Passive margin stratigraphy for numerical models calibration: diffusion coefficient measurements in the Ogooué delta, Gabon

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One major and under-appreciated aspect of stratigraphic modeling by diffusion process is the wide range of diffusion coefficients used to simulate natural examples without considering their meaning in term of transport and deposition processes. Most of the time, stratigraphic simulation tools are indeed used as a semi-inversion tool based on a "best-fit" approach to reproduce well-constrained sedimentary architectures.

The aim of this work is to consolidate inputs of stratigraphic numerical modeling such as stratigraphic architectures, slopes of sedimentary systems, grain-size distributions and diffusion coefficients calibrated on a natural example of passive margin delta: the Plio-Pleistocene Ogooué Delta in Gabon.

We calculate diffusion coefficients from high resolution seismic stratigraphy and well analyses in three-steps: (1) calibration sand/shale ratio variations (from wells) along the depositional profile; (2) restoration of the slope of sedimentary systems at time of deposition (including differential compaction corrections); (3) calculation of accumulation rates using a high resolution age model and quantification of uncompacted volumes for each time step in various stratigraphic context.

Calculated diffusion coefficients range over two orders of magnitude (x0,01 to x1 km2/ka), i.e. less than the range proposed in published diffusion processed-based stratigraphic modeling (x0,0001 to x10 km2/ka). Our results suggest that: (1) neither the stratigraphic context nor the sand/clay ratio impact the diffusion coefficients but, (2) they strongly depend on the slopes along the depositional profiles. We also observe (3) a high variability of coefficients on the shelf and the basin floor that could reflect the occurrence of sedimentary processes that cannot be simplified to a simple diffusion (e.g. oceanic currents, turbiditic channels).

We use the diffusion coefficients values to calibrate the stratigraphic model developed by Yuan et al. (COLORS project) based on Bayesian inversions and optimization scheme of geometrical parameters of observed stratigraphic architectures (such as the angle of migration of the offlap-break or slope variations along depositional profiles).