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Deglacial and Holocene evolution of the Vietnam shelf: stratigraphy, sediments and sea-level change

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Abstract

On the Vietnam Shelf more than 1000 miles of shallow high-resolution seismics were analyzed to unravel post-glacial evolution in a tropical, siliciclastic environment together with 25 sediment cores from water depths between 21 and 169 m to determine stratigraphy, distribution and style of sedimentation. Fourty-seven samples were dated with the AMS-^{14}C technique.

The shelf was grouped into three regions: a southern part, a central part, and a northern part. On the broad *Southern Shelf*, sedimentation is influenced by the Mekong River, which drains into the SCS in this area. Here, incised valley fills are abundant that were cut into the late Pleistocene land surface by the Paleo-Mekong River during times of sea level lowstand. Those valleys are filled with transgressive deposits. The Holocene sedimentation rate in this low gradient accommodation-dominated depositional system is in the range of 5–10 and 25–40 cm/ky at locations sheltered from currents. The *Central Shelf* is narrow and the sedimentary strata are conformable. Here, numerous small mountainous rivers reach the SCS and transport large amounts of detrital sediment onto the shelf. Therefore, the Holocene sedimentation rate is high with values of 50–100 cm/ky in this supply-dominated depositional system. The broad *Northern Shelf* in the vicinity of the Red River Delta shows, as on the *Southern Shelf*, incised valleys cut into the Pleistocene land surface by paleo river channels. In this accommodation-dominated shelf area, the sedimentation rate is low with values of 5–10 cm/ky. Where applicable, we assigned the sampled deposits to different paleo-facies. The latter are related to certain intervals of water depths at their time of deposition. Comparison with the sea-level curve of [Hanebuth, T.J.J., Stattegger, K., Grootes, P., 2000. Rapid flooding of the Sunda Shelf; a lateglacial sea-level record. Science, 288: 1033–1035.] indicates subsidence on the *Central Shelf*, which is in agreement with the high sedimentation rates in this area. In contrast, data from the *Northern Shelf* suggest tectonic uplift that might be related to recent tectonic movements along the Ailao Shan–Red River Fault zone. Data from the *Southern Shelf* are generally in agreement with the sea-level curve mentioned above.

Keywords: South China Sea; Holocene transgression; sea level; shelf sediments; terrigenous input; Vietnam

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1. Introduction

The Vietnam Shelf, as the western margin of the South China Sea (SCS) with a total area of 700 000 km^2, was widely exposed during the last sea level lowstand (Fig. 1). Sea-level rise of approximately 120 m (Fairbanks, 1989; Hanebuth et al., 2000) following the Last Glacial Maximum (LGM) resulted in flooding of those exposed areas. In particular the northern (Gulf of Tonkin) and the southern part (close to the Sunda Shelf) of the Vietnam Shelf experienced flooding over large areas due to the wide extension and low gradient of the shelf. Here, the shoreline migrated over hundreds of kilometers within 10 ky from rising sea level. In contrast, the shelf off central Vietnam is only 20 km wide and shoreline migration was restricted to a few tens of kilometers. Nevertheless, the changing oceanographic conditions resulted in a reorganisation of the depositional system. The water masses mostly inundated morphological structures and a marine type of sedimentation set in. The interplay of deposition and erosion was significantly altered. Sediments were frequently reworked on a large scale, they are regarded as palimpsest sediments (Swift et al., 1971).

The main objective of this study is the reconstruction of the deglacial and Holocene evolution of different tropical shelf settings, the narrow Central Vietnam shelf and its transition to the wide shelf

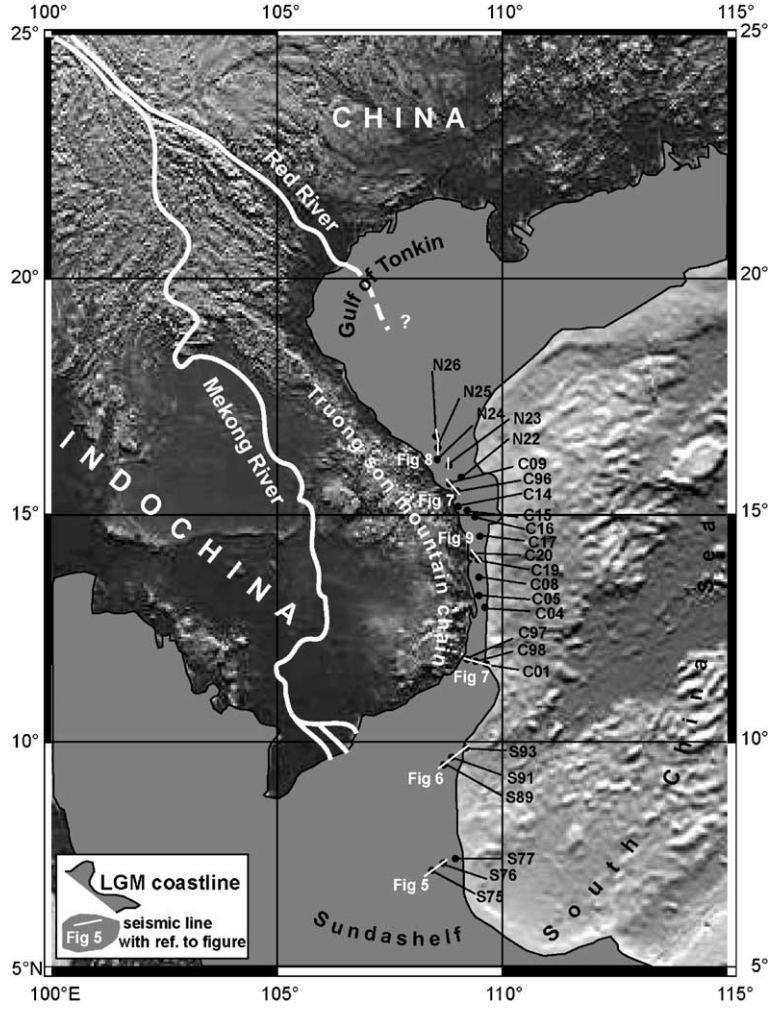

Fig. 1. The Vietnamese Shelf today with core locations and at the time of the LGM with sealevel lowstand of −120 m.