

Latest Developments In Stratigraphic Forward Modelling

Scientists at CSIRO Petroleum are using the latest Stratigraphic Forward Modelling (SFM) technology to help geoscientists and engineers 'visualise' the location of stratigraphic traps and predict reservoir quality on Australia's North West Shelf.

SFM can produce a 3D simulation of sedimentary deposition over geological time periods on grid sizes ranging from metres to kilometres. The model used by CSIRO is a modification of Stanford University's original Sedsim program - a hydraulic process-based 3D program which numerically replays the erosion, transport and deposition of sediment in a basin over geological time.

Since 1994, Sedsim has been under development and modification in Australia and has been applied to a number of regional scale exploration problems with the support of several major oil companies.

According to CSIRO Petroleum's Dr Cedric Griffiths, Sedsim generates a 3D distribution of sediments of up to six different grain sizes plus carbonate, and typical exploration projects cover areas of 1 to 400 km² with resolutions of 2 to 5 km. When used for field studies, the area is of the order of 10 x 10 km at a resolution of 50 to 100 m.

"We generally run the simulator over 10 to 20 million year intervals with time steps of 5 to 20,000 years", Dr Griffiths says.

"The resulting model can then be viewed using animation to create a better understanding of the depositional history and lateral changes in sediment type and reservoir quality.

"The stratal patterns and lithofacies continuity within the simulated sedimentary bodies are influenced by different combinations of input parameters, such as sediment supply, sea

level changes, tectonic subsidence and wave action. The simulation output, at each grid node, consists of the preserved succession of time layers each characterised by the thickness of each grain size unit and carbonate content."

SFM can be used to predict sand / seal location and quality within a licence area, visualise a conceptual deposition model, communicate a model to management or engineers, choose between alternative depositional models for a reservoir, provide deterministic stratigraphic surfaces as the basis for geostatistical reservoir characterisation and model complex heterogeneity.

Dr Griffiths and his team of geoscientists have already worked with Woodside, Mobil, Texaco and Shell in applying Sedsim to hydrocarbon exploration and production problems in Australia and are currently the only organisation conducting 3D SFM simulations at a regional scale on a contract basis.

Problems already addressed by Stratigraphic Forward Modelling on the Australian North West Shelf include:

- Where can we expect better quality sands in the Kendrew Trough? (140 x 40 km model, 1 km², 10 ka resolution, 2 Ma of Oxfordian deposition).
- What is the likelihood of deep marine sands in the Inner Browse Basin? (300 x 200 km model, 5 km², 20 ka resolution, 6 Ma of Neocomian deposition).
- The constraints on the Barrow Delta depositional system (485 x 280 km model, 5 km², 20 ka resolution, 7 Ma of Neocomian deposition).
- Where can we expect better quality sands around the Yampi/Shelf Cornea? (320 x 250 km model, 4 km², 20 ka resolution, 12 Ma of Aptian-Albian deposition).

Plans for Sedsim development in the near future include: the ability to use variable resolution grids, a greater number of grid cells (currently limited to 150x150x1000), integration with proprietary tectonic modelling, organic maturity and hydrocarbon migration software, organic material (peat) and aeolian modules.

CSIRO Petroleum is currently inviting interested companies to participate in a multi-client research project which will use SFM to predict sediment entry points, and distribution of reservoir and seal lithologies in the Neocomian of the Australian Northwest Shelf, with the area including the Carnarvon, Browse and Canning Basins.

Dr Griffiths believes the increasing exploration maturity of the North West Shelf means increasing emphasis will be placed on stratigraphic traps, especially near existing infrastructure.

"The project will use Sedsim to show the development of potential stratigraphic traps over the Northwest Shelf and Browse province areas during the Neocomian (Base Cretaceous to Top Hauterivian)", he said.

"Maps of net:gross throughout the area, Common-Risk-Segment (depositional only), intraformational seal character, total sediment thickness for each biozone, and Neocomian play fairway maps will be produced at appropriate scales."

Project details can be obtained from Dr Griffiths via phone +61 8 8303 8787 or email: cedric.griffiths@per.dpr.csiro.au. Further information and examples of simulations can be found at CSIRO Petroleum's web site at <http://www.petroleum.csiro.au>