The Mekong River Delta – variation of sedimentation and morphology in a mega-delta

DANIEL UNVERRICHT1, WITOLD SZCZUCIŃSKI2, THANH CONG NGUYEN1,5, CHRISTOPH HEINRICH1, KARL STATTEGGER1, KLAUS SCHWARZER1, NIKO LAHAJNAR3 & THUYEN XUAN LE4

1 Institute of Geosciences – Department of Sedimentology, Christian-Albrechts-University of Kiel, Germany unverricht@gpi.uni-kiel.de
2 Institute of Geology, Adam Mickiewicz University, Poznań, Poland
3 Institute for Biogeochemistry and Marine Chemistry, University of Hamburg, Germany
4 Institute of Resources Geography, VAST, Ho Chi Minh City, Vietnam
5 Department of Oceanology, Meteorology and Hydrology, University of Sciences, Ho Chi Minh City, Vietnam

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The Mekong Delta

Various sediment- and hydrodynamic factors including tides (meso-tidal system), waves, coastal currents and seasonal-driven river discharge influence the coastal zone. Mega-deltas, especially like the Mekong River Delta (MRD), represent these land–ocean interactions. Subaerial and subaqueous coastal morphology are both regulated by the local energetic environment and supply of sediment. In reverse, delta morphology and sedimentary pattern reflect these impacts.

In the MRD that belongs to the Asian mega-deltas, the influence of different factors can be seen. Tidal processes influence the delta shaping permanently due to their persistent occurrence (Unverricht et al., 2012). Wave processes have a more long-term impact due to beach-ridge-shaping in the delta morphology (Tamura et al., 2012a,b). Outside the river mouth region, other factors have recently not been sufficiently investigated.

However, after the classification of Orton & Reading (1993) the MRD is a tide- and wave dominated delta. Investigations on the delta plain support this classification. The transition from tide-dominated to tide and wave dominated regime appears around 3500 years BP (Ta et al., 2002). Its tidal regime changes from semi-diurnal tides over mixed tides to diurnal tides along a more than 500 km-long coastline (Nguyen, 2012). The eastward exposed coastline is more strongly influenced by waves than its western part in the Gulf of Thailand. The monsoon seasons dominate the flow regime and sediment transport along the river, in the delta plain and also in the subaqueous delta. Both coastal erosion and accretional progradation occur along the deltaic coast. However, only sparse data exist on delta dynamics and their footprints in the subaqueous delta.

The present study aims to contribute information about seafloor relief and sedimentation of the MRD to interpret modern sediment dynamics.

Applied methods

Three cruises in 2006, 2007 and 2008 were conducted in the subaqueous Mekong Delta Region between the Bassac River, the main distributary of the MRD, and the Gulf of Thailand. All cruises took place during the inter-monsoon season between March and May where wave and wind influences are not dominant in comparison to the summer monsoon (May to early October) and winter monsoon season (November to early March). Investigations present data of suspended matter (turbidity meter, water samples, LISST-instrument), seismic profiles (Boomer and C-Boom-system), grab and sediment core sampling and point and transect current-measurements (using ADCP) which provide data on current directions and velocities. Data of different tidal gauge stations in the MRD were also integrated, compared to the mixed semidiurnal–diurnal tidal cycle and related to our own relevant measurements.
Morpho- and sediment dynamic processes in the recent MRD

Two delta fronts were detected 200 km apart, one at the Bassac River mouth (the biggest branch of the MRD) and the other around Ca Mau Spit (most southwestern end of the MRD). It indicates a clockwise sediment transport in a southwesterly direction. The two fronts are connected by an area of mixed depositional and erosional characteristics, respectively. There, subaqueous clinoforms vary in shape and size. Into the subaqueous delta platform and slope is incised a large channel-like system up to 13 m deep and subparallel to the shore (Unverricht et al., 2013a,b). It consists of two approx. 4 km wide mega-furrows that extend over more than 120 km from east to west and serve as a sediment conveyor between the delta fronts.

Regional dependencies in variation of sediment supply and hydrodynamic processes lead to great variations of sediment accumulation rates that have reached up to 10 cm/year for the last century.

Sediment types of the subaqueous MRD could be reduced to two end members (well sorted sandy and poorly sorted silty sediment). Distant delta regions in conjunction with the open shelf are characterised as third end member consisting of medium to coarse sand. Sediment features of the delta-shelf-transition, such as increasing percentages of organic matter and carbonate content in the delta base area, shell fragments, foraminifera and concretions of palaeo-soils that do not occur in typical delta sediments, support the grain size-based classification (Unverricht et al., 2013b).

During the inter-monsoon season, LISST-data of suspended sediment show significantly distinct areas of suspended sediment concentrations (SSCs) greater 25 µL/L in the Mekong River delta branches and its subaqueous delta (Unverricht et al., 2012). However, only 20% of all measured SSCs in the subaqueous MRD exceed 100 µL/L and the highest concentrations were near the seabed. Regions transitional to the open shelf are characterised by a decrease in SSCs. The open shelf area has distinctly low suspension load, particularly on the southern shelf (99% of all samples <25 µL/L).

However, in the southern shelf area around Ca Mau Spit, in water depths of 20–25 m higher SSCs (>25 µL/L) occur close to the seabed. These can be attributed to resuspended sediment due to the strong tidal currents with velocities of up to 0.6 m/s near the sea bed during neap tide conditions. Additionally, tidal phases are asymmetric and lead to a sediment net-transport into the subaqueous delta (Unverricht et al., 2012).

Sediment cores show time variations in the sediment deposition and sediment distribution pattern. Seismic profiles of prograding delta regions show submarine landslides along the delta slope that may be triggered by the high seasonal sediment accumulation rates. Although the Mekong River Delta grows fast southwestwards, it erodes in other regions.

References


