# 3D Driven Seismic Channel Sandstone Reservoir Modeling

## The Challenge

Alluvial reservoirs in Western Siberia show great variations in reservoir properties, and a lack of understanding of the depositional system often results in expensive dry holes. A poor understanding of the reservoir also makes it difficult to position production wells at optimal drainage points, which affects the overall economic viability of a field.

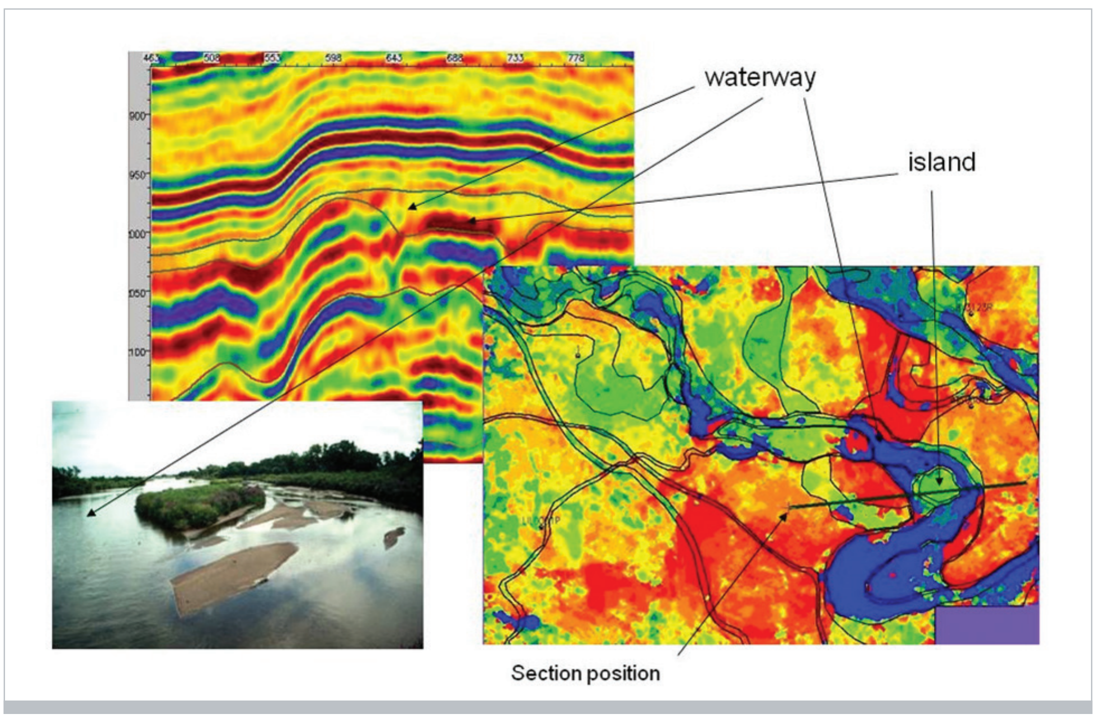
To solve these issues, it is highly desirable to perform the geological modeling of reservoirs during the initial stages of exploration. This requires the design and execution of new workflows, and the application of new technologies, to be successful. In particular, it is essential to interpret concurrently, the petrophysical information and the seismic data, to create both structural and depositional maps.

3D data provides critical information for understanding the history of stacked meandering rivers alternately depositing and eroding materials in the flood plain. Without a clear picture of these elements, drilling runs a near-certain risk of missing the reservoir areas that offer favorable porosity and permeability.

## The Assessment

Neural network classification techniques applied to the analysis of waveforms give a fast and reliable view of the distribution of seismic "facies." A seismic facies can be defined as the amplitude signature of a specific stack of rock properties. Other attributes of the seismic trace can be combined in the classification exercise.

Spectral decomposition attributes have proven of particular use in this region. The maps displaying the distribution of the different facies show depositional morphologies similar to the aerial photography of modern depositional systems. Waterways, banks, active or abandoned meanders, islands and alluvial plains can be inferred from the detailed images, and the sediment nature and its properties can be predicted based on the depositional model. Where a well penetrates the fluvial sequence, detailed interpretation of the petrophysical properties within the borehole and the core data give added calibration points that significantly increase the reliability of the facies maps. As more experience is gained in the region, the detailed description of the fluvial sand reservoirs is increasingly precise, often down to a few meters thickness for individual units.

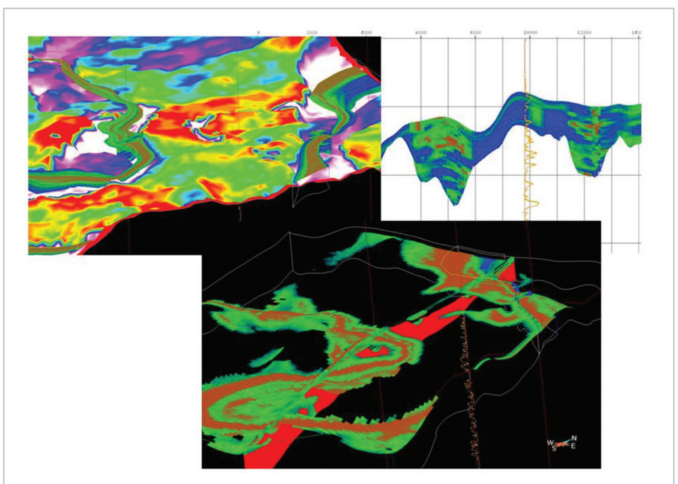



▲ Seismic images of the alluvial facies on section and horizon slice.

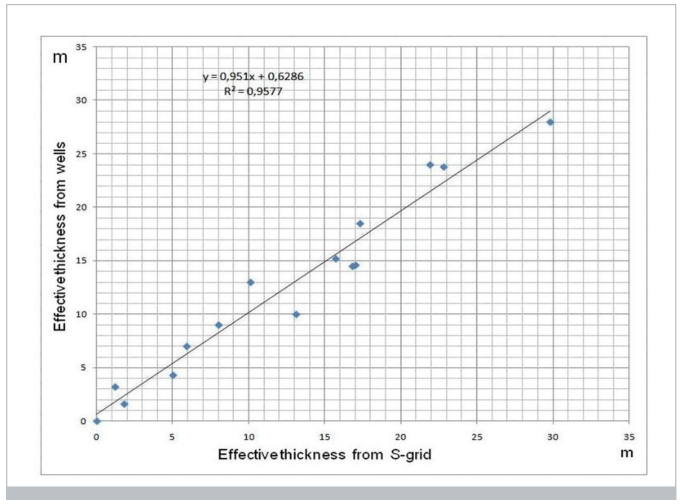
## The Solution

The following workflow was utilized, leveraging Paradigm software, to address the challenges faced in this Western Siberian reservoir:

1. Build a reservoir model and within the model added facies information retrieved from seismic facies classification using neural networks.
2. The company then utilized analogs from neighboring fields to verify classification data and were confident in the result due to the seismic similarities between the analog field and the target reservoir.
3. With limited wells and seismic data, they created pseudo wells with analogs from neighboring fields and combined the geologic reservoir model reservoir property data from actual wells and analog pseudo wells.  Reservoir properties such as depositional facies and porosity were obtained.
4. From the model, they derived effective thicknesses of the reservoir zones to the limit which could be determined using the seismic data.



▲ Waterway model on the seismic facies images (top left); 3D grid cell with porosity (middle bottom); vertical section of porosity model (top right).




▲ Crossplot with comparison of effective thickness from wells and reservoir model.

## The Results

The team built a reservoir model of alluvial sandstones which allowed the definition of the extent and porosity values of this stratigraphic trap; thereafter, they were able to choose new well locations with confidence.

By selectively drilling into the best porosity and thickness areas of the reservoir, production rates and total recoverable hydrocarbons were significantly increased while reducing the number of wells needed to effectively drain the field. This generated increased revenues as well as lower operating costs.