

Paper Number: 2385

Development of the northeastern shelf margin of the South China Sea since the Late Miocene: sequence architecture, depositional evolution and sea-level changes



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On the basis of core, log and seismic data, the formation and depositional evolution of the shelf slope of the northeastern shelf margin of the South China Sea since the Late Miocene is documented. Two composite sequences (Composite Sequence 1 (CS1) and Composite Sequence 2 (CS2)), bounded by regional unconformities (Composite Sequence Boundary 1 (CSB1) and Composite Sequence Boundary 2 (CSB2) respectively), and eight sequences defined by local unconformities or discontinuities are recognized in the slope clinofolds of the Late Miocene to Pliocene siliciclastic section. The regional unconformities are characterized by extensive erosion and angular unconformities in the uplift zone of the basin margin. Five sequences have been recognized for the late Miocene-Pliocene strata (CS1) according to truncating surfaces at the base of shelf-slope channels and their corresponding conformities. According to the variation of seismic reflection structure within the Quaternary shelf-margin prograding complexes, three sequences are identified for CS2, with each sequence containing several subordinate sequences.

Depositional systems identified in the study area include shelf margin delta and slope channel-fan systems. The slope channel-fan system covers almost the whole shelf-margin zone. Based on an integrated analysis of cores, logs, and seismic data, four depositional-palaeogeomorphological elements have been identified in the slope channel-fan system: broad, shallow and unconfined or partly confined outer-shelf to shelf-break channels; deeply incised and confined unidirectionally migrating slope channels; broad or U-shaped, unconfined erosional-depositional channels; frontal splays-lobes and non-channelized sheets. The slope channels are mostly oriented NW-SE; these migrated unidirectionally northeastwards and intensively eroded almost the whole shelf-slope zone. The channel infillings are mainly mudstones, interbedded with siltstones. They might be formed by gravity flow erosion as bypassing channels and were filled with limited gravity flow sediments at the base and mostly filled with lateral accretionary packages of bottom current deposits. The gravity-flow sediments bypassing the channels were finally deposited at the end of the slope channels, and a series of small-scale slope fans developed and coalesced into fan aprons along the base of the slope. Shelf-margin deltas were developed within the typical Quaternary prograding complexes with the corresponding well logs presenting a coarsening-upward sequence.

The regional unconformity CSB1 and the intensive development of the channel-fan systems over the shelf slope might be related to the Dongsha Tectonic uplift which possibly resulted in a stepped slope

and concomitantly intensified gravity flow in the study area in Late Miocene. The unidirectionally migrating characters of the slope channels are the result of northeastward bottom currents. The extensive erosional CSB2 might be related to the onset of the Northern Hemisphere Glaciation and corresponding sea-level fall.

