



Unraveling the Complexity of Deepwater Fine-Grained Sediments: A Case Study from the Lower Cretaceous, Lingshan Island, Eastern China

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ABSTRACT

Understanding the depositional dynamics of fine-grained sediments is vital to understand the sedimentary characteristics and their distribution patterns, which is crucial for unconventional oil and gas exploration and development. Fine-grained sediments from the middle of the Dengta Section in the Cretaceous Laiyang Group on the Lingshan Island, eastern China were studied using detailed outcrop description, thin section observation, and laboratory measurements. Lithofacies and lithofacies associations were identified according to detailed sedimentary characterization of the fine-grained sediments. The depositional processes and dynamics of the fine-grained sediments were then inferred from lithofacies, sedimentary structures and lithofacies associations. The fine-grained sediments in the study area are dominated by a silt-dominated subclass, which is composed mainly of thin-bedded siltstones with normal grading and horizontally laminated mudstones. The horizontal lamination in some mudstone units is attributed to suspension settling. The lithofacies associations of Bouma-like sequences are believed to have been caused by fine-grained turbidity currents moving downslope. Hybrid event-bed lithofacies associations were formed by hybrid flows. Turbidity currents were transformed to muddy debris flows downslope. The thin sandstone and mudstone interbed lithofacies associations were resulted from downslope transitional flows between turbidity currents and muddy debris flows. The vertical stacking patterns of the fine-grained sediments indicate that the evolution processes of gravity flows from transitional flows to debris flows, and then to low-density turbidity flows and hybrid flows. Lithofacies associations caused by hybrid flows and transitional flows are potential sweet spots of fine-grained unconventional oil and gas reservoirs.