

Miocene Shelf-Edge Delta Behaviour and Influence on Deepwater Slope Morphology, Northwest Shelf of Australia

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Shelf deltas and shelf-edge deltas, identified in the Neogene of the Northern Carnarvon Basin, Northwest Shelf of Australia, show distinct clinoform morphologies. Also, along-strike variability of slope morphology and sediment transport occurs as a result of localized shelf-edge delta sedimentation. Key bounding stratigraphic surfaces were mapped using 3-D seismic data and horizontal and proportional slicing of seismic amplitude and coherency volumes used to interpret depositional systems and their architecture.

Late-middle Miocene siliciclastics in the Northern Carnarvon Basin (Bare Formation) represent shelf and shelf-edge deltas that prograded across a preexisting carbonate shelf. Mapping of these deltas reveals lobes that display distinct clinoform characteristics (e.g. heights of tens versus hundreds of meters) depending on their location with respect to the shelf break. There were distinct fluctuations between shelf and shelf-edge delta deposition within at least one interpreted delta lobe complex. Accordingly, some of the lobes within this complex deposited sediments at and beyond the shelf break forming shelf-edge deltas, whereas other lobes did not reach the shelf break before they retreated or were abandoned. Seismic stratigraphic analysis suggests that the stratigraphy was built by regressive pulses that cause a basinward shift of deltaic deposition (shelf-edge deltas) and transgressive pulses that pushed deposition landward (shelf deltas) within this lobe complex.

Deepwater slope morphology in plan view changes from linear to convex-outward where shelf-edge deltas were deposited. Incisions were already conspicuous on the slope even before deltas reached the shelf-break. Nevertheless, slope gullies immediately downdip of the shelf-edge deltas display greater erosion of underlying strata and are wider and deeper (>1 km wide, ~100 m deep) than incisions that are laterally displaced from the deltaic depocenter (~0.7 km wide, ~25 m deep). We interpret this change in slope gully morphology as the result of erosion by sediment gravity flows sourced from the delta itself. Furthermore, localized deposition of the shelf-edge deltas had significant impact on along-strike variability of margin progradation. Late-middle and late Miocene margin total progradation is ~26 km to the south where there are no shelf-edge deltas; whereas shelf-edge progradation is ~37 km to the north where the deltas were concentrated.