Pore Pressure Prediction in Highly Compressional Stress Regimes: Examples from Australia and Papua New Guinea

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Accurate knowledge of pore pressure is essential for designing stable holes. Complex geological settings such as faulted blocks, pressure compartments and high tectonic stresses make pore pressure prediction difficult and often inaccurate due to uncertainty in pressure-generating mechanisms. Because pore pressure and horizontal stresses are coupled, it is possible to use detailed observations of drilling induced tensile fractures and borehole breakouts in image logs to back calculate the stress and pressure regime consistent with rock properties and drilling conditions.

The Ieru and Toro Formations in the Papua New Guinea Fold Belt region are known for abnormally high pore pressures regimes. The use of pore pressure profiles from conventional log-based methods has many shortcomings because of the tectonic deformation associated with the PNG region. Similarly the Vulcan and the Plover Formations in Browse Basin, Australia are associated with normal pore pressure but a highly compressional stress regime where the magnitude of maximum horizontal stress can be 1.6 to 2 times greater than minimum horizontal stress. Conventional log-derived Pp estimates suggest abnormally high pressures at the base of Vulcan Formation, inconsistent with Pp and drilling data.

In both cases detailed analysis of image logs, drilling data, Pp measurements and indicators, rock property and leak off tests are used to quantify the complete in situ stress tensor. The geomechanical models with the resultant pore pressure profile are consistent with the stress and pressure conditions needed to explain wellbore failure (or lack of failure) and drilling experiences.