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Editorial: Extensional basins associated with collisional tectonics

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Editorial on the Research Topic
Extensional basins associated with collisional tectonics

The Frontiers in Earth Science's Research Topic "*Extensional Basins Associated with Collisional Tectonics*" focuses on a particularly original theme in geology, which has seldom been looked into by the scientific community, though it has major implications in both pure research and geohazard assessment. It is worth pointing out that extensional basins are more often associated with active, crustal extensional systems than collisional ones. Nevertheless, understanding the evolution of extensional basins in collisional tectonics is paramount as tectonic inversion can reactivate the basin's dip-slip faults into reverse ones, yielding the tectonic setting that will turn the basin into a collisional domain of the Earth's crust. This Frontiers in Earth Science Research Topic has been aimed at bringing together studies focusing on the origins, spatial and temporal evolution, and deformation mechanisms of extensional basins associated with compressional tectonic settings. It includes five articles, each resulting from cutting-edge, original research.

Vignaroli et al. describe a subsidiary tectonic structure (the Amatrice Fault System, AFS) accommodating Quaternary extensional deformation in the Amatrice Basin (central Apennines, Italy), an intermountain depression involved in the 2016–2017 seismic sequence that wreaked havoc to local communities in Central Italy. The authors analyzed stable carbon and oxygen isotopes on calcite veins and fibers on fault surfaces belonging to the ~10 km-long AFS. The AFS is a minor structure that, during the Mid-Late Pleistocene, accommodated tectonic deformation at the hanging wall of a master extensional fault, the Gorzano- Laga Fault. The main result of this study is the reconstruction of the AFS activity, which recorded fault growth, hydrodynamic regime, and structural permeability network developed under possible coseismic conditions. The authors state that the evolution of minor tectonic structures, such as the AFS, can provide insights into the localization of tectonic deformation at the hanging wall of a master fault, with implications on the release of seismogenic potential in active tectonic domains similar to the central Apennines.

The study by Shah et al. concentrates on refining existing knowledge on the formation and evolution of the Kashmir and Peshawar intermontane basins, respectively located east and west of the Hazara-Kashmir syntaxis (HKS), in NW Himalaya. Although their age is similar, these two intermontane basins have different orientations, with the Kashmir basin trending NW-SW, similar to the strike of the Himalayan thrusts, whereas the Peshawar basin is NE-SW trending. The authors demonstrate that the intermontane basins on either side of the HKS have rotated during their evolution. The estimated >45° clockwise rotation of the Kashmir basin is in contrast to the <45° anticlockwise rotation of the Peshawar basin, and this rotation coincides with the development of a 120-km-long strike-slip fault, the Jhelum fault (JF), which is marked by the dominantly left-lateral strike-slip movement to the north, and oblique to the south. The authors show that the JF largely controls the rotation and the present configuration of the areas on either side of the HKS.

Bai et al. have studied the basins around the Ordos Block, adjacent to the northeast margin of the Tibetan Plateau, in western China. Their main focus is on the Hetao Basin, a Cenozoic rift basin between the Ordos Block and the Yinshan Mountains; Late Quaternary sedimentary strata with lacustrine facies are widely distributed inside this basin. However, its evolution, as well as that of the related fault systems, is still a matter of debate, mainly due to the lack of tectonic evidence. Thus, the authors analyzed the lithology and structure of four stratigraphic sections from the Hetao Basin. The results show that multiple angular unconformity events occurred in the lacustrine layers, dating back to 80 ka. These events may be correlated to similar ones in North China, linked to Quaternary and present-day tectonic movements. The authors conclude that the tectonic processes responsible for the unconformities may have caused the gradual disappearance of the Hetao Lake and its transformation into the Hetao Basin.

Abundant natural gas resources and the potential of developing its major oil resources make the northwestern Sichuan Basin, on the eastern edge of the Tibetan plateau, a site worth investigating. Xu et al. have looked into the architecture and evolution of this basin, surrounded by peripheral thrust belts: the Longmen Shan belt to the west and the Micang Shan to the north. The basin itself is composed mostly of Permian to Cretaceous deposits. A section through the basin reveals blind reverse faults to the NW and a mostly horizontal attitude of the strata towards the SE. The authors used numerical simulations to elucidate the development of a contractional foreland basin under multiple detachments and erosion conditions, with a particular emphasis on deep structural deformation, to understand the geometric features and tectonic evolution of the NW Sichuan Basin, to shed further light on this important structure, for both regional geological investigation and deep gas exploration purposes.

Moving from China to the Andean forearc of Northern Chile, we introduce the study by Martínez et al. focused on an area dominated by intermontane basins, namely the Salar de Atacama, Salar de Punta Negra, and Salar de Pedernales. All these basins are isolated topographic lows nested on a 2500-m a.sl. plateau. The intermontane basins are covered by salt flats and recent volcanic products, which hide their internal tectonic and stratigraphic architecture. The authors chose to investigate the Salar de Punta Negra (understudied in comparison to the Salar de Atacama) to gain insight into the Late Paleozoic–Cenozoic tectonic evolution of the inner Andean forearc in general. Both crustal extension and contraction characterize this Salar: in fact, field and 2D seismic data show clear evidence of extensional tectonic activity between Late Permian and Jurassic times, followed, from the Late Cretaceous to the Paleocene, by basin inversion that transformed the tectonic setting from extensional to contractional.

Author contributions

FP and KG wrote the Editorial working together.

Conflict of interest

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