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Unidirectional-migrating Slope Channel Systems in the Baiyun Depression, Pearl River Mouth Basin: morphology, architecture, and depositional processes

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A series of unidirectional-migrating slope channel systems are discovered in the Baiyun Depression, Pearl River Mouth Basin, northern South China Sea. The purpose of the paper is to document their morphology, internal architecture, and evolution using integrated 2D/3D seismic, well log, core, and biostratigraphy data and 3D visualization techniques.

Morphologically, each of the systems can be subdivided into a narrow “V”-shaped up dip segment, a broad “U”-shaped middle segment, and a down dip segment with low erosional relief. East flanks of the channels and channel complex sets within different channel systems are overall steeper than the west flanks.

An integrated seismic facies and well data analysis shows that: 1) internally, each of the channel systems consist of channel complex sets, which in turn are composed of stacked and nested channel complexes and channels; 2) vertically within each of the channel complex sets, sandy thalweg and channel fills in the lower part grades upward into debris flow/slump deposits, and finally into shale drapes in the upper part.

Depositional processes within the channel systems are controlled by a series of interacting factors, including seafloor morphology, relative sea-level change, sediment supply, and gravity flow and tidal bottom currents. During relative sea-level fall and lowstand, the paleoshoreline progrades to the shelf edge and quick sediment loading triggers significant sliding and sediment failure in the upper slope. When moving down slope, these lead to the development of large erosion scours, within which channel complex sets are developed. Meanwhile sandy sediments shed from the paleo Pearl River and its shelf edge deltas are delivered into and deposited within the complex sets. During relative sea-level rise, the paleoshoreline shifts landward and sandy sediment supply is largely shut down and debris flows and slumps are more common due to increased channel wall instability. The channel complex sets are eventually abandoned and draped with widespread shales. These processes are repeated during the ensuing relative sea-level cycles, resulting in vertically stacked and nested channel complex sets within each of the slope channel systems.