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The interaction between deepwater channel systems and growing thrusts and folds, toe-thrust region of the deepwater Niger Delta

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Gravity-driven seaward-verging thrusts, landward-verging back-thrusts and associated folds often characterize the slope and deepwater settings of passive margins. These structures, found in the "toe-thrust" region of the system, exert a significant control on sediment gravity flows because they create and determine the location and configuration of sediment depocentres and transport systems. However, to fully understand the interaction between sediment gravity flows and seabed topography we need to evaluate and quantify the geomorphic response of sub-marine channels to faulting in an area where the degree of tectonic shortening can be well constrained.

This study exploits 3D seismic data in the outer toe-thrust region of the deepwater Niger Delta to analyze the interaction between Plio-Pleistocene channel systems and actively growing folds and thrusts. We first mapped folds and thrusts from the seismic data and we used this data to reconstruct the history of fold growth. We then used the sea-bed seismic horizon to build a 50 m resolution Digital Elevation Model (DEM) of the sea floor in ArcGIS. From the DEM, we extracted channel long profiles across growing structures for both the current channel thalwegs and for the associated channel cut-and-fill sequences identified from the seismic data. We measured channel geometry at regular intervals along the channel length to evaluate system response to tectonic perturbation, and we used this data to help us approximate the down-system distribution of bed shear stress, and hence incision capacity.

Initial results show that changes in submarine channel longitudinal profiles are directly correlated to underlying seabed thrusts and folds. Channels gradients are typically linear to slightly concave, and have an average gradient of 0.9^0. Actively growing thrusts are associated with a local steepening in channel gradient (up to 200% change), which typically extends 0.5 to 2 km upstream of the fault. Within these "knickzones", channel incision increases by approximately 50%, with a corresponding width decrease of approximately 25% or less. Our data demonstrate that submarine channel systems dynamically adjust their geometry and basal gradient in order to keep pace with the growth of tectonic structures and our results provide new data to test models of turbidite incision.