GEOGULF2021
AUSTIN
October 27–29, 2021

Tectonic Preconditioning of Recurrent Large Scale Canyon Incisions: Example from the Cretaceous and Paleogene Gulf of Mexico

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ABSTRACT

A 100–150 km wide clustering of six large Late Cretaceous to Paleogene incisions along the northern Gulf of Mexico, up to 1000 m deep and 100 km long suggest a structural rather than eustatic control on their development. Counterintuitively, the incisions align with the basinward trend of the San Marcos Uplift instead of forming in front of large adjacent sedimentary depocenters of the Rio Grande and Houston embayments where large rivers were discharging. Three plausible mechanisms are proposed for canyon formation, both triggered by tectonics. A shelf edge bulge scenario proposes, somewhat similar to previous continental flexure theory, a slow vertical rise of the sub-regional uplift onto the shelf and shelf-edge area that increased the gradient, triggered the initial incision and supported long term headward erosion. The high uplift rate scenario suggests a fast-vertical rise and extension of the uplift into the inner shelf area, whereby the high uplift rate diverted the rivers away from the area and protruded the shorelines as a headland. A third model envisions a deltaic headland caused by a tectonically locked (by uplift) river valley. The structural or deltaic headland diverted the longshore currents and sediment transport basinward, eventually causing a cascading over the shelf-edge and initiating incision and formation of the canyons. Erosion by sediment-laden flows played a critical role in initiating canyon formation, but with tectonics playing a preconditioning role. Other uplift regions around the Gulf of Mexico, Sabine, LaSalle and Tamaulipas (in Mexico) arches also align with large Wilcox Formation sedimentary incisions offshore, strongly suggesting that tectonism was a main control on canyon formation.

Olariu, C., and C. A. Clayton, 2021, Tectonic preconditioning of recurrent large scale canyon incisions: Example from the Cretaceous and Paleogene Gulf of Mexico: GeoGulf Transactions, v. 71, p. 467.

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