Paradigm®

Paradigm Plays an Essential Role in the GNS Science 4D Taranaki Project

The Background

The 4D Taranaki project is being conducted by GNS Science, a leading provider of earth, geoscience and isotope research and consultancy services in New Zealand. This project aims to improve understanding of the general geology, tectonic evolution and petroleum systems in the Taranaki and adjacent basins, and provide this information as state-of-the-art digital products for immediate assimilation by the petroleum industry and others.

Taranaki is currently the only sedimentary basin in New Zealand with commercial hydrocarbon production. The basin remains the focus of a considerable effort to find more petroleum reserves, necessitating the collation and communication of up-to-date information about its geology. The last comprehensive open-file accounts of the tectonic framework, depositional sequences, lithostratigraphy and petroleum systems of the Taranaki Basin were undertaken in the mid 1990's (e.g. Armstrong et al., 1996; King and Thrasher, 1996).

The Kupe mapping area was the pilot for seven offshore regions to be seismically mapped as part of the GNS Science 4D-Taranaki Project.

Seventeen seismic horizons were identified within the basin-fill succession, and were mapped on the basis of observed bounding discontinuities (allostratigraphy). These horizons were depth converted to derive structure and isopach maps that illustrate the distribution and thickness of the mapped sequences, from which new insights into the structural and depositional history of this part of the Taranaki Basin can be drawn.1 The project will also spawn a number of associated derivative products, such as 4D petroleum system models and structural restorations.

The Challenge

The size of the Taranaki Basin is roughly 330,000 km2. GNS Science's Taranaki seismic database currently contains more than 2000 2D seismic lines and 10 3D seismic datasets. In addition, a database of over 400 onshore and offshore wells is being updated on an ongoing basis.

Long-term integration of large, multi-disciplinary datasets and interpretations plays an important role in the development of basin-scale 3D static and 4D dynamic models of the petroleum generation and migration through time. A consistent workflow, robust metadata catalog and consistent data archiving protocols, including data types, sources, inter-dependencies and editing versions, is essential in projects of this scale.2

The 4D Taranaki project involves a multi-disciplinary team of 10 to 15 scientists, including geologists, geophysicists and paleontologists. The initial research utilized various specialist and industry-standard software packages. The mix of software soon created many complications, such as a lack of multi-user functionality, difficulty keeping various databases up to date, or simply linking interpretations from other areas into the Taranaki Basin. This led to an unproductive situation where significant amounts of time, effort and expense were spent managing and maintaining the various databases, and transferring and QC'ing data. In addition, the incumbent modeling solution, utilizing 'pillar gridding' technology, was incapable of accurately representing the variety of structural styles and fault architectures that typify the Taranaki Basin.

[1] Fohrmann, M., Reid, E., Hill, M. G., King, P. R., Zhu, H., Bland, K. J., Strogen, D. P., Roncaglia, L., and Scott, G. P. L., 2012, Seismic reflection character, mapping and tectono-stratigraphic history of the Kupe area (4D Taranaki Project), south-eastern Taranaki Basin, GNS Science Report 2012/36, p. 66, 1 CD.

[2] Roncaglia, L., Milner, M., Baur, J. R., Fohrmann, M., Kroeger, K. F., Strogen, D. P., Zhu, H., Arnot, M. J., Bland, K. J., Bushe, H., Funnell, R. H., Ilg, B. R., Hill, M. G., Jones, C. M., King, P. R., Leitner, B., Morgans, H. E. G., and Reid, E., 2010, Procedures and metadata protocols used in modelling Taranaki Basin petroleum systems : guidelines from a pilot case study in the Kupe area, Lower Hutt, GNS Science, GNS Science report 2009/49, p. 70.

The Solution: An Integrated Software Product

After a review of available commercial solutions, GNS Science selected the ParadigmTM software solution. Paradigm provides a robust database (Epos®) with excellent data security, and can be accessed simultaneously by multiple users (seismic interpreters or geo-modellers). The Paradigm SeisEarth® multi-survey, regional-to-prospect interpretation system incorporates 2D and 3D seismic visualization and interpretation capabilities, while the GOCAD®/SKUA® modeling suite is able to generate full 3D models from datasets created in SeisEarth, which can be populated with geological attributes (Figure 1).

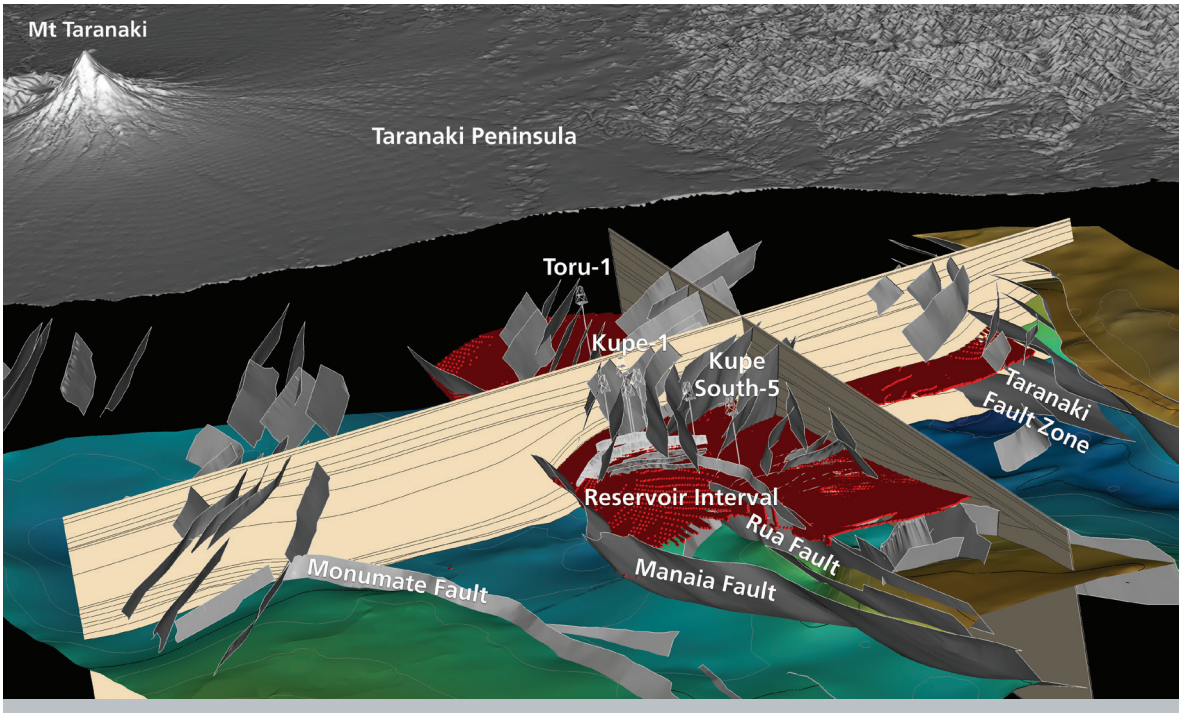
The Benefit

Since adopting the Paradigm technology, GNS Science has benefitted from significantly shorter interpretation and modelling time, with more accurate results.

The ability to interpret a huge amount of 2D seismic data in a 3D environment has proven to provide excellent quality control and enabled enhanced understanding of the geology in a 3D sense.

The SKUA/GOCAD system has made model building much easier for GNS Science geoscientists. Using GOCAD, the geoscientists have been able to obtain a good velocity model for time-to-depth conversion, while the latest version of SKUA has enabled them to build static models with a higher degree of fidelity and accuracy than was previously achievable. Some of the GNS Science interpreters have also started building models using the advanced SKUA Modeling While Interpreting (MWI) feature, for even greater time savings.

Faster and easier access to shared data in the Epos data management system by multiple users and different teams has resulted in better integration of reliable data, workflow efficiency and data appraisal within a shorter cycle time. All of this has helped GNS Science extend its seismic and well database to include data from over 22 sedimentary basins within New Zealand's exclusive economic zone (EEZ) that covers approximately 1,700,000 km2.



▲ Figure 1: Subsurface structural GOCAD model of the Kupe and Central region within the Taranaki Basin. The top basement surface is shown and the reservoir interval of the Kupe field is annotated in red.

References:

Armstrong, P. A., Chapman, D. S., Funnell, R. H., Allis, R. G., and Kamp, P. J. J., 1996, Thermal modeling and hydrocarbon generation in an active-margin basin; Taranaki Basin, New Zealand: AAPG Bulletin, v. 80, no. 8, p. 1216-1241.

King, P. R., and Thrasher, G. P., 1996, Cretaceous-Cenozoic Geology and Petroleum Systems of the Taranaki Basin, New Zealand., Lower Hutt, New Zealand, Institute of Geological and Nuclear Sciences, Institute of Geological and Nuclear Sciences Monograph 13, p. 243, 6 enclosures.