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A Complex Fluvial-Estuarine Geologic Model, Cerro Negro, Venezuela

Cerro Negro Field (Orinoco Basin of Venezuela) produces heavy oil from the Morichal Member of the Oficina Formation, which consists of channel and channel-margin complexes with associated floodplains in a fluvial to estuarine setting.

One major challenge in modeling this field was in defining the channel trends to the modeling program. This was done by creating horizon slice facies probability and azimuth maps. To cover the 800-foot Morichal formation, the reservoir was subdivided into forty 20-foot thick slices parallel to the major flooding surfaces. Average Gamma Ray class (Facies Association Code, or FAC) grids were created for each depth slice. Due to low impedance contrasts it was not possible to identify the lithology directly from 3-D seismic. However, shapes and lineations consistent with fluvial channel geometries could be interpreted, captured and then posted on the FAC maps.

The Facies Association Code contours were manually edited, bringing the channel edges into conformance with the seismic lineations. Once the FAC contours were edited, channel axis flow lines were digitized as source-to-basin directed line files. The FAC grids were algebraically split into facies probability grids and the flow line vectors were gridded for use as azimuth Locally Varying Means (LVM). The FAC probability and azimuth grids were read into the SGM model, creating rather blocky facies probability and azimuth 3-D LVMs for use in a Sequential Indicator Simulation.

The resulting facies simulations closely follow the facies trends as defined in the probability LVMs, and even fine features can be observed to be steered by the azimuth 3-D LVM.