Pennsylvanian Ross Sandstone Deep-Water Fans Sliced and Diced

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ABSTRACT

Recent virtual outcrop studies, additional biostratigraphy and behind-outcrop drilling in the Ross Sandstone Formation, western Ireland, reveal new details of the structure of stacked fan complexes on the floor of a tropical icehouse basin. Ross deposition overlapped with high-frequency glacio-eustasy during a particularly intense phase of the Late Palaeozoic Ice Age. The succession records at least nine stacked cycles of sand deposition (30-90m thick) separated by muddy condensed sections. Here we focus on the hierarchy present within the constituent lobe complexes and across the wider succession as a whole, also an issue in many of the subsurface systems for which the Ross is a useful analogue. The bulk of the succession comprises weakly confined distributive fan lobes with both lobe elements and subordinate distributary channels. A new correlation framework and palaeogeographic maps constrain details of the lateral transitions at km scale spanning the Loop Head area, west Clare. The framework ties together the detailed cliff panels and confirms that channels were locally constrained to distinct fairways, the locus of which switched from cycle to cycle. Significant fan sectors lacked channels although some show evidence of local erosion and bypass. Three modes of lobe organisation are inferred; aggradational, compensational and accommodation-limited, and these are associated with different levels of hierarchical organisation. The stratigraphic architecture may have been controlled by proximity of the depositional surface to a nominal equilibrium profile with accommodation-limited stacking in areas already close to that profile, for example, where avulsions fed lobes in more proximal sites. Larger scale organisation across the stacked cycles is revealed by vertical changes in net sand and in the expression of the condensed sections. Mid-Ross cycles are sandier and separated by less well developed condensed sections and these may correspond to an amplified fall of sea level due to compounding of longer and shorter term sea level fluctuations. Both lobe complexes and condensed sections show evidence of higher frequency forcing, implying external control may have operated inside the main depositional cycles and contributed to the mesoscale heterogeneity structure. The distribution of elements, including mass transport complexes in the mid and upper Ross, appear to have been influenced by the position of the trough axis along which the system advanced.