FAULT SEAL INTEGRITY IN THE TIMOR SEA AREA: PREDICTION OF TRAP FAILURE USING WELL-CONSTRAINED STRESS TENSORS AND FAULT SURFACES INTERPRETED FROM 3D SEISMIC

D. A. Castillo[1], D. J. Bishop[2] and M. de Ruig[3]

[1] GeoMechanics International Inc. (Asia Pacific), Perth, Western Australia 6000

[2] Woodside Energy Ltd, Perth, Western Australia 6000

[3] Shell ,Rohöl-Aufsuchungs A.G, Schwarzenbergplatz 16, 1015 Vienna, Austria

ABSTRACT

Drilling in the Laminaria High and Nancar Trough areas has shown that many hydrocarbon traps are underfilled or completely breached. Previous studies have shown that fault-trap integrity is strongly influenced by the state of stress resolved on the reservoir bounding faults, suggesting that careful construction of a geomechanical model may reduce the risk of encountering breached reservoirs in exploration and appraisal wells. The ability of a fault to behave as a seal and support a hydrocarbon column is influenced in part by the principal stress directions and magnitudes, and fault geometry (dip and dip azimuth). If a fault is critically stressed with respect to the present-day stress field, there is a high likelihood that the fault will slip, thereby re-creating fault zone permeability that enables hydrocarbons to leak. Leakage could be intermittent depending on the degree and rate of fracture healing, and on the recurrence rate between reactivated slip events.

High-resolution wellbore images from over 15 wells have been analyzed to construct a well-constrained stress tensor. Constraints are based on geomechanical parameters, along with drilling conditions that are consistent with the style of drilling-induced compressive and tensile wellbore wall failure seen in each of these wells. This regional stress analysis of permits AC/P8, AC/P16, Zone of Cooperation and surrounding areas indicates a non-uniform strike-slip stress regime (SHmax > Sv > Shmin) with the orientation of the maximum principal horizontal stress (SHmax) varying systematically from N-S compression in the northern reaches to NE-SW farther south (Figures 1 and 2).

Fault surfaces interpreted from 3D seismic data have been subdivided into discrete segments for the purpose of calculating the shear and normal stresses in order to resolve the Coulomb Failure Function on each fault segment. Hydrocarbon accumulation (column height) and leakage (residual column) deduced from well results may be explained in part by the CFF resolved on their respective reservoir-bounding faults. By integrating the geomechanical model with fault imaging technologies, explorationists and reservoir engineers will gain the ability to use these predictive tools to help quantify the likelihood of encountering a breached reservoir prior to drilling.

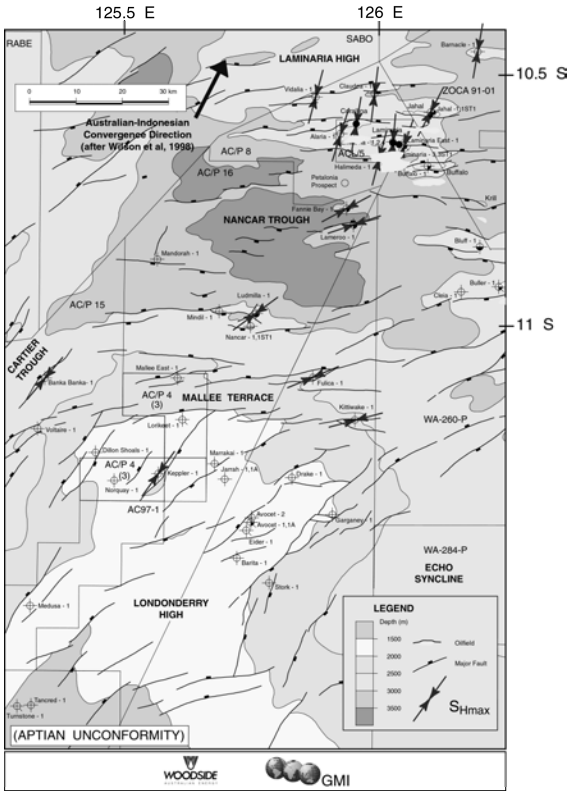

Figure 1

Timor Sea Stress Magnitudes

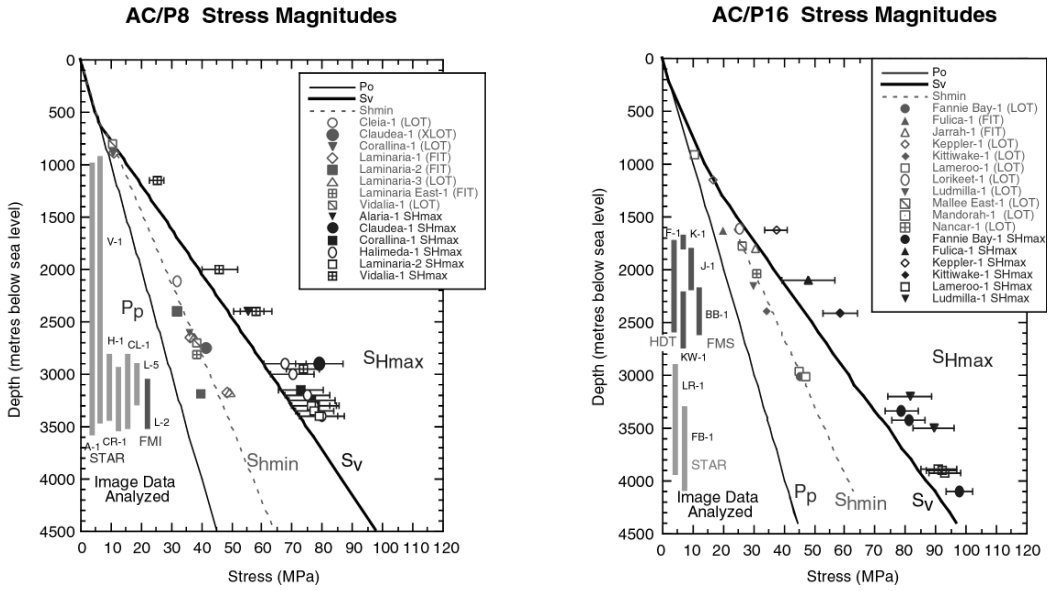

Figure 2