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Wilcox Submarine Fan Deposition during the Paleocene to Eocene of the Deepwater Gulf of Mexico: Greenhouse Conditions and Importance of Source to Sink Concepts

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ABSTRACT

Wilcox deposition from late Paleocene to early Eocene in age (60–52 Ma), recorded one of the largest and most laterally extensive periods of deepwater sand deposition within the Gulf of Mexico. Unique to the Wilcox submarine fan deposition, is that it occurred during an ice-cap free world where greenhouse conditions dominated and is not the characteristic "lowstand fan" we associate within our sequence stratigraphic concepts. Deposition extends nearly 300 miles from its equivalent shelf margin and extends laterally approximately 450 miles with gross thickness more than 3000 feet. Based on previous research utilizing detrital zircons to reconstruct mid-Cretaceous to Paleogene drainage systems, Wilcox sediment drainage system incorporated a large portion the entire continental United States ranging from the Appalachians to the Sierra Nevada's. Massive amounts of sediment were transported through intervening large fluvial-deltaic systems into the deepwater environment in response re-routed drainage patterns to the Gulf of Mexico during the late Paleocene to early Eocene. Periodic climate warming from the mid Paleocene–early Eocene resulted in erratic high rates of erosion experienced in hinterland sediment sources and contributed to an unusually high sediment flux into the Gulf of Mexico Basin. The Paleocene-Eocene Thermal Maximum (PETM) boundary of approximately 54–52 Ma, separates the Lower Wilcox 2–4 sequences of approximately 60–54 Ma from the Upper Wilcox 1 sequence. Core and log observations suggest the PETM marked a significant change in depositional architecture going from a Lower Wilcox environment of more laterally continuous, high energy sustained flow with high sedimentation rates into an Upper Wilcox dominated by less extensive fan architecture of more sporadic higher energy system with varying sedimentation rates.

Stratigraphic thickness of the deepwater Wilcox interval ranges from approximately 2000 to 5000 feet. Based on the integration of foraminifera, calcareous nannofossils, palynology, and radiolarians that aid in both age determination as well as duration, the Wilcox chronostratigraphic framework is subdivided into four depositional sequences referred to as Wilcox 1–4. Wilcox 4 is the first sequence into the basin and serves as a proxy for early paleotopography of the basin as the architecture observed during the onset of Wilcox 4 deposition appears to be influenced by a re-setting of the paleotopography in response to the Cretaceous, Chicxulub meteorite impact on the Yucatan Peninsula. Lower Wilcox intervals commonly exhibit high net to gross, blocky, laterally extensive weakly confined distributive channel-lobe architecture. Conversely, Wilcox 1 tends to be highly variable across the basin possibly due to (1) sporadic sediment flux from the river systems and associated ephemeral nature of these deposits in response to the effects of high CO2 levels and extremely warm climate and (2) basin gradients approaching regional equilibrium establishing more bypass of sediments further out into the basin.

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