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Process based modeling of sedimentary basin properties - Peïra Cava Basin, SE France

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The Eocene-Oligocene Grès d'Annot Formation which crops-out in the Peïra Cava region of south-eastern France is a 1200 m thick succession of sandstones and mudstones deposited in a confined, synclinal sub-basin plunging to the north. The Peïra Cava turbidite system is dominated by interceded high- and low-concentration turbidity deposits with several marker beds that can be correlated throughout the basin fill, providing a robust stratigraphic framework for analysis (Amy *et al*, 2007).

Using deterministic process based simulations it is possible to recreate the flow events that deposited the basin fill. The aim of the present study to utilize this methodology and investigate the role of the confinement, relief, and the size of the turbidity currents events required to reproduce the observed stratigraphy. MassFLOW-3D™ is a 3D Computational Fluid Dynamic (CFD) software for the numerical simulation of the physical equations describing fluid flow and sediment transport for turbidity currents. Flows are simulated on a structural restored, back-stripped and decompacted palaeo-bathymetry. The sedimentary infilling was the results of 18 major events (the marker units of Amy *et al*, 2007) and many thousands of minor ones. Each stratigraphic package includes a major flow and numerous minor ones having similar characteristics (flow entry point, sediment species and concentration, velocity inlet). The numerical modelling aimed to reproduce these 10 major units as the result of 10 major gravity flows. The different boundary conditions, such as the turbidity current inflow dimensions, inlet velocity, grain size and sand concentration used were based on outcrop observations and analysis found in the literature.

Comparison of the depositional results to the outcrop can highlight topographic issues but also validate the choice of palaeobathymetry. Overall good match were found with correct areas of erosion, bypass and deposition regarding outcrop observations. The fill of this basin initiated with deposition that was ponded within topographic lows and the earliest units are less continuous than the subsequent, more sheet like deposits. There was a clear up-slope back-lap of the basin fill and the retrogradation of the base of slope caused a reduction in the degree of erosion by successive surges (flow events) at the slope to basin transition. Reflection and refraction effects can be observed numerically as it had been observed in the outcrop (Amy et al, 2007).

The process based modelling was able to reproduce the distribution of deposits observed in the outcrop. This suggests that while non-uniqueness may be an issue, the assumptions made for flow size, flow velocity, sediment concentration, surge time and grain size were reasonable. Modelling the stratigraphy as 10 discrete surges rather than several thousand beds does not appear to have impacted the ability to reproduce the large scale stratigraphic architecture and mimic the fill of the basin. It does not capture however the distribution of bed scales heterogeneities. The modelling process is sensitive to the palaeo-bathymetric surface that is used.