Structural Framework Workflows for Petrel 2018

Module 8: Structural gridding for depogrids

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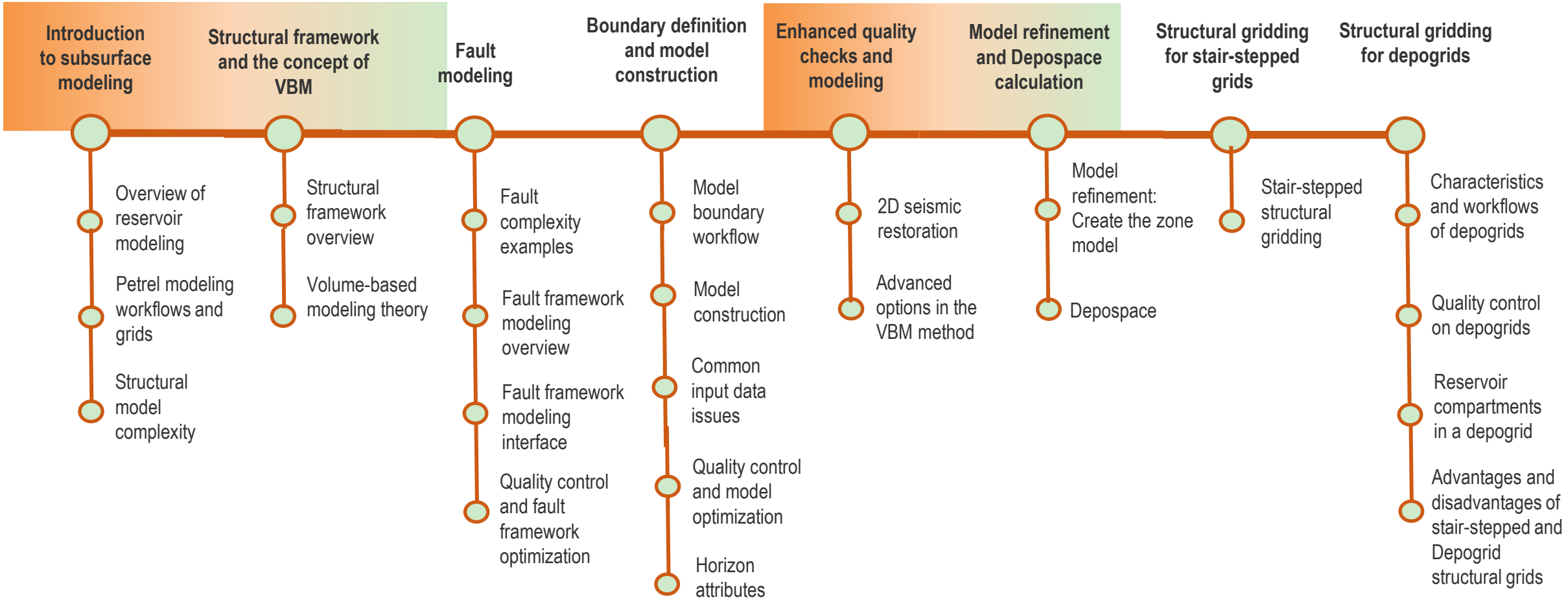
Structural framework with Petrel 2018 – Modeling line



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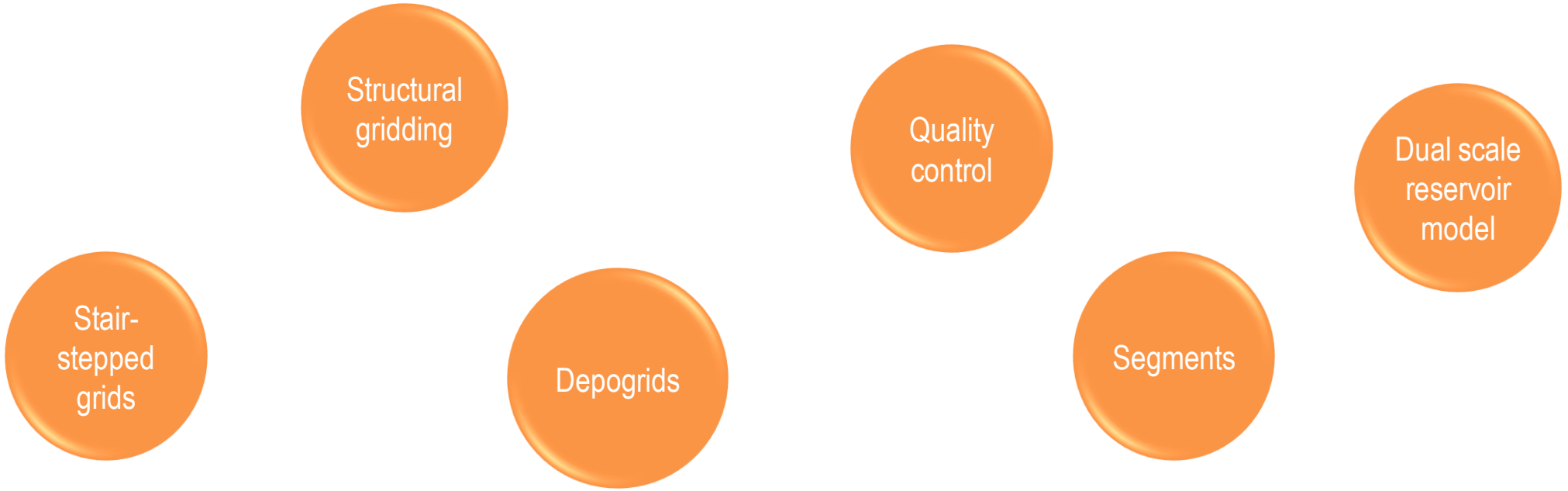
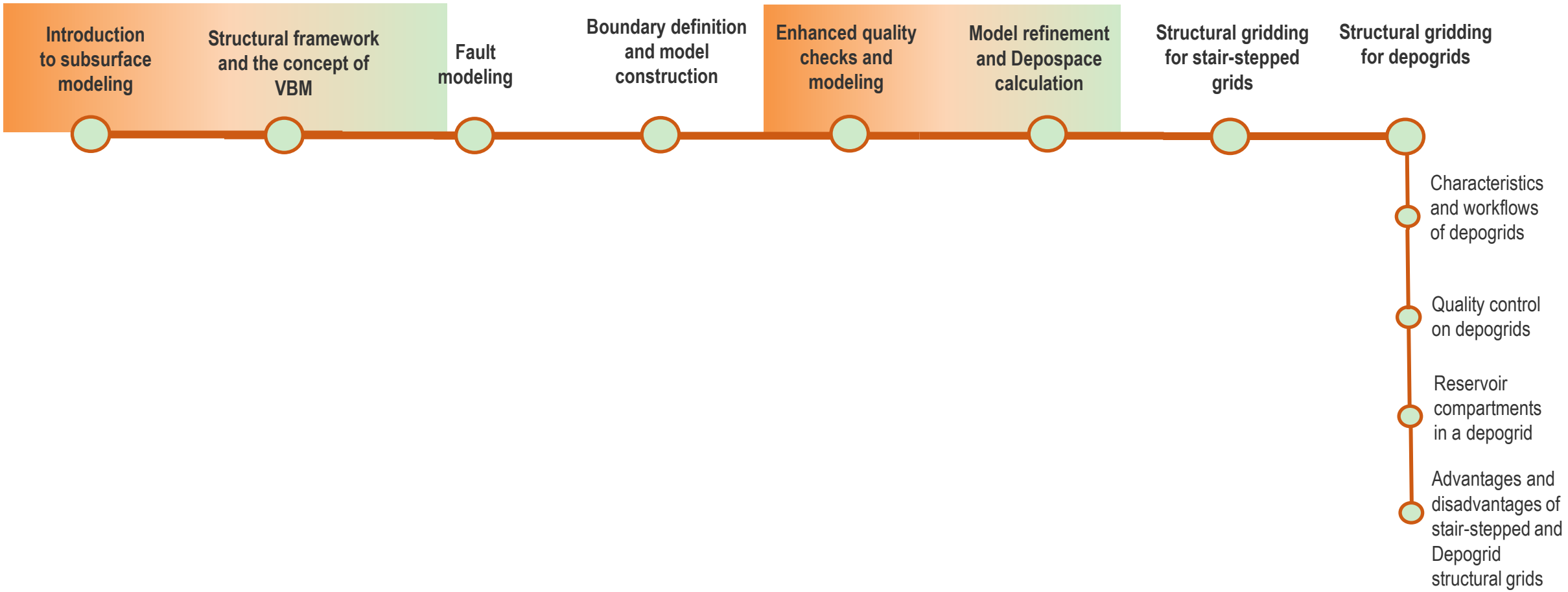
Agenda
Structural framework– Day 3

9.00-12.00	12.00-12.30	12.30-16.30	16.30-17.00
Structural gridding for stair-stepped grids	Lunch	Structural gridding for depogrids	Review and recap

KEYWORDS



Module 8: Structural gridding for depogrids



Learning objectives

When you complete this module, you will know how to:

- build a depogrid from a structural framework model
- run property modeling on a depogrid
- create alternative segmentations of a stair-stepped grid
- create segmentations of a depogrid

You also will know the advantages and disadvantages of stair-stepped grids and depogrid structural grids

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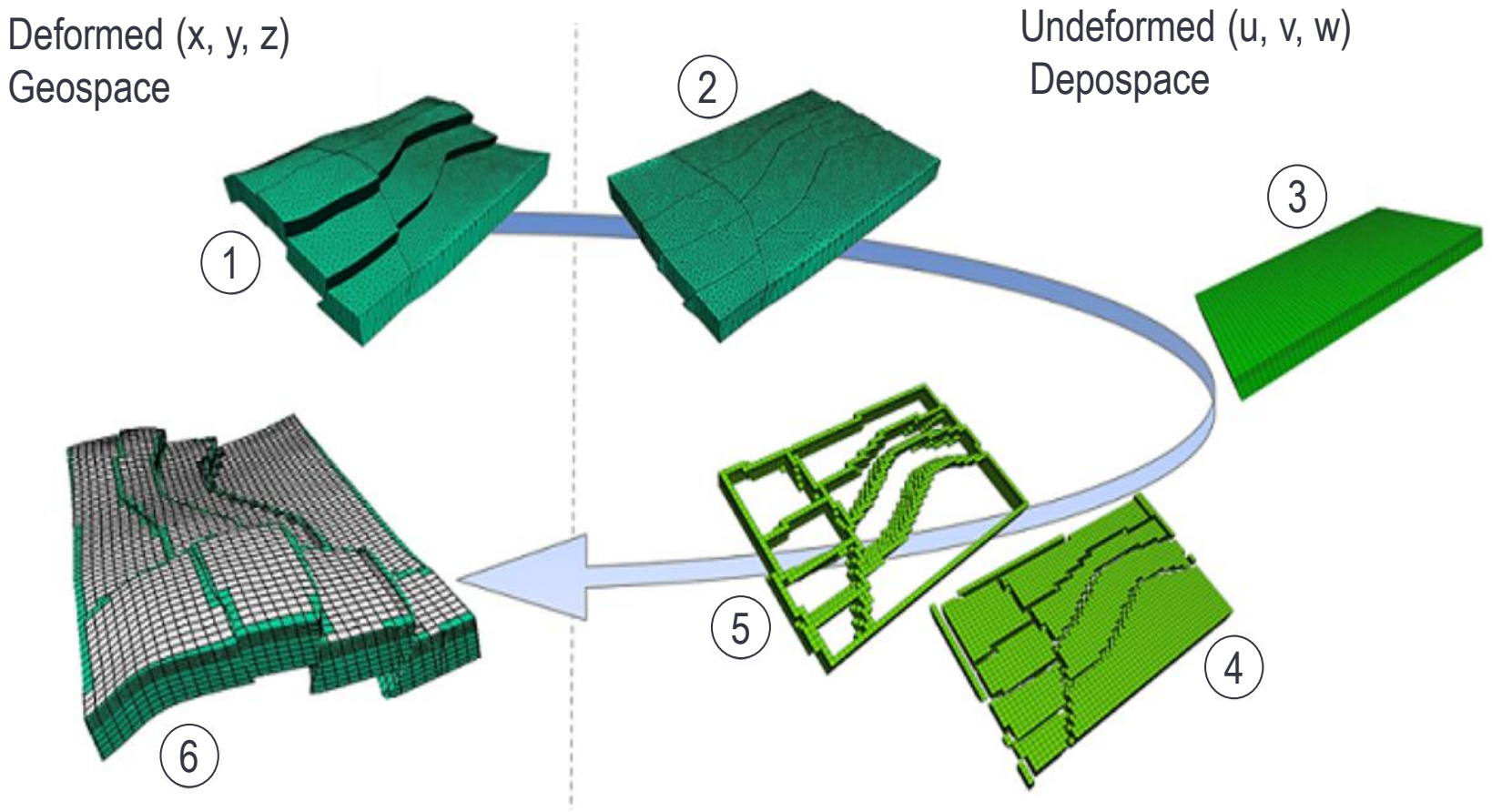
Structural gridding for depogrids

- Characteristics and workflows of depogrids
  - Property modeling in depogrids
  - Split cells in cell-based algorithms
  - Split cells in object-based facies modeling
  - The workflow (Demo)
- Quality control on depogrids
- Reservoir compartments in a depogrid
- Advantages and disadvantages of stair-stepped and Depogrid structural grids

Depogrid workflow



1 Structural model
2 Depospace mesh
3 Regular grid in Depospace
4 Structured part
5 Unstructured cells (cut cells)
6 Depogrid

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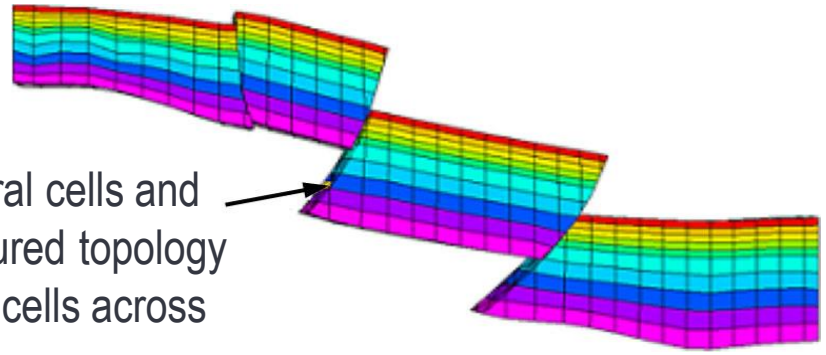
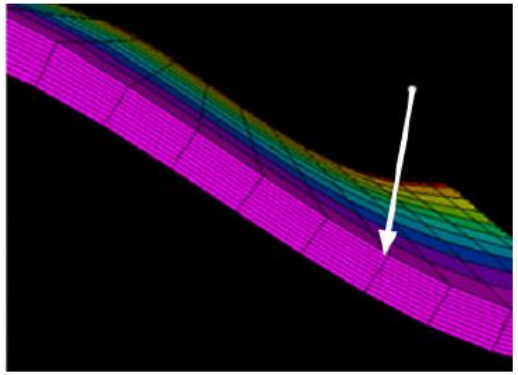
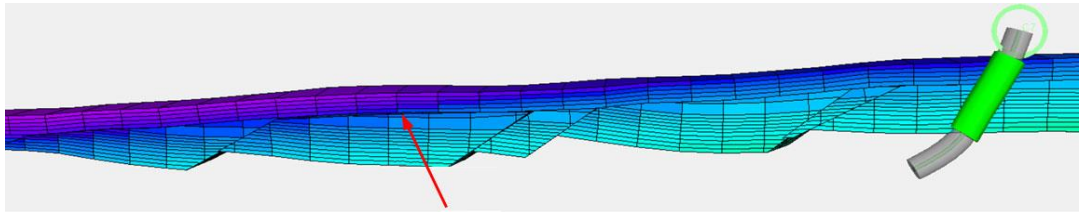
Characteristics of Depogrids



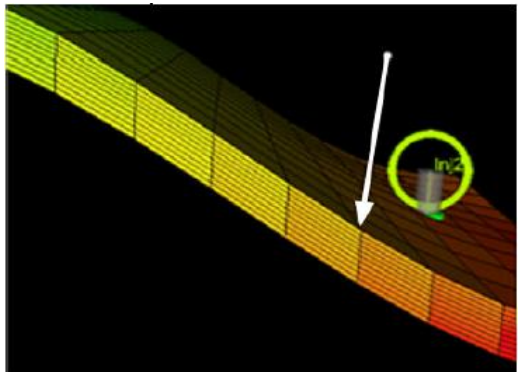
Polyhedral cells and unstructured topology from cut cells across faults



Depogrid pillars are orthogonal to the horizons and hence non-vertical and non-aligned with faults



Depogrid construct grids within each sequence independently
-> Grid column offset across sequence boundaries



Pillar grid pillars

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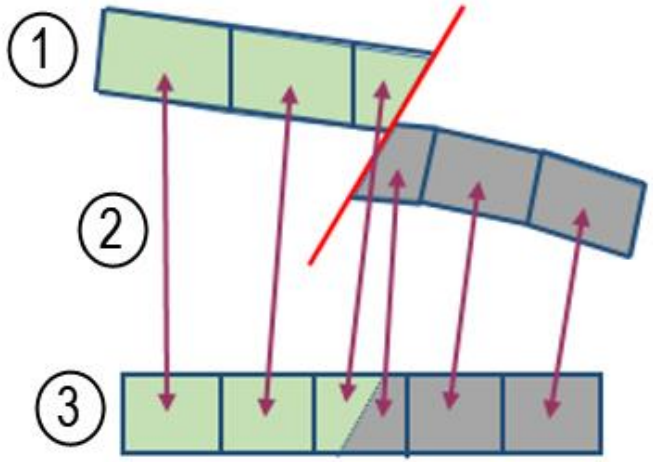
Property modeling in Depogrids (1)

- Property modeling methods are enhanced to handle splits cells
- The simbox used is the uncut grid in Depospace
- Each cut cell is mapped to a unique regular simbox cell

Split cells in cell-based algorithm



1 Depogrid
2 Bijective map
3 Depospace

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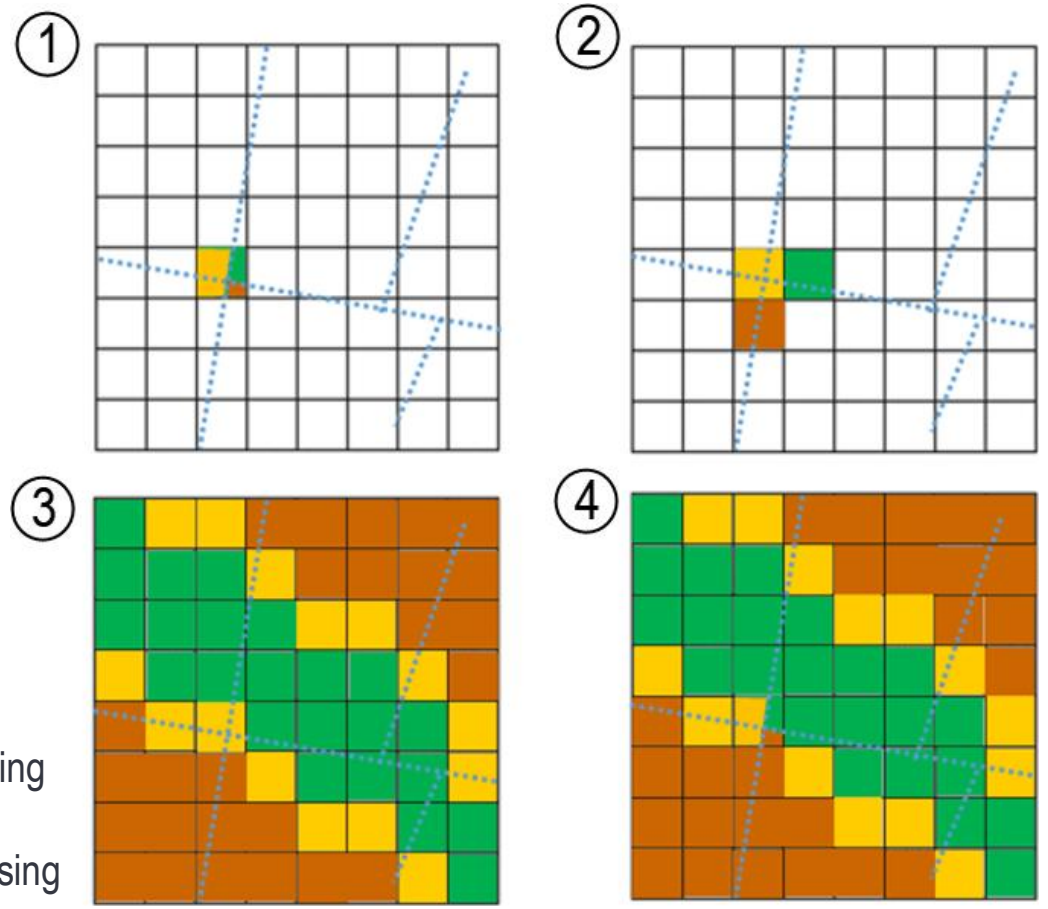
Property modeling in Depogrids (2)
Split cells in object-based facies modeling

Object-based facies modeling methods on Depogrids produce results that are similar to pillar grids or stair-stepped grids.



1 Upscaling
2 Pre-processing
3 Modeling
4 Post-processing

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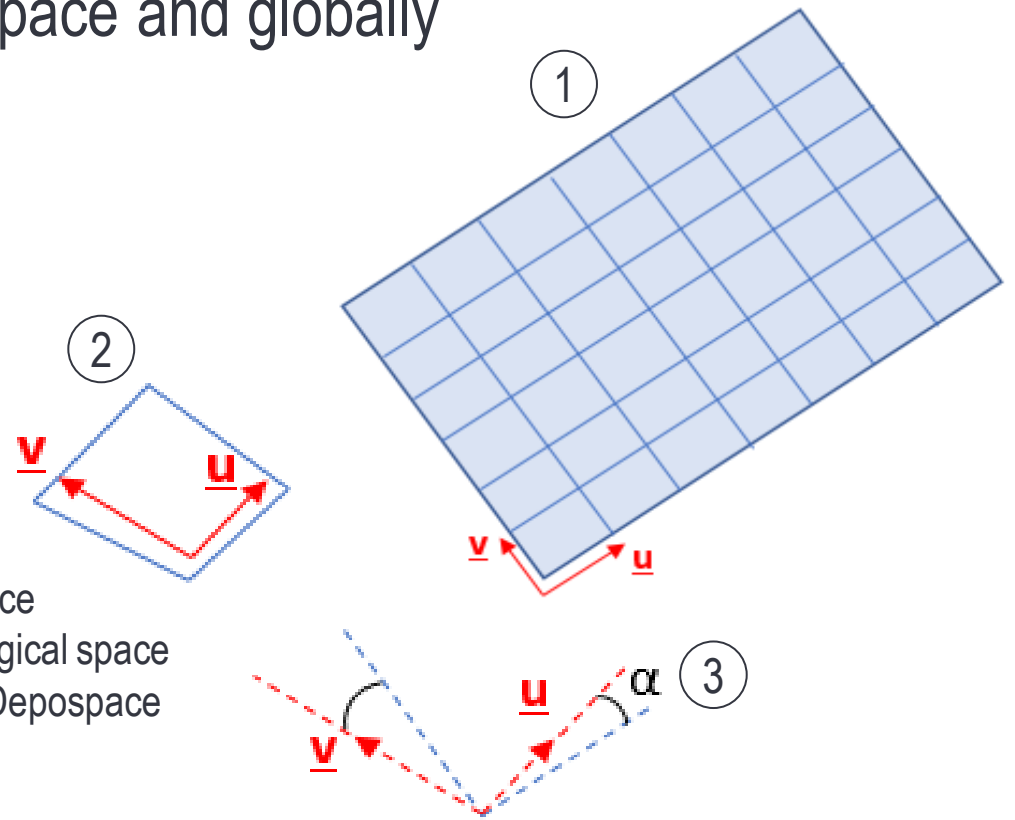
Structural gridding for depogrids

- Characteristics and workflows of depogrids
- Quality control on depogrids
  - Relative rotation angle
  - Orthogonality assessment
  - Compaction and dilation
- Reservoir compartments in a depogrid
- Advantages and disadvantages of stair-stepped and Depogrid structural grids

Relative rotation angle (1)

Compares the direction of local cell axes in Geospace and globally defined cell axes in Depospace.



1 Global v and u axes in Depospace
2 Local cell v and u axes in Geological space
3 Comparison of v and u axes in Depospace and in Geological space

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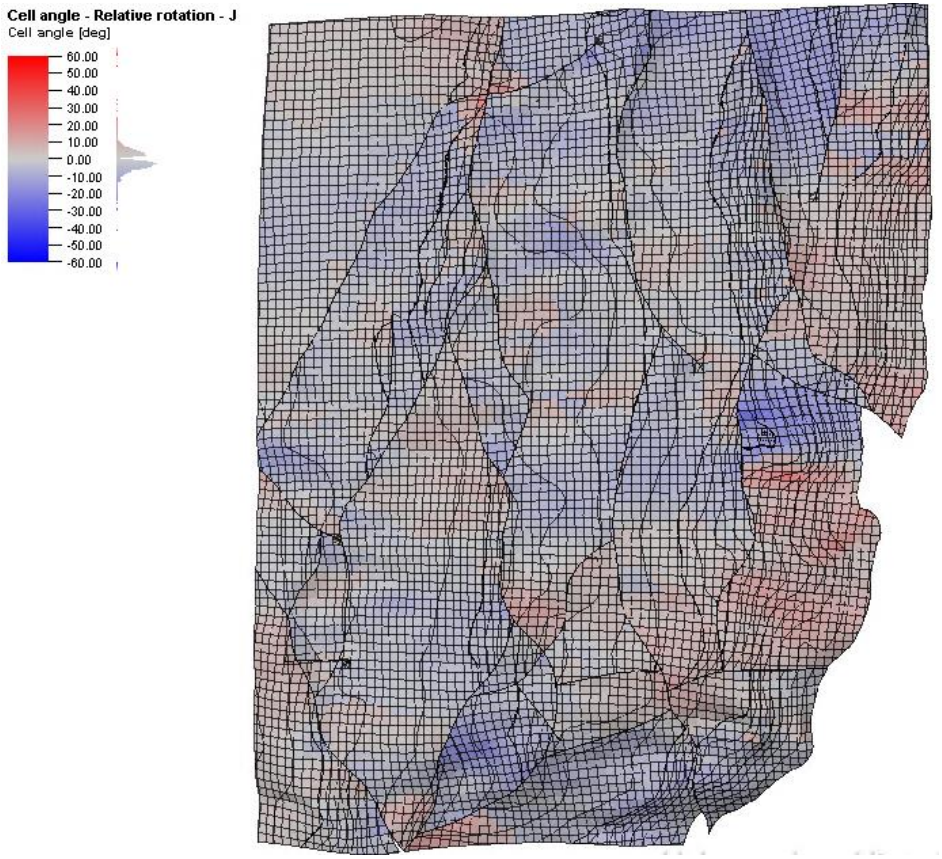
Relative rotation angle (2)

Highlights area with differences between the two axes.

As part of the QC phase, ask yourself:

- Is there a geological reason for the result?
- Is there a local rotation due to Depospace flattening?
- Are small-scale individual rotations caused by input data or modeling decisions when you constructed the structural framework?



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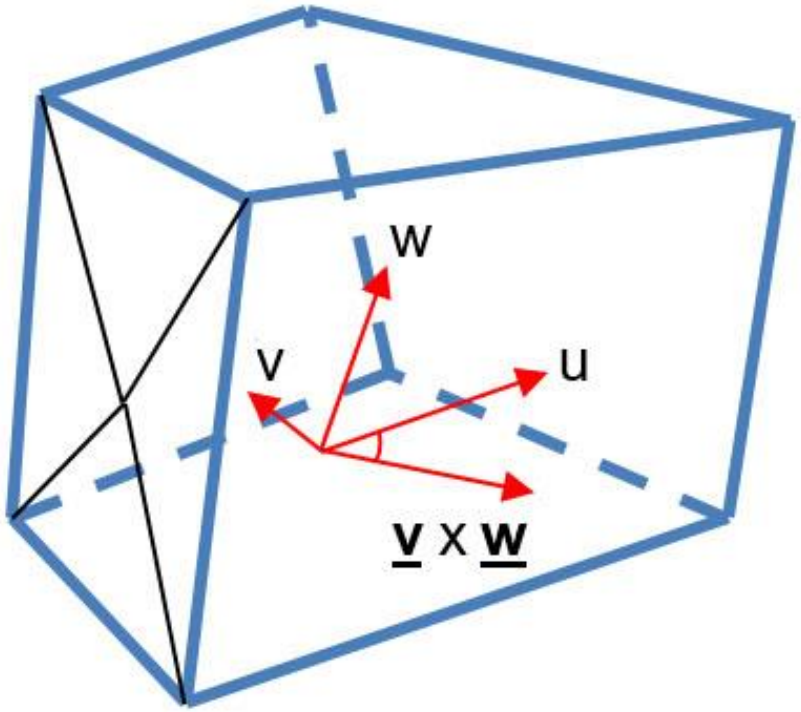
Orthogonality assessment (1)

In Depospace, the cells are a perfect cube, so the local u, v, w cell axes are mutually orthogonal.

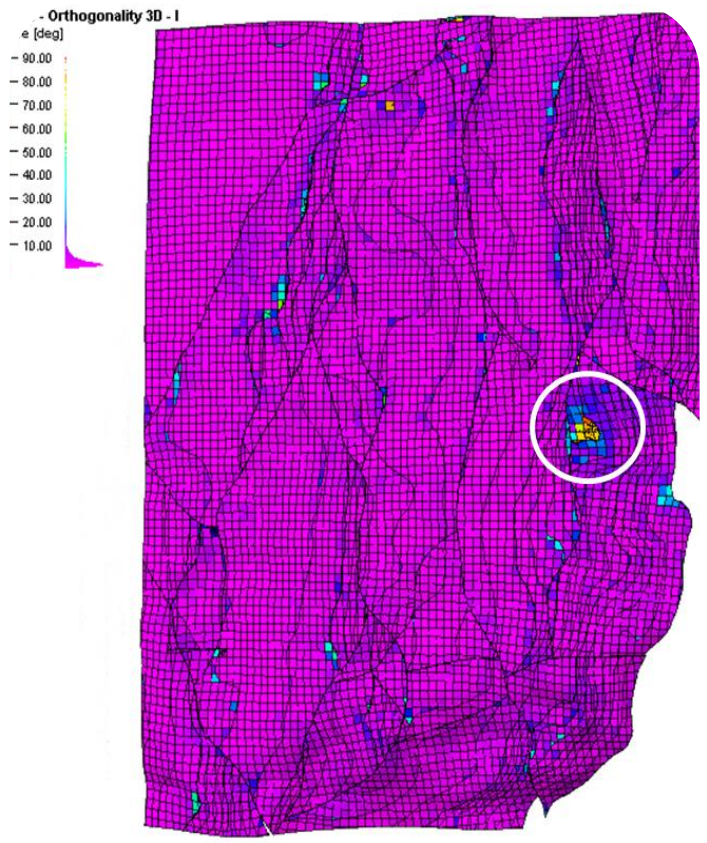
- Orthogonality angle 3D property compares each local cell axis directions in Geospace with the vector cross product of the other two axes directions.
- Orthogonality angle 2D property measures the angle between each pair of u, v, or w local axes and returns the deviation from 90 degrees.



Orthogonality assessment (2)

Deviations from orthogonality (rotations) may have an impact on directional properties.

- Are local distortions of cells due to input data/structural model/Depospace issues?
- Larger areas have more impact on simulation.



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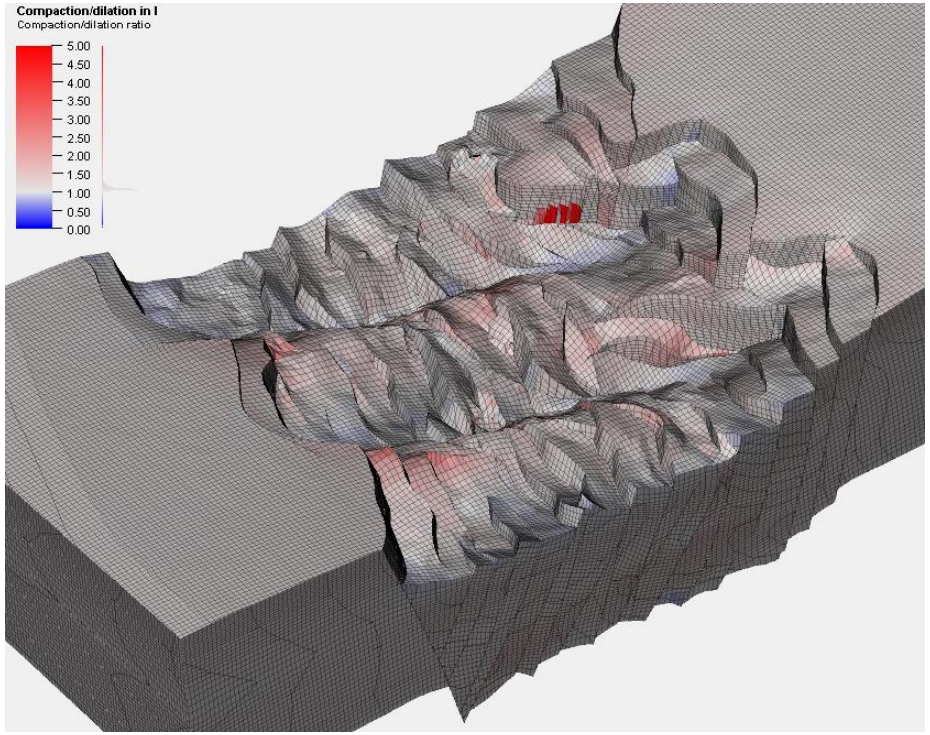
Compaction and dilation

Compaction of dilation of each cell is the ratio of the geological space length to the depospace/simbox length.

As part of the QC phase, ask yourself:

- Is there a geological reason for the result?
- Is there a general location dilation due to Depospace unfolding?
- Are local distortions of cells due to input data/structural model/depospace issues?



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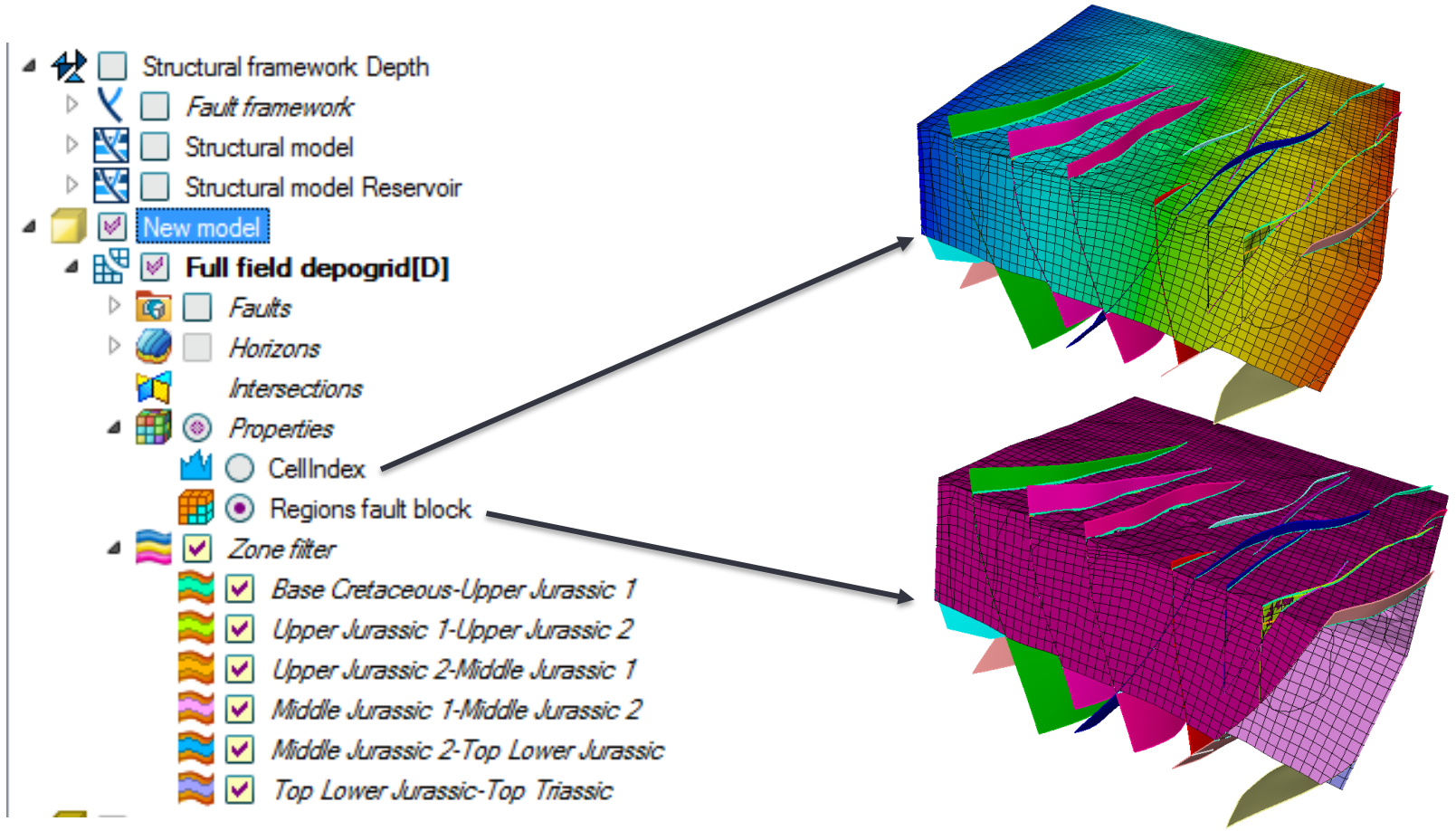
Structural gridding for depogrids

- Characteristics and workflows of depogrids
- Quality control on depogrids
- Reservoir compartments in a depogrid
  - Structural framework modification to create isolated fault blocks
  - Fault-fault connection
  - Fault-boundary connection
  - Vertical extent
  - User-defined segments
- Advantages and disadvantages of stair-stepped and Depogrid structural grids

Depogrid output



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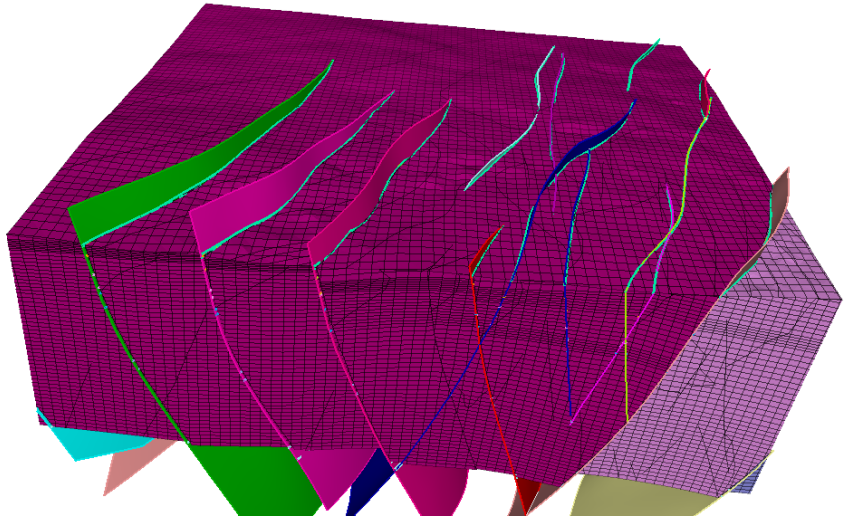
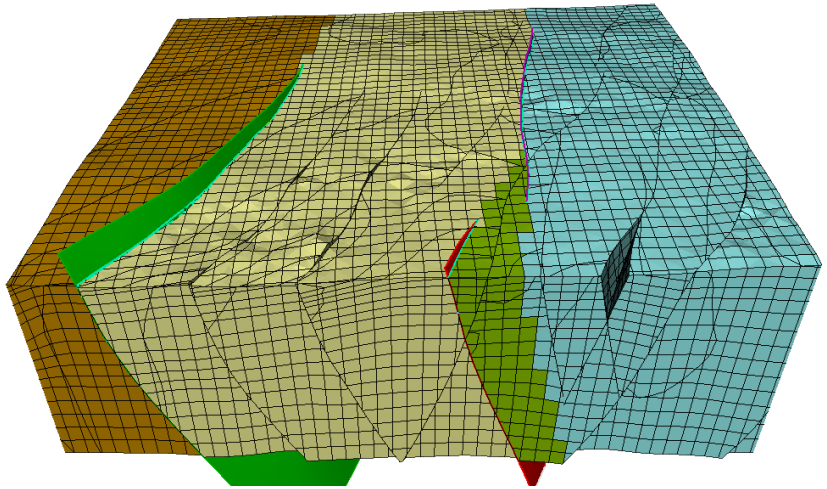
Reservoir compartments in a Depogrid (1)

Use to define reservoir compartments or regions for geomodeling and reservoir simulation workflows.



Regions fault blocks



User-defined segments

Reservoir compartments in a Depogrid (2)

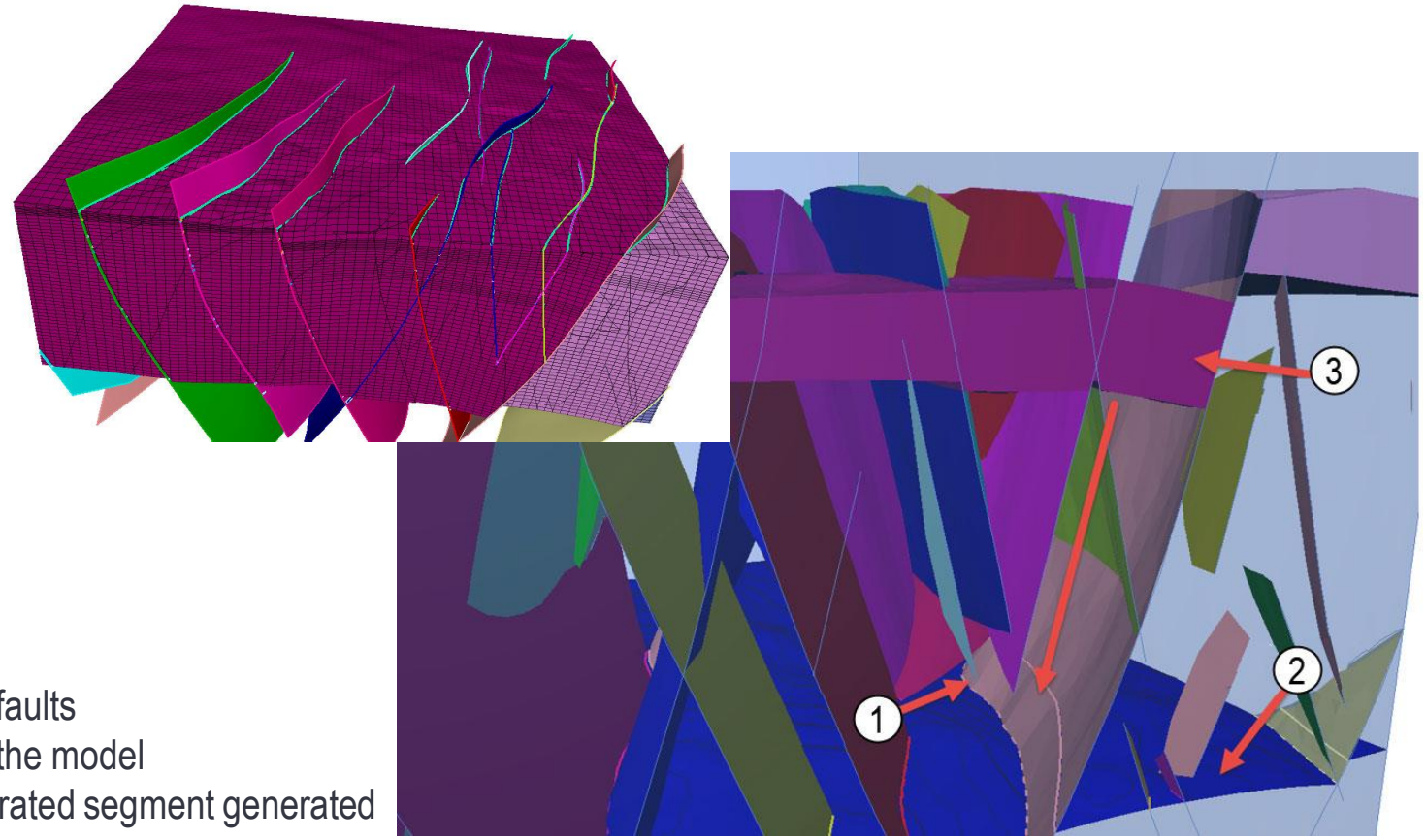
Is there a lack of fault blocks?

- Inspect to see if gaps or leaks are present in the fault-fault connections.
  - ‘Discontinuous fault intersection’ report in QC manager
  - ‘Fault/fault proximity’ report in the QC manager
- Inspect if poor connection is present between faults and model boundary
- Inspect the vertical extent of the faults

Reservoir compartments in a Depogrid (3)

Case 1 - You realize the faults are correct and you want to structurally isolate one part of the reservoir from another.

You must modify the structural framework to create isolated fault blocks.

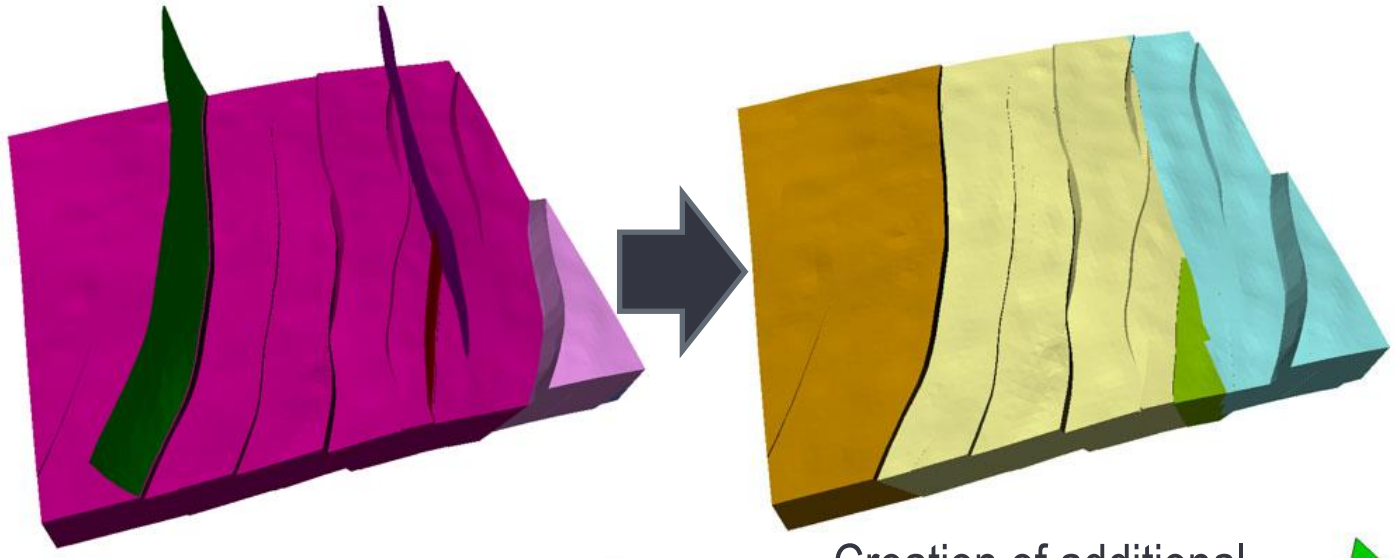


1 Base of faults
2 Base of the model
3 No separated segment generated

Reservoir compartments in a Depogrid (4)

Case 2 - You are confident the structural model and the grid structure are correct.

Define segments at a finer granularity for use in the downstream modeling and simulation workflows.



Inconsistent fault connections in the model generate a wrong compartmentalization

Creation of additional segment boundaries with the Segments tool

Structural gridding for depogrids

- Characteristics and workflows of depogrids
- Quality control on depogrids
- Reservoir compartments in a depogrid
- Advantages and disadvantages of stair-stepped and Depogrid structural grids
  - Advantages and disadvantages of stair-stepped grids
  - Advantages and disadvantages of depogrids

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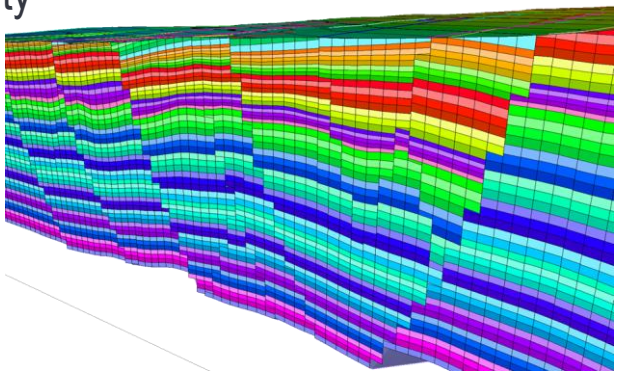
Stair-stepped grid and Depogrid: comparison

Stair-stepped grid

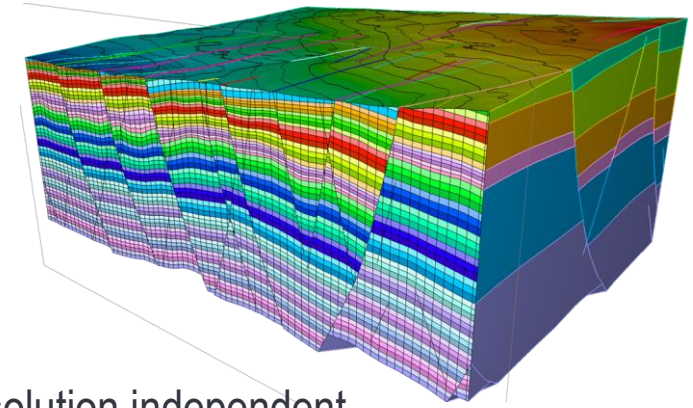
- Structured corner point grid
- Extensive **Petrel** functionality supported



- Supports all flow simulators
- Faults look non-geological
- Handling well tops near faults
- Fault juxtaposition area approximations
- Limited structural operations support*
- Volumes depend on cell resolution

Depogrid

- Limited structural operations support*
- **INTERSECT** flow simulator required
- Honors structural geometry exactly
- Honors well-tops close to fault and fault-ties



- Faster grid creation
- Volumes largely resolution independent
- Well completions on correct side of fault

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Exercises and workflow example videos:

- Exercise: Build and QC a full Depogrid
- Workflow example video: Build a Depogrid
- Exercise: Build a Depogrid of selected zones from the structural framework
- Exercise: Segment your Depogrid
- Exercise: Modify a segment model
- Workflow example video: Segment your Depogrid and combine segments and regions

Summary

In this module, you learned how to:

- build a Depogrid from a structural framework model
- create alternative segmentations of your stair-stepped grid
- create your own segmentations of a Depogrid

You also learned about the advantages and disadvantages of Stair-stepped grids and Depogrid structural grids.

Learning game: Structural gridding for depogrids (1)

Instructions:
There are several questions. Select the correct answers.

Learning game: Structural gridding for depogrids (2)

How do you fix grid quality issues seen in a Depogrid?

a. Identify problems in Depospace
b. Identify geological/geomechanical/structural inconsistencies in the framework model
c. Use Structural geology knowledge
d. Examine input data and interpretation
e. All the answers above are correct

Learning game: Structural gridding for depogrids (3)

What is the simbox for a Depogrid?

a. It represents the unfaulted structural model from which the Depogrid is created
b. It represent the unfolded structural model from which the Depogrid is created
c. There is no simbox in a Depogrid
d. Both a. and b. are correct

Learning game: Structural gridding for depogrids (4)

How can you define the compartments you want on a Depogrid?

a. With the default Regions fault block property

b. With user-defined segments

c. With the Property calculator

d. All the answers above are correct

e. Both a. and b. are correct