Testing the Sequence Stratigraphic Paradigm of Deep-Marine Sedimentation Along an Ancient Upper-Slope to Basin-Floor Transect, Neoproterozoic Windermere Supergroup, Western Canada

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Abstract

Deep marine rocks of the Windermere Supergroup record a several km-thick sedimentary pile that accumulated along the passive continental margin of Neoproterozoic Laurentia (ancestral North America). The succession comprises mostly siliciclastic sedimentary rocks intercalated with carbonate and mixed carbonate-siliciclastic intervals. Observations along a several 100 km-long depositional transect that stretches from upper slope canyons to deep basin floor deposits show a number of systematic changes, but only in the slope part of the transect. Slope deposits are dominated by levee deposits intercalated with slope channels that range up to >100 m-thick by several km-wide, and exhibit two end member kinds: aggradational and laterally accreting. Unlike aggradationally-filled channels, laterally-accreting channels are associated with the input of carbonate sediment. Additionally, evidence of mass wasting, in the form of thickly developed, areally extensive debrites, slump and slide deposits become an important component in the stratigraphy. Moreover, stromatolite and oolite fragments, in addition to abundant carbonate cemented sandstone and mudstone clasts, indicates the resedimentation of debris sourced from an upslope shallow-water carbonate platform under late transgressive, highstand to possibly early falling stage conditions. The eustatic rise that led to the

development of the carbonate platform, is also interpreted to have significantly modified the make-up of the siliciclastic sediment supply, principally in terms of its grain-size distribution, which accordingly controlled the character of the slope channel systems. Central to the systematic change in sediment supply is the presence of a topset -- a physiographic feature that is absent in ramp-style basins, and therefore where modification of the hinterland sediment supply would be minimized. Further basinward, basin floor deposits form a succession of intercalated decameter-thick “sheetlike” sandstone and mudstone layers. Sandstone layers are composed mostly of terminal splay deposits with lesser distributary channel complexes and rare feeder channels. Grain size of the sand is little different from that on the slope. Mudstone layers are dominated by thin-bedded, upper division turbidites. Unlike the slope, the basin floor stratigraphy shows no systematic temporal (i.e. upward) change in architecture. This suggests that the effects of eustatically controlled changes in sediment supply became attenuated and apparently completely filtered as flows descended the continental slope, ultimately resulting in a basin floor stratigraphy largely unaffected by upslope conditions but instead controlled principally by local seabed topography.