frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 09 May 2023
DOI 10.3389/feart.2023.1204067

OPEN ACCESS

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RECEIVED 11 April 2023
ACCEPTED 03 May 2023
PUBLISHED 09 May 2023

CITATION
Pei Q, Wang H, Lin B, Senapathi V and Li D (2023), Editorial: Sichuan-Tibet traffic corridor: fundamental geological investigations and resource endowment. *Front. Earth Sci.* 11:1204067.
doi: 10.3389/feart.2023.1204067

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

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KEYWORDS

geological investigations, tectonic-thermal evolution, active tectonics, remote sensing, mineral deposits, Sichuan-Tibet traffic corridor, Himalaya

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

The Sichuan-Tibet traffic corridor (STTC), which extends across the western Sichuan Basin on the Yangtze block and the Tibetan Plateau (also called the Qinghai-Tibetan Plateau), acts as one of the most important external transport conduits in China (Lu and Cai, 2019). Specifically, the STTC has experienced a prolonged and complex tectonic history involving ocean spreading, subduction, accretion and continental collision events, and finally generated the broadest and highest elevation collisional system on Earth (Yin and Harrison, 2000; Ding et al., 2022). Its unique geological and geomorphic environment (e.g., high seismic intensity, high tectonic strain rates, elevated geothermal activity and extremely high elevation) makes the engineering construction along the STTC face unprecedented challenges (Peng et al., 2020; Cui et al., 2022). Over the past decades, progress regarding the primary geological problems of the STTC has been made to aid development of high-speed railways, hydropower stations, tunnels, urban planning projects, especially in the formation mechanisms of geological hazards and corresponding prevention and control technologies (e.g., Wang et al., 2020; Ma and Yao, 2023; Yang et al., 2023), which provides valuable guidance and scientific support for safe construction and operation in this area. However, the geology and surface processes in the STTC are still relatively poorly understood and require further investigation. Some key geological information such as tectonic evolution, lithological sequence, sedimentary environment, behaviour of active faults, magmatic-hydrothermal activities and associated resources needs to be further documented. Here, we have briefly summarized the key findings of ten original research articles on this Research Topic.

Revealing the tectonic evolution and structural deformation of the major faults in the Tibetan Plateau is of crucial importance to understanding the uplift mechanisms of the Tibetan Plateau and the related geologic hazards and resource exploitation (Wang and Shen, 2020; Spicer et al., 2021; Zhang et al., 2022a). The article by Shailendra et al. reports the first record of granitoid magmatism (tonalite gneiss) in the eastern Karakoram terrane. Based on the identical geochronological and geochemical records, they conclude that the south-central Pamir, Karakoram and central Tibet microcontinents were a single continental block during the Neoproterozoic. Along the eastern margin of the Tibetan Plateau, Wang et al. provide new multi-proxy provenance data using U-Pb dating of detrital zircons, paleocurrent data, and detrital garnet geochemistry, and suggest that significant surface uplift and rapid denudation of the Longmen Shan Fault were probably initiated in the mid-Cretaceous (~120 Ma). Moreover, Feng et al. conduct multiple trenches and use radiocarbon dating to show paleoseismic history along the Xianshuihe Fault, which indicates a multi-fault seismic rupture behaviour. When it comes to the south Tibet, Wan and Wang utilize the broad magnetotelluric and audio magnetotelluric method to reveal three-dimensional electrical structure of the Gulu Fault, which is helpful in constraining the middle and upper crust conductors that could be used for geothermal exploitation. Also in South Tibet, Li et al. investigate two large-scale antimony deposits within the Abunabu mining area of the Tethys Himalayan metallogenic belt by field geological and mineralogical studies and He-Ar-S isotopic geochemical analyses.

Along the STTC, leucogranitic rocks, also known as Himalayan leucogranites, are widely distributed, which could be used as a "probe" to explore the deep Earth and are critical for understanding the tectonic-magmatic-metamorphic evolution and related economic mineralization of the Himalayan orogeny (Cao et al., 2022). Based on zircon and monazite U(-Th)-Pb ages, Sr-Nd-Pb-Hf isotopes and whole-rock major and trace element compositions for the Liemai two-mica granite in the Yardoi area of eastern Himalaya, together with previously published data, Dai et al. propose that underplating of mafic magmas following slab breakoff of the Neo-Tethys oceanic lithosphere, causing partial melting of the thickened (~50 km) amphibolitic lower crust in Himalaya and thus generate granites with adakitic signatures in the Yardoi area. Another case study from the Gyirong area of the central Himalayan orogenic belt by Pei et al. focuses on the Himalayan pegmatite. From the perspective of tourmalines, the authors document the geochemical behavior of tourmaline precipitation and its origin in the Gyirong pegmatite through *in situ* major and trace element and boron isotope studies. The results demonstrate that the Gyirong pegmatite was the product of crustal anatexis and that the crustal metapelitic rocks within the Greater Himalayan Crystalline Complex were the most likely source components. Notably, this leucogranite belt has world-class metallogenic potential for rare metal deposits.

With the rapid increase in data volume (big data) and the improvement of computing power, emerging technologies such as machine learning (ML), deep learning (DL) and optimization algorithms (OA) have significantly changed ways to solve specific problems in geoscience and geoengineering (Zhang et al., 2022b). Zeng et al. make an attempt at lithology identification by using three supervised-classification algorithms, namely, the k-nearest neighbors (KNN), maximum likelihood classification (MLC) and support vertical machine (SVM). Making use of Landsat-5 TM and ASTER data, this work establishes six methods to identify basalts in the famous Emeishan Large Igneous Province (LIP), which is of great significance for mapping the distribution of flood basalts and exploring the world-class Fe-Ti-V deposits and Ni-Cu-(OGE) sulfide deposits throughout the Emeishan LIP. The article by Dai et al. performs inversions of water depth, salinity, and lithium concentrations in the Zabuye Salt Lake of Tibet by using Landsat-8 remote sensing data and the Light Gradient Boosting Machine (LightGBM) algorithm. Compared with traditional station observations, it can overcome many disadvantages such as spatial discontinuity, long time consumption, and high labor costs. This study achieves high prediction accuracy of the LightGBM machine learning algorithm and could provide technical insight for remote sensing inversion of Salt Lake resources in the future. Furthermore, Guo et al. introduce an intelligent prediction model to estimate the Li, B, and TDS contents of two typical salt lakes (Bieruoze Co and Guopu Co lakes) on the Tibetan Plateau. Their model combines a feature selection algorithm with a machine learning algorithm using Sentinel-2 satellite data. The combined strategy of the genetic algorithm (GA)-based feature selection method and the random forest (RF) shows excellent performance and applicability in mineral content prediction of salt lakes.

The articles collected in this Research Topic undoubtely contribute to fundamental geological investigations and resource endowment within the STTC. We hope that some of the methods proposed and the findings obtained could help inspire future research in geosciences. We also need to recognize that the STTC represents a collage formed by multiphase subduction-collision processes and is one of the most tectonically active regions. This area is characterized by extremely complex geological-geomorphological attributes, which require long-term interdisciplinary research and integrated interpretations in the future.

Author contributions

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

Funding

This Research Topic was supported by the Sichuan Natural Science Foundation (2022NSFSC0410), the second Tibetan Plateau Scientific Expedition and Research (STEP) program (2019QZKK0603) and the National Natural Science Foundation of China (42072244).

Acknowledgments

We greatly appreciate the time and effort of the reviewers, editors, and authors who contributed valuable insights and suggestions to these papers in this Research Topic. Our special thanks go to the Chief Editor Prof. Derek Keir and Associate Editor Prof. Stanislaw Mazur. The first author would also like to thank Prof. Inna Safonova for a helpful discussion.

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.

10.3389/feart.2023.1204067

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