Paradigm®

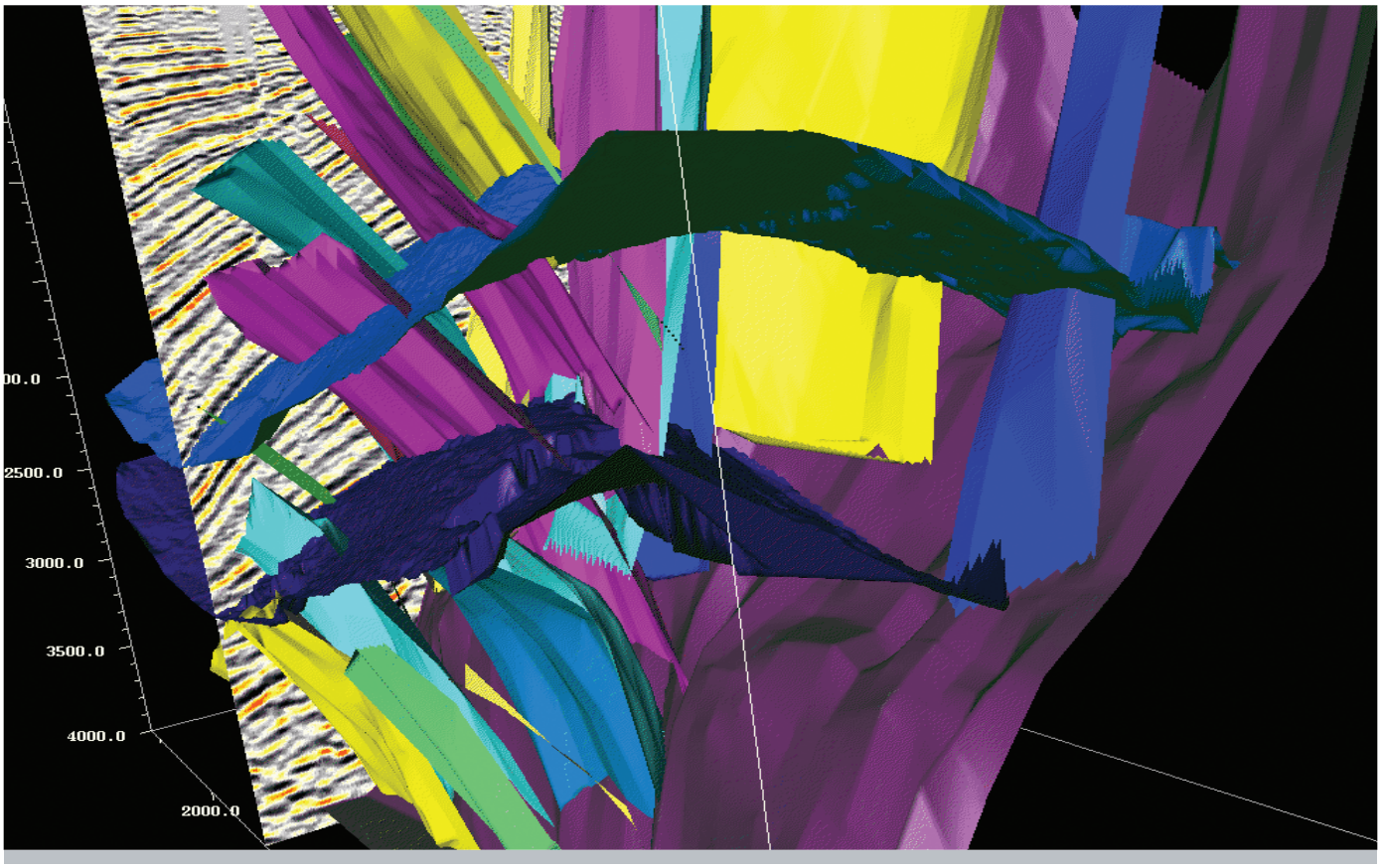
Pressure Estimation in a Structurally Complex Regime

The Challenge

Petroleos Mexicanos (PEMEX), the Mexican national oil company, wanted to study pore pressure distribution in the Macuspana basin to better understand its pressure regime and explain the pressure compartmentalization they had observed from drilling. PEMEX also wanted to reduce risks from geo-hazards while drilling, as well as better optimize field development.

The Assessment

Previous geological studies confirmed that pore pressure was highly compartmentalized, in part due to shale movement and faulting acting as pressure boundaries. The initial velocity model was not detailed enough to fully capture the compartmentalization and could not be utilized in such a structurally complex area.

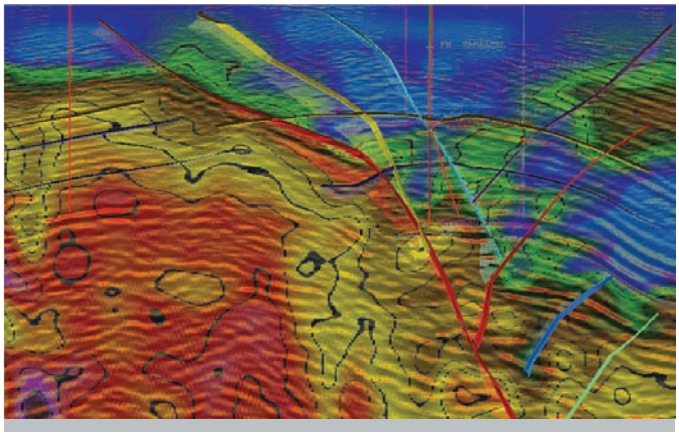


▲ Highly faulted reservoir heavily impacts pore pressure

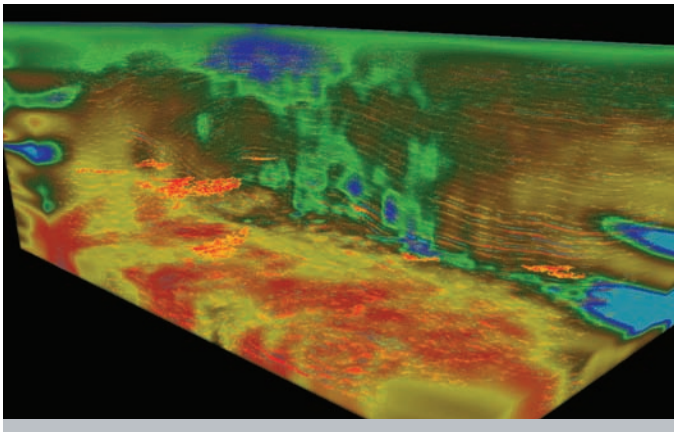
The Solution

Based on the integration of all available data, Paradigm developed a customized workflow which consisted of:

- Petrophysical analysis to determine the lithology and pressure at the well locations.
- Structural interpretation to understand the tectonic history and its impact on pore pressure prediction.
- Residual move-out analysis on a high density, high resolution grid, using manual and automated techniques to deliver an updated seismic velocity volume. This was converted to interval velocity using a constrained Dix inversion technique and calibrated with well velocities.
- Computation of pore pressure from the refined interval velocity volume, using the Eaton method.
- Co-visualization of the structural interpretation with pore pressure and seismic data volumes.



▲ Compartmentalization of the pore pressure volume (red is high pressure; blue is low pressure)



▲ Potential prospect identified using AVO inversion overlain by the known pore pressure

The Results

The Paradigm customized workflow for PEMEX:

- Helped to understand the hydrocarbon migration pathway
- Aided in determining which faults were sealing and/or leaking
- Associated pore pressure prediction with the pattern of the growth faults
- Reduced well planning risk
- Optimized development

The customer obtained a calibrated model that could be used to position production wells in optimal locations for the most effective drainage of the structure. The detailed pore pressure model also assisted the drilling planning process, allowing the engineers to design boreholes that stayed clear of areas of highly abnormal pore pressure. This dramatically reduces the risk of hole failure, which could lead to catastrophic loss of downhole equipment, damae to the rig as well as severe injury to the drilling personnel. Even if a pressure kick is controlled, substantial operational loses are incurred while remedial action is taken to stabilize the hole.