FAULT GEOMETRY AND RESERVOIR PRESSURE DATA, COOPER BASIN (AUSTRALIA) – ISSUES, PROBLEMS AND LESSONS LEARNED

"HOT OFF THE PRESS"

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The Cooper Basin is Australia's largest onshore natural gas producing basin. Ongoing development and exploration since the 1960's has led to the accumulation of a wealth of seismic and pressure data, which we utilise to constrain the complex fault pattern and to demonstrate the status of fault seal integrity in the basin, respectively.

The paper presents ongoing work that is currently undertaken to assess in particular the remaining exploration potential for gas accumulations in the footwall of major fault blocks.

Two major fault systems trending northwest and northeast dominate the structure of the Cooper basin. Compression from the north resulted in oblique shortening along these fault systems. The fault systems in turn controlled Permian-Triassic deposition of peat swamps (coals) and sandstone reservoirs in a fluvio-delatic environment. Ongoing shortening segmented the Cooper Basin into structurally controlled highs separating broad lows ('troughs'). Second order faults lead to significant internal compartmentalisation of reservoirs. Most faults were reactivated after hydrocarbon charging during early Tertiary compression.

The present-day fault seal integrity of the Cooper Basin appears to be controlled by the interaction of the in-situ stress regime and the varying orientations of pre-existing fault patterns. The in-situ stress regime is at the cusp of a reverse stress geometry ($\sigma H >> \sigma h \geq \sigma v$) and a strike-slip stress geometry ($\sigma H >> \sigma v \geq \sigma h$). The azimuth of σH is roughly west northwesterly throughout the basin. Stress magnitudes of σH are up to three times the value of σh and σv.

Fault seal integrity was assessed using fault susceptibility maps incorporating the regional distribution of (σH) of the maximum horizontal in-situ stress from borehole breakout data together with fault orientations as key input data. The results indicate that stress related fault susceptibility is one important parameter in determining fault seal integrity. Importantly, several faults appear to be sealing despite (post-charge) Tertiary reactivation.

Reservoir pressure data were used to check the fault susceptibility prediction where possible. In several cases faults appear to be sealing despite adverse fault seal integrity prediction based on in-situ stress and fault orientation. Juxtapostion seals are most likely to hold back greater than anticipated hydrocarbon columns. Conversely, pressure data can indicate leaking faults where good fault seal integrity is indicated using in-situ stress and fault geometry based seal integrity predictions.