The Contemporary Stress Field of Australia's North West Shelf and Collision-Related Tectonism

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Abstract

A major new analysis of borehole breakouts in the Carnarvon and Bonaparte Basins of the Australian North West Shelf has revealed contemporary maximum horizontal stress (σ_{Hmax}) directions to be 090°N-100°N and 055°N-060° respectively. The first-order σ_{Hmax} direction rotates 40° between the western and eastern ends of the North West Shelf.

Stress magnitude analyses reveal that in both the Carnarvon and Bonaparte Basins the stress regime is broadly on the boundary between strike-slip and extension. In the Carnarvon Basin stress regime changes from strike-slip near the shoreline to extensional with increasing distance northwest towards the Indian Ocean Basin. In the Bonaparte Basin the stress regime changes from extension in the southwest to strike-slip northeast towards the plate margin.

In the context of the plate boundary forces controlling regional stress orientations, the observed stress rotation can be explained solely by the focusing of the forces balancing ridge push along collisional segments of the northeastern boundary of the Indo-Australian Plate.

Stress indicators in the Carnarvon Basin exhibit consistent orientations that differ between the basin's depocentres and its flanks. σ_{Hmax} is consistently oriented E-W within the relatively structureless depocentres of the Barrow-Dampier Sub-basins, and oriented NE-SW in the more structurally complex basin margins. Stress orientations in the faulted basin margins may differ from the regional mean due to: contrasting elastic

properties between rocks forming the basin margins and those comprising the depositional centre (i.e a lower Young's modulus on the basin margins), and/ or; active faults locally perturbing stress magnitude and orientation.

The contemporary σ_{Hmax} directions determined have important consequences for the style and orientation of fault reactivation within the North West Shelf. On the margins of the Barrow-Dampier Sub-basins, faults oriented NE are most susceptible to normal reactivation, the E-W faults to sinistral strike-slip reactivation and the N-S faults to dextral strike-slip reactivation and the NW oriented faults are not likely to be reactivated. In the Bonaparte Basin, the dominant NE/E-NE structural trend is susceptible to extensional reactivation, the E-W trend is most susceptible to sinistral strike-slip reactivation and the Palaeozoic NW structural is unlikely to be reactivated.