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Interactions between down-slope and along-slope processes on the South China Sea Slope off southwestern Taiwan: Processes, products, and depositional models

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A high-quality 2-D database, that includes the multi-beam bathymetry, high-resolution seismic profiles, piston cores, AMS 14C dating, micropaleontological data, and the concentrations of rear earth elements, was used to investigate: (1) the recent depositional processes and associated deposits on the South China Sea Slope off southwestern Taiwan; (2) the spatial distribution and temporal evolution of the surface and near-surface deposits; (3) the interactions between down-slope turbidity currents and along-slope bottom currents in the study area.

High-resolution seismic profiles and piston core analysis suggest nine facies, which can be further grouped into four major depositional systems: the shelf-edge deltaic depositional system, turbidite depositional system, mixed contourite and turbidite system, and contourite depositional system.

The surface and near-surface deposits vary both spatially and temporally. Spatially, the shelf-edge deltas are the predominate depositional features on the flat-lying shelf. High-energy gravity flows and associated erosional features, in contract, are common on the steep and narrow upper slope. Seaward, the gentle middle slope is characterized by intense gravity flows and their resultant turbidite depositional system. The interactions between down- and along-slope processes generated mixed contourite and turbidite system are the most representative characteristics on the lower slope. Along-slope processes associated contourite depositional system, in contract, are the dominant deposits on continental rise. Temporally, the mixed contourite and turbidite system as shown the sandy and coarser grained units TS01-2 and TS02-2 are well developed during the glaciations.

The integrated data shows that the spatial distribution and temporal evolution of the surface and near-surface deposits were likely controlled by a series of factors, including slope gradient, shelf break and slope-break belts, lee effect, the glacial/interglacial cycles, sea-level fluctuation, and the climate change. In addition, rapid uplift and denudation of the Taiwan Island due to arc-continent collision most probably led to high sediments supply to and sedimentation rates in the study area.

Recent depositional processes and interactions between down- and along-slope processes vary both spatially and temporally. Spatially, high-energy gravity flows most probably dominate over the relatively weak bottom currents, leading to the intense erosion and erosional features on the steep and narrow upper slope. On the gentle middle slope, the gravity flows may lose part of their energy but still vigorous which most likely mask the relatively weak bottom currents, resulting in the well development of turbidite depositional system. On the lower slope, both turbidity currents and bottom currents are active, the interactions between down- and along-slope processes are typical and predominant, resulting in a mixed contourite and turbidite system. Further basinward onto the continental rise, turbidity currents wane to minimal and along-slope processes are predominant, leading to the wide occurrence of contourite depositional system in this region. Temporally, interactions between down- and along-slope processes are strong during glaciations, and wake during interglacial periods. As a result, the mixed contourite and turbiditie system were widely developed during the glaciations. The proposed depositional models are markedly different in which interactions between down- and along-slope processes are variable in space and time.

The results from this study also provide the further evidence for the intrusion of the Northern Pacific Deep Water into the South China Sea and suggest that this intrusion has probably existed and been capable of affecting sedimentation in South China Sea at least since Quaternary.