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Plio-Pleistocene Sequence Stratigraphic architecture of the Eastern Niger Delta: Climate Controls, Gravity Driven Deformation and Associated Sedimentary Systems

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This study synthesizes the stratigraphic behavior of the whole eastern Niger Delta during the Plio-Pleistocene and discusses controls on deposition by eustasy, subsidence and sediment supply at various scales. The sequence stratigraphic architecture is determined by integrating the whole sedimentary system from the coastal plain down to the abyssal plain. We combined structural geology, sedimentology biostratigraphy, and seismic stratigraphy. Data included 2D regional sections connected by 3D seismic surveys and 45 well-logs for lithologic calibration and well-cuttings for biostratigraphic calibration.

We identified three sequence orders in the stratigraphic architecture of the eastern Niger Delta and calibrated their biostratigraphic ages into absolute ages using two end-member models to estimate uncertainties. We discuss their causes and propose that the major influence was climate-driven eustasy for both the (i) short-duration (a duration around 0.1 to 0.4 My) and (ii) long-duration progradation/retrogradation sequences (around x1 My in duration).

We mapped in detailed the evolution in time and space of the gravity driven deformation. The upslope extensional deformation evolved significantly through time: (i) it decreased in amount and rate, (ii) it evolved from distributed over the whole area to localized either to the west or to the East and (iii) was accommodated by asymmetric grabens with either synthetic or antithetic main faults. In the transitional deformation, deformation was accommodated bya few folds to the east, and thrust related folds to the West. The compressional front of the gravity driven deformation system was characterized by a. The spatial variability of compressional deformation (fold and thrust belt) through time was more limited but followed the same evolution than the extensional one (spatial migration and intensity variation) demonstrating the strong coupling between these two domains domains.

We mapped in detailed the evolution in time and space of the associated sedimentary systems. This allowed us to characterize, for the first time, the spatial variability of a depositional profile of a passive margin delta from the littoral systems to the abyssal plain. We defined the temporal evolution of this depositional profile for every stratigraphic states (relative sea-level) and, in doing so, a tool to predict the location of domains in erosion/transfer/sedimentation. We then focused on the behavior of the shoreline and turbiditic systems within a stratigraphic sequence to better illustrate the control of gravity driven deformation on the sedimentary system.

Keywords: Eastern Niger Delta, gravity driven deformation, shoreline, turbiditic systems