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Editorial: Sichuan-Tibet traffic corridor: fundamental geological investigations and resource endowment—volume II

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Editorial on the Research Topic
Sichuan-Tibet traffic corridor: fundamental geological investigations and resource endowment-volume II

Introduction

The Sichuan-Tibet traffic corridor (STTC), which spans the western Sichuan Basin and the Tibetan Plateau, serves as a critical external transportation conduit in China (Lu and Cai, 2019). The STTC has undergone a complex geological history involving ocean spreading, subduction, accretion, and continental collision events, ultimately forming the Earth's widest and highest elevation collisional system (Yin and Harrison, 2000; Hou et al., 2024). Its distinctive geological and geomorphic environment, characterized by high seismic intensity, rapid tectonic strain rates, elevated geothermal activity, and extreme elevation, presents unprecedented challenges for infrastructure construction along the corridor (Cui et al., 2022). Significant advancements have been made in recent decades in addressing the geological challenges within the STTC, which has supported infrastructure development and mineral resource exploitation (e.g., Wang et al., 2020; Cao et al., 2022; Yang et al., 2023; Shen et al., 2024). In 2023, we organized a Research Topic entitled "*Sichuan-Tibet Traffic Corridor: Fundamental Geological Investigations and Resource Endowment*", and the principal findings of ten original research articles have been succinctly summarized in Pei et al., 2023. It is noteworthy that this area has consistently been a hot spot in the field of earth science, with new research progress and various methodologies continuing to emerge. To further document the active faults and magmatic-hydrothermal activities in this area, the second volume of this Research Topic is considered.

Contributions in this topic

The occurrence of large earthquakes and the structural characteristics associated with primary active faults in the Tibetan Plateau have been the subject of extensive research, which has facilitated a more comprehensive understanding of the recent deformational patterns of the Tibetan Plateau and related seismic mitigation strategies (Zhang et al., 2013; Yang et al., 2024). The article by Liao et al. presents evidence of Holocene active left-lateral strike-slip faulting on the Abuduo fault along the tectonic boundary between the Bayan Har and Qiangtang blocks in eastern Tibet from detailed field investigations and remote sensing interpretation, which is consistent with the classic tectonic model highlighting south-eastward escape of the plateau. To the southeast of Tibet, Zhou et al. use paleoseismic trenching, radiocarbon dating, and interpretation of tectonic landforms to present new age constraints for past large earthquakes on the southern segment of the Red River Fault. They show that three events were constrained to 785-504 BC, 26–492 AD, and 1415–1857 AD, which yields an approximate average earthquake recurrence interval at 960–1320 a. Furthermore, Dong et al. employ a range of techniques, including seismic relocation, b-value analysis, seismic energy, density distribution research, focal mechanism solution inversion, and a regional stress field study, to elucidate the tectonic relationship between the Xianshuihe-Xiaojiang fault system and the Red River fault zone. They present a new geodynamic evolution model to explain deformational patterns within the intersection of the two fault systems since 5–5.5 Ma. The aforementioned results collectively suggest that crustal deformation in the Tibetan Plateau might have been primarily accommodated by large-scale boundary faults, which also indicates complex spatial-temporal fault activity. Therefore, the potential risk for large earthquakes along faults is likely to be complicated due to the presence of variant long-term strain accumulation.

From a tectonic perspective, the STTC is situated within the eastern portion of the Tethyan tectonic domain. This region has undergone prolonged and intricate continental fragmentation, oceanic subduction and collision orogeny events. At present, there are various competing models for the tectonic evolution history of the Tibetan Plateau (Ding et al., 2022). Take the Bangong-Nujiang Suture Zone as an example, it is a remnant of the Meso-Tethys Ocean, lies between the southern Qiangtang and Lhasa Terranes in central Tibet. Two primary models exist: a "hard" collision from northward subduction (e.g., Yan and Zhang, 2020) and a "soft" collision from divergent double-sided subduction (e.g., Shi et al., 2022). The work by Chen et al. focuses on Early Cretaceous bimodal volcanic rocks in the Wuga Co area, central Tibet. Based on new geochronological, geochemical, and isotopic data, they propose that these bimodal volcanic rocks represent the inaugural identification of direct products derived from slab sinking in the Bangong-Nujiang suture zone. Specifically, the Bangong-Nujiang oceanic slab ruptured from the two overlying terranes at approximately 130 Ma and subsequently sank into the mantle at approximately 108 Ma.

Moreover, frequent material and energy cycle exchange has resulted in the formation of a diverse range of mineral resources along the STTC (Cao et al., 2023; Zhang et al., 2023; Ding, 2024; Lin et al., 2024; Pei et al., 2024). A case study from the Naruo porphyry Cu deposit (including chlorite data from prior studies) of central Tibet by Li et al. employs principal component analysis (PCA) to assess the correlation between chlorite elements and various types of mineral deposits. These findings support the use of geochemical characteristics of chlorite in distinguishing deposit types, including orogenic Au deposits, granite-type U deposits, and skarn-type Sn polymetallic deposits. Additionally, this study highlights the prospect of significant mineral exploration potential in deep regions based on the observed spatial variation in the major element geochemistry of chlorite. Another contribution by Song et al. reports the first record of metal reserves and average grades of 57 deposits (or prospects) from the Bangong–Nujiang belt of central Tibet. This new world-class metallogenic belt hosts a number of well-developed mineral deposits, including porphyry copper, skarn copper-iron, orogenic gold, ophiolite-related chromite and nickel, and quartz-vein and greisen-type tungsten deposits. The authors demonstrate that future exploration efforts should prioritize the following targets: porphyry-epithermal copper, orogenic gold, skarn copper deposits, and post-collision (less than 100 Ma) Mo-W mineralization.

The articles compiled in the second volume of this Research Topic, along with the preceding papers, will facilitate fundamental geological investigations and resource assessments within the STTC. The geological exploration of the STTC will remain a focal point of interest and research for the foreseeable future. We anticipate that the methodologies employed and the findings obtained on this Research Topic will inspire future research endeavours.

Author contributions

QP: Writing–original draft, Writing–review and editing. HW: Writing–original draft, Writing–review and editing. IS: Writing–review and editing. RP: Writing–review and editing. VS: Writing–review and editing. BL: Writing–review and editing.

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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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