

Ultramag Deep Ground Penetrating Radar

Applications in Coal for Geological Structure Detection

28th June 2017

 **ULTRAMAG** GEOPHYSICS

<http://www.ultramag.com>

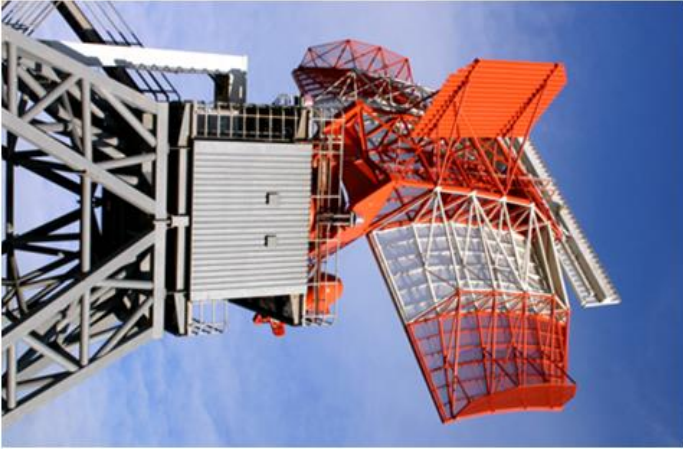


Conventional RADAR

Send Pulse & Listen for Echo

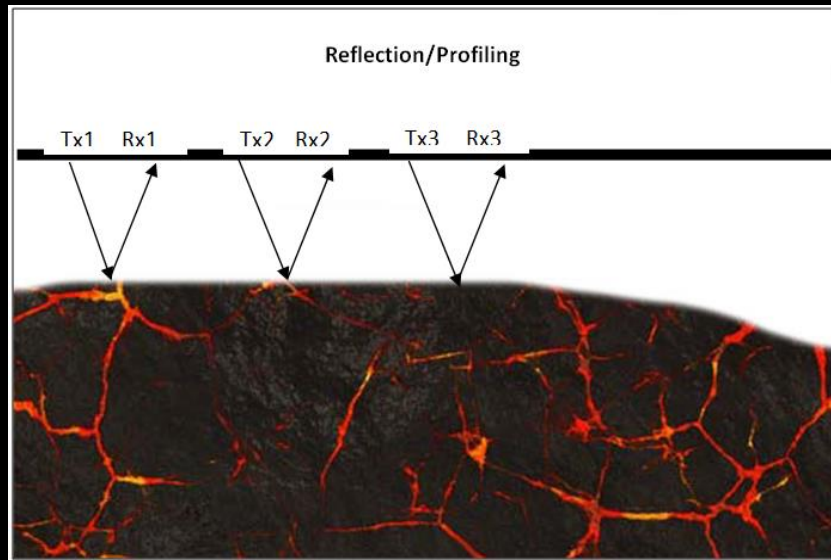
Distance = Travel Time / Velocity

Speed of Light 299,792,458 m/s

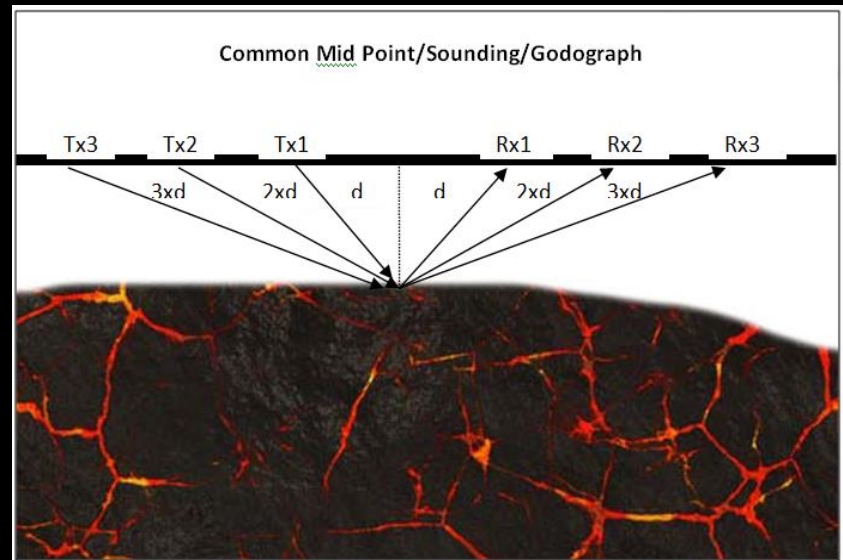


Operating Modes

Profiles



Sounding for Velocity/Depth Calibration



25 MHz Antennas (6m + 6m)



Brief Theory

Dielectric constant

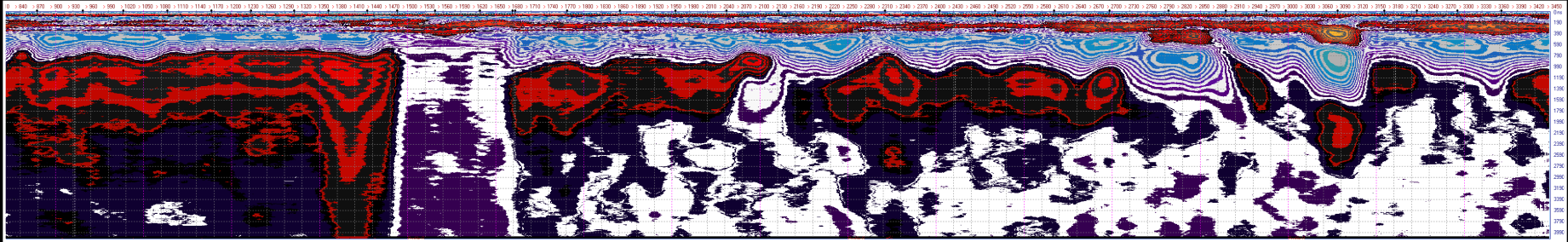
- Air 1
- Rock 3 - 8
- H₂O 80

DGPR is thus very sensitive to clays, faults, joints, porosity, water content.

Limitations

- High conductivity (saline) groundwater

Bowen Basin Coal

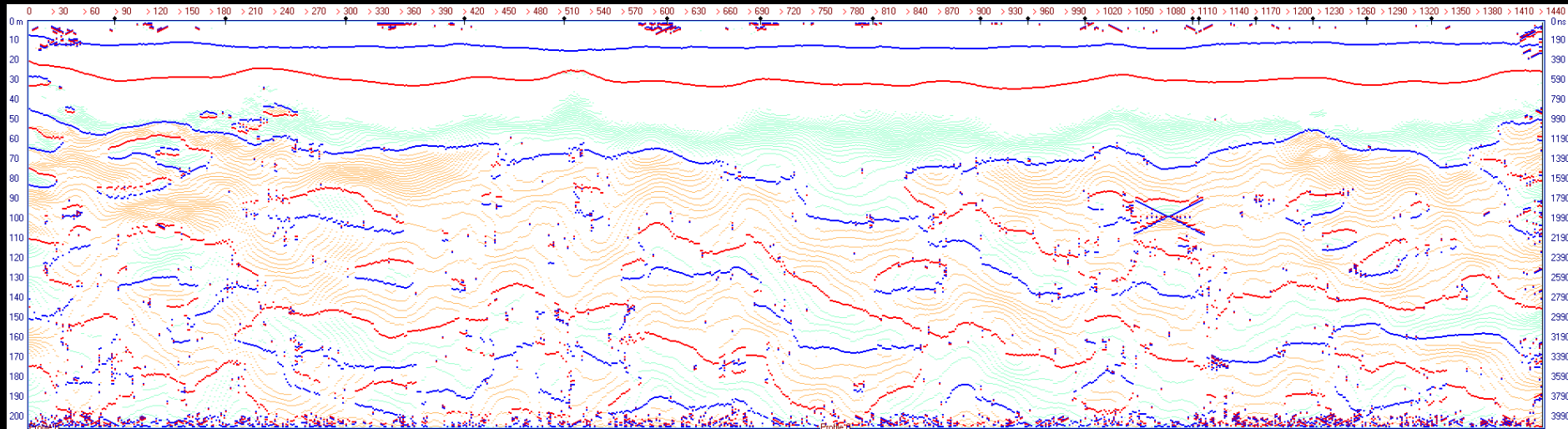


200m

Amplitude Form Filter showing:

- 3.5km E-W profile to ~200m depth
- Blue is alluvial (top 30-40m)
- Faulted coal sequence in red
- Two regional faults (purple block left of centre) with dykes ?
- Multiple thrust blocks (centre and right, white)

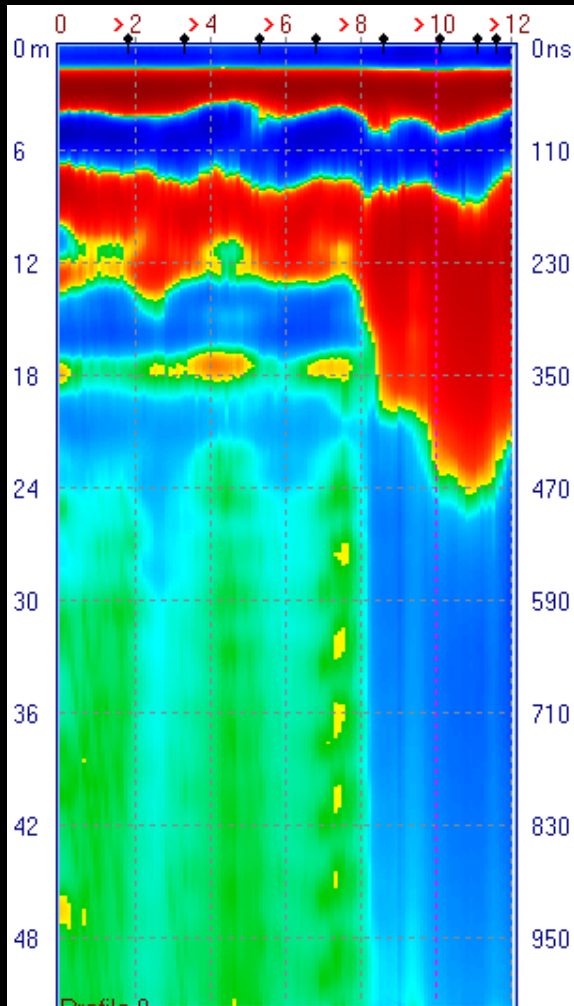
Bowen Basin Coal



MinMax Filter showing:

- Sedimentary Stratigraphy to 200m depth.
- Paleo channel (centre) associated with coal sub-crop. Coal dipping to the right.
- Vertical / Horizontal = 0.142

Paleo Channel - Hunter Valley

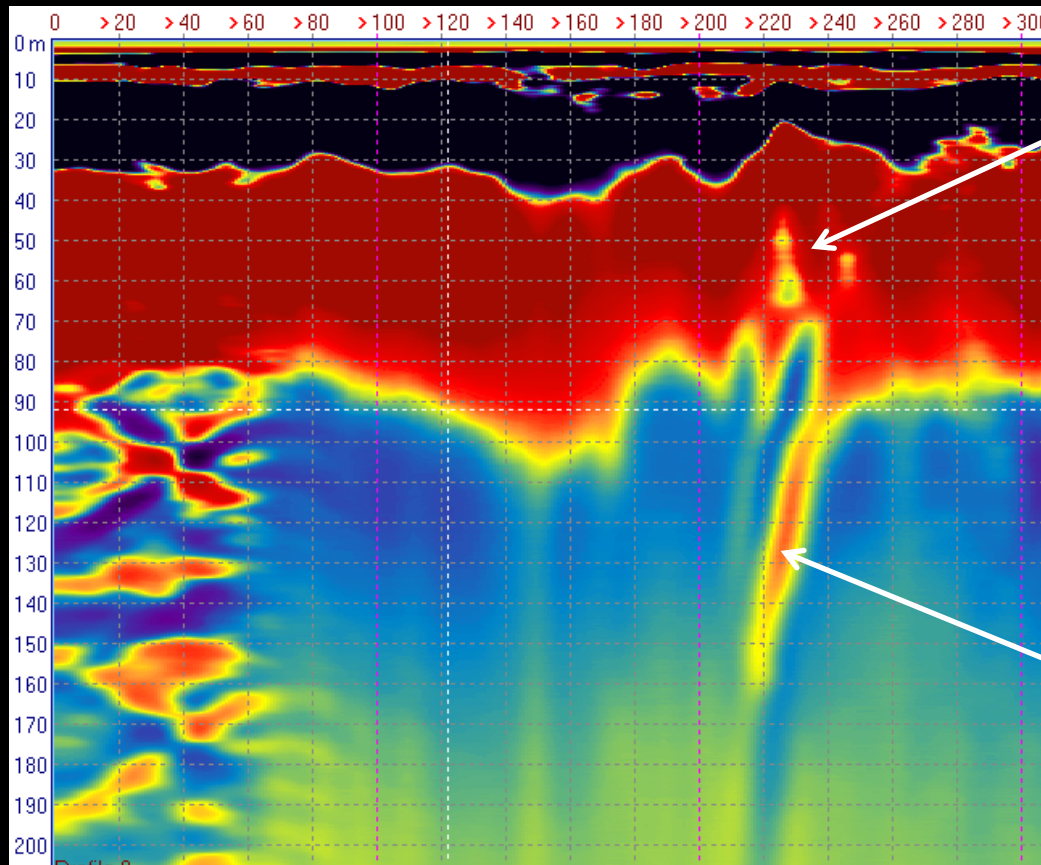


Paleo channel (red) to 26m depth cutting and destroying the coal resource - 6m thick coal seam from 12m and 18m depth.

50MHz antenna.

Conventional GPR run by a competitor over the same line penetrated just 1m due to clays.

Decline - Myuna Colliery NSW



Spiral decline (voids)
intersected 3 times.
Maximum depth 75m.

Teralba
Conglomerate

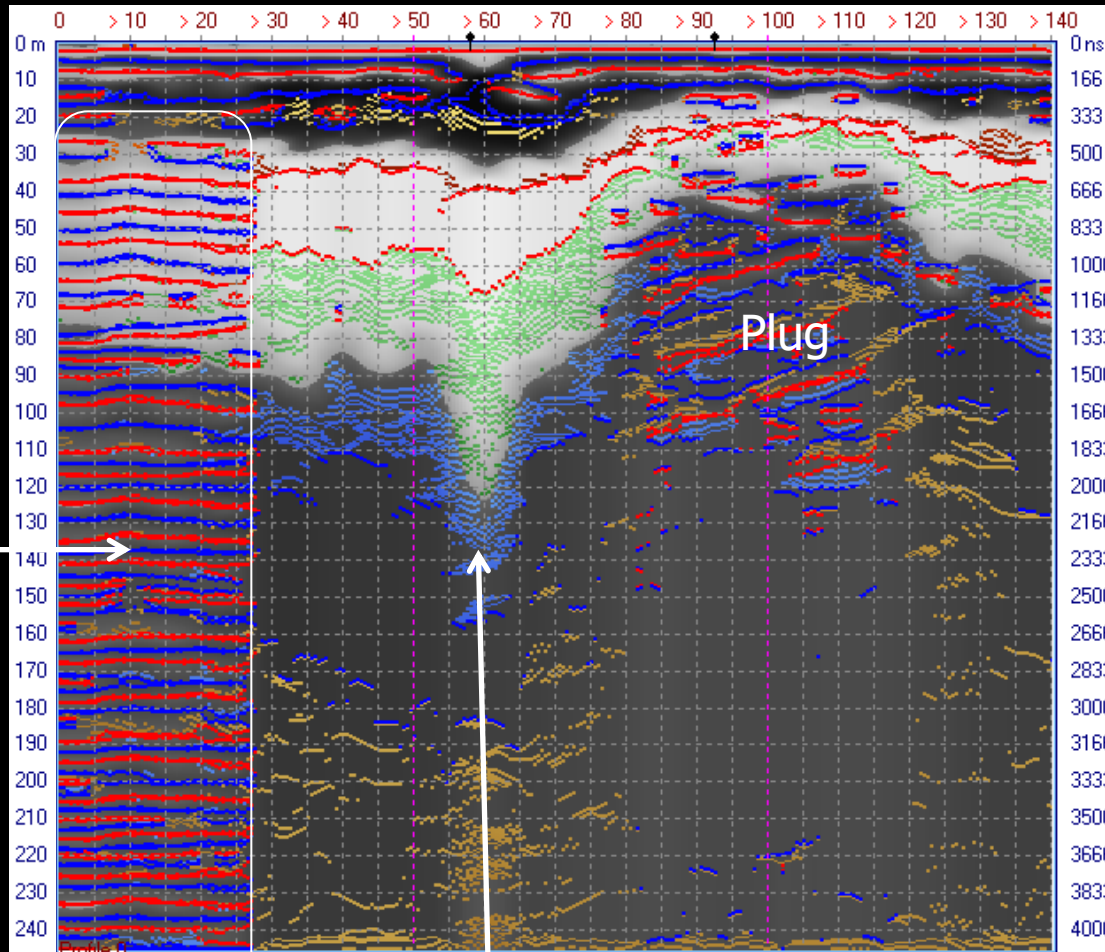
Fault

Powerline
Noise

Data acquired along a
public road in 10min

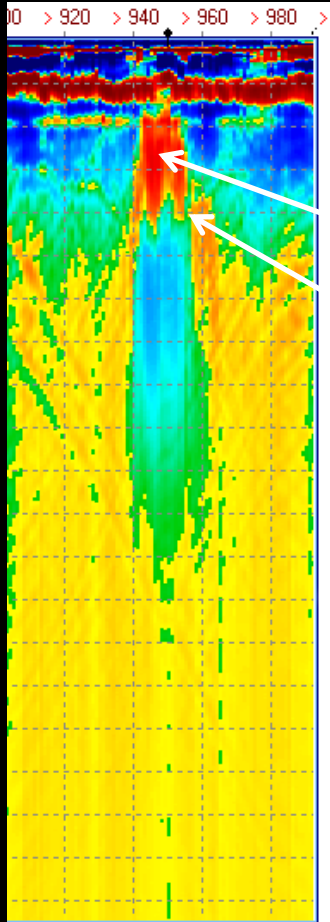
Intrusions in Coalmine - Bowen Basin

High Voltage
power line
noise
(20m off grid)



Dyke or fault seen
over several lines

Dyke – Hunter Valley

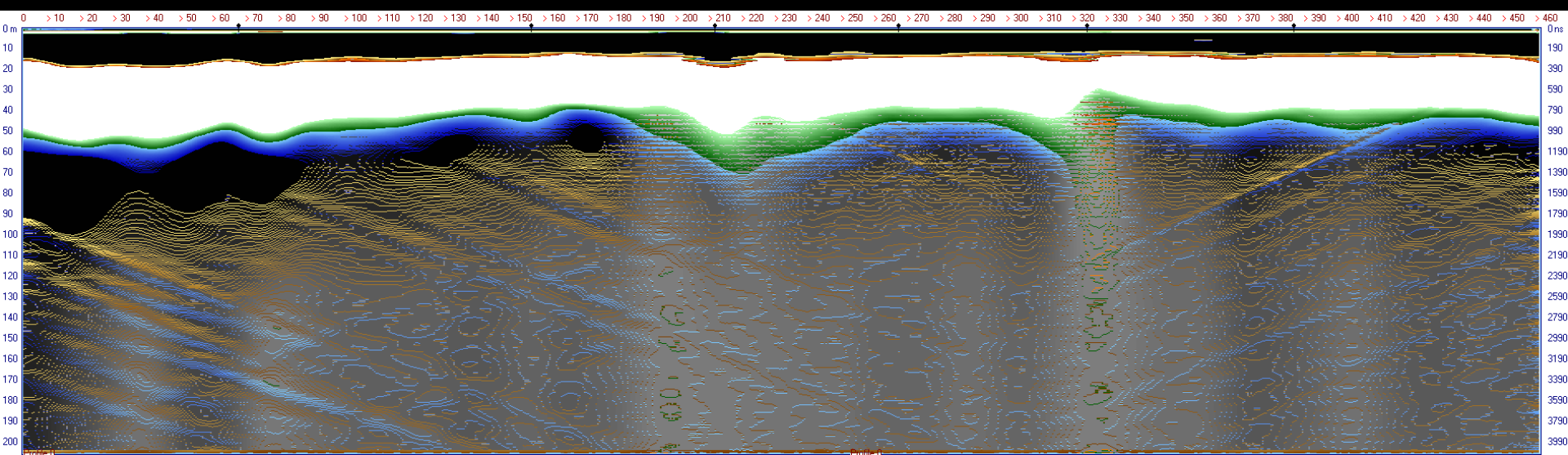


Vertical Dyke (~2m thick) known from ground magnetic survey.

Polarity change @ 40m depth is due to weathering.

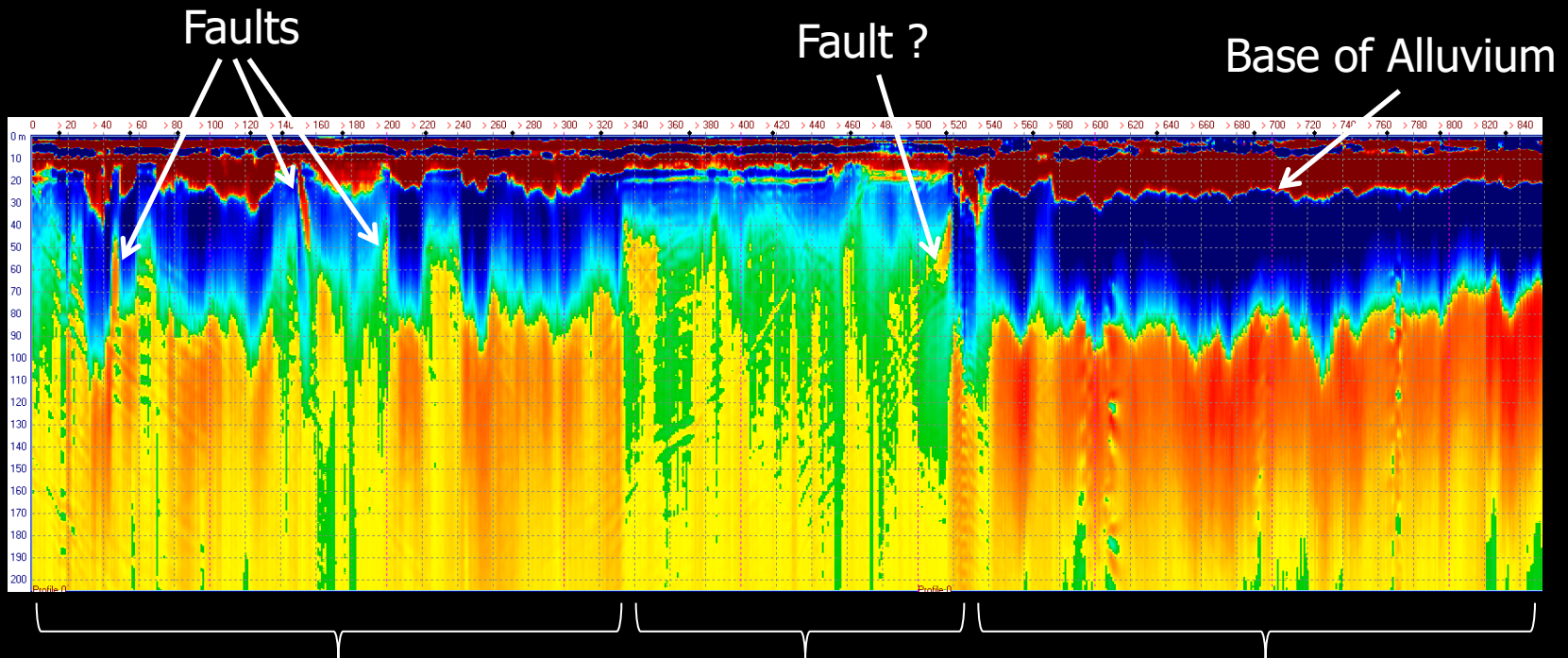
Apparent width (8m) is due to oblique profile.

Salt Water



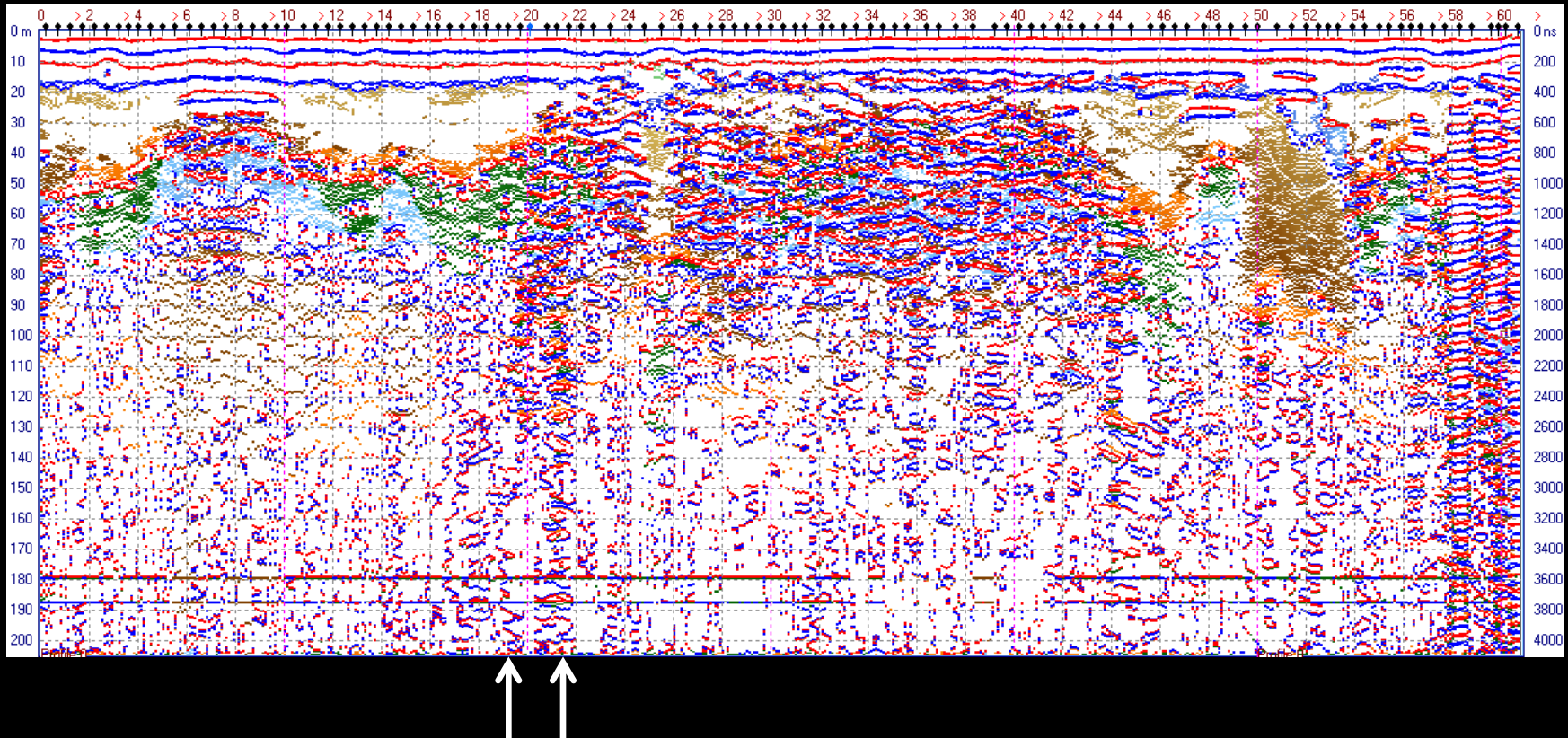
- We cannot penetrate through salt water
- Green is faulted coal strata 45-60m depth.
- Black area > 50m depth is salt water.
- Diagonal lines (gold) are airwave artefacts from adjacent wash plant.

Hunter Valley Coalmine



Tuff at surface
scatters some
energy

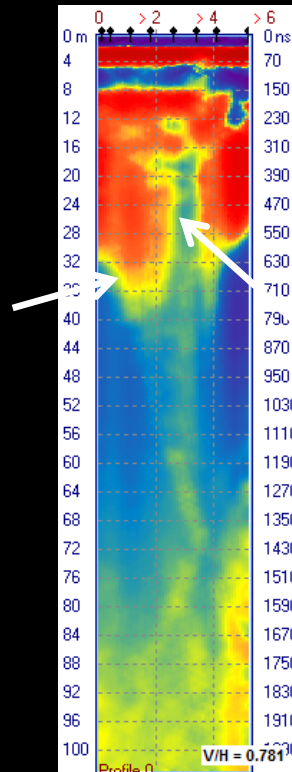
Twin Drill Holes, Bowen Basin



Voids from 2 sub vertical, open drill holes. No steel casing. Left hole depth = 140m. Right hole depth >200m. Left dip on Left hole is real. Filter was optimised for target strata not drill holes !

Coal Pit - Backfilled

Thin Mud layer
(yellow) target

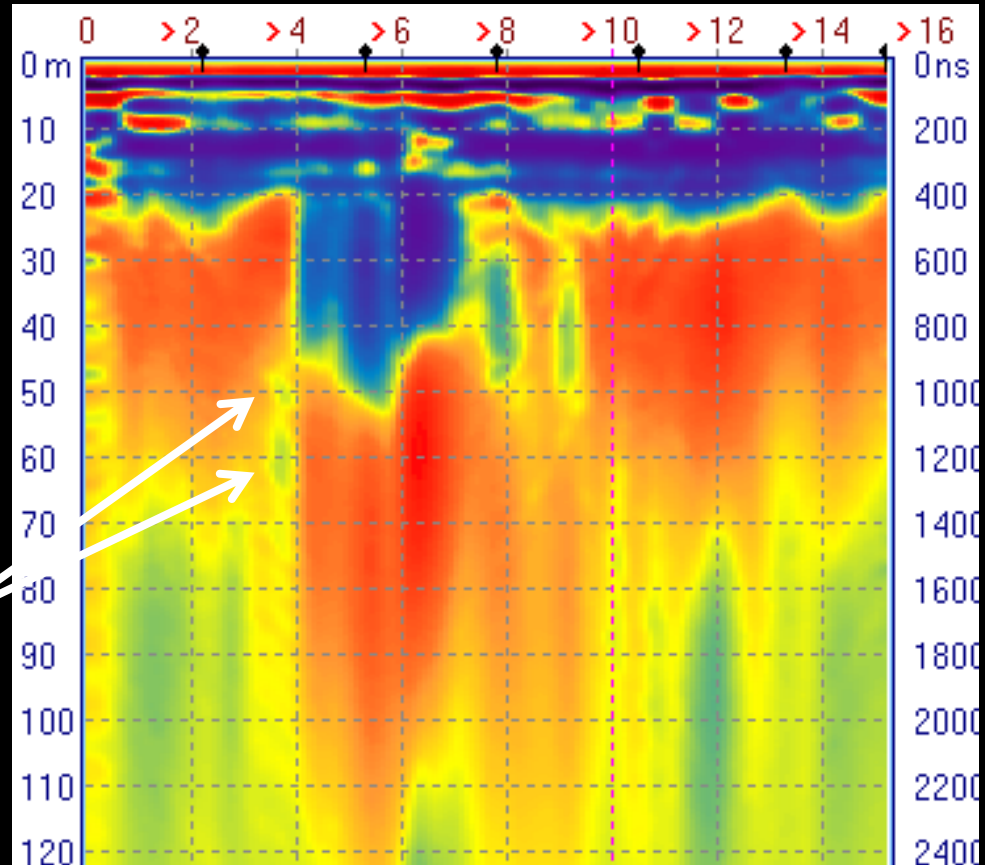


Old Ramp
(dark green)

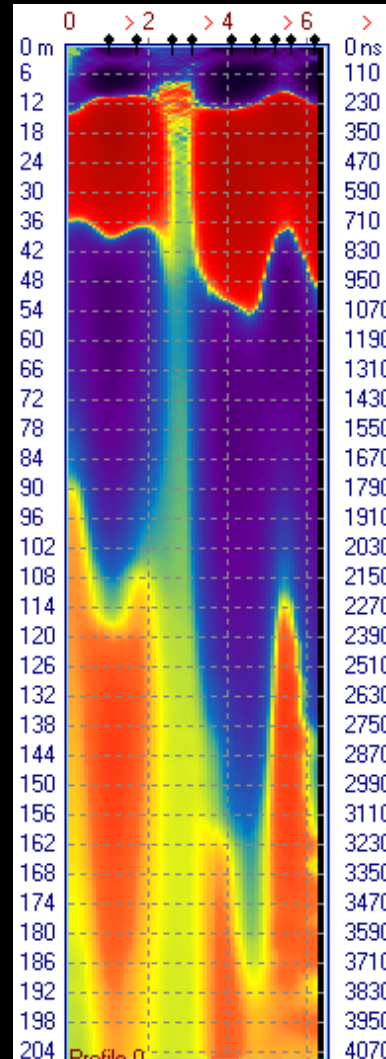
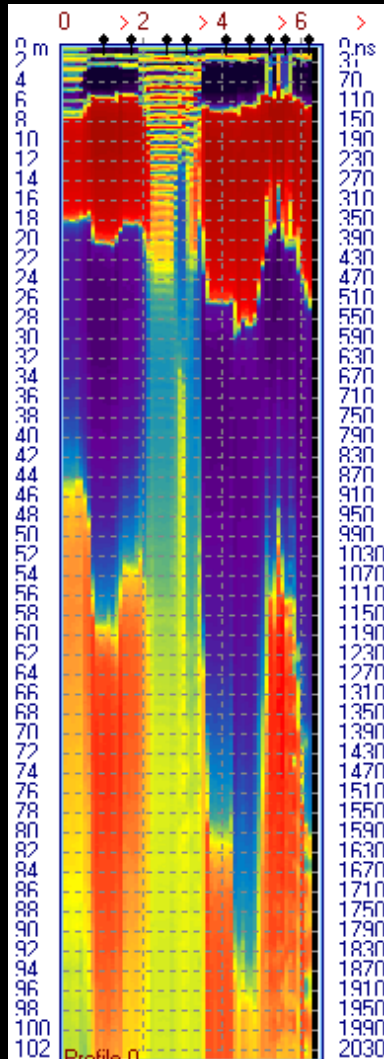
Other UG Coal Applications

- Fractures in roof
- Locating Mine Voids

1m x 2m drives
hand mined, 50m
and 60m depth.



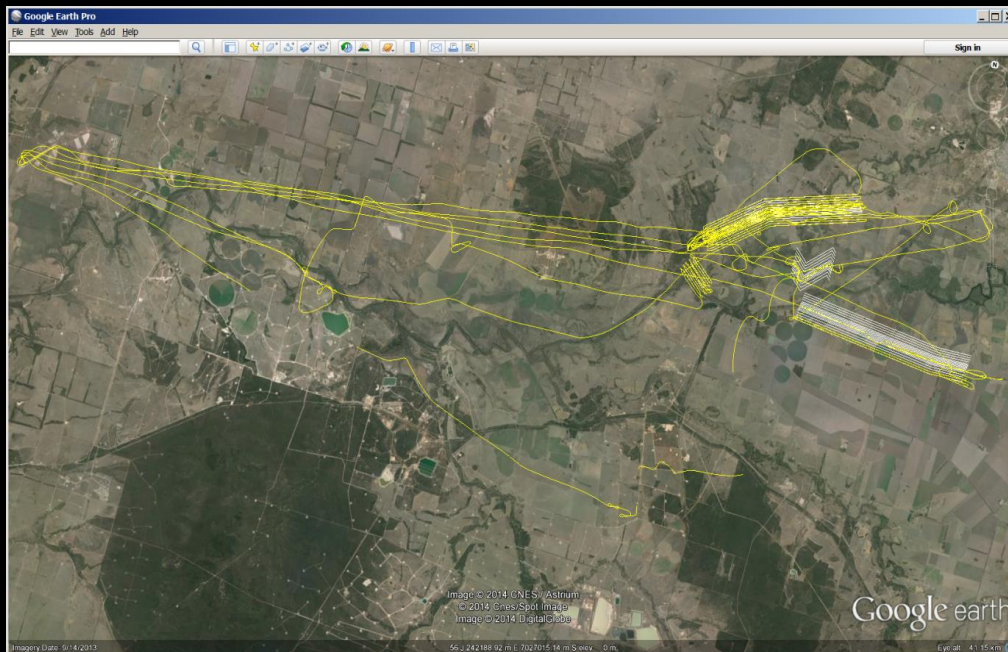
Dyke in Underground Coalmine



- Survey in underground drive 5m x 3m.
- This is a very difficult area to operate due to multiple pipes, cables wall and roof bolt support plus roof mesh + wall and roof reflections.
- 100m long profile
- 2m thick Dyke
- Unfiltered image (Left) shows ringing from steel mesh roof support.
- Filtered image (right) removes airwaves from mesh to reveal dyke (yellow).
- No velocity corrections applied.

ALMA Heli Methane Detector

- 50 readings/sec
- 20ppm
- 100m range -
- No need to fly through plume





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