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Quantifying the Tectonic Influence on the Distribution of Slope Channels in the Toe-Thrusts Region, Deep-Water Niger Delta

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ABSTRACT

It is widely recognised that deep-water systems are controlled by tectonically-induced seabed topography, but the processes by which this occurs are still matter of debate. In this study we quantitatively investigate the relationships between seafloor deformation and the distribution of turbidite channels in the lower slope of the southern lobe of the Niger Delta. In this region gravity-driven deformation has resulted in the development of a fold and thrust belt since middle Miocene times. A 3D seismic survey covering an area of 6200 km2 is used for this study and shows a number of thrust-faults perpendicular to the slope which, over time, have controlled the distribution of the main depositional elements. Age data are also available for 6 key horizons. Building a reliable structural framework is a pre-requisite to evaluate the extent of the tectonic forcing on the depositional architecture of the region. Structural strain has been measured along the strike of the major thrusts from dip-oriented seismic sections using the principles of line-length balancing. This has allowed us to evaluate cumulative strain profiles over time for each structure as well as estimates of interval strain rates. Results show that not all the structures were active at the same time and that for each time interval strain rates varied both between and along the strike of the same structures. This methodology enables us to identify past strain minima which might have been exploited by sediment dispersal systems. Seismic mapping was conducted simultaneously with the strain analysis to subdivide the stratigraphy into major units. As accommodation space is primarily controlled by growing structures, the creation and integration of isopach maps of the mapped intervals allows us to identify where the main depocentres were located, thus helping to define the regional deformation field through time. We created sediment accumulation rate maps from the isopachs and combining these with the interval strain rates, we derived estimates of the sedimentation to deformation ratio (S/D) and its spatial distribution within the study area. We use this ratio in conjunction with seismic-amplitude maps to understand the presence and location of the depositional elements. Our results give new insights into the way in which growing thrust-folds control submarine channels and allows us to quantify the required strain (or S/D ratio) to produce channel deflections around growing topography on the seabed.