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Passive-margin delta stratigraphy from source-to-sink numerical models: parametric studies and comparison with natural systems

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One major and under-appreciated aspect of coupled erosion-deposition numerical modeling is the ranges of input parameter values used to simulate natural source to sink systems without considering their meaning in term of erosion, transport and deposition processes. Most of the time, numerical models are used as a semi-inversion tool based on a “best-fit” approach, especially in its marine part where it aims to reproduce well-constrained sedimentary architectures which are great recorders of landscape evolution through time.

In this study, we performed several simulations using a new numerical landscape evolution model that accounts for both erosion and deposition onshore, as well as sediment deposition in the marine domain (Yuan et al., 2019; COLORS project, funded by Total). In the marine domain, sediment dynamic is described by a diffusion equation and the diffusion or transport coefficient has been calibrated from natural delta geometries. This model is highly efficient and allows the separation of the different processes involved and exploration of various setups and parameters values in order to address a large variety of questions. Its efficiency also allows inverse simulations that are powerful to determine the best possible scenarios in terms of climatic or tectonic reconstructions, or to determine the evolution of several key parameters.

In order to evaluate the model reliability to reproduce realistic sedimentary geometries, we explore the impact of perturbations in climatic, eustatic or tectonic parameters of the model on the stratigraphic architecture of passive margins shelf-edge deltas and discuss its feedbacks with the erosion dynamic of the onshore domain. This sensitivity analysis also allowed us to define the most relevant geometrical parameters of observed or theoretical stratigraphic architectures that have to be include in the misfit function of the inversions and optimization scheme.

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