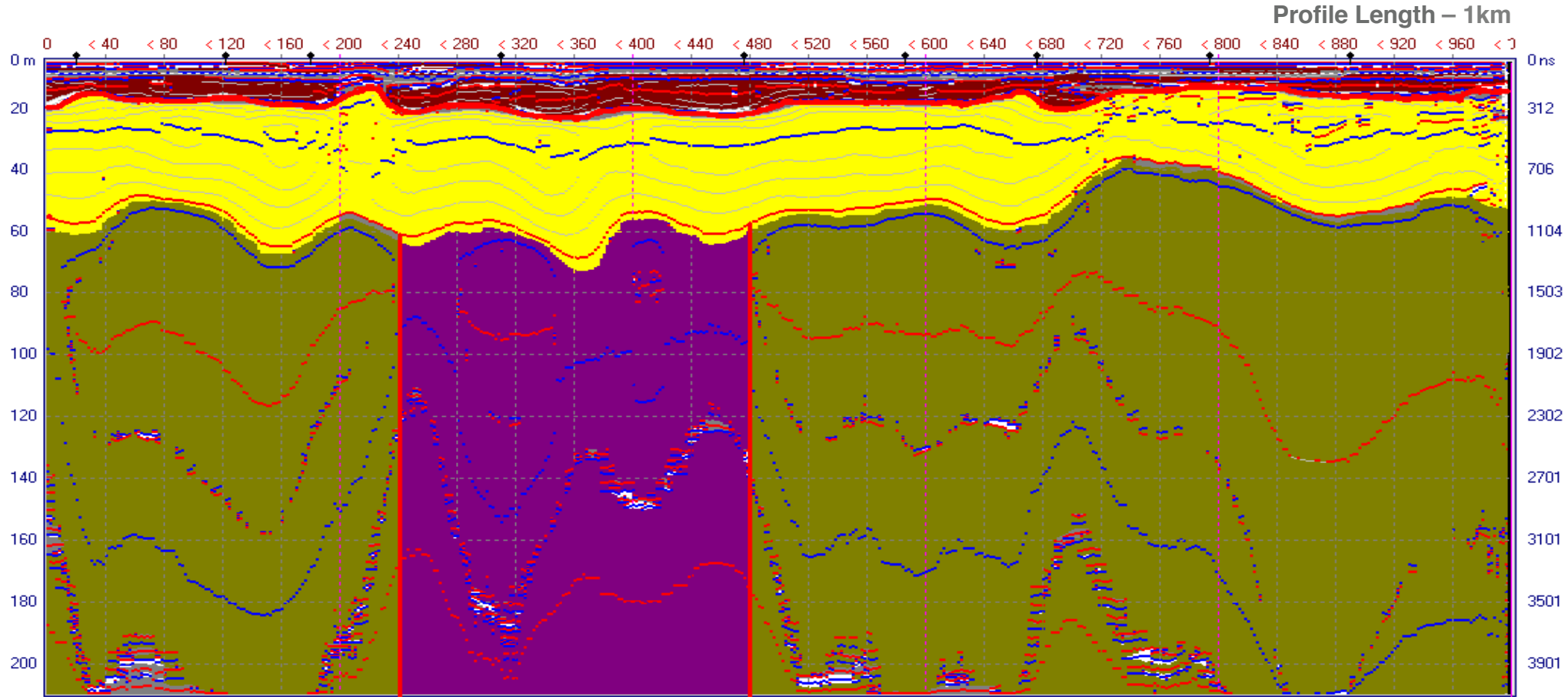
Green – Basalt (1); Grey – Basalt (2);

Yellow – Silcrete, Calcrete; Black – contact zones;

Pink – Kimberlite bod;

The lines show layered structure

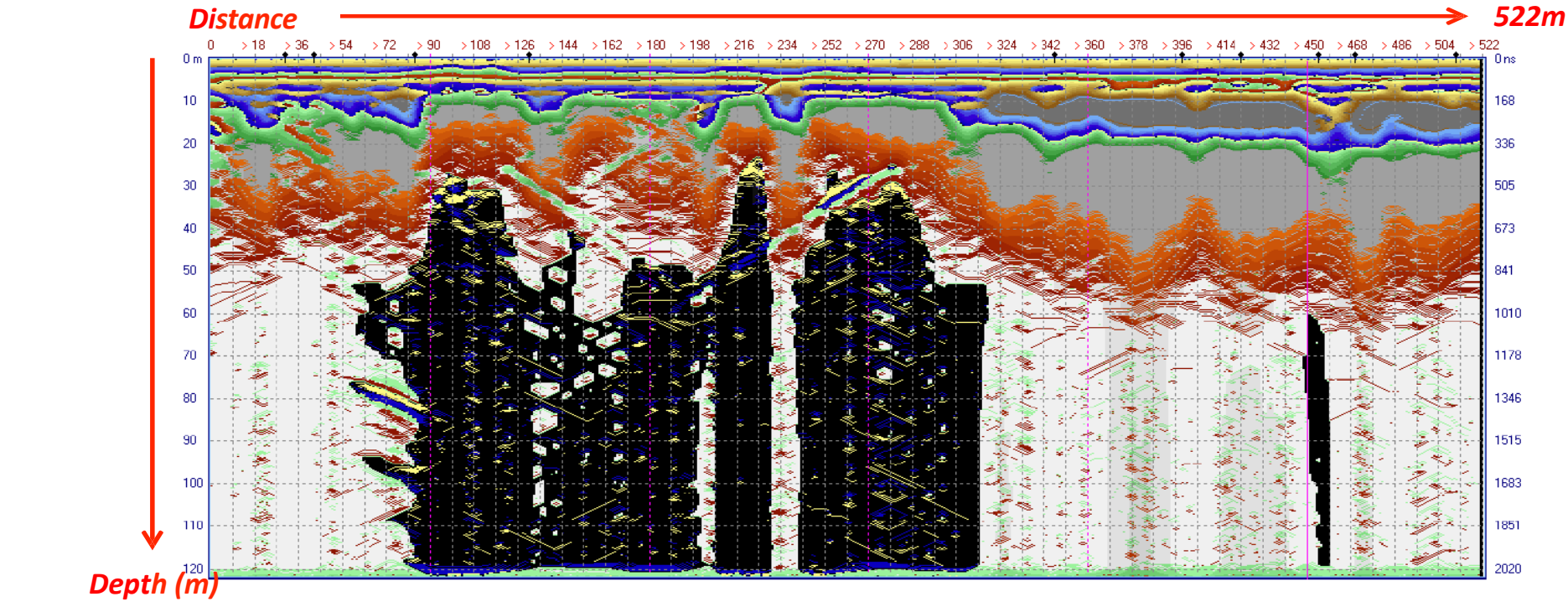
KIMBERLITE MAPPING EXAMPLE 2

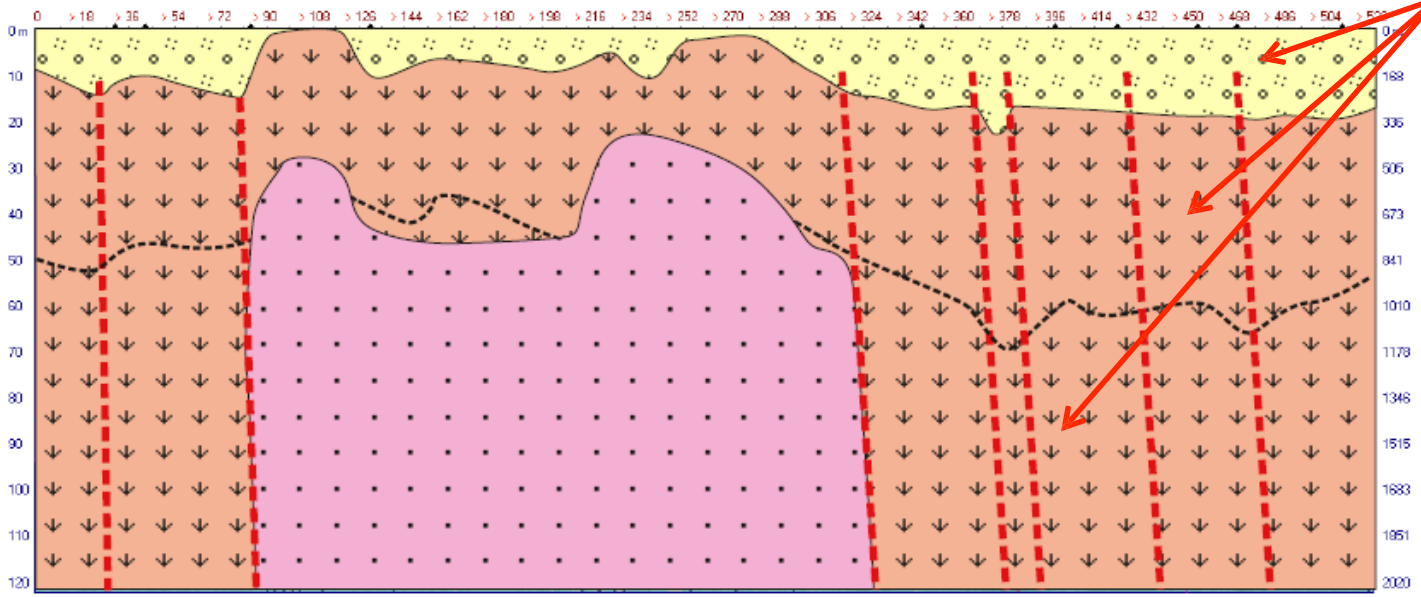


Section View – Kimberlite under clacrete, hosted in basalt

- Sands 1st formation
- Silcrete, Calcrete etc. (lines show structure in layer);
- Basalt (lines show structure in layer)
- Kimberlite body

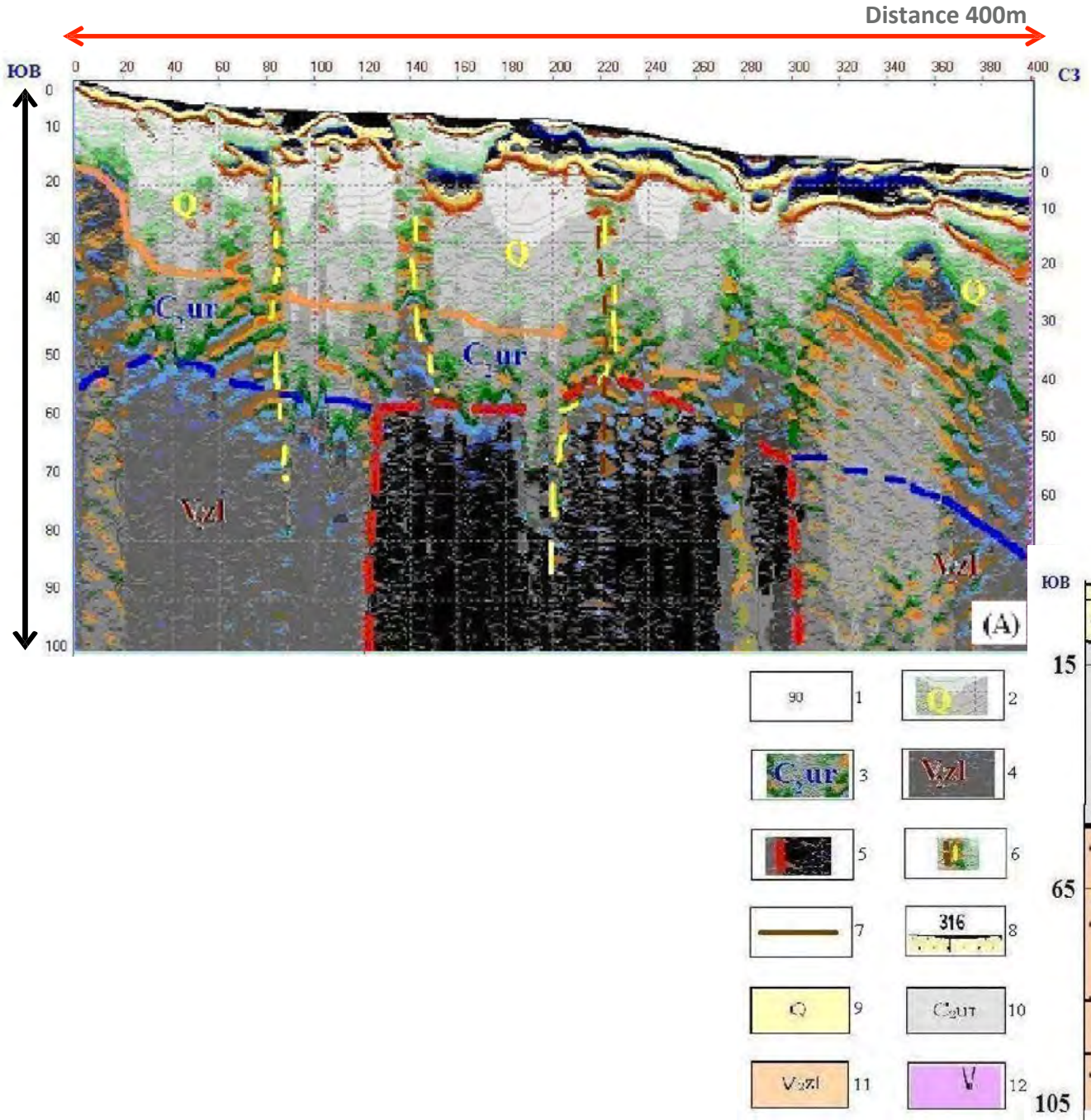
KIMBERLITE MAPPING EXAMPLE 3





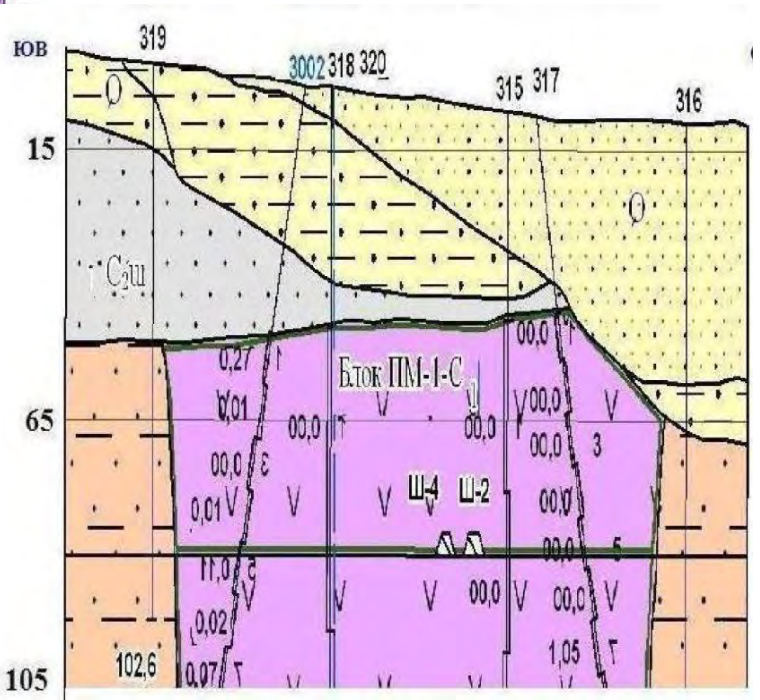
1. Faults – Structure is seen
2. An “overburden” of 30m to 40m is seen
3. Feature is delineated to 230m wide and surveyed to 200m depth
4. Time taken to survey – 1 hour

KIMBERLITE MAPPING EXAMPLE 4

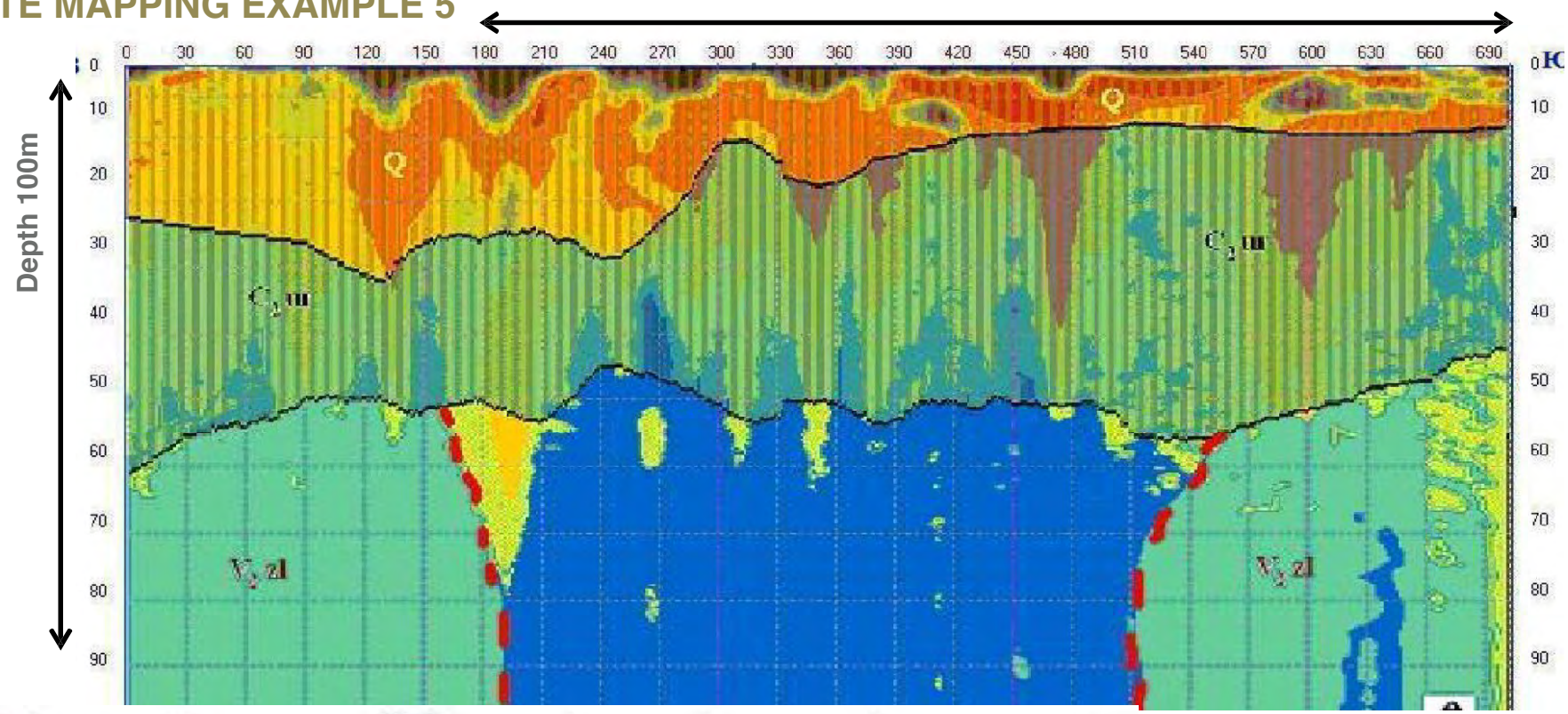


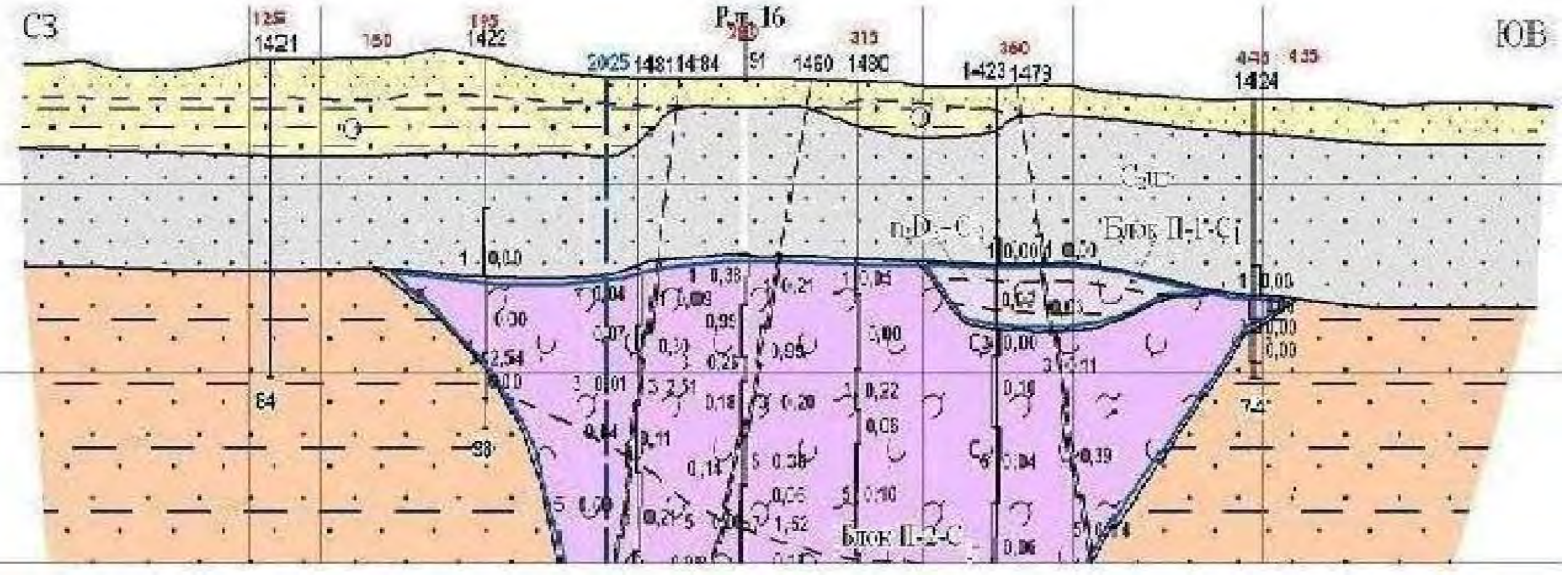
Mapping Drilled Kimberlites

Terravision has mapped extensive numbers of Kimberlites in Russia

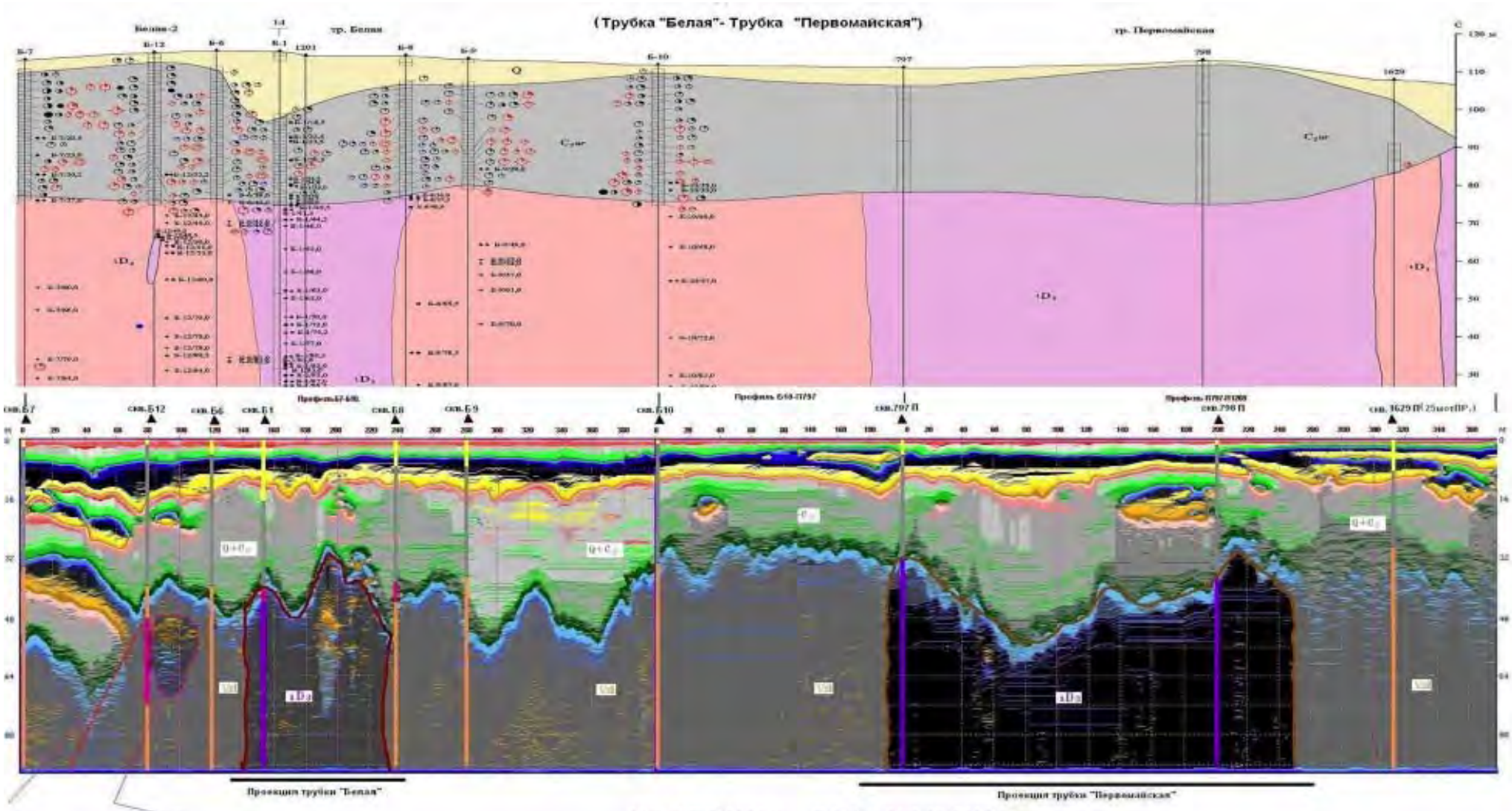


KIMBERLITE MAPPING EXAMPLE 5





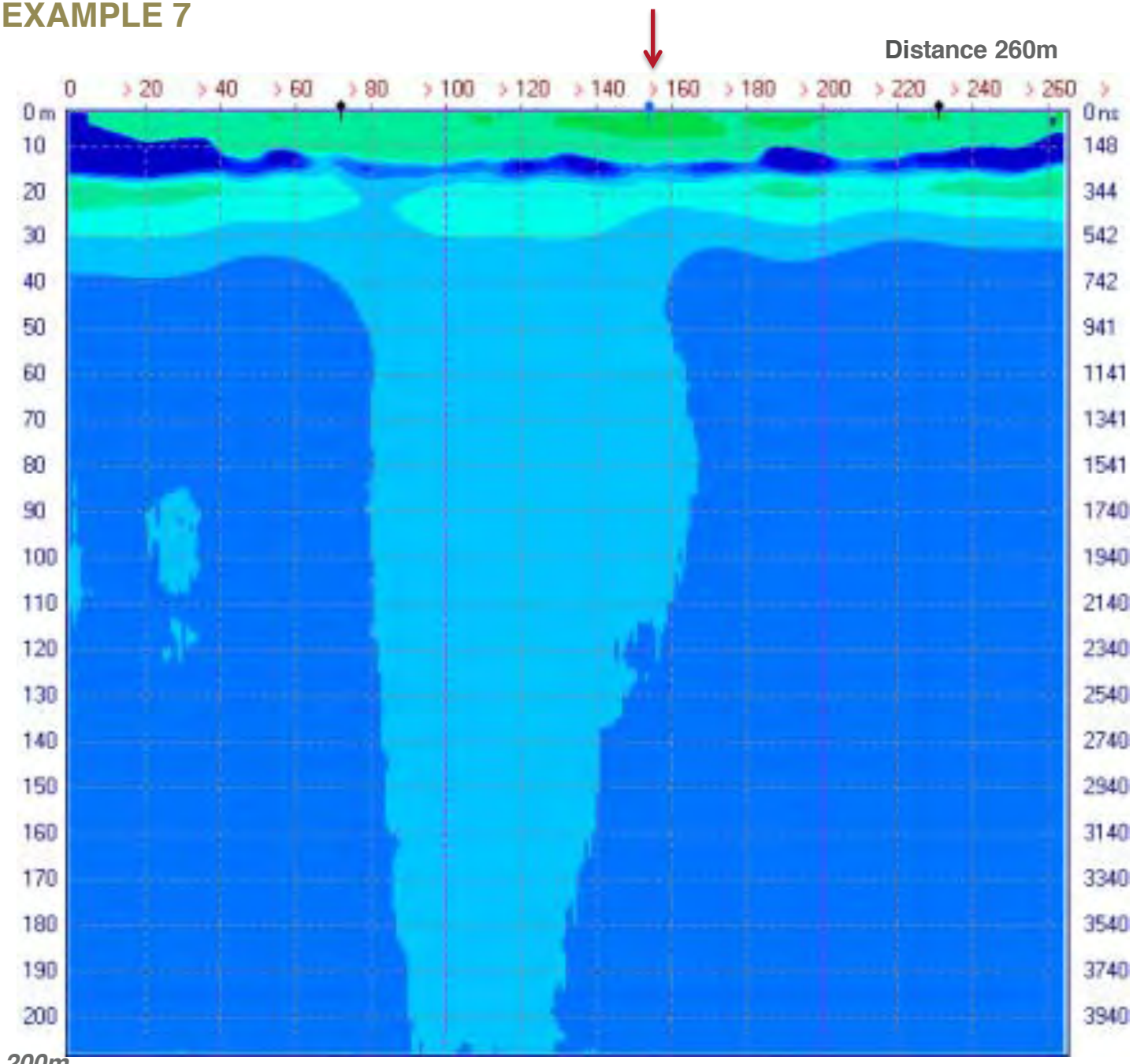
KIMBERLITE MAPPING EXAMPLE 6



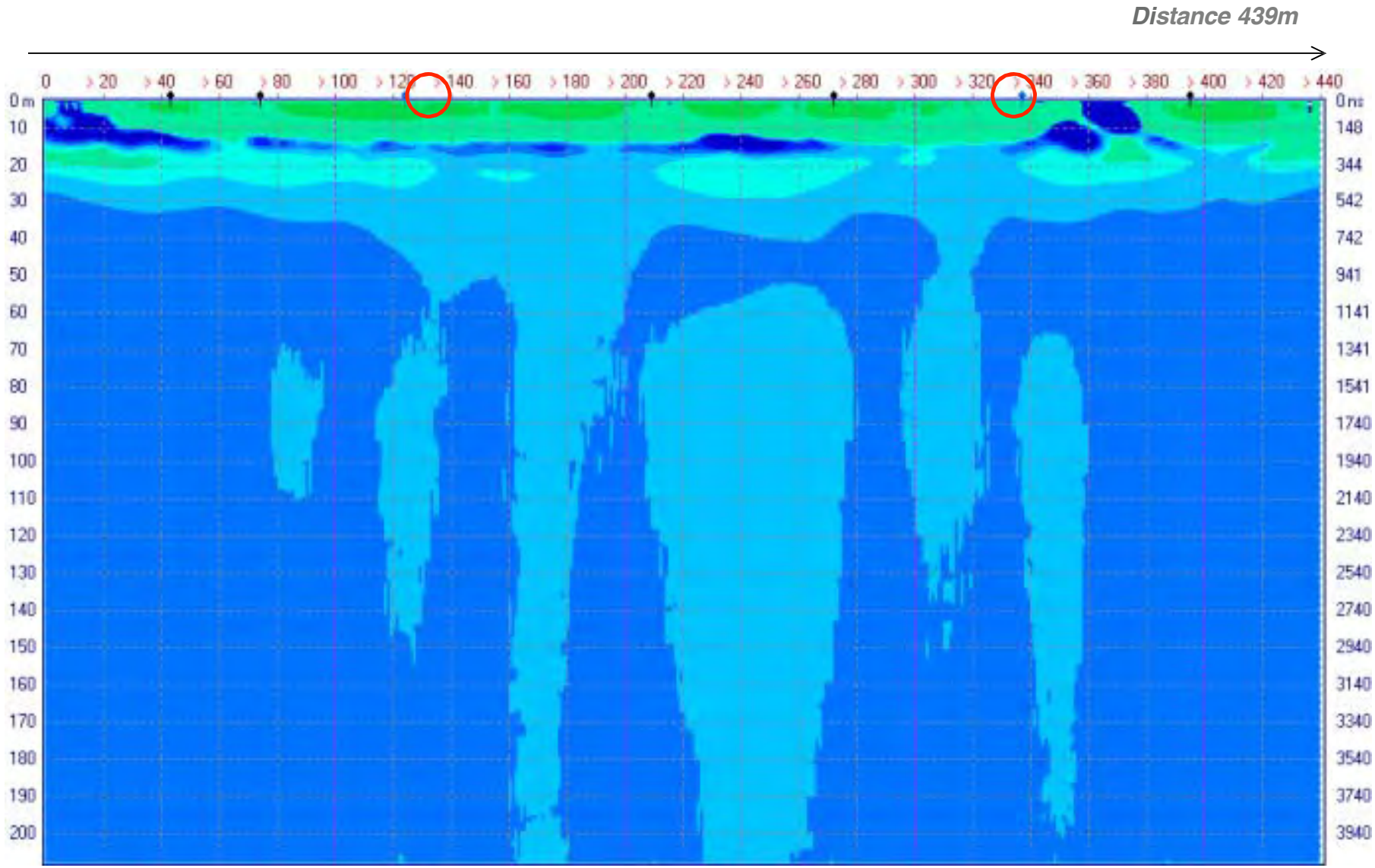
KIMBERLITE MAPPING EXAMPLE 7

Recent Work in Southern Africa

Small Pipe delineated: Drill hole indicated by the arrow in red at 150m



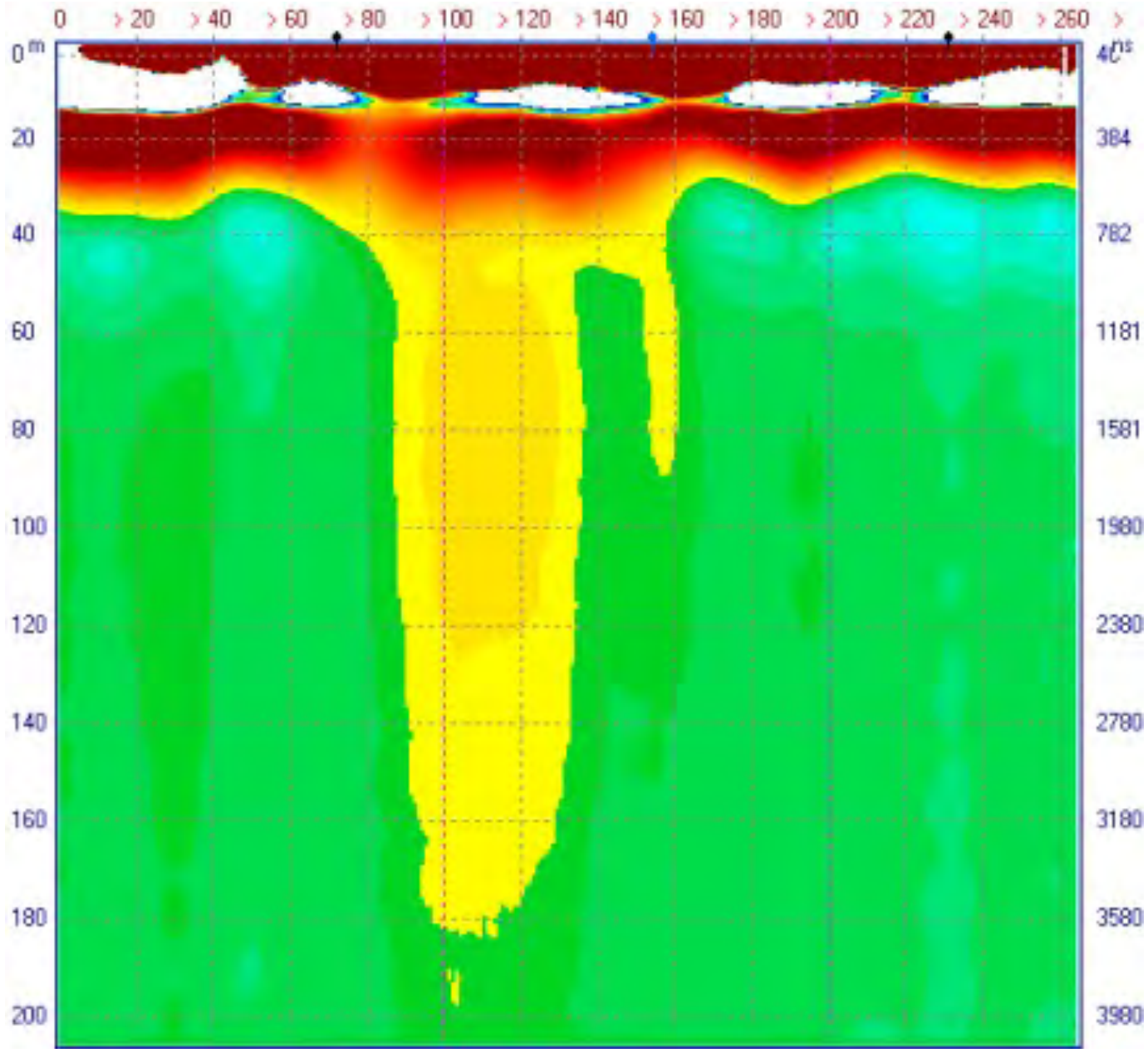
Depth 200m



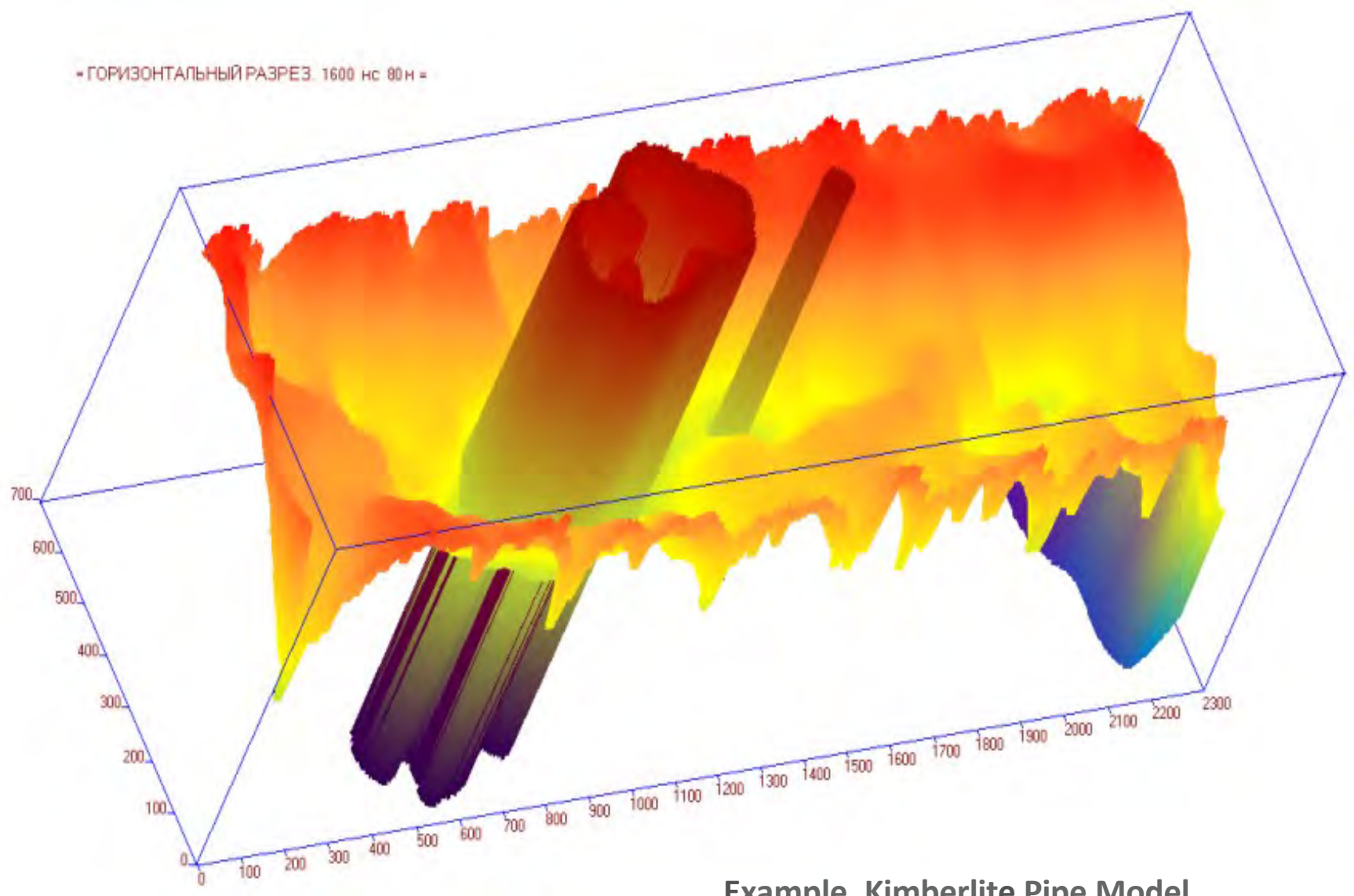
We recommend investigative drilling of the feature in the center of the profile, to understand whether the dyke seen is kimberlitic.

KIMBERLITE MAPPING EXAMPLE 8

Pipe is clearly visible.Please note the geophysical signature of the weathered zone being discontinuous with the surrounding areas. The vertical boundries to depth are also indicative of an intrusive.



KIMBERLITE MODEL



Example, Kimberlite Pipe Model

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TECHNICAL SPECIFICATIONS

TECHNOLOGY OVERVIEW

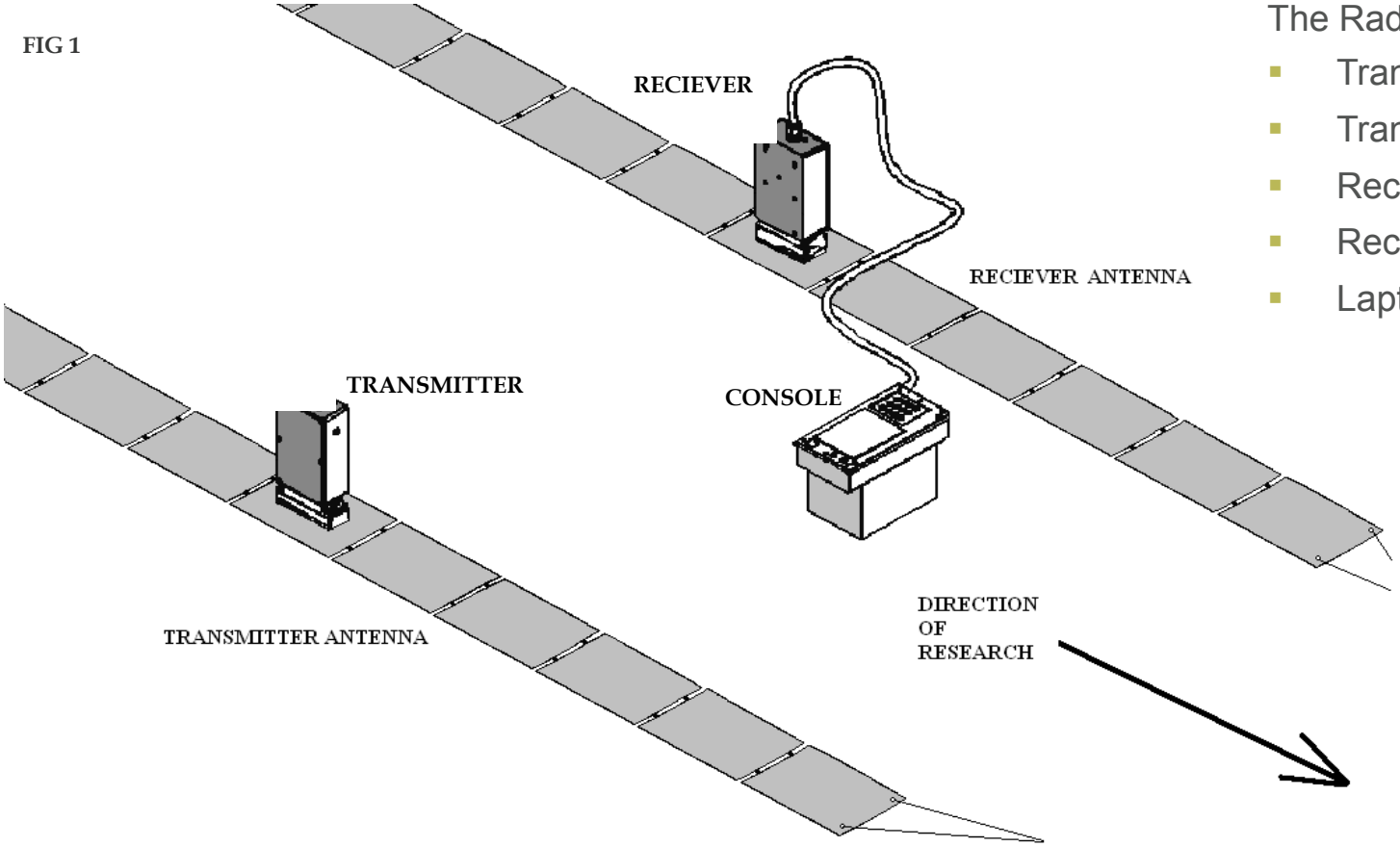
- The company uses a 4th generation Ground Penetrating Radar system.
- The radar scheme has been completely revised: pulse transmitter power has been increased by a minimum of 100,000 times, and the stroboscopic transformation replaced to direct detection of signal.
- The antennas used by Terravision-Radar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

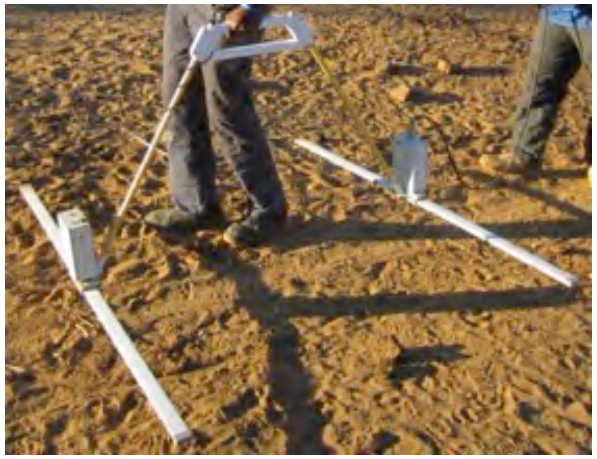


The Radar is configured as follows:

- 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

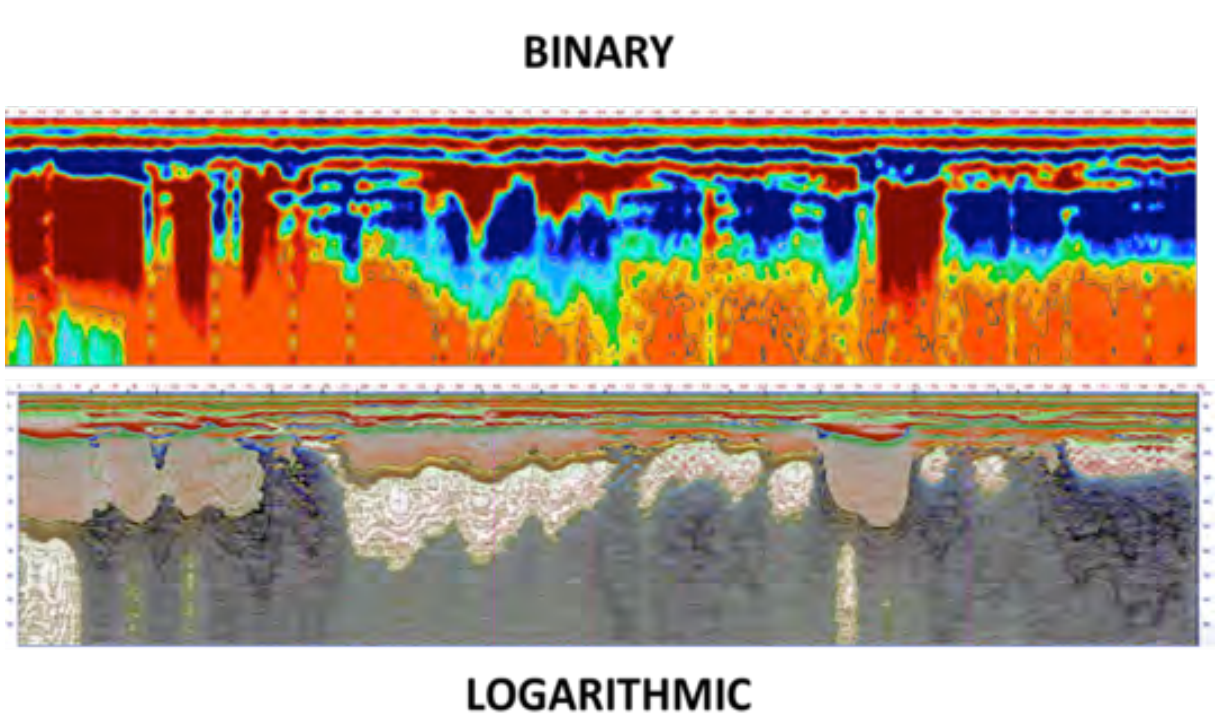
The Radar in Action – 10m and 3m antenna array manually pulled over the target.

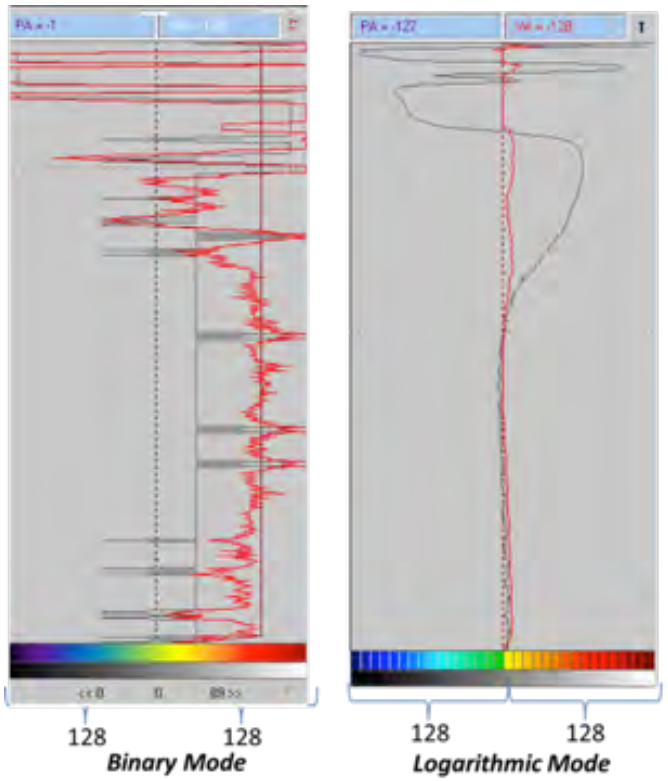
Real time location of anomalies/channels

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.

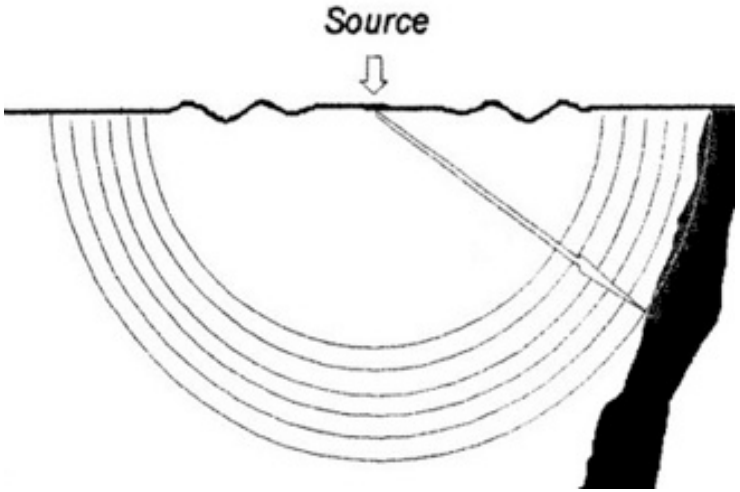


Fig 6 (Left): *Capturing Structural Detail*

- 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.

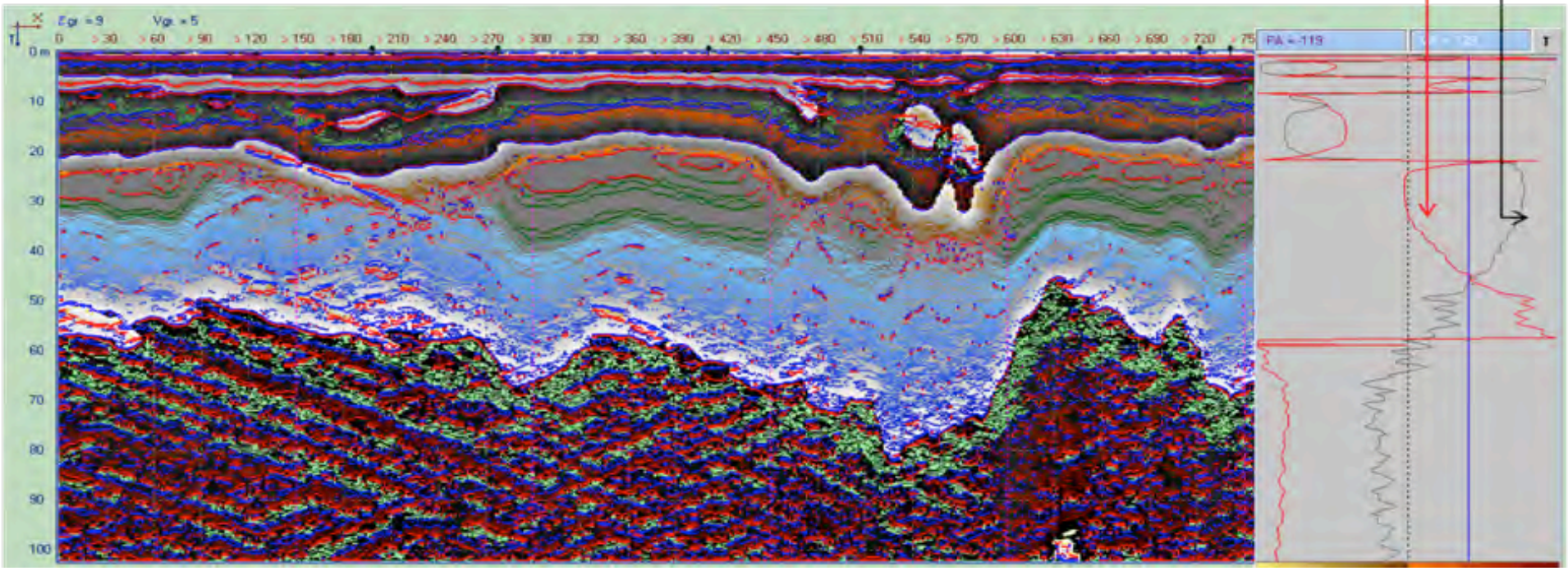
Fig 7 (above): *“Shot” spacing*

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.