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Palaeoenvironmental shifts and sequence analysis of the Early-Middle Devonian Bokkeveld Group in the Clanwilliam Sub-basin of South Africa

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The Early-Middle Devonian Bokkeveld Group (Cape Supergroup) of South Africa is a meta-sedimentary rock succession which outcrops along a substantial portion of the Cape Fold-and-Thrust Belt comprises five to six, along-tectonic-strike continuous, upward coarsening successions each comprising lower argillaceous and upper arenaceous lithologies. Previous studies of the Bokkeveld Group by Csaky [1], Csaky et al. [2] Theron [3], Tankard and Barwis [4] and Theron and Looek [5] suggest that each upward coarsening succession represents a series of progradational wave-dominated deltaic depositional complexes with some tidal influence and comprises shelf-prodelta, distributary mouth bar, tidal flat, interdistributary bay and beach-shoreface (comprising washover, estuarine and tidal inlet and channel environments only) depositional environments. Lateral continuity of lithologies has been reasoned to be due to reworking and lateral amalgamation of delta-front and delta-plain environments by longshore drift, storm, wave and tidal action at time of sedimentation. Delta-plain environments are not preserved and have been inferred by previous workers to have been transgressively eroded with initiation of each successive upward coarsening succession. These data suggest that upward coarsening successions in the Bokkeveld Group are allocyclic and represent five to six 3rd order transgressive-regressive sequences. The mechanism controlling cyclicity is, however, debated. Theron [3] and Tankard, et al. [6] favour a tectonic control on 3rd order cyclicity whereby alternation and generation of accommodation space in the Cape Basin during Bokkeveld Group sedimentation was controlled by periodic tectonic instability followed by quiescence. Tankard et al. [6] considered the Chanic Phase of the Famatinian Orogenic Cycle in northwest Patagonia to be the major tectonic driver of subsidence during Devonian times in the Cape Basin and that the Bokkeveld Group and overlying Witteberg Group represent a single 2nd order flooding event. With comparison to the Devonian eustatic curve for Laurussia, and noting the association of benthonic offshore-shelf Malvinokaffric Realm taxa with “black shales” within the Gydo and Waboomberg Formations of the Clanwilliam Sub-basin, Cooper [7] alternatively suggested that cyclicity in the Bokkeveld Group was controlled eustatically and that two 2nd order flooding events may be discriminated for at the base of the Ceres and Bidouw Subgroups.

Recent analysis of the sedimentology and palaeontology of the Bokkeveld Group in the Clanwilliam Sub-basin (Cederberg, Western Cape Province) suggests that each upward coarsening succession is unique in its partitioning of an array of constituent depositional environments and represents larger storm-and-wave dominated offshore-shoreface-beach depositional systems, or wave-and-tide dominated estuarine depositional systems. Sequence analysis of the Bokkeveld Group has tentatively revealed the presence of at least three-to-four unconformity bounded 2nd order sequences and at least eight 3rd order transgressive-regressive sequences within the Clanwilliam Sub-basin.

References:

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