How Geocellular Models Handle Net Pay Mapping Issues*

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Abstract

Most net pay mapping issues occur in areas where gross pay thickness tapers from full zone thickness down to zero at the fluid contact, the wedge zone. In traditional mapping projects, a zone's net pay is calculated at each well and those values used to build a net pay contour map. In areas of full zone thickness, simple contour drawing techniques are used. In wedge zones care must be taken to account for vertical variations in pay distribution. When pay has a uniform vertical distribution through the zone, net pay values taper smoothly to zero in the wedge zone. When pay is not uniformly distributed vertically through the zone, then net pay contours will drop quickly towards zero upon entering the wedge (pay in bottom half of zone), or contour values will stay relatively high through much of the wedge (pay in top half of zone) until going to zero at the wedge edge.

When hand mapping, the *"Walking Wells Out of Water"* technique is traditionally used to account for vertical variations in pay through the wedge zone. When using the computer to calculate pay contours, supplemental data (based on the Walking Wells Out of Water technique) or special data-tie techniques are used in the wedge zone. These techniques honor wedge zone pay values, keep their influence from extending outside the wedge zone, and, if carefully implemented, provide a good representation of pay distribution within the wedge.

Geocellular modeling attempts to model vertical variations in a reservoir zone. It does this by separating the mapping area into cells laterally (typically 50 to 100 units on a side) and then breaking the reservoir vertically into thin layers. One reservoir may have ten to hundreds of layers depending upon its total thickness and how thin individual sands and shales are. The goal is to build a model that has each significant sand or shale assigned to one or more layers. When done correctly, the vertical variation seen in the reservoir is built into the model. Those cells that are classed as pay are assigned a pay ratio value of 1.0 and those that are not pay are assigned a

value of 0.0 (pay ratios between 0.0 and 1.0 can be used). Of course, all cells below the fluid contact are assigned a ratio value of 0.0. The following steps are used to convert the model's cell values into a net pay contours:

1. The thickness of each layer in each cell is multiplied by its pay ratio value creating a pay thickness for each layer of the cell.
2. The pay thickness from each cell's vertical stack of layers is summed and assigned to the cell center.
3. The total pay thickness at the center of each cell is used to generate a contour map.

Because each pay sand is modeled through the reservoir and into the wedge zone and because those sand thicknesses (pay values) are summed vertically, the pay contours generated from that summation accurately map the distribution of pay through the wedge zone

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A detailed geocellular model accurately portrays net pay throughout the reservoir and into the wedge zone.

We will:

- Discuss input data
- Review the parts of a model
- Learn how this model was built
- Understand how cells are used for net pay volume calculation
- View a net pay map built from the volume calculation process

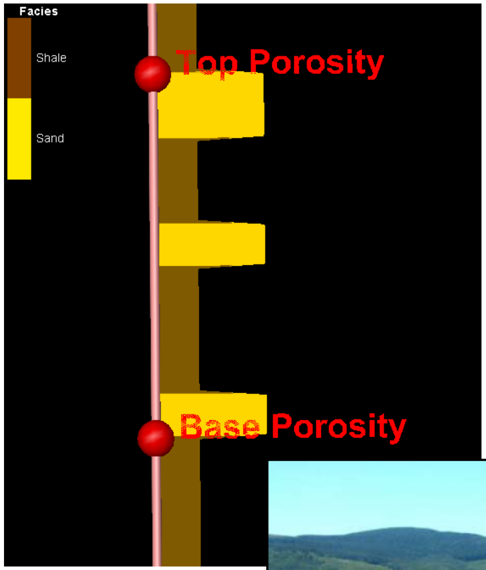
Petrel, a mark of Schlumberger, was used to build this model.

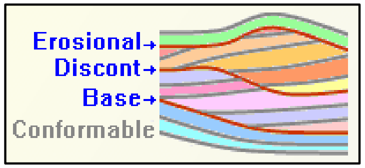
Input to Geocellular Modeling

Inputs to geocellular modeling are the same as for hand mapping.

Inputs include:

- Wells (location and survey)
- Logs
- Top picks
- Seismic interpretation
- Geologic relationships
- Depositional environments

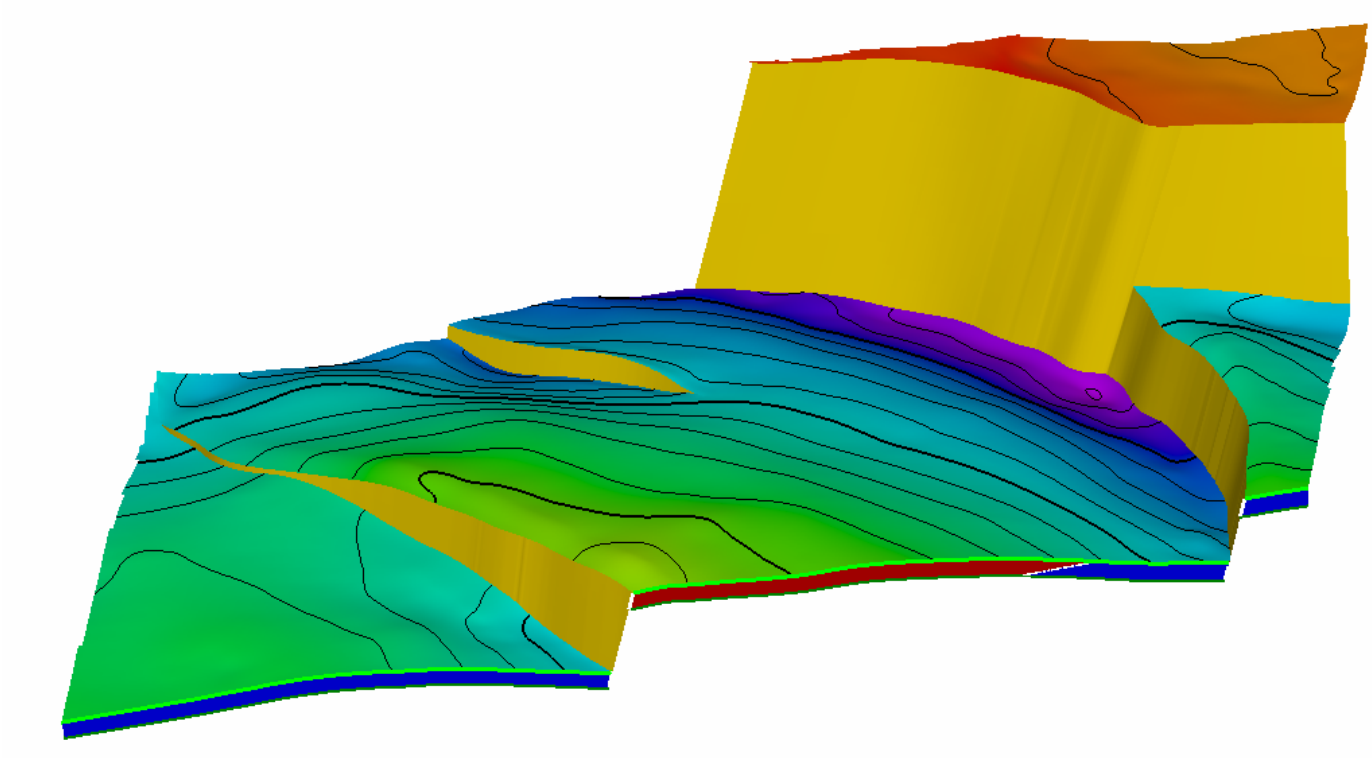




The Geocellular Model

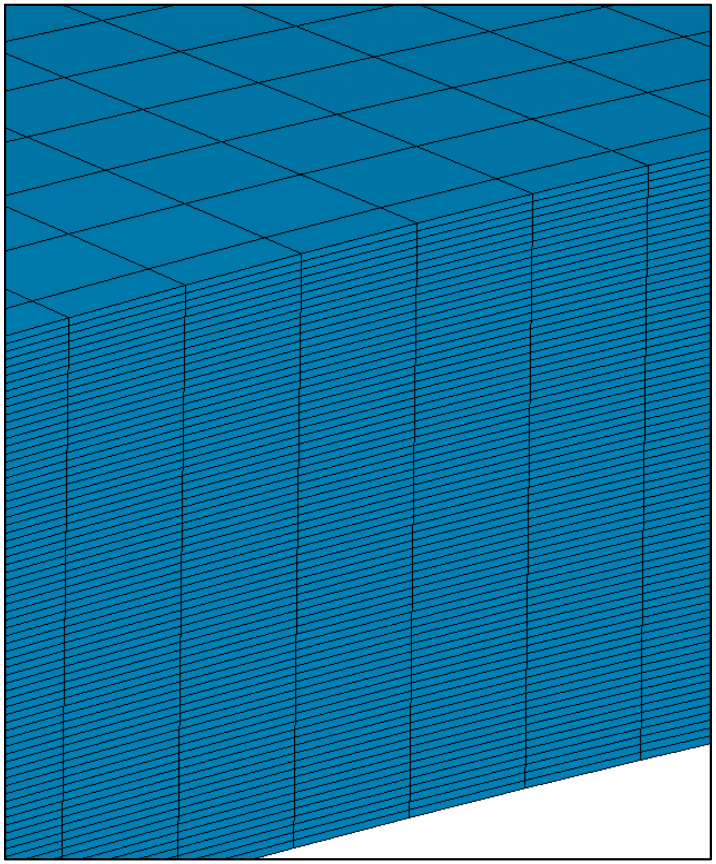
The model consists of three components:

1) Structural Framework

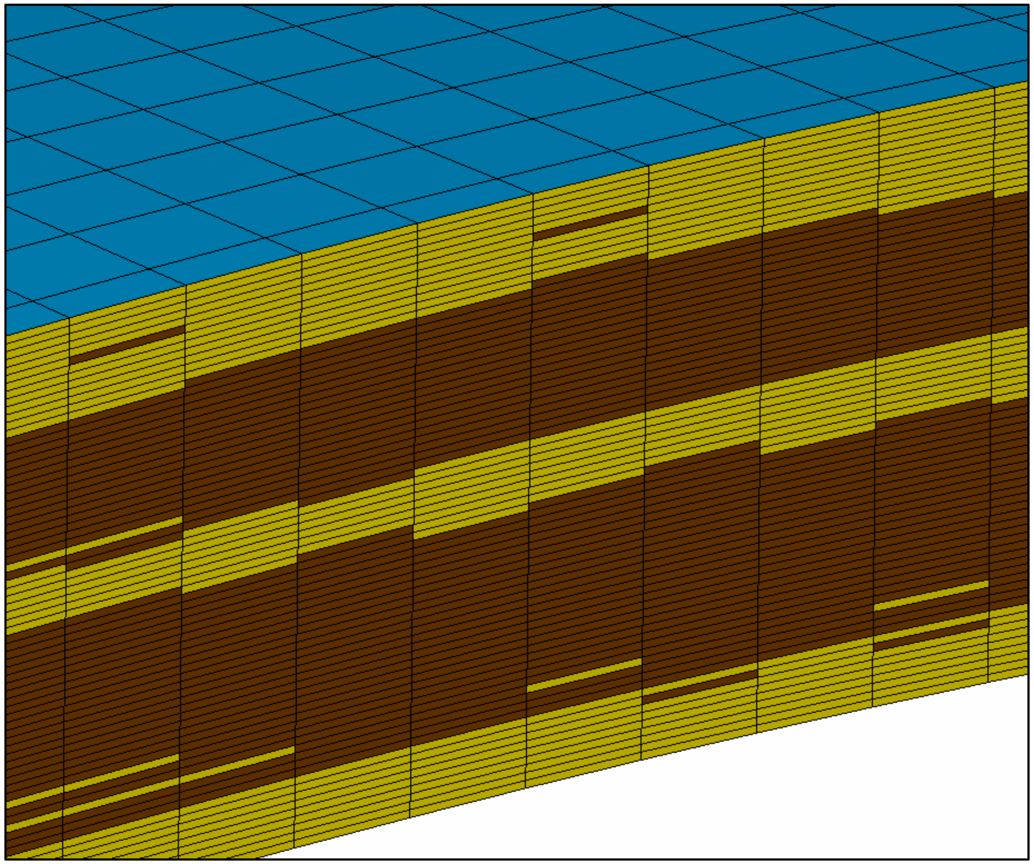


The Geocellular Model

2) Cells



3) Values in the cells



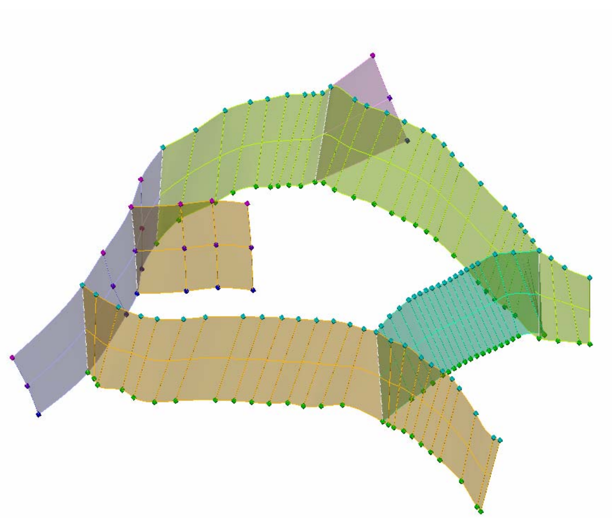
Constructing the Sand Model

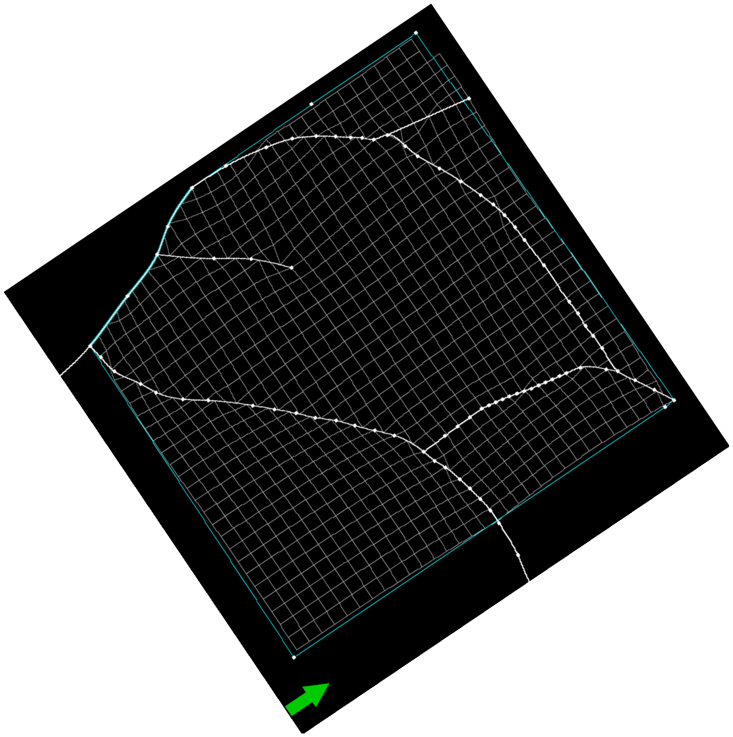
1) Build top structure

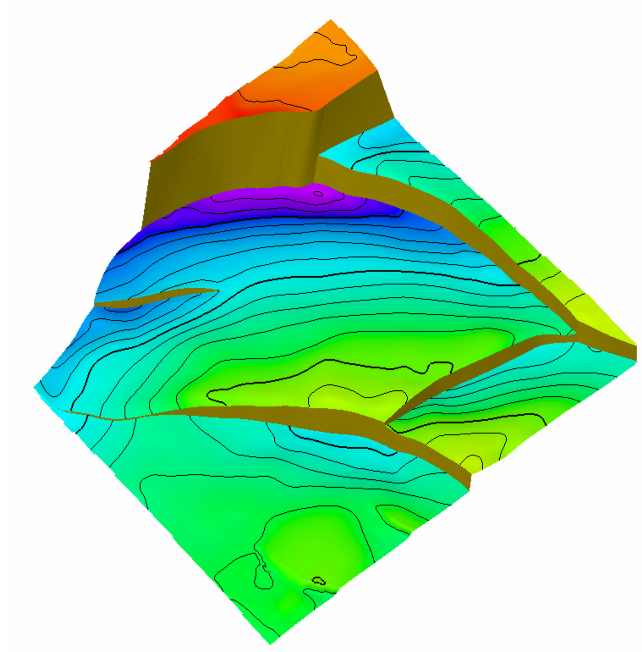
a) Model the faults

b) Define the cell geometry (X-Y sides)

c) Insert the top horizon







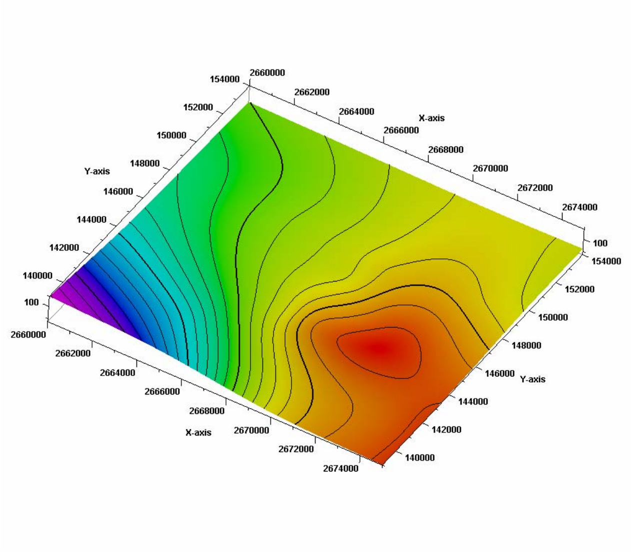
Constructing the Sand Model

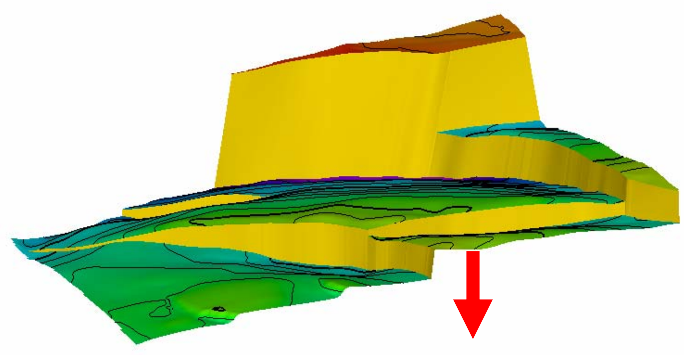
2) Build the base horizon

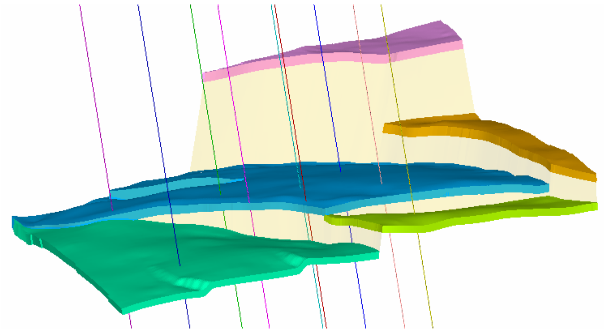
a) Grid the zone thickness

b) Stack down from the top horizon

c) Tie to the base picks







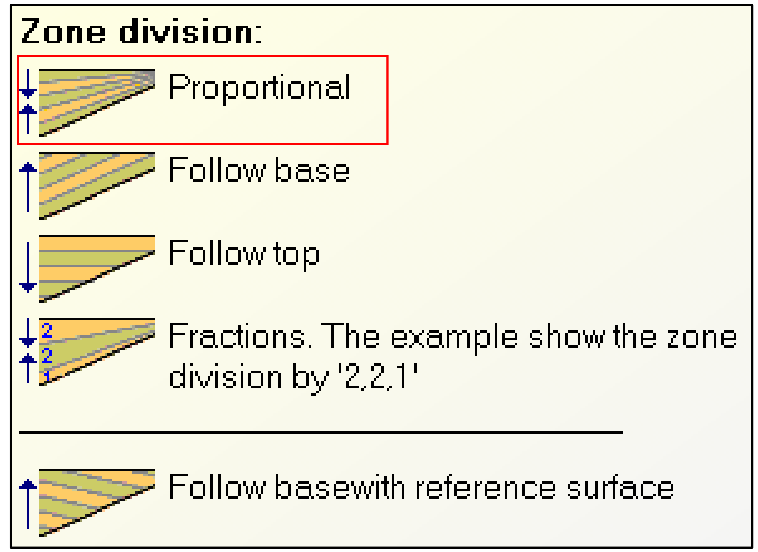
Constructing the Sand Model

3) Define the layering

a) Type = Conformable (proportional)

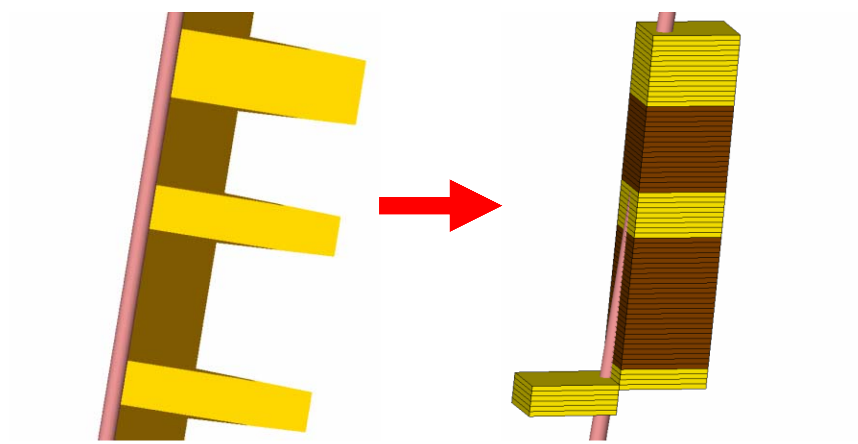
b) Set number of layers (1 foot thick)

Zone division		
Proportional	Number of layers:	75



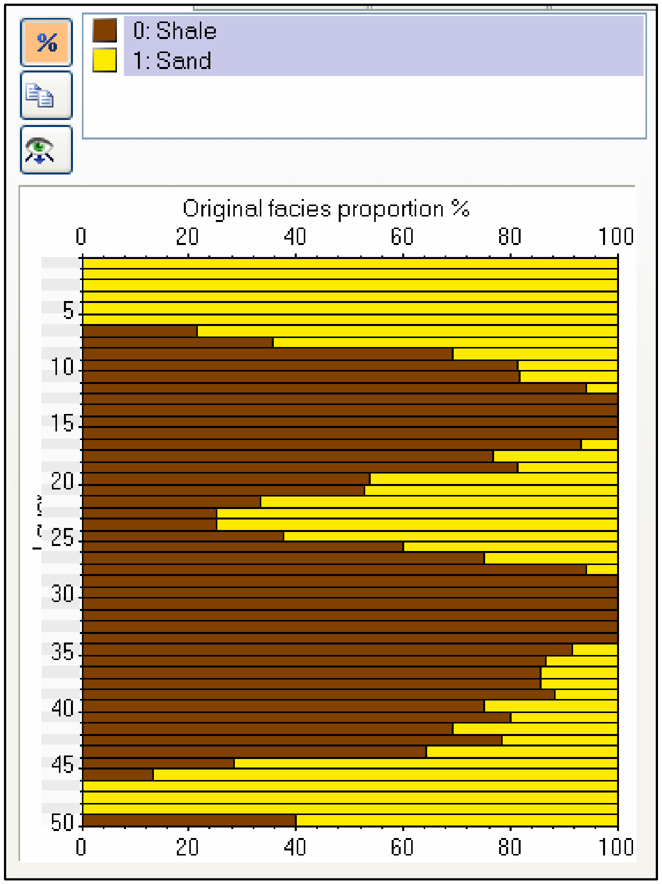
4) Assign log data to cells penetrated by wells

Average method: Most of

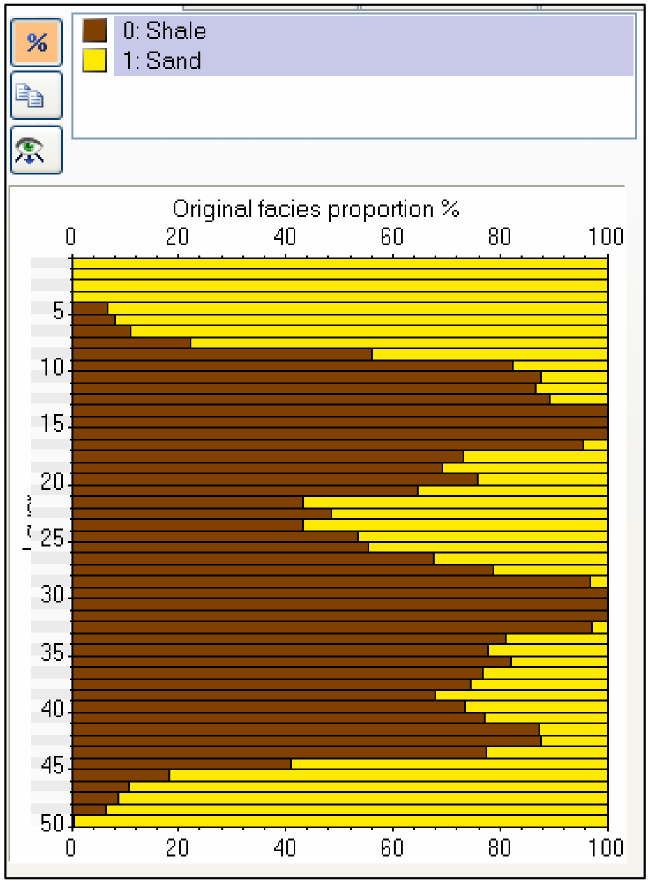


Constructing the Sand Model

5) Evaluate vertical distribution of log data



Log data



Final model

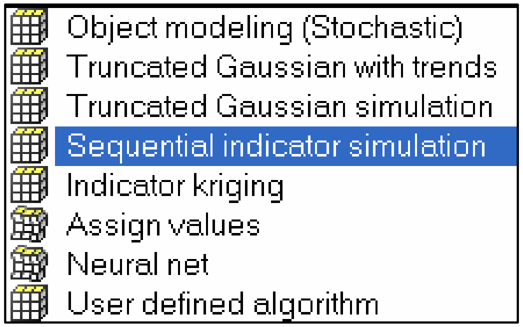
Constructing the Sand Model

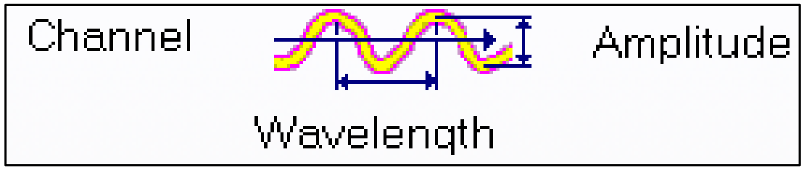
6) Assign values to cells of the model

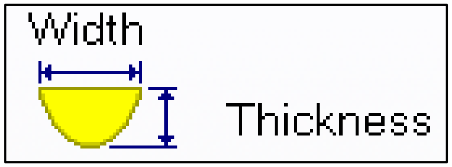
a) Select the modeling method

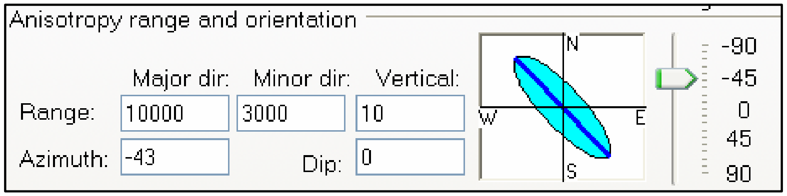
b) Define the shapes of the features

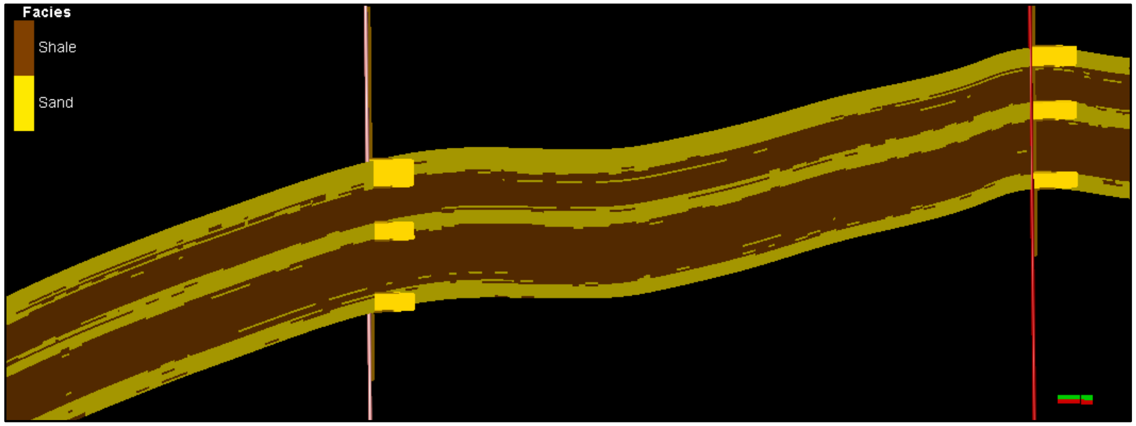
c) Select or define any trends



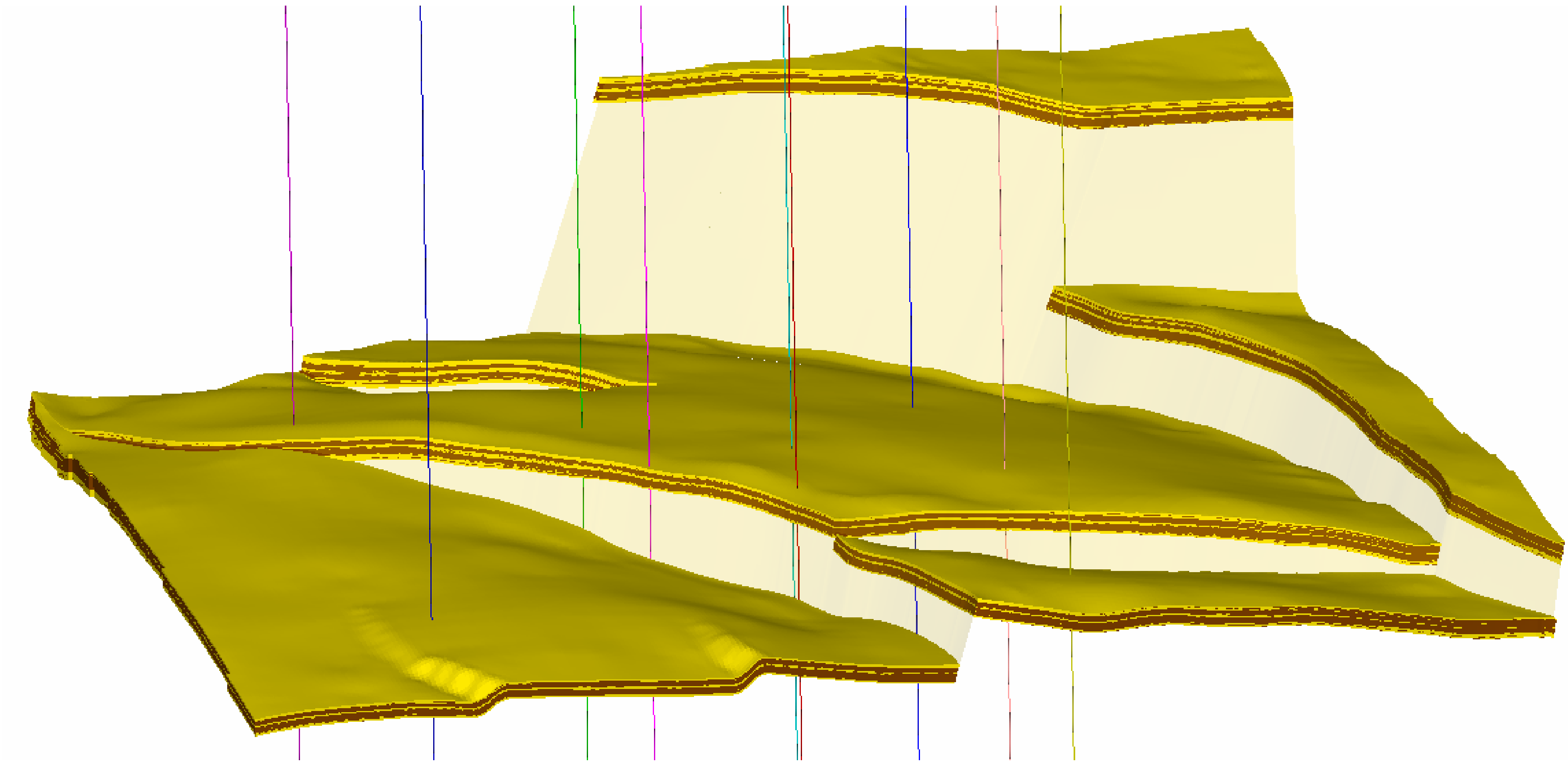








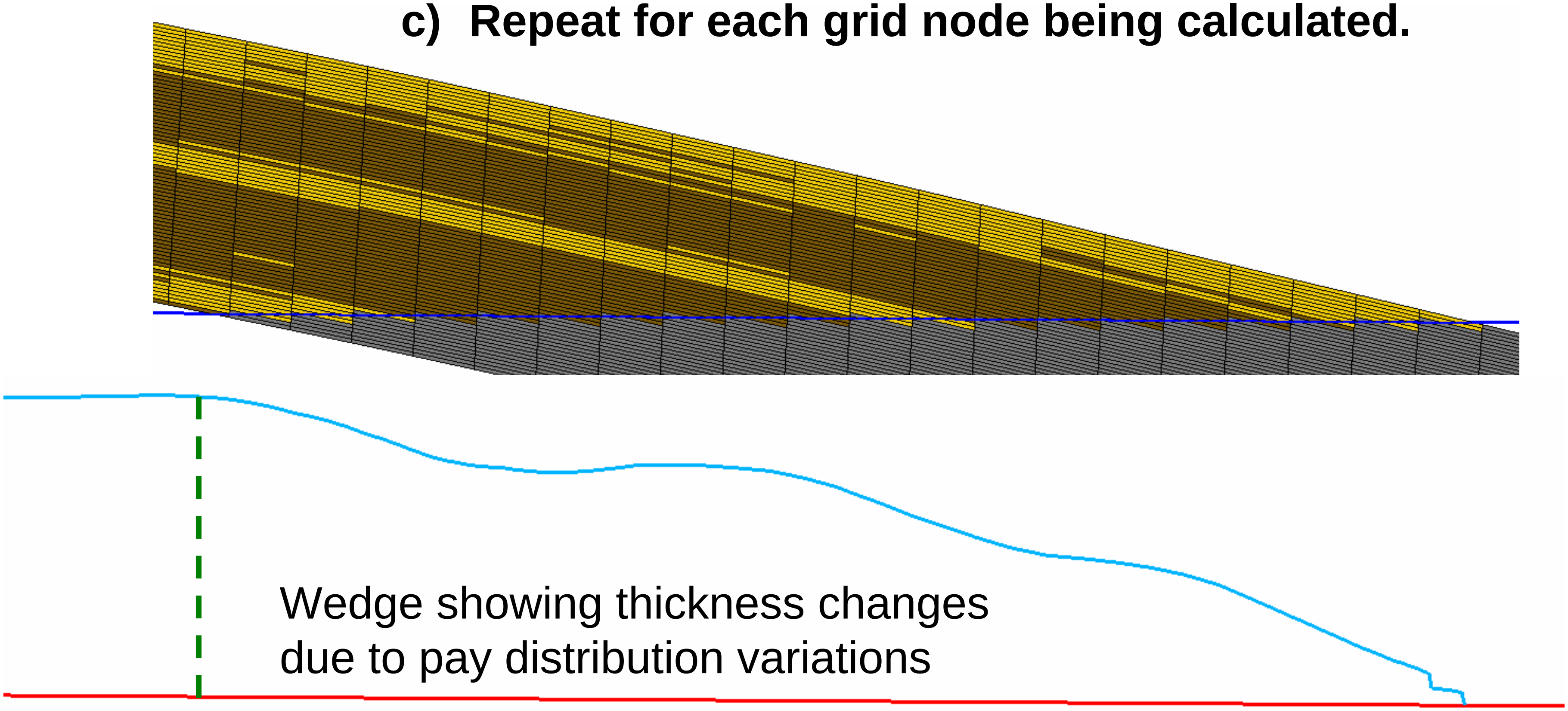
The Sand Model



Pay in the Wedge zone

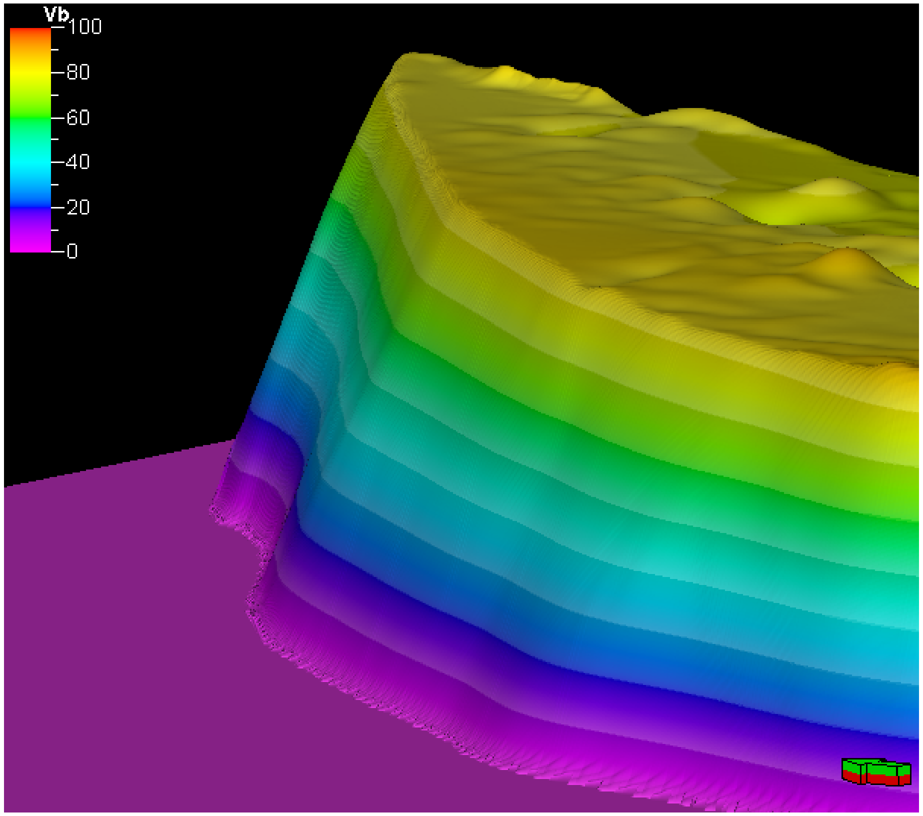
Pay thickness is calculated by summing cells vertically.

a) **Cell thickness * N:G ratio**
b) **Sum cell results vertically**
c) **Repeat for each grid node being calculated.**

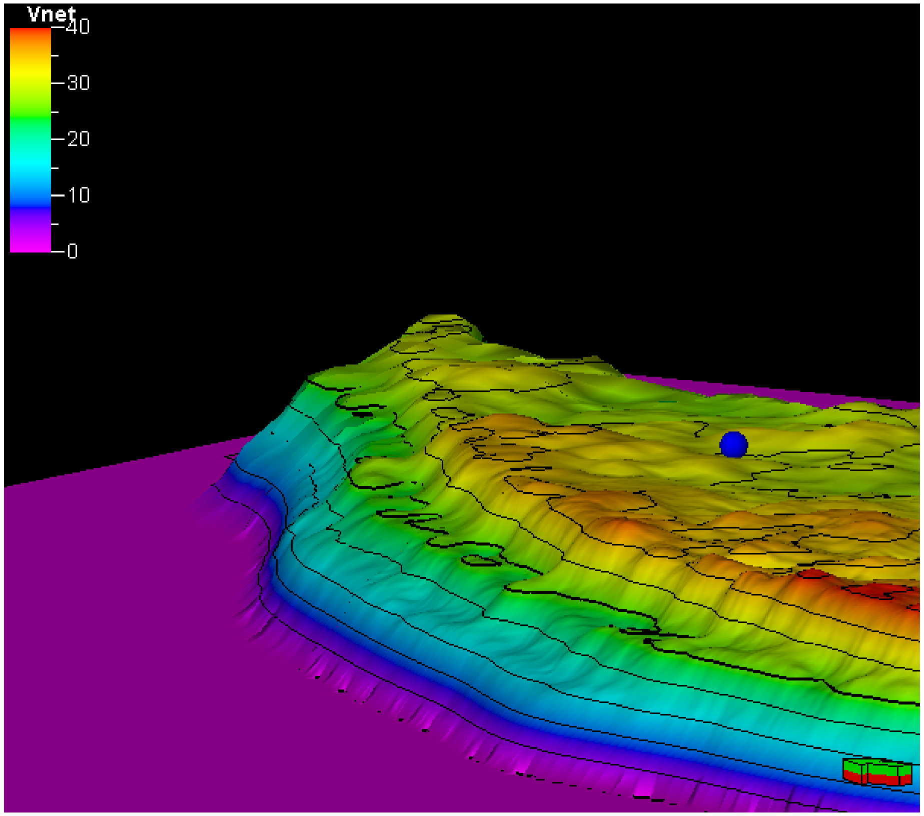


Pay in the Wedge zone

3D Views of thickness



Gross Pay thickness



Net Pay thickness
(Note steps in the wedge)

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Map and 3D View of Net Pay