Paradigm®

SKUA®

Structure and Stratigraphy

Interpretation and Modeling

A Need for Change

The search for hydrocarbons takes place in a broad range of geological settings. Geoscientists face constant challenges in the characterization and modeling of subsurface geology, and new demands for increased accuracy and detail. Traditional modeling processes are limited by their design constraints, and can only operate through compromises and approximations. Outdated techniques, using pillar-based 3D modeling, fail in the presence of Y faults, oblique faults or thin layers. Until now, the workaround has been to simplify the fault geometry or to remove faults from the model. Pillar-based techniques also introduce deformations of the grid cell geometry, which adversely affect the distribution of petrophysical properties and the reliability of flow simulation results.

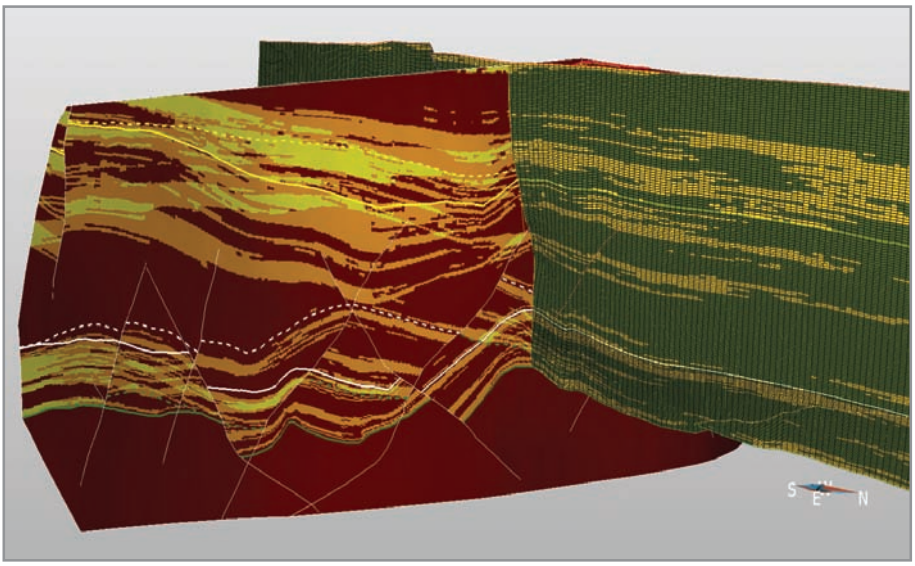
A Revolution in Modeling

Paradigm™ has met this challenge through the development of a mathematically-derived 3D methodology, known as the UVT Transform, that decouples the model from the grid and removes subsequent limitations and distortions. Enabled by Paradigm SKUA® (Subsurface Knowledge Unified Approach) the UVT Transform generates a fully-3D description of the subsurface, including the structure, stratigraphy, geological grid, and flow simulation grid.

A Model with Many Uses

In addition to the comprehensive description of the subsurface, the direct output of the SKUA UVT model can be used to compute a wide variety of structural attributes that facilitate fault trap and fractured reservoir analysis. These include:

- Displacement maps everywhere on the fault surface
- Juxtaposition maps
- Shale-gouge ratio and weighted-shale-gouge ratio on faults
- Spill points
- Deformation of layers, strain and stress
- Probability of fracturing and direction of fractures



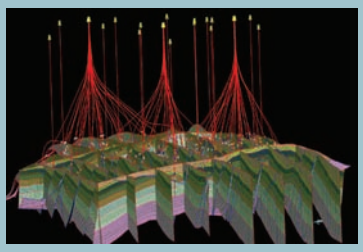
Facies juxtaposition, branching faults and horizon traces on a fault surface, computed on a geologic grid

UVT Transform®: A New Understanding

The UVT technology is based on the understanding that horizons represent paleo-geochronological surfaces. Working with a paleo-geographically non-deformed grid, geoscientists can model geobodies, reservoir properties and other attributes in their true depositional state without distorting the current geometry or paleo-geometry.

The geological constraints under which the SKUA UVT model operates provide the interpreter with confidence that the model honors basic geological principles, including:

- Seismic interpretation data and well markers
- Dip/azimuth information anywhere in the volume
- Well path information
- Fault type (normal, inverse) information
- Sequential stratigraphic and erosion rules
- Intra-formation chrono-stratigraphy



SKUA geological grid created using UVT Transform techology

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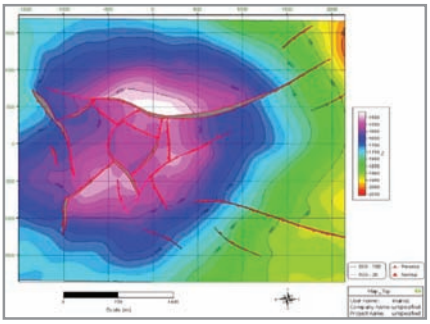
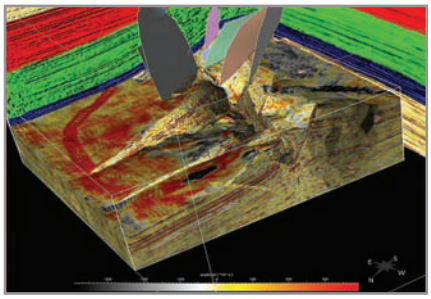
Workflow Optimization

The intrinsic knowledge contained in the UVT model enables a one-click generation of many types of data representations required for a variety of workflows:

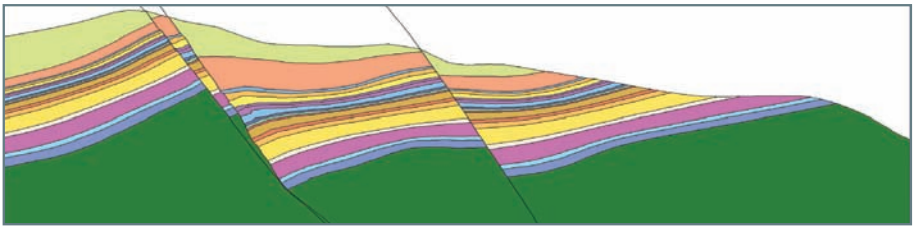
- 3D geologically consistent maps are automatically constructed from the faulted and sealed horizons, saving time and improving accuracy when compared to traditional 2D mapping.
- An infinite number of faulted chrono-stratigraphic seismic slices can be extracted directly from the UVT model, enabling a quick and efficient interpretation of stratigraphic formations.
- Paleo-flattening of seismic volumes can be performed in order to QC the interpretation and the UVT model, and ensure proper use of seismic attributes inside the reservoir model.
- 3D paleo-geographically consistent geological grids can be computed directly from the UVT model and populated with geologically coherent rock properties, with no need for user interaction.
- SKUA delivers reservoir grids optimized for reservoir simulation, including all necessary faults. These can be extracted directly from the UVT model.
- Geomechanical meshes for coupled flow-geomechanical simulations may be exported directly, reducing the need to perform time-consuming, finite element mesh construction.
- 4D basin modeling grids can be created, using a combination of the SKUA model and Paradigm 3D restoration to construct a present-time grid of the basin, and to restore it sequentially and automatically through geological time.



3D consistent structural map from SKUA model



Faulted chrono-stratigraphic slice inside SKUA model highlighting stratigraphic features



SKUA geological cross-section

Features

- Automatic fault network construction
- Faulted horizons extended up to fault planes to create seal models
- Horizon position constrained by well path, even for horizontal wells, and fault displacement information
- Fit to well markers, for reviewing seismic interpretation to well mismatch
- Automatic identification of fault/ fault contact and manual editing
- Horizon/fault contact editing
- Fault displacement and juxtaposition maps, Smear Gouge Ratio
- Computation of thickness maps, gross-rock volume
- Horizon deformation computation
- Fracture probability computation
- Output of T-surfaces to SeisEarth®

Interoperability

All Epos®-based applications enable interoperability with third-party data stores, including:

- OpenWorks® 2003.12, R5000
- GeoFrame® 4.5
- OpenSpirit® 3

System specifications

- 64-bit, for x64 architecture processors
- Microsoft® Windows® 7, XP, Vista
- Red Hat® Enterprise Linux® 5.3 and above, 6.0 and above

The Paradigm Advantage

+ SKUA delivers a true shared earth model with many direct uses, faster processing cycles and higher consistency.
+ Avoids deformation, incorrect spatial correlations and wrong volumetrics common to pillar modeling approaches.
+ Uses all available data and enforces geologic rules to ensure model accuracy.

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