Linking Autogenic and Allogenic Controls on Fluvial-Deltaic Stratigraphy Through Hydrodynamics of Non-Uniform Flow: Tested in the Westen Irish Namurian Basin, County Clare, Ireland

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ABSTRACT

The hydrodynamics of rivers approaching a basin are influenced by the onset of non-uniform 'backwater' conditions that give rise to decelerating flow velocity and decreasing boundary shear stress. These changes occur across a spatial gradient, in which decreasing sediment transport capacity triggers morphodynamic responses that include sediment deposition at the transition from uniform to non-uniform flow near the outlet. As a consequence, channel width-to-depth ratios and bed sediment grain size decrease downstream. While non-uniform flow is crucial in shaping the morphology of modern fluvial-deltaic systems, the influences on the rock record remains unclear. Moreover, the signals of the autogenic backwater processes have yet been resolved in stratigraphic record. This study seeks to identify linkages between fluvial-deltaic strata and backwater morphodynamics by measuring variability in fluvial deposits across the backwater zone identified for the Tullig Cyclothem in the Western Irish Namurian Basin (WINB). The results of this analysis will bolster analytical models that seek to link observed stratigraphy with predicted depositional patterns. Furthermore, the proposed research provides a basis for a direct assessment of the diachronous nature of the fluvial-deltaic stratigraphy in the WINB by combining time-and-space variable changes in grain size and channel dimension with reconstructions of paleo-hydraulics. This research will produce quantitative metrics to evaluate the dimensions and grain size variation of channel bodies produced by ancient fluvial-deltaic systems, and thereby provide valuable geological insights into hydrocarbon bearing rocks. Initial modeling results show that (1) non-uniform flow drives development of stratigraphic patterns via sediment partitioning and channel bed aggradation. (2) The condition of non-uniform flow can manifest differently depending basin type, however the condition so as to influence stratigraphy is not as well developed if the gradient of the subaqueous basement is high. (3) Base level fluctuations enhance the development of non-uniform flow.

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