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Editorial: Basins and related tectonics

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Editorial on the Research Topic
Basins and related tectonics

Sedimentary basins are the largest potential stores of captured carbon dioxide and serve as important environments for other resources such as hydrogen and hydrocarbon fuels. Better understanding the stratigraphy, structural geology, and related tectonics of basins is critical to recognize the evolution history of basins and utilize them for societal and environmental needs. Since the year 2000, new methods have been applied in basin-related research, motivating global data and detailed basin data concerning their tectonics, structures, sedimentary facies, exploration, and utilization. We believe that a Research Topic focused on basins and their tectonics is necessary to resolve the needs of the open access-based science community.

This Research Topic presents the state of the basin-related research, including new methods and ideas applied in the interpretation of seismic reflection data, salt tectonics, fractures, structure and tectonics of a basin, the prototype basin, tectono-paleogeography, evolution of basins, and coupling between basins and orogens. The methods include the seismic profile explanation, balanced section technique, sedimentary facies analysis, and numerical and physical modeling approaches, along with research from basins including paleomagnetism, zircon dating ages, sedimentary data, and lithological facies. These papers contribute to promote research on basins and related tectonics.

The Research Topic Basin and related tectonics concludes 10 papers, including eight research articles, one method article, and one review article. The Research Topic focused on the Tarim Basin, Junggar Basin, Sichuan Basin, Songliao Basin, Bohai Bay Basin, and South China Sea Basin, which are important hydrocarbon basins in China.

The Tarim Basin is a large superimposed basin rich in petroleum resources in northwestern China, which has experienced five stages of complex tectonic-sedimentary evolution. The reconstruction of the prototype basin and its surrounding background is of great significance for understanding the distribution of petroleum reservoirs in the superimposed basin, and provides a tectonic background and theoretical guidance for petroleum exploration in the Tarim Basin.

The Tarim Basin is a prospective hydrocarbon basin in northwestern China. Based on high-confidence paleomagnetic data and peripheral background analysis, the global plate tectonic patterns of the Tarim Block in different periods of the early Paleozoic, the late Paleozoic, the Mesozoic, and the Cenozoic are reconstructed by Zhong et al., Xia et al., Li et al., and Wei et al. According to the distribution of sedimentary facies and the pattern of uplift and depression, the boundaries of the three stages of the prototype basin are determined by marginal sedimentary facies, and the denudation areas are supplemented

by the thickness trend method and restored by decreasing amounts based on 81 large sections of the whole Tarim Basin. The prototype basin and tectono-paleogeographic maps of the Tarim Basin in the different stages of the early Paleozoic, late Paleozoic, Mesozoic, and Cenozoic are reconstructed by Zhong et al., Xia et al., Li et al., and Wei et al. based on the aforementioned basic research. The Tarim Basin underwent important tectonic evolution in the early Paleozoic, the late Paleozoic, the Mesozoic, and the Cenozoic. The prototype basin and tectono-paleogeography of the Tarim Basin are related to the tectonic environment surrounding the basin.

The Junggar Basin is another important hydrocarbon basin in northwestern China. Li et al. analyzed 15 apatite samples of fission-track dating and eight zircon samples obtained from the northern Junggar Basin. Apatite FT ages ranged from 131 to 42 Ma, and zircon FT ages ranged between 205 and 132 Ma. The northern Junggar Basin underwent three tectono-thermal events during 165–161, 93–81, and 72–66 Ma. The thermal events of 165–161 Ma may suggest magmatic activity during the Yanshanian stage, while the 93–86 and 72–66 Ma events show Late Cretaceous uplift and cooling. These results suggest that the Yanshanian tectono-thermal events involve the evolution of the Junggar Basin in the Mesozoic.

The Sichuan Basin is one of the important basins in southwestern China. The deep reservoirs are explored and developed for these years. The Tongnanba anticline in the northeastern Sichuan Basin was subjected to the compression of the Micangshan and Dabashan thrust belts, forming a complex superimposed structure with three deformation structure layers controlled by three detachment layers in three stages. Zhai et al. proposed that these deformation layers extended in the NW-SE direction and formed the long-distance detachment thrust structure controlled by the Micangshan thrust belt in the late stage.

The Songliao Basin is a large Mesozoic–Cenozoic basin discovered earlier in China. He et al. proposed that the hydrocarbon accumulation in the upper member of the Quantou Formation is controlled by folds and faults in the central Songliao Basin. The faults in the area are classified into three stages. The three-dimensional structure of the third member of the Quantou Formation is explained by the integration of well logging and seismic data; then, the fracture characteristic and the tectonic history of the Yangdachengzi oil layer are analyzed in the Research Topic.

The Bohai Bay Basin is a well-developed hydrocarbon basin in eastern China. Based on the most recent progress of exploration and development, Wang et al. quantitatively analyzed the structural characteristics and fault activity of the buried hill using the balanced section technique in the Research Topic. The structural evolution of the area was simulated by a tectonophysics modeling experiment. The NNE-trending fault is a left-handed fault that formed in the background of the left-handed strike-slip activity of the Tanlu fault zone. The EW-trending fault is closely related to the near-SN extension in the Late Cretaceous.

The South China Sea Basin is an important prospective sea basin with rich hydrocarbon resources. Using 2D and 3D seismic data and modeling, Guo et al. proposed that the Zhu I Depression in the basin, as a series of half-grabens bounded by NE-NEE-trending normal faults, has undergone two phases of extension during the Paleogene. Two phases of structural-sedimentary evolution suggest that the Panyu 4 Sag was formed in the multi-stage extension. Since the Paleogene, the structural evolution of the Panyu 4 Sag has been controlled by coupling among the Pacific, Eurasian, and Indian plates, related to the orientation of subduction of the Pacific plate transferring from NNW to NWW.

Zili et al. proposed two methods that are proposed in the Research Topic to identify effective faults for hydrocarbon accumulation in slope areas. The first method focuses on the location of the sand bodies and paleotectonic ridges, controlling the lateral migration path of hydrocarbons in slope areas. The second method resolves the lateral sealing parts of faults that are oriented perpendicular or oblique to the channel sand bodies.

These papers on the Research Topic Basin and related tectonics suggest that the structures, sedimentary facies, and evolution of these basins are related to the tectonics surrounding these basins. The tectonics control the structures, facies, configuration of depressions and uplifts, and stress field, along with the reservoirs, migration, and accumulation of petroleum in these basins.

Author contributions

GH: writing-original draft, review, and editing, and conceptualization.

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Conflict of interest

The author declares 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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