dGB++ Newsletter of dGB

March 2004

dGB++

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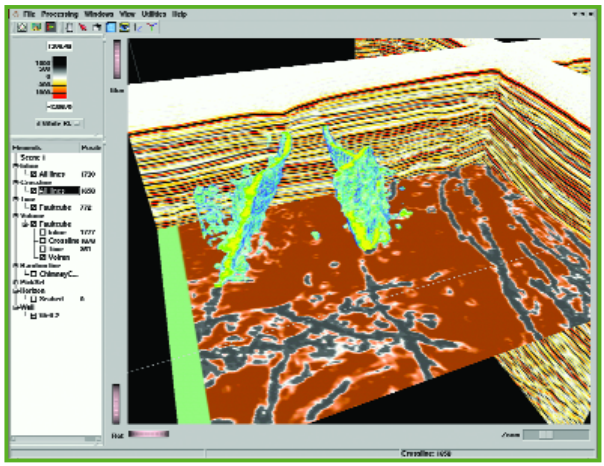
Flying start for OpendTect



Fault enhancement by neural network technology and 3D-visualisation by volume-rendering

OpendTect, our Open Source seismic interpretation and development environment received a warm welcome by industry and academia alike. Since the first release early November, the software has been downloaded more than 2000 times! To streamline communications with the vastly expanding community three new mailing lists are maintained: "announce", a low traffic list to announce new releases, a "users" list and a "developers" list. Meanwhile, the development of new features continues and resulted in several major releases.

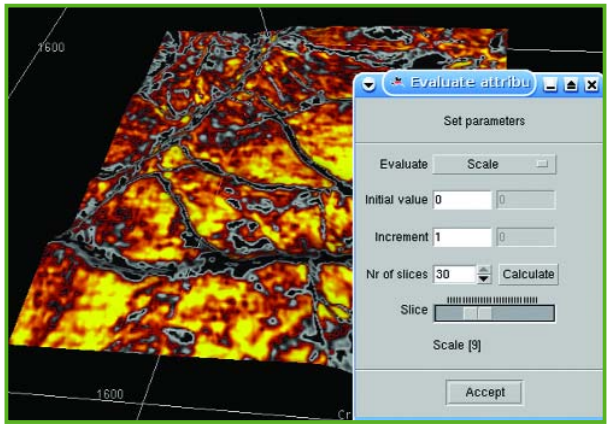
2000+ downloads since Nov. 2003

Website

To join one of the mailing lists, or to download the software, please visit the www.opendtect.org website. OpendTect is released under an Open Source license agreement, which states that the software is free for R&D and education. Commercial usage is subject to a modest maintenance fee. OpendTect is released without license manager restrictions and runs on PC-linux, Sun-Solaris, Sgi-Irix and PC-Windows (XP/NT/2000). The functionality can be extended at runtime by adding (free or commercial) plugins.

Spectral decomposition

BG-Group, Wintershall and JGI sponsored the development of spectral decomposition and graciously allowed the new functionality to be released under the Open Source scheme for the benefit of the entire community. In spectral decomposition the data are transformed to the frequency or wavelet scale domain. Objects, such as fluid-contacts, or stratigraphic features may be better visible at certain frequencies (scales). In OpendTect, spectral decomposition is implemented as yet another attribute. Frequencies (scales) can be inspected in movie-style fashion on any visualization element in the system. Typically this is done on mapped horizons to illuminate zones of interest. Subsequently, new (sub-) volumes can be created for components that reveal interesting features. Two algorithms are supported: Short Time Fourier Transforms (STFT) and Continuous Wavelet Transforms (CWT).



Spectral decomposition: interactive inspection of different scales (frequencies) along a mapped horizon.

You are hereby kindly invited to the first

OpendTect Breakfast meeting
Tuesday 8 June, 7:00 - 9:00am
venue: EAGE Paris, Salle Hemisphere

RSVP
Herald.Ligtenberg@OpendTect.org

IN THIS ISSUE

Company news

New Faces

Menno Dillen is our new 4D and rock-physics specialist. Menno joined the case studies department in Enschede in Januari 2004 as a Senior Geoscientist. He studied in Delft where he received M.Sc. and Ph.D degrees at the Technical University. His Ph.D research was on time-lapse seismic reservoir monitoring of production-induced stress dynamics. He continued with post-doc positions in Delft and the University of Texas in Dallas.

Ph.D Kristofer Tingdahl

On April 2nd Kristofer Tingdahl will defend his Ph.D thesis on Semi-automated detection and extraction of seismic objects at Göteborg University. Kristofer's Ph.D work was sponsored by dGB and much of Kristofer's work is now part of OpendTect. Kristofer will continue to work for dGB after his graduation. Copies of Kristofer's thesis can be obtained via info@dgb-group.com.

New developments

We are currently working on the following new functionalities:

Horizon & fault tracker

A semi-automated horizon and fault tracker is under development that will simultaneously track multiple surfaces in a spatially consistent manner (meaning fault - and horizon patches connect without crossing). See page 4.

GDI and OpendTect

We are developing a new workflow in which spatial locations are assigned to GDI's stochastic pseudo-well simulator. This allows pseudo-wells to be combined with OpendTect multi-trace attributes and opens various possibillities for volume reservoir property predictions and uncertainty measurements.

OpendTect SSIS

dGB, TNO, BG and Statoil have teamed up to develop and test a sequence stratigrapic interpretation system (SSIS). This two-year project has been awarded Eureka status and receives significant funds from the Dutch government. New sponsors are welcome until 31 April 2004. For more info, please contact paul.degroot@dgb-group.com or fred.aminzadeh@dgb-group.com.

Chimney cubes for basin modeling

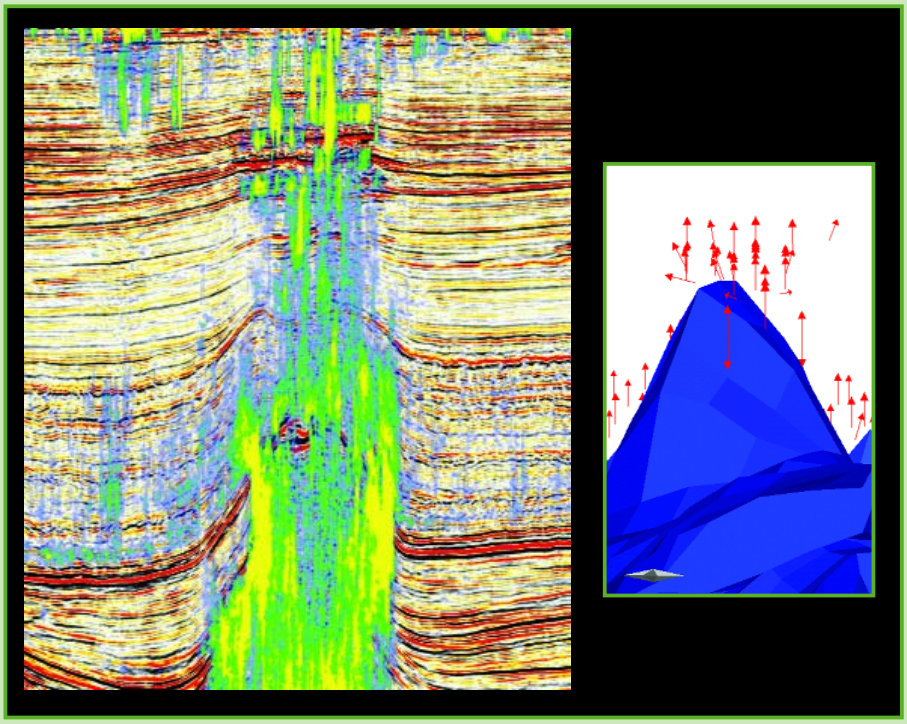


Figure 1. Chimney activity over a salt diapir (left) indicating escape of fluids at the top of the structure. The picture on the right shows modeled gas escape over the salt diapir.

Basin modeling or petroleum systems modeling has a long history of contributing to hydrocarbon exploration. The technology has been through periods of glory and periods dominated by scepticism. Today the technology is well established and recognised as an integral part of the exploration workflow.

When the petroleum technical evaluation has reached the prospect level the majority of the evaluation is concentrated on size of closure, reservoir properties and to some extent seal capacity. At the time of risking and ranking the hydrocarbon charge often receives less attention and little regard is paid to the four key charge elements necessary for a successful hydrocarbon filled reservoir to exist:

- *hydrocarbon generation*
- *expulsion*
- *migration*
- *accumulation*

Modeling the petroleum system is therefore essential when assessing these dynamic aspects of oil and gas accumulations. The timing of hydrocarbon generation, expulsion, migration, trap formation, accumulation and preservation are all parameters being evaluated prior to any commitment to drill an exploration well. Evaluation of charge is an integral part of the evaluation procedure.

Integrating fluid migration path detection and basin modeling

As with all predictive tools there is no certainty. Although a typical 3D model includes all available knowledge and information and is based on the best possible interpretations of seismic and well data, the results may seem reasonable but never certain.

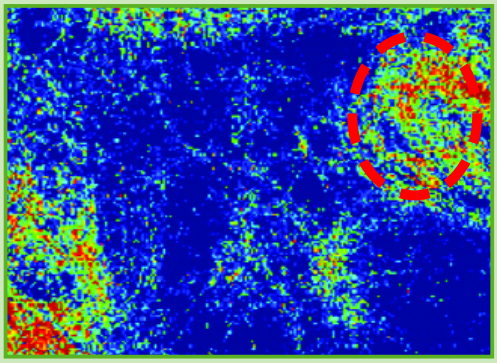
Hydrocarbon exploration is in many ways similar to early stages of criminal investigations driven by circumstantial evidence and one is always looking for

additional supporting evidence. The 3D Chimney Cube where vertical features resulting from neural network-based pattern recognition are interpreted as zones of higher vertical fluid flux may provide such additional supporting evidence (fig. 1). The chimney cube appears to be detecting fluid movement in the subsurface. Not only vertical fluid movement stands out in the Chimney Cube but also areas where hydrocarbons are being generated and expelled can be interpreted (fig. 2 and 3). The combined 3D modeling and special chimney cube processing offers not only potential identification and mapping of possible hydrocarbon migration pathways but also delineation of areas of mature source rocks.

Interpreting migration pathways and identification of source rocks

The integration of the seismic Chimney Cube with the 3D modellng tool (PetroMod 3D from IES) adds a new dimension to petroleum systems modeling. The chimney cube may be able to substantiate the modeled areas of active hydrocarbon generation, thus providing additional evidence for delineation of areas with mature source rock. In the same way modeled migration patterns may be supported by activity patterns in the chimney cube. In the calibration phase where the modeling results are fitted to known accumulations, the chimney cube provides additional insight into the location of possible entry points linking the source rock to the carrier system. Knowledge of how source rocks are linked to the source is essential for correct modeling of migration patterns and subsequent prediction of hydrocarbon accumulations. The combination of the two technologies has proven beneficial to the understanding and prediction of essential elements of the petroleum system.

Basin modeling images have been generated with Petromod from IES



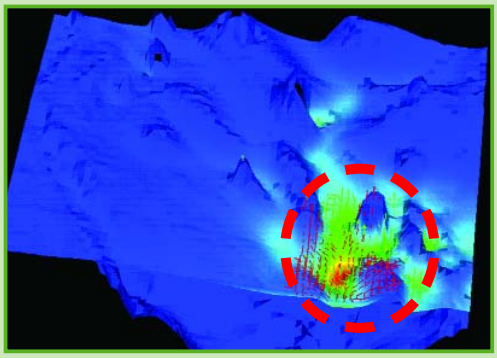
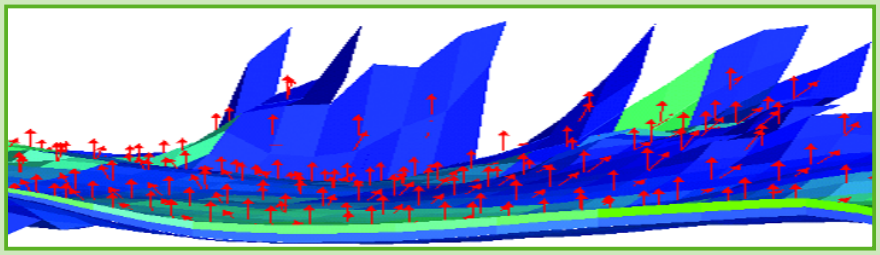
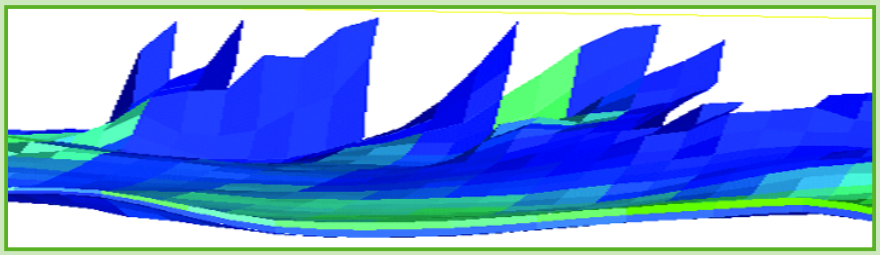


Figure 3.
Top: horizon slice through the chimney cube showing distinct areas of higher activity.
Bottom: modeling of expulsion and migration from the same area.





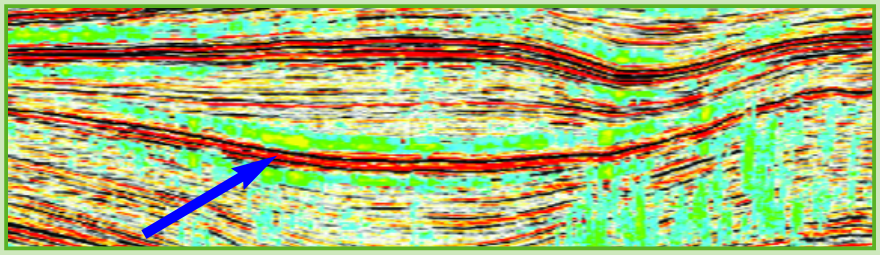
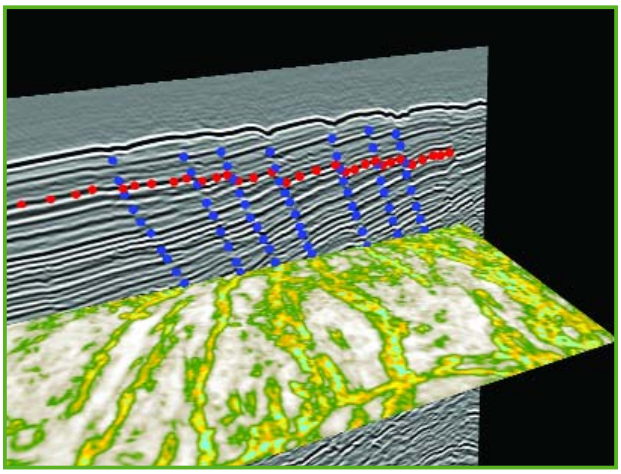


Figure 4. The picture at the bottom shows increased chimney activity around an interpreted Upper Jurassic source rock (red arrow) indicating possible generation and expulsion of hydrocarbons. The picture in the middle shows modelled gas leakage from the source rock (blue no gas escape and green high gas escape). The top picture shows the same as the middle but with flow arrows for the gas.

This is a contribution from one of our basin modeling customers.

For more information: visit us in the IES stand at the AAPG annual meeting, Dallas, April 18-21, 2004 or contact us: info@dgb-group.com

Simultaneous tracking of horizons and faults



Seed interpretations are made by the interpreter.

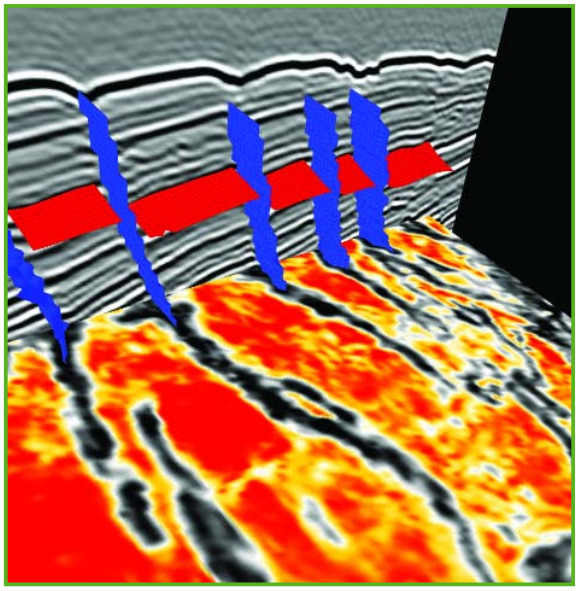
dGB is currently developing a seismic horizon and fault tracker that will lift OpendTect from a seismic attribute processing and visualization system to a fully-flexed interpretation system. The tracker that will be released Q2 2004 grows multiple horizons and faults simultaneously in a spatially consistent manner. This leads to a reduction of post-interpretation editing efforts, thus faster turn-around as well as improved accuracy. The tracker is part of a new seismic interpretation workflow in which the user continuously interacts with the data and checks the surfaces as they grow and corrects them when necessary.
The workflow starts with seed interpretations that are manually picked by the interpreter. Seismic data and attributes are selected and tracking parameters and termination constraints are set per event. Surfaces grow in a user-driven direction as the interpreter drags an interpretation plane through space. At every point in the workflow the user can add new surfaces and correct the interpretation by manual editing, backtracking and restarting the tracking.

Planned release Q2 2004

Free version & commerical extensions

Method
When the interpretation plane is dragged to an adjacent section, the edge of the surface is copied to the new section. Alternatively, a more intelligent guess of the actual interpretation can be made by following the local orientation of the tracked surface or the tracked data. This local orientation information is derived from pre-calculated steering cubes.

Once the initial extension of the tracked data is created, the vicinity of the initial extension is searched to find the best positions. This search is performed by maximizing a score function that depends on the position of the expanded surface itself, and the tracked data. When all active surfaces are expanded and optimized, the extensions are checked for geometrical inconsistencies, and corrected where necessary.



Surfaces are grown by dragging the interpretation plane in a user-driven direction. The user Q.C.s and corrects when neccessary.

dGB intends to release the event tracker as part of the OpendTect base system under the Open Source license agreement. The basic tracker can be extended with commercial plugins for more advanced work, e.g. using dip-steering and neural networks.

Visit us on the internet at http://www.dgb-group.com

Publications

The following is a selection of recent publications and forthcoming talks by dGB staff.

Articles

Aminzadeh, et.al, 2004. **Soft Computing for qualitative and quantitative seismic object detection and property prediction.** Part 1: Neural network applications, Part 2: Fuzzy logic applications, Part 3: Evolutionary computing and other aspects of Soft Computing. First Break March, April and May, 2004.

Poster

Connolly, D., Aminzadeh, F. and Ligtenberg, H., 2004. **Reducing seal and charge risk by detecting fluid migration paths using seismic data.** 2004 AAPG annual meeting, Dallas.

Mailing list

If you are not on our mailing list yet please contact us via telephone +31 (0)53-4315155, fax +31 (0)53-4315104, or e-mail info@dgb-group.com