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Editorial: Interaction of tectono-sedimentary processes in the South China Sea and their implication for hazards

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Editorial on the Research Topic
Interaction of tectono-sedimentary processes in the South China Sea and their implication for hazards

Introduction

The South China Sea (SCS), one of the largest marginal seas in the western Pacific, has a distinct setting that superposes complex tectonic environments, such as subduction setting, continental rifting, and seafloor spreading. Even through the SCS is a well-studied marginal sea, there are a number of unsolved questions concerning its formation, evolution, geodynamic processes, and geohazards. With the expanding of seafloor infrastructure (submarine cables, oil platforms) and increasing coastal population, the SCS region is particularly vulnerable to marine geohazards, e.g., submarine earthquakes, landslides and their associated tsunami hazards. In this context, it is of great scientific significance to further study the tectonic and sedimentary processes that have taken place in the past, as well as the present, in the SCS, and to better characterize the geological hazards they may pose.

To address these Research Topic and advance our understanding of the SCS, we proposed this Research Topic in Frontiers in Earth Science and collected a total of 17 high-quality papers. The papers cover the following four subjects: 1) Tectonics around the SCS; 2) Sedimentary process in the northern margin of SCS; 3) Geohazards; and 4) Numerical modeling. The multiscale, interdisciplinary and thematic nature of the research will allow for a better assessment of geological processes, climate and environmental changes, and potential marine geo-hazards in the region. By bringing together cutting-edge research on the SCS, this Research Topic aims to provide a comprehensive and up-to-date understanding of the region's geology and help mitigate the impact of future hazards in this following.

Here we present a short review of the contributions organized by the main subjects.

Tectonics around the SCS

Tan et al. estimated the uplift rate of the Hengchun Ridge (ca. 0. 3 km/Ma) based on a linear regression between the hyperstretched continental crust (HSCC) and the observed depth of the prism crest. They suggest a two-stage collision hypothesis for the Taiwan orogen: the first stage was dominated by structurally underplated HSCC, and the second is a combination of the arrival of the continental shelf and arc–continent collision.

Yin et al. proposed compressional tectonic stress field weakened gradually from south to north, while the northern Zhongjiannan basin was formed under the dextral strike-slip movement of the Red River Fault. The above knowledge provides a reference for studying the initiation time of dextral strike-slip along the Red River Fault Zone.

Wu et al. confirmed the initial spreading of the South China Sea was dominated by local punctiform break-up, with the oldest anomaly, C12n (~30.8 Ma), appearing at two turns of the continent-ocean boundary. The study also observes the opening of the northwestern Sub-basin was rotated around a fixed point at the west, with a fault at the eastern end formed by the trajectory of the conjugate point during seafloor spreading.

He et al. suggested that the value of fault deformation width is generally less than 80 km and mostly less than 50 km in the northern South China Sea margin. They analyzed an inverse discrepancy in the southeast of the Qiongdongnan basin, likely due to differences in syn-rift sediment thickness causing a transition between inverse and positive extension discrepancies.

Liang et al. mapped four wave-cut platforms in the southern Pearl River Delta and dated two of them, with results suggesting uplift rates ranging from 0.30 to 0.38 mm/a during 239–128 ka and 0.09 mm/a since 128 ka. A decrease in the uplift rate, may correspond to a weakened differential uplift onshore of the seismically active Littoral Fault Zone.

Zhan et al. proposed that the NW-trending Yanjiang-Yitong'ansha strike-slip fault zone have initiated sinistral motion around 35 Ma and served as a transfer zone during the intense rifting in the Pearl River Mouth Basin from 65 to 35 Ma, and then became a sinistral transtensional fault from 35 Ma to 16.5 Ma.

Chen et al. confirmed mottled clay overlying fluvial deposits or embedding homogeneous aeolian yellow silt can provide useful information on paleo-earthquakes. They suggest that the mottled clay structure in the Huizhou Basin is a product of liquefaction-induced soft-sediment deformation structure, and provide a potential indicator of paleo-earthquakes in the coastal Quaternary basins of the northern South China Sea.

Sedimentary process in the northern margin of SCS

Yang et al. investigated weak and high energy deposition influenced by El Niño-Southern Oscillation (ENSO) activity and high-frequency tropical storms. Growing human activity during 1.0–1.6 kyr impacted sediment flux. Understanding these dynamics can inform sustainable development in the Pearl River Delta.

Liu et al. revealed the Xuande Atoll is a carbonate platform formed since the early Miocene followed by a final shrinking stage in the southern and western parts due to tectonic subsidence and increased sediment inputs.

Zhong et al. analyzed intensified erosion in the neritic region of the northeastern South China Sea occurred due to fluvial incision caused by sea-level decline during the last glacial period and strong transportation by coastal currents.

Xiong et al. evaluated the pore pressure profile and indicates that overpressure zone mainly develops from the middle of Zhujiang Formation to the upper member of Enping Formation due to fluid expansion from hydrocarbon generation.

Geohazards

Zhou et al. systematically studied the geological hazards in the Xisha Sea area since the Miocene using high-resolution seismic data and provide a guide for future exploration and disaster prevention in the Xisha Sea area.

Nawanao and Ramos identified more than 1,200 submarine landslides and found that small submarine landslides are mainly controlled by submarine canyon systems at shallow depths, while large submarine landslides cluster where seamount subduction induces slope steepening. The study highlights the importance of understanding spatial, geomorphological, and tectonic controls in identifying offshore areas susceptible to large submarine landslides and tsunamis in active margins.

Ramirez et al. compared two tsunami models-one with only an earthquake component and one with an additional submarine mass failure component based on the San Andres submarine mass failure, suggesting an earthquake-triggered submarine mass failure source mechanism for the 1994 Mindoro tsunami.

Numerical modeling

Ma et al. used 2-D thermo-mechanical modeling to examine how bathymetric highs affect the topography of the overriding plate and the morphology of the subducting plate. The results show that the dramatic changes in the dip angle and the convex shape in the northern Manila Trench were caused by subduction of a large thin continental terrane, while the smooth morphology of the subducting slab in the southern segment and straight trench were associated with normal oceanic subduction with small seamounts.

Li et al. utilized 3D geodynamical numeric models to study how pre-existing transform faults interact with rifting/spreading centers. The results showed that the pre-existing transform faults affect rifting/spreading propagation, leading to the formation of ridge segments with offset distance.

Wen et al. applied two travel time correction methods to image different S-wave velocity structures the northeastern South China Sea. This study shows that sedimentary layer velocity was the main influencing factor for S-wave phase ray tracing, while the velocity of sediments had little effect on Moho S-wave reflections.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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.

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