

Shelf Margin Facies of the Kookfontein Formation: Impact of Process Regime Changes and Delta Position Relative to the Shelf Edge

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The Kookfontein Formation is a member of the Permian Ecca Group in the Tanqua Karoo Basin and is composed of a series of coarsening upward deltaic cycles that record deltaic deposition at the shelf edge and on the shelf. Interest in shelf margin deltas has increased due to their important role in the deposition of deep water sands; however, the complex relationship between sedimentary processes on the shelf and shelf edge and sediment delivery to deep water is not fully understood. This study provides a 3-D examination of the linkage of the facies along the Kookfontein shelf margin profile.

Mountainside exposures, 10 km wide and 250 m thick, on Pienaarsfontein Se Berg were studied by measuring 21 detailed stratigraphic sections and by “walking out” the tops of each of the coarsening upward units within three stratigraphic cycles of shelf-margin progradation. The outcrop trends in an East-West direction, oblique to the depositional dip, and thus enables a partial three-dimensional reconstruction of the deltaic depositional system. Stratigraphic Unit 1 records a delta with mixed fluvial, wave, and tidal energy where sediment partitioning onto the slope was primarily controlled by the occurrence of flood-dominated sustained quasi-steady turbidity currents as well as surge-type turbidity flows. The occurrence of channels at the shelf edge resulted in increased shelf-edge instability and localized slumping. The position of the delta near the shelf edge resulted in increased soft sediment deformation that predominately occurred in situ. In Stratigraphic Unit 2 the deltaic system has backstepped relative to Unit 1; however, sands are still being transported across the outer shelf and onto the slope by quasi-steady turbidity currents. These deltaic deposits reflect abundant scour and fill features up-dip and high rates of deposition in massive to plane parallel laminated beds down-dip. The amount of soft-sediment deformation has decreased significantly with no beds suggestive of slumping. Stratigraphic Unit 3 shows the reoccupation of the delta near the shelf edge; the strata are dominated by wave and tide influenced mouth bars with a very limited soft sediment deformation. The change in process regime from fluvial flood-dominated in Stratigraphic Unit 1 to an increase of tide and wave control in Stratigraphic Unit 3 is thought to affect the amount of soft sediment deformation as more frequent reworking reduced the instability of the sediment.