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Steven L. Forman,
Baylor University, United States

*CORRESPONDENCE
Jian Liu,
liujian0550@vip.sina.com

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Editorial: Sedimentary evolution and hazardous geology during the Holocene in the Yangtze River and the Red River Deltas and the neighboring coastal areas

Jian Liu[1,2]*, Alessandro Amorosi[3] and Xiaoyong Duan[1]

[1]Qingdao Institute of Marine Geology, Qingdao, China, [2]Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China, [3]Department of Biological, Geological and Environmental Sciences, University of Bologna, Bologna, Italy

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Editorial on the Research Topic
Sedimentary evolution and hazardous geology during the Holocene in the Yangtze River and the Red River Deltas and the neighboring coastal areas

The Yangtze River and Red River both originate from the Tibetan Plateau and are among the top ten rivers in Asia in terms of sediment discharge (Milliman and Meade, 1983). These rivers have a significant impact on the global carbon cycle (Gao et al., 2017). The Yangtze River Delta is located on the west coast of the East China Sea, while the Red River Delta occurs on the west coast of the Gulf of Tonkin in the South China Sea. Both deltas began forming during the early to middle Holocene with the stabilization of global sea level (Hori and Saito, 2007). There is a growing body of literature on the evolution of the deltas and the neighboring coastal areas (e.g., Tanabe et al., 2006; Liu et al., 2023; Song et al., 2013), yet further research is required to enhance our understanding of the intricate interplay between sea-level and climatic changes, hydrodynamic processes, and human activities for these delta areas. Fortunately, collaborative research on these delatic settings between geoscientists from China and Vietnam has increased understanding on the sedimentary record for the past ca. 10,000 years and potential geologic hazards.

The objective of this Research Topic is to explore new findings on sedimentary evolution and geologic hazards in the Yangtze River and Red River deltas and the adjacent coastal areas during the Holocene. This study is part of the collaborative research effort between China and Vietnam, and this collection of manuscripts focuses on the following aspects:

1) Studying the sedimentary evolution and stratigraphic records in the deltas and coastal areas under the influence of sea level changes, climate variations, sediment sources and dynamics, and human activities.
2) Investigating the source-to-sink processes in the deltas and coastal areas during the Holocene.
3) Analyzing the types, distribution, formative mechanisms, and trends of geohazards in the deltas and coastal areas.

We provide a summary and analysis of the nine papers associated with this Research Topic on the Sedimentary Evolution and Hazardous Geology during the Holocene in the Yangtze River and the Red River deltas and the Neighboring Coastal Areas.

Two articles by Chen et al. and He et al. discuss recent advancements in the study of the sedimentary evolution of the Jiangsu coast, which is located at the northern end of the modern Yangtze River Delta. Chen et al. conducted a comprehensive analysis of two cores obtained from the central North Jiangsu Plain (NJP) to reconstruct the sedimentary history of the area since MIS 2. They discovered a significant shift in sediment source from the Yangtze River to the Yellow River during the early Holocene in north central NJP. This change may be or is attributed to the transport of Yellow River sediments by strong tidal currents and waves or the southward migration of the Yellow River. He et al. investigated the formation and evolution of the radial tidal sand ridge (RTSR) off the Jiangsu coast in the South Yellow Sea, which is a remarkable and distinctive seabed formation. The analysis of sedimentological and paleoecological data from cores retrieved from the Jiangsu Plain and offshore from the sand ridges indicates that the RTSR originated 9,000 cal yr BP under transgressive conditions. These forms persisted throughout the Holocene but experienced significant development after 1128 AD, coinciding with the southward flow of the Yellow River into the Yellow Sea.

Sun et al. conducted a study on the formation of authigenic pyrites and gypsums in core JC-1, located offshore of Zhoushan Islands near the current delta of the Yangtze River. They discovered the presence of gypsum minerals or the coexistence of pyrite and gypsum in the enriched authigenic pyrites in different sedimentary facies. The results indicate that local environmental acidification leads to the formation of authigenic gypsums, with sulfate derived from overlying seawater and pyrite oxidation. This research provides important insights into the impact of sea level rise and climate change on different sedimentary environments.

Qiu et al. conducted an analysis of sediment thickness and source during the Holocene in Sanmen Bay, located on the Zhejiang coast. The study aimed to understand the sedimentary processess of the bay in relation to the transport of sediments from the Yangtze River. These results indicate that the fine-grained sediments in Sanmen Bay primarily originate from the Yangtze River and that the bay serves as a significant sink for these sediments. This study documented a high rate of sedimentation during the early and late Holocene, which decreased notably during the mid-Holocene. Thess changes in sedimentation rate are attributed to the southward transport processes of Yangtze River sediments under the influence of the East Asian Winter Monsoon. The study emphasizes the important role of coastal bays in Zhejiang coast for the source-sink process of Yangtze River sediments.

Tong et al. conducted a study of core G02 on the northwestern continental slope of the South China Sea (SCS) to investigate the variations in organic matter sources and distribution over the past ~8,600 years. Core G02 showed a significant increase in $\delta^{15}N$ values between 8.4 and 4.6 cal kyr BP, indicating the intrusion of low-oxygen subsurface water from the Kuroshio Current into the northern SCS. Furthermore, they found negative $\delta^{13}C$ values from 8.3 to 3.0 cal kyr BP, suggesting a weakening of the East Asian Monsoon. In turn, positive $\delta^{13}C$ values during 3.0–1.4 cal kyr BP may indicate the weakening of the Indian Summer Monsoon. The study also highlighted the increasing influence of human activities on organic carbon production and burial since 1.4 cal kyr BP. These findings contribute to our understanding of organic matter source-sink processes and the factors influencing these processes on continental slopes in low-latitude marginal seas.

Dong et al. used end member modeling analysis (EMMA) and grain size trend analysis (GSTA) to study the sediment transport in the nearshore seabed of Hai Hau, Nam Dinh Province, southwest of the Red River Delta. They found that sediments from the Hai Hau coast are eroded and deposited in the center of the study area due to various dynamic processes. The fine-grained components of transported sediments may originate from the Ba Lat River mouth, and the sand component from the Ba Lat River mouth which is partially transported to deeper water areas (below 28 m depth). This study provides new insights into the offshore sediment transportation for the Red River Delta.

Three articles in this issue focus on the research of geological hazards in the study region. The article by Jiang et al. investigates the type, distribution, and origin of geological hazards in the Oujiang estuary on the Zhejiang coast. Through analysis of shallow seismic profiles and boreholes, the authors identify various geological hazards, such as shallow gas pockets, active sand waves, shallow-buried irregular bedrock, erosion channels, steep submarine slopes, and buried paleochannels. Jiang et al. also provide maps of recoginzed geologic hazards. The formation of these hazards is influenced by the geological structure and external dynamic forces, including sea-level changes, modern hydrodynamics, and human activities. The other two articles explore the origin and hydrochemical characteristics of confined groundwater in coastal areas, enhancing our comprehension of the formation and evolution of saline groundwater in coastal areas. Zhan et al. analyze the hydrochemistry of 87 groundwater samples collected from five confined aquifers in the Yangtze River Delta. They propose that the groundwater samples have two different origins, marine-continental and continental, with distinct hydrochemical characteristics. These results indicate that human activities have caused the infiltration of saline water into the groundwater near surface aquifer over the past century. Gao et al. compare the hydrogeochemical characteristics and relationships between saline groundwater and the sedimentary environment in two representative muddy coastal zones, the Yellow Sea coast (YSC) and the Bohai Sea coast (BSC). The findings demonstrate that the enrichment of total dissolved solids (TDS) in the BSC and YSC is primarily caused by freshwater-seawater-brine and freshwater-seawater mixing, respectively. The salinity of groundwater is mainly due to saltwater intrusion, followed by water-rock interactions.

In summary, this Research Topic has brought together state-of-the-art studies on sedimentary evolution and hazardous geology

during the Holocene in the Yangtze River and the Red River deltas and their nearby coastal areas, and sheds new light on the deeper understanding of the Holocene sedimentary history and geo-hazardous mechanism. It is our belief that a thorough and unbiased evaluation of the geological investigation and research results, in conjunction with the latest advancements and innovative findings, could potentially shed light on the most favorable ways for future research.

Author contributions

JL: Writing–original draft. AA: Writing–original draft. XD: Writing–original draft.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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