Pore Pressure Prediction in the Scotian Basin

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ABSTRACT
A joint collaborative interdisciplinary project was undertaken by ChevronTexaco and Schlumberger on behalf of partners in Exploration License 2359, Petro-Canada and ConocoPhillips to study pore pressure prediction and overpressure in the Scotian Basin. The more than 40 years of drilling history in the Scotian Basin suggests that high pore pressure has a very significant influence on well cost, safety and the ability to reach objectives. Despite this impact, pore pressure in the Scotian Basin remains poorly understood. It is estimated that a reasonably predictive pore pressure model could reduce well costs by 15-20%. The primary objective of this project was to develop an understanding of the regional pore pressure mechanisms in the Scotian Basin and create a model appropriate for accurate pore pressure quantification.

Pore pressure is the pressure of the fluid in the rock. In overpressure, fluids are confined in the pores and support part of the weight of the overlying solids. The term overpressure can have several different meanings depending on the context in which it is used. Overpressure is the amount of pore pressure in excess of the hydrostatic pressure for a given depth. The point at which pore pressure is greater than the hydrostatic pressure is the definition of the “top of overpressure”. However, the “top of overpressure” reported in most wells in the Scotian Basin is where there is an operationally detected pore pressure related event such as a kick.

Most pore pressure prediction techniques are focused on determining the pore pressure state of the shale. Yet most of the operationally detected pore pressure events (*i.e.* kicks, borehole collapse) occur in sandstone reservoirs, fractured zones or at fault planes, where ever there is permeability. The pore pressure in the shale is not directly measured but rather empirical relationships have been developed that attempt to relate the compaction-dependant petro-physical properties of the rock (*e.g.* velocity, density) to effective stress ($PP=S_{OB}-S_{eff}$).

A key outcome of this study was the development of a pore pressure prediction workflow that accounts for pore pressure trends in both the shale and the

reservoirs. An understanding of secondary pressuring mechanisms is a critical component of the model. Post well wireline analysis shows that in many cases the top of the overpressure can be significantly above or even below where the operationally detected top of overpressure event occurred.

It is important to develop a complete understanding of the pore pressure from all available information prior to well spud. Real-time drilling and wireline information can then be used to continuously update the pore pressure models to minimize operational risk and eliminate surprises.