Handling Complex Stratigraphic Relationships Using Volume Based Modeling and Stair-Step Grids

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Abstract

Traditional Corner Point Gridding [CPG] methods have limitations when dealing with very complex structural geometries resulting in distorted cells. The lack of cell orthogonality can lead to issues like convergence complications during the simulation stage. The challenge of the study was to model a complex carbonate's geology in a three-dimensional reservoir model representative enough of the reservoir's behavior and connectivity. For that purpose, the CPG methods were not appropriate and resulted in a simplified 3D grid with a large number of distorted cells which lead to problems during the simulation stage. The main objectives of this study were: 1] to build a structural 3D grid capturing both the structural and the stratigraphic complexities of a naturally fractured carbonate field using Stair Step Gridding [SSG], 2] to reduce the time spent on building the structural grids compared to CPG method, 3] to preserve volumetrics, below 10% difference, between the original corner point grid and the new stair-step grid, and 4] to assure the most optimal grid to run dynamic simulations.

The implemented methodology involved input data conditioning which was the key to achieving a successful structural model. The "tepee" shape of the reservoir meant that the fault modeling step was crucial for the boundary definition in order to create a watertight model constrained by the horizons within the structure. In addition, due to the stratigraphic complexity of the area, a logical stratigraphic relationship and proper horizons type definition were mandatory to be handled by the modeling algorithm. The final structural model was used as input to build a three dimensional stair-step grid ready for property population.

Results showed that stair-step grids reduce the cell distortion and capture the structural and stratigraphic complexities. The good orthogonality of the final 3D grid reduces the run-time of dynamic simulations.