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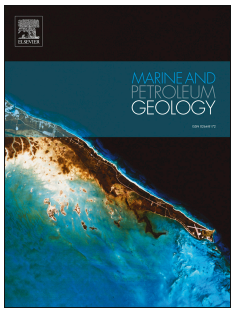

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Sea-level Control on the Submarine Fan Architecture in a Deepwater Sequence of the Niger Delta Basin

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Abstract

Submarine fan architecture has long been considered much complicated as controlled by both allogenic and autogenic mechanisms. However, to which extent the allogenic sea-level change controls the submarine fan architecture is still unclear. This study uses integrated 3-D seismic, well-log and core data to characterize the submarine fan architecture in a deepwater sequence of the Niger delta basin. Correlation of the timing of architecture units to high-frequency sea-level curve helps to investigate the sea-level control on architecture distribution and evolution of submarine fan systems.

The studied sequence is a 3rd-order sequence that formed during 12.5–10.5 Ma and contains a lowstand systems tract (LST) and a transgressive-highstand systems tract (TST-HST). We find that the LST develops a single channel system that is terminated by a lobe system; whereas the TST-HST develops two mutually incised channel systems and mudflow deposits, which are distinct from the conventional condensed sections and interpreted to result from the repeated 4th-order sea-level cycles during the TST-HST of the 3rd-order sequence. Single submarine fan systems, which last for ~0.3–0.6 Myr, are assumed to form in response to single 4th-order sea-level cycles since they are well correlated with each other. Each single submarine fan system contains several vertically stacked complex sets, which are well correlated with 5th-order sea-level cycles that last for ~0.1–0.2 Myr, suggesting their potential genetic links. Different complex sets in a single submarine fan system exhibit variable architectural features, which are interpreted to result from the evolution of gravity-flow types as the 4th-order sea-level fluctuates. Thus for the Niger system, at time scales >0.1 Myr, the allogenic sea-level change is considered to have played a major role in controlling the submarine fan architecture at the scale of submarine fan systems and complex sets, whereas autogenic effects on the submarine fan architecture may increase and become dominant on time scales <0.1 Myr.

Keywords: submarine fan system; depositional architecture; high-frequency sea-level change; Niger Delta Basin

1. Introduction

Submarine fan systems have been the subject of extensive studies because of their enormous hydrocarbon potential. Due to the multiple triggering mechanisms of deepwater sediment gravity