Application of High Resolution 3D Seismic to Shallow Pt Mine Planning

Target

- The challenge of imaging a very shallow target (200-500m depth) is two fold
  - The technical challenge of discriminating between signal and noise,
  - The economic challenge of increased cost with decreased depth – which is opposite to borehole drilling.

  Boreholes were considered for a long time to be the main tool to derive a 3D structural image of an ore body in South Africa and will always be required to directly sample the grade of the target ore-body, but have two significant drawbacks:
  - The time taken to drill with respect to the size of the target and
  - The density of boreholes required for adequate structural sampling is often many times that required for facies & grade sampling.

  Then the question is: would a 3D Seismic survey efficiently reveal structures with significant impact on mine planning, which even a dense borehole campaign would miss?

Seismic acquisition trials

- In 2004, a 2.5 x 2.5m bin dimension was selected as the smallest bin size that could be technically possible at an economically viable cost.
  - The distance between receiver lines was set at 20 m with 5m between receiver groups and distance between vibrator lines was set at 20 m
  - The distance between VP's was 20 m and with a x-line shift of 5m allowing a 2.5 m bin size

Mine scale survey

- Based on the 2004 trial a cost effective acquisition was recorded and processed early in 2006
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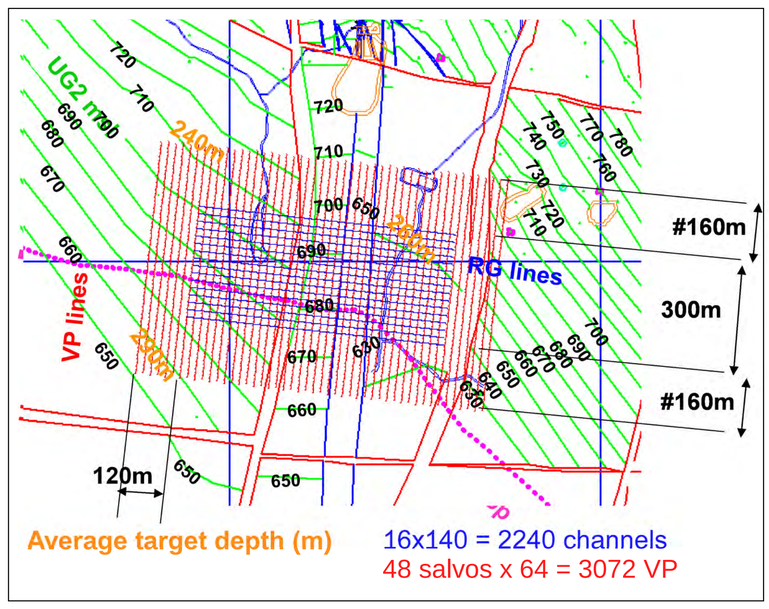
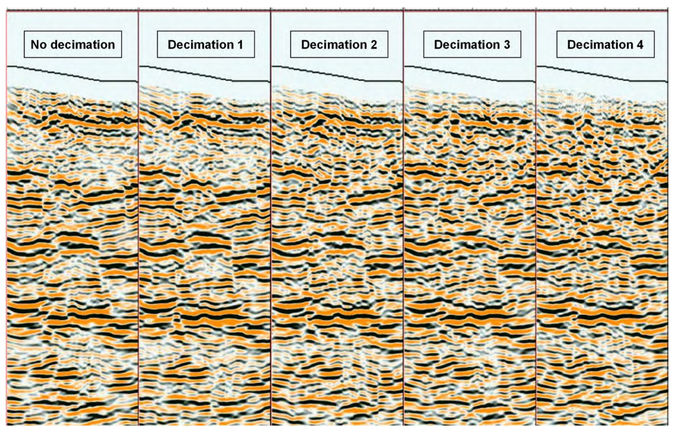
- Surveying started in April 2006 and recording of 12000 VP's occurred between 6th and 13th May 2006
- The decimation rules were applied in order to optimize the density of surface points and consequently meet the mine budget, giving this project an economical viability
- The main Middle fault was known but not included in the mine initial planning and the other faults were only detected by this seismic survey.
- The vertical resolution helped to resolve fault throws of 10m, a small pothole on the East of the survey and a series of small faults, mainly North South but one East West, on the West of the Middle fault.

Aims

- To ascertain the best economical approach to image the UG2 orebody on Modikwa mine by surface 3D seismic, a trial was conducted in 2004 using a dense surface sampling patch.
- This data was then decimated at processing stage by reducing fold of cover to reach a compromise between surface sampling and cost
- This established a cost effective acquisition sampling scenario

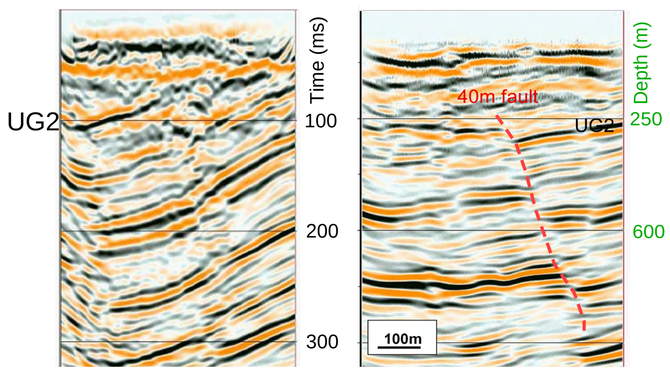


Analysis of decimations



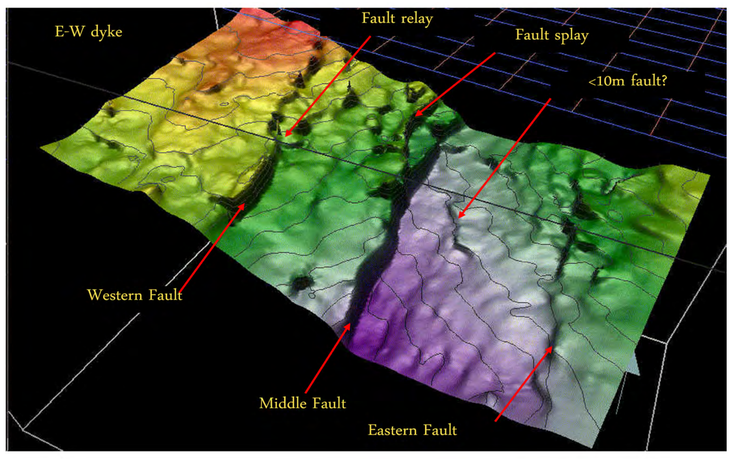
A sampling rule was defined linking target shallow depth versus density of surface sampling
- 100m – 230m depth : Decimation 1
- 230m – 350m depth : Decimation 2
- 350m – 450m depth : Decimation 3

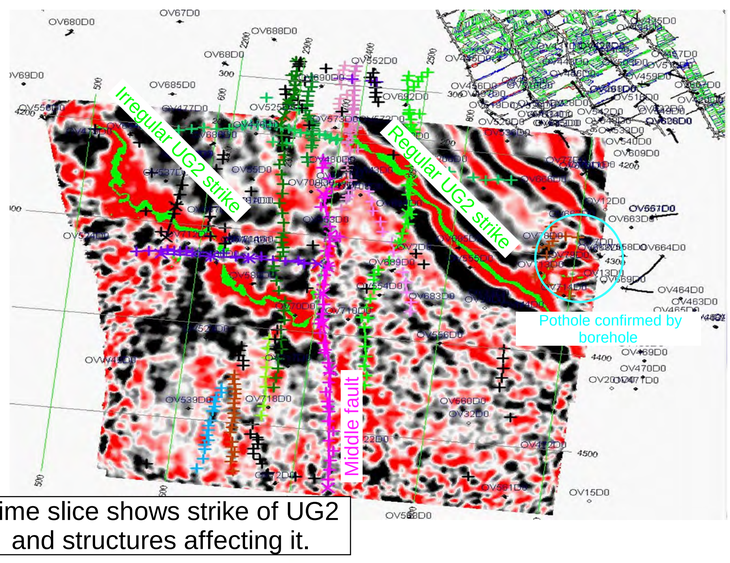
Under these rules a very reliable structural image of the ore body is achieved.



Example of 2D seismic sections

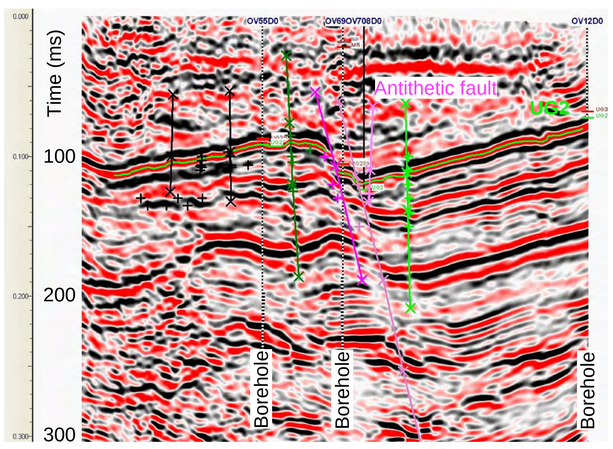
3D interpretation





Time slice shows strike of UG2 and structures affecting it.

Interpreted 2D seismic section



Boreholes have good correlation with UG2 reflector

60m fault imaged with associated drag

<u>Results were structurally sound</u>

The main Middle Fault was known but not included in the mine initial planning and the other faults were only detected by this 3D seismic survey.

The vertical resolution helped to resolve fault throws of 10m, a small pothole on the East of the survey and a series of small faults mainly North South but one East West on the West of the Middle fault.

While the cost of boreholes has increased over the years, 3D seismic has not followed the same trend. With 3D seismic acquisition techniques being more and more productive we are able to maintain the price of 3D seismic. The paradigm that boreholes are a cost effective manner to de-risk mining activities can be questioned with regards to these 3D seismic achievements.

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MODIKWA PLATINUM MINE