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Global Interpretation and Modeling: the Holy Grail

A volume-based modeler accepts any number of partially interpreted reflectors as input to produce a geologically consistent model.

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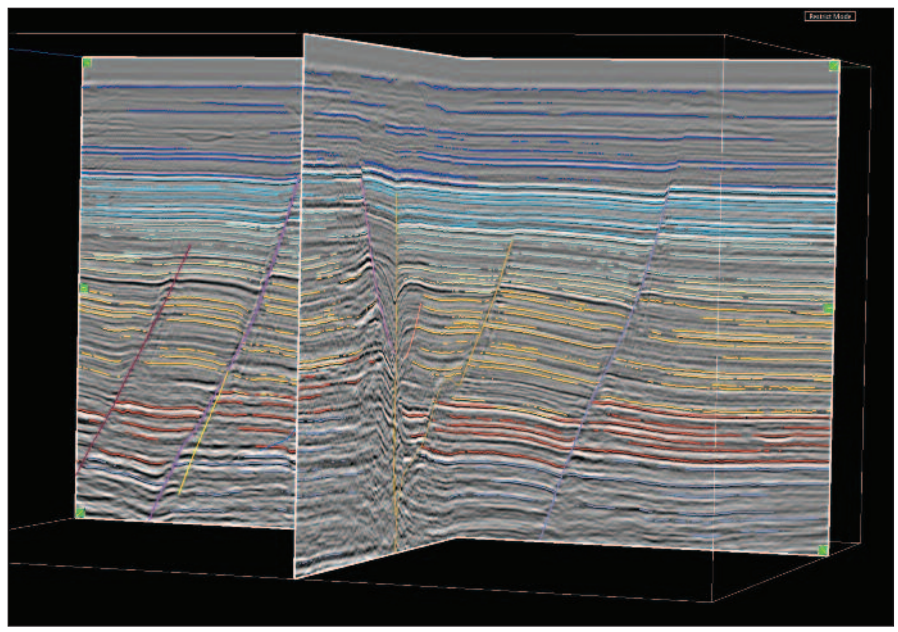
In recent years, the quality of seismic volumes has increased tremendously due to better acquisition techniques and improved seismic processing algorithms. The amount of stratigraphic details in these volumes has also improved proportionately. This, in addition to the size of seismic data lines and surveys, has created a significant challenge for seismic interpreters and their prospect generation deadlines. To alleviate this problem, interpreters have come to rely on automated or semi-automated tracking tools. For faults, seismic attributes (e.g. semblance) are computed and faults are auto-tracked either globally or one by one. For horizons, correlation-based techniques are now commonly used with extended implementations to support automatic seeding and simultaneous autopicking and even semi-automatic correlation.

At the same time, even if all the reflectors can be picked, it is mainly an "academic" exercise since most of the commercial modeling solutions cannot make use of all this information. One of the fundamental reasons that they cannot use this information is that the modeling tools are primarily horizon-based and horizon-constrained. To solve this issue, Paradigm is offering a volume-based modeler, SKUA, that can accept any number of partially interpreted reflectors as input and use them to produce a geologically consistent model that can honor all the stratigraphic details. The tool is based on a paleogeographical transform called the UVT transform.

This global interpretation and modeling solution follows a 25-year Paradigm tradition of bringing innovative technology to the exploration and development market.

The proposed workflow is intuitive and remarkably simple. The user interprets the faults, either by hand or using automatic or semi-automatic tools. The user can then model the faults using the SKUA modeler without having to simplify any of the complexity of the fault network. The user then transitions to horizon interpretation.

For the automatic approach, seeds are placed across the entire survey, and reflectors are tracked automatically using the "3-D propagator" technology or other technologies. The fault network can be used to make sure the propagation of the horizon patches are not leaking through. The user can edit and correlate patches and transform some of them to horizons. Horizons are key as they define the stratigraphy column that will guide the interpolation process of the stratigraphy. The user has full editing capabilities on any of the patches and also can incorporate manual interpretations with it. Then the full 3-D model is built by a simple click of a button using all of the data available, including even the smallest patches. The final model is a full perfectly sealed structural model including all of the faults and all the horizons without any simplification of the data.



In this example of fully automatically picked reflectors, each color shows different stratigraphic units as set by the user. One can note also the use of the modeled fault to ensure better autotracking. All of that information is used to build a full 3-D model that will closely fit the seismic information thanks to the UVT transform. (Image courtesy of Paradigm)

It is important to note that the interpretation and modeling process is an iterative loop. To validate the wealth of interpretation data and the model, Paradigm is proposing another innovation: the paleo-flattening space, based on the UVT transform. Once the model is built, a single click of a button places the seismic data, the well data, and all of the interpretation data in a Wheeler space where all of the fault displacements are removed and all of the horizons are flat. Unconformities are represented by void volumes. The user will look for nonflat seismic events in the volume, making the quality control obvious.

All of these steps and processes are integrated in a single straightforward workflow on top of a multiuser database. The benefits of such a workflow are numerous:

- Accelerated interpretation. The workflow offers to automatize anything that can be done automatically;
- Automatic reflector correlation. Interpreters are spending a huge amount of time trying to match seismic reflectors on each side of a fault. The UVT transform, based on geological rules, provides a valid solution for this;
- Use of all the data, even partial reflectors. This is key, especially in areas where the seismic events are not continuous or well-correlated (subsalt, oil sands, complex stratigraphic plays, growth faults, etc.);
- A fully unified model for velocity modeling, inversion, geological modeling, reservoir modeling, or even geomechanics; and
- A flatten volume where each slice is a stratigraphic slice. This usually reveals hard-to-spot stratigraphic features that are easily missed on a regular volume.

With the global interpretation and modeling workflow, the user has full control on decisions and the knowledge to make the right decisions. The innovative technologies are provided as enablers or facilitators to meet the demanding data requirements and project deadlines of the interpreter. ■

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