

Fine-grained quartz OSL dating for reconstructing the Holocene evolution of the Mekong River floodplain

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The Holocene evolution of coastal floodplains and delta plains is influenced by sea-level and climate changes. Two well-known examples from Mississippi and Rhine-Meuse rivers demonstrate that sea-level changes mainly controlled the style of fluvial deposition. However, evolution of Asian large river systems is yet to be fully understood partly because of problems in chronology. OSL dating of fluvial deposits is challenging because of the incomplete bleaching of sediment grains during transport that potentially causes age overestimate. Sand-sized quartz grains are generally used because measurements of the small number of grains or a single grain are considered to allow separation of incompletely bleached grains. However, the Mekong River floodplain is mud-dominated and the sediment load does not contain enough amount of sand grains for OSL dating. Our previous comparison between fine-grained and sand-sized quartz OSL ages from the Holocene and modern deposits indicate that the fine grains are better bleached and thus considered suitable for constraining the chronology of the fluvial deposits. Here we present the chronology of the Mekong River floodplain based on fine-grained quartz OSL ages determined for sediment succession in 12 boreholes.

Progradational avulsion and crevasse splay deposition promoted rapid aggradation before 7 ka. The abrupt cessation of aggradation is correlated to the lowering rate of eustatic sea-level rise. After 7 ka, fluvial deposition was limited near the river courses, and a hiatus between 7 and 4 ka was observed at one site. Ages obtained at the upstream end of an abandoned large distributary channel suggest that it was fully or partially abandoned at 3.5 ka. A previous study also indicated that another channel was abandoned at 4 ka. The relative sea-level fall since the middle to late Holocene in the area would have lowered the river bed and stabilized the distributary channels. A sharp precipitation decrease associated with the weakening of the EASM at 4 ka may have reduced the discharge of the Mekong River, promoting the channel abandonment. Upstream of Phnom Penh, the river actively migrated and a series of abandoned inner bank levees were preserved. The OSL ages obtained from the levee deposits are < 0.5 ka, which demonstrates rapid migration at least after 0.5 ka. The Digital Surface Model indicates that there are no older levees around the area. A human-induced increase in sediment discharge possibly promoted the rapid channel migration or older series of levees may have been eroded by recent channel migration.

Keywords: OSL dating, floodplain, Mekong River, Holocene