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Clinoform Drivers of the Late Miocene to Pliocene Paleo-Orinoco Delta

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The paleo-Orinoco River delta system and associated continental slope was a mixed river, tide, wave, and sediment-gravity flow system that tracked down to deep-water submarine fans. The Orinoco River built a 10-km-thick sedimentary prism since the late Miocene, which disperses more than 200 km wide at present. The Upper Miocene-Pliocene prism, with its linkage to the southern Columbus Basin and Columbus Channel, is composed of four progradational clastic wedges, each with a thickness up to 2 km, separated by well-known, Trinidad wide marine flooding intervals of similar extent. The studied sedimentary prism spans an approximate 4 Ma period and shows an irregularly rising shelf-edge trajectory towards the Atlantic, with very thick topset aggradation (aggradation rate $>$200 m/Ma during the late Miocene; $>$550 m/Ma during the Pliocene) and rapid progradation (progradation rate =33 km/Ma during the late Miocene; =18 km/Ma during the Pliocene) of the fronting deepwater slope, despite an overall and periodic falling eustatic sea level during this global icehouse period. The tramline-like trajectory changes demonstrate at least three major stages of clinoform evolution, with each stage starting from progradational basinward shifts, followed by aggradational clinothem with decreased thickness. And for shorter (approximate less than 100 k.y.) time scale, Paleo-Orinoco shelf-margin growth was generated by repeated cross-shelf, regressive-transgressive transits ($>$100 km) of the Orinoco delta system, with internal variability in clinoform architecture and process-regime changes during shelf-margin construction.

The clinoform drivers of the long-term growth of the Paleo-Orinoco margin include that: (1) large sediment supply and paleoflux driven by Orinoco sediment loading from one of the Earth's biggest rivers feed the whole system persistently. The Pliocene sediment discharge is estimated to have been about 11.3×10^6 ton/yr based on flux calculation by using clinoform morphology and geometry parameters; (2) Forced regression at shelf margin during high-frequency icehouse sea level changes drives the topset deltas across the shelf. And a eustatic fall is considered as the driver of the shelf collapse into the Columbus Canyon; (3) as one of the most rapidly subsiding shelf-margin prisms, the Orinoco margin with high tectonic-subsidence rate up to 1000 m/Ma, provides accommodation for sediments to be stored on the shelf and delivered down to the slope and deepwater area; (4) the development of northwest-southeast oriented, down-to-the-northeast, extensional normal growth faults is the dynamic trigger for the coeval outbuilding of the paleodelta system across the region.