

# Paradigm SKUA Delivers a Full Static Model in a Highly Complex Structural Environment

## The Challenge

The Middle Magdalena Valley basin, located in the central part of Colombia, has evolved through many stages, resulting in a complex structural and stratigraphic framework. After many years of oil production, and based on the results of recent drilling campaigns, the client, Ecopetrol, felt that various reservoirs in the basin had not been accurately mapped, leading to sub-optimal exploitation. The main challenge was to understand the geometry and kinematics of the basin, provide new insight into the tectonic setting, and gain a clearer picture of the migration and trapping of hydrocarbons in the various reservoirs.

Paradigm® was asked by Ecopetrol to undertake a project that would create an accurate image of the reservoir and add information regarding the location of potential resources, and to perform a volumetric evaluation.

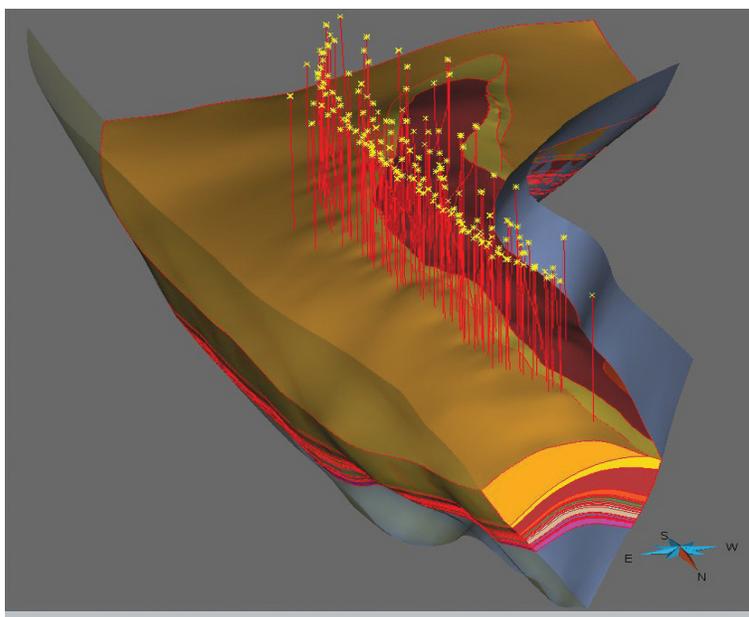
## The Solution

Paradigm performed the project using its SKUA® subsurface modeling technology, which is designed to support a complete workflow, from seismic to simulation, in one integrated environment.

The pillar-less technology embedded in SKUA allows the geologist to take into account all interpreted horizons and faults, together with well markers, with no need to simplify the data to fit technologies that cannot handle high levels of complexity. SKUA enables the creation of an accurate structural and stratigraphic static reservoir model, which in turn provides a more reliable model for reservoir properties modeling and simulation workflows.

Previous studies had not succeeded in associating information from the 185 wells (23 stratigraphic units) and seismic interpretation data (inverse faulting and main horizons) in a unique 3D geologic model. By building a precise stratigraphy column from well markers, seismic interpretation and the deposition mode, this unique full 3D approach provided a true representation of the complexity of the reservoir, through an accurate static model.

The next challenge was to understand the internal distribution of the facies within the reservoir, as this distribution has an impact on propagation of the reservoir properties. Integrating the petrophysical data from the wells, combined with a conceptual deposition model from sedimentology maps, enabled the creation of a 3D facies proportion cube which provided the geological background for all the property models.



▲ Final structural and stratigraphic geological model, and current producing wells

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By using Paradigm Jacta® (Reservoir Risk Assessment) to consider the uncertainties associated with the reservoir properties, it was possible to quantify and model the uncertainty related to each property, and come up with a wide range of geologically feasible, stochastic scenarios to define the impact of uncertainty when estimating the reserves. The system also ranked the degree of influence of each property in the reservoir volume calculation through spider and tornado charts.

SKUA enabled the QC and validation of the static model by integrating the dynamic data and by comparing the production history with the model prediction, before performing simulation.

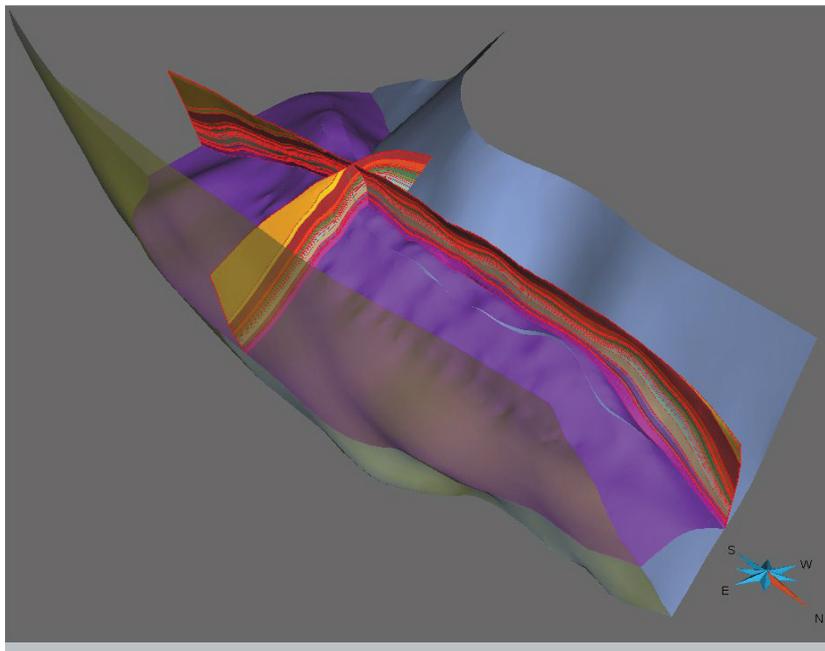
### The Results

The first result of this project was a validated, accurate structural and stratigraphic model containing 22 stratigraphic units which

honored both the seismic interpretation and the well markers. The geologic grid created from the final structural model honored both the geology and the stratigraphy. A solid statistical analysis of the petrophysical well properties was delivered, as were property models honoring sedimentology and petrophysical data. Advanced QC merged static and dynamic information.

“The SKUA modeling solution was able to provide us with new and accurate information about reservoir volumetrics in the Middle Magdalena Valley,” said Carlos Chaparro, head of the Enhanced Recovery Department at Ecopetrol. “This information enhanced our confidence when making drilling decisions, since we knew it was based on advanced technology that took all the data into account.

“In addition, the Paradigm consultant worked at our office daily in order to ensure that the study was carried out efficiently. This gave us the feeling that Paradigm was a true partner, working side by side with us to obtain the best possible results before deadline.”



▲ Visualization of the geological grid between the main faults delimitating the reservoir

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*Carlos Chaparro, Ecopetrol*