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Process-based numerical modelling of turbidity currents on a stepped slope-to-basin profile of the Fort Brown Fm., South Africa

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The depositional architectures of deep-water turbiditic deposits are strongly influenced by seafloor topography. Slope gradient variations of less than one degree might be sufficient to change the distribution of sands significantly along the basin profile. Stratigraphic units of deep-water sandstones from the Fort Brown Fm. in the Laingsburg depocentre (Karoo Basin, South Africa) are an example of that. Regional mapping and stratigraphic correlation of Units C to F (Van der Merwe et al., 2014) show a change from sand-attached systems in Units C and D to sand-detached systems in Units E and F. The sand-attached systems show a continuity of sands from entrenched slope valleys to basin-floor lobe complexes, while in the sand-detached systems there are widespread sand bypass zones of approximately 10 to 30 km where almost no sand is deposited and erosive features are observed. This is interpreted to reflect the development of a stepped slope profile. Lobe deposits occur before and after the bypass region, but significant differences in depositional architecture are noticed between these lobe deposits. The intraslope lobes are characterized by an aggradational to compensational stacking pattern and a common occurrence of erosive features, while the basin floor lobes show a lateral compensating stacking pattern with less erosive features. In this study, process-based numerical modelling of turbidity currents are performed to test if a stepped slope to basin profile with subtle gradient changes similar to that interpreted for the Laingsburg depocentre during the deposition of Unit E are suitable to generate the sediment distribution pattern observed in the field. Through an iterative modelling workflow we aim to constrain the paleoslope gradient changes using the parameters constrained from outcrop. The study also investigates how flow parameters such as sediment concentration, flow velocity, flow thickness and Froude number behave as a function of different slope gradients. The first promising results of these simulations are presented.

Reference

Van der Merwe, W.C.; Hodgson, D.M.; Brunt, R.L.; Flint, S.S. (2014). Depositional architecture of sand-attached and sand-detached channel-lobe transition zones on an exhumed stepped slope mapped over a 2500 km2 area, Geosphere, v. 10, n. 6, pp. 1-18.