Tectonics, Eustasy and Climate: Controls on Cyclicity, Devonian Reef Complexes, Canning Basin, Western Australia

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Devonian reef complexes of the Canning Basin exhibit metre-scale cycles in outcropping platform carbonates, basinal carbonates, interfingering platform-level carbonates and siliciclastics, and in platform-level conglomerates associated with the reef complexes. All platform-level cycles have a typical saw-tooth pattern of gradual infill then rapid drowning into the next cycle. Transgressive drowning deposits are rarely preserved. Carbonate-dominated infill cycles and mixed carbonate infill - clastic prograde cycles can be explained by orbitally forced eustasy in a greenhouse setting. Basinal deposits locally show a regular facies alternation, between background shale deposition and thin distal debris flows shed from the platform, that can be correlated with and attributed to platform-level cyclicity. Additionally, outcropping conglomerate bodies associated with the complexes span many tens of cycles, indicative of tectonic control rather than reciprocal deposition.

Mixed clastic/carbonate infill cycles, from an area where platform carbonates interfinger with and are cut by alluvial fan deposits, have a less intuitive origin. The key to their interpretation is recognizing sharp boundaries and facies shifts that indicate a significant hiatus in deposition. Cycles show sandstone and conglomerate gradually diminishing upwards in favour of shallow-water carbonate facies, and fenestral fabrics also increase upwards in both sandstones and carbonates. Cycles culminate locally in small-scale fenestral desiccation polygons in microbial carbonates, and tepees can be discerned in places. These facies are then abruptly overlain by conglomerate and sandstone - the sharp boundary between them is, by empirical observation, the drowning surface, and the deepening from peritidal carbonate to sub-aqueous conglomerate or sandstone has no associated deposition. Traced laterally, conglomerates fine first to sandstone then terrigenous siltstone over a few kilometres. In each of these cycles, terrigenous influx waned upward, allowing progressive dominance by carbonates, rather than the more intuitive scenario of background carbonate deposition being regularly overwhelmed by terrigenous progradation. A regular humid-to-arid climatic alternation could explain the pattern of conglomerate regularly diminishing in favour of carbonate.