



## **Quantifying Tectonic Controls on the Depositional Architectures of Submarine Channels in Time and Space: Examples from the Deep-Water Niger Delta**

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Conceptual models of the evolution of deep-water deposits along continental slopes suggest that sediment gravity-flows are commonly confined within erosional canyon on the upper slope, passing downslope to levee-confined to unconfined distributive systems on the basin floor. Many studies show this evolution to be driven by changes in slope gradient, with shallower slopes favoring flow deceleration and decreased confinement. These concepts, applied to the study of the sequences developed on above-grade slopes, may help to explain the sudden change in depositional architecture and geomorphology of deep-water deposits resulting from irregular slope topography in tectonically active regions. Most of our understanding on sediment-structure interaction, however, derives from studies on modern seafloor and does not extend far into the geologic past, due to the deformation that older sequences usually have undergone and the inherent difficulties in restoring past seafloor topography.

We overcome this problem with examples from the Niger Delta where gravity-driven deformation has resulted in the development of a large fold and thrust belt on the lower slope. We quantified structural deformation in this region from 3D seismic data by measuring the strain attained by each thrust-fold at multiple locations using line-length-balancing, enabling cumulative strain for individual structures over time and along-strike to be obtained. We integrated this information with seismic interpretation and facies analysis, focusing on the interval of maximum deformation (15 to 3.7 Ma) where maximum strain rates reached 7%/Ma. Within this interval, we observe a vertical change in depositional architecture where: (1) lobe complexes at the base pass upward to (2) levee-confined channels followed by (3) ponded lobes with erosionally-confined channels and finally (4) channelized sheets. Our analysis demonstrate that this change is tectonically-induced and we show that structures have controlled both the distribution and the architecture of turbidite deposits at any one time. Specifically, we show that levee-confined channels exist when they can exploit strain minima between growing faults or at their lateral tips, particularly at early times when faults have not linked yet. Conversely, in result of fault linkage, increased strain rates and complex 3D interaction between faults, submarine channels may be forced to cross folds at their strain maxima (crests), hence increasing the erosional component. Therefore, our results provide a means to understand the cumulative strain, strain rate and the degree of 3D fault interaction needed to alter depositional style from levee to erosionally confined channels, or to deflect seabed systems around growing structures.