PGC Group Pty Ltd trading as

PGC Geophysics

3D Inversion Modelling of magnetic and gravity data

Inversion modelling of magnetic and gravity data is a *fast and low cost method* of creating 3D models of the subsurface geology. Suitable data ranges from freely available government surveys to high resolution proporetary surveys.

PGC Geophysics offers 3D inversion analysis based on magnetic, gravity and EM data to model mineral, oil & gas, and geothermal targets and resources

The unconstrained inversion produces a 3D model with an optimum balance between matching the geophysical data and a simple model of the geology as possible. The complexity of the geological model can be increased by applying geological information and additional data, to run a constrained inversion.

Applying geological concepts to the inversion results produces likely 3D models of the subterranean structures at a *low cost* and with a *fast turn-around*. The inversions will be better constrained and will produce results with higher confidence if any available depth information is included eg. 2D seismic or wells.

PGC Geophysics operates its own rack-mounted cluster of highperforming Xeon CPUs running.

Contact Ron Palmer 0413 579 099 or ron.palmer@pgcgroup.com.au for an assessment of any public domain data covering your project, and to give indications on likely results.

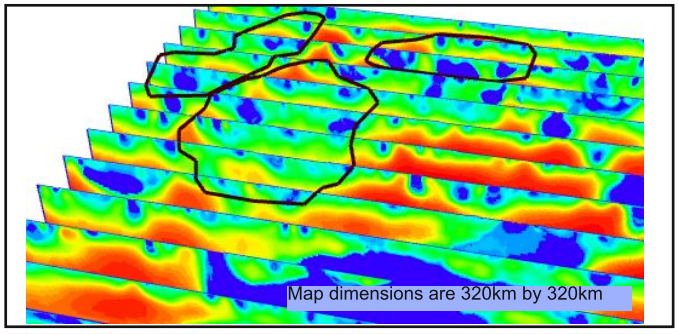
Case Study 1 - Shale Gas structures

The objectives in Case Study 1 were to define likely structures that were prospective for unconventional hydrocarbon reservoirs, and to assist in planning seismic surveys to assess the permits. The freely available magnetic and gravity data were modelled and integrated with the geological knowledge of the area.

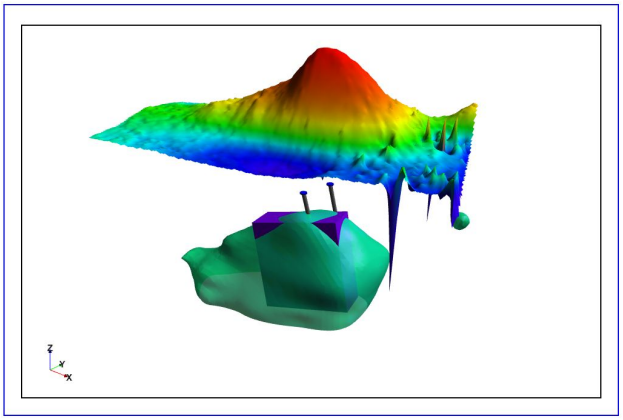
The results are presented in sections in the upper image (red represents more magnetic rocks than blue) and an iso-surface of magnetic susceptibility indicating magnetic basement (blue represents deeper than red), is in the lower image. The results detailed several sub-basins, overlaid as 3D targets for future programs.

Case Study 2 - mapping basinal structures

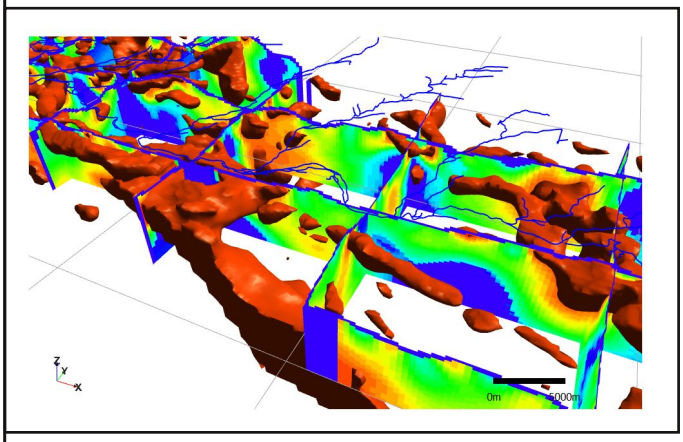
The objective of Case Study 2 was to define likely structures that were prospective for conventional and unconventional hydrocarbon reservoirs. Seismic data were available on the western margin and an area to the far south, shown in blue. The



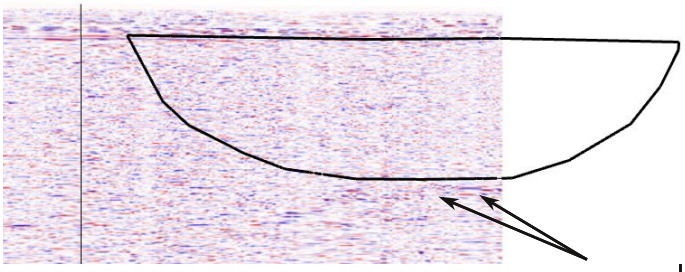
project area was 230km long and 440km wide. It had a solid cover of magnetic data, but only wide station gravity data, all sourced at no cost from Geoscience Australia. Interpretation of the results suggested several possible basin style synclines of which six have been mapped in 3D from this inversion modelling. The first image presents the interpreted sub-basins (dark red) over an image of gravity with ava

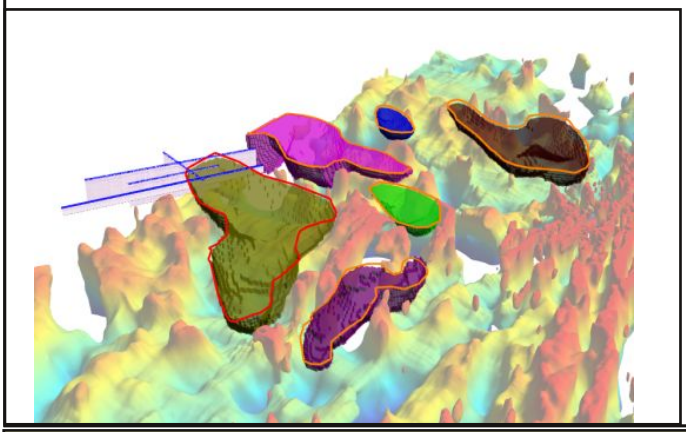


ilable seismic lines (in blue). The second image is a 3D view of the inversion model of the magnetic data with the interpreted basinal structures, as well as one of the seismic lines included as a section.



The intersection between one of the basins and the middle NE-SW seismic line is displayed below. There are a few horizontal events, see arrows, in support of the model, but otherwise there are few distinguishable features below the shallow to deeper sediments interface as processing was optimised for these shallow sediments. The section outlined is 18km wide and 4km thick, and its top is located at 1.2km depth.





Inversion modelling

is a process of providing the results, the field measurements, and calculating the cause, the geology. Inversion modelling solves the inverse problem by minimizing a global objective function, φ:

$$\min\varphi = \varphi d + \beta\, \varphi m \qquad \text{s.t. } \kappa l \leq \kappa \leq \kappa u$$

created from the combination of a data misfit term, φd, (the degree that the resulting model matches the survey data) and model objective function, φm, (the degree that the resulting model matches a reference model and any other geological or petro-geophysical data). The trade-off parameter β balances the data fit and model smoothness. The model is specified in a mesh of rectangular cells, each with a single, constant value of susceptibility. The magnetic response can then be calculated anywhere above the model volume to simulate or compare with ground or airborne surveys.

PGC Geophysics is a geophysics consultancy offering services in the minerals, coal, Oil & Gas and engineering geophysics markets. Its services include:

- Sedimentary basin modelling, CSG, Oil & Gas
- Geophysics survey design
- Survey management and quality control
- Interpretation and targeting
- Survey scale 3D inversion modelling

PGC Geophysics operates its own small cluster of rack-mounted Xeon computers to generate inversion results, and interpretaton and integration with available geology. Based in Brisbane Australia, the company has wide experience from a multitude of terranes and countries including Australia, Canada, Africa, Russia, China, and the Pacific Rim.

For more information contact
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