Structural restoration of AGSO deep seismic lines across the Timor Sea, using GeosecTM: - implications for fault style, leakage and basin formation.

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ABSTRACT - From an address given to the WA PESA Branch meeting on Thursday, September 21, 1995 by Kevin Hill.

Constructing balanced sections across basins, such as the Vulcan Sub-basin, which have undergone multiple directions of tectonic transport is difficult. However, sections oriented within 25° of all transport directions can be restored and result in ≤10% error in the amount of extension-compression. Extensional faults are commonly oblique to the transport direction, so the inferred extension direction may be verified by dip analysis of the pre-rift sections.

Inversion events add further uncertainty as the estimates of the magnitude and timing of such events are imprecise. For strongly inverted and eroded anticlines, the timing and amount of material eroded can be estimated from structural analysis of restored sections. This can be confirmed by comparison with borehole vitrinite reflectance and apatite fission track profiles, which constrain the timing and amount of denudation allowing reconstruction of the original anticline morphology. Thus, strata may be replaced on the balanced section and the inversion restored to reveal the syn-rift basin morphology, which may constrain hydrocarbon migration paths (Hill & Cooper 1996).

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In the Timor Sea area, balancing of sections has demonstrated that an interpretation of listric faults is NOT valid and that steep-dipping planar faults are more likely. In the areas of domino faults, as on the Ashmore Platform, these planar faults appear to pass into a ductile zone at 4-8 km. Many of the significant Miocene faults are related to underlying Late Jurassic extensional faults, although the relationship is often not a simple one. The Miocene fault extension is small (1-2%) so the reactivated faults pass up into the Miocene section as overlapping vertical and lateral relay faults. Thus, the offset of a single fault is likely to be small, such that the risk of breaching may be small.

Our section restoration suggests that in the early Mesozoic, the Ashmore Platform was buried by an additional 2.5-3 km of Triassic-?Jurassic strata, consistent with the Vulcan Sub-basin and Timor Trough on either side. This leads to the following Mesozoic geological history: Minor regional Triassic extensional faulting (1-2%) was followed by the main faulting event by the Late Jurassic, with 10% extension across the Ashmore Platform, but <1% across the Cartier Trough-Jabiru-Challis area. Initial down-faulting of the Swan Graben and Skua Syncline occurred in the Callovian and may have been related to uplift of the Ashmore Platform at that time. The steep-dipping, planar faults observed do not appear to detach at a constant horizon, but rather at a common initial depth of 4-6 km, perhaps controlled by water depth in the adjacent new ocean basins, but locally by a suitable incompetent horizon (eg. Mount Goodwin).

We propose to expand this study to cover all of the ZOCA/Timor Sea area, which will reveal the true basin morphology at any time and the detailed faulting relationships. This will aid in determining migration paths, changing trap morphology in time and potential sites of breaching.

Acknowledgements

BHPP sponsored this pilot study, and BHPP and AGSO allowed presentation of their proprietary data and interpretations.

Reference

Hill K.C. & Cooper G.T., 1996. A strategy for palinspastic restoration of inverted basins: thermal and structural analyses in SE Australia. *In* Buchanan P.G. & Nieuwland D.A. (eds), Modern Developments in Structural Interpretation, Validation and Modelling, Geological Society Special Publication No. 99, pp 99-115 (in press).