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Editorial: Evolution of tectonic structures and mineralisation in orogens and their margins

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Editorial on the Research Topic
Evolution of tectonic structures and mineralisation in orogens and their margins

1 Introduction

Orogens have complex tectonic histories that include plate subduction, collision, and orogenesis (Bagas, 2004; Cawood et al., 2009; Jamieson and Beaumont, 2013). The formation processes of orogens not only shapes new topography following multiple tectonics events, but also accompanies climatic changes, weathering, and erosion (Whipple and Meade, 2006; Armijo et al., 2015; Jepson et al., 2021; Wolf et al., 2022). Additionally, orogens also host abundant mineral resources, particularly precious metals, such as Au, Ag, and Pt (Groves et al., 1998; Zhou et al., 1998; Chen et al., 2004; Chen, 2006; Hou and Cook, 2009; Deng and Wang, 2016). For example, China includes, from north to south, Central Asian, Central China (Tongbai-Dabie-Qinling-Qilian-Kunlun), Jiannan, and Tibetan-Himalayan orogens (Windley et al., 2007; Leng et al., 2013; Li et al., 2015; Yang et al., 2019; Yao et al., 2019; Dong et al., 2021), which have influenced the North China, South China, and Tarim blocks during different periods (Lu et al., 2008; Zhao et al., 2012; Cawood et al., 2018; Yang et al., 2018). The topography of China has been changed by climatic fluctuations and orogenic events (Dong et al., 2011; Shen et al., 2022; Yu et al., 2022). It is during these events that Au was deposited along orogens and their nearby margins (Zhou et al., 2002; Deng and Wang, 2016; Zhang et al., 2020). However, several Research Topic related to the structurally controlled magmatism, mineralisation and exhumation, tectono-thermal evolution, climatic changes, and surface processes in orogens remain unsolved. Systematic studies of orogens and their nearby margins are necessary, which would improve the understanding of orogens and help the exploration

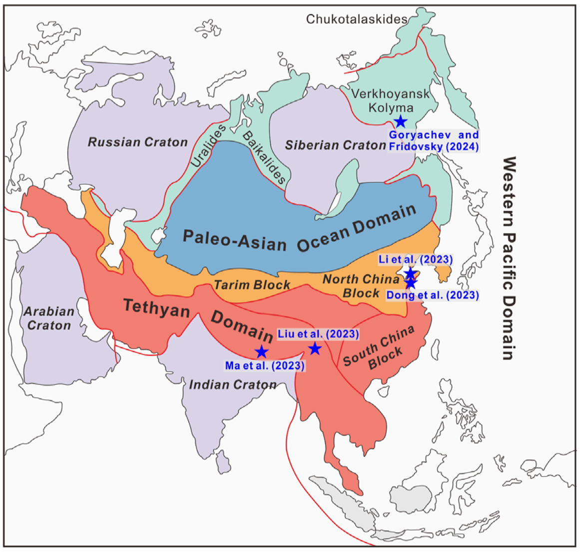

FIGURE 1
Simplified tectonic map of Asia (modified after Şengör et al., 1993; Xiao et al., 2010) showing the distribution of papers in this Research Topic.

of new mineral resources. We, thus, propose the Research Topic of the "Evolution of Tectonic Structures and Mineralisation in Orogens and their Margins" in Frontiers in Earth Science.

In this Research Topic, a total of five papers related to magmism, mineralisation and tectonic evolution in orogens and their margins were published (Figure 1). Of these, two papers are on the Late Mesozoic magmatism and associated Au mineralisation, and tectonic evolution of the Jiaodong Peninsula in the eastern North China Block. Two papers are related to the cooling and exhumation history of the Tibetan Plateau. One paper reports the orogenic Au-As and relatively shallow Au-Sb mineralisation in the orogenic belts to the east of the Siberian Craton. The brief introductions of the five papers are summarized in this Research Topic below.

2 Summary of papers

Dong et al. conducted zircon trace element studies on the Late Mesozoic magmatic rocks in the Jiaodong Peninsula, eastern North China. These data have been integrated with published zircon U-Pb ages to trace the change of crustal thickness and reveal the decratonization (craton destruction) processes of the Jiaodong Peninsual during the Mesozoic. The crustal thickness of the Jiaodong Peninsula underwent a change from ~70 km in the Late Jurassic (ca. 170–150 Ma) to ~89 km (peak) at ca. 130 Ma, and subsequently decreased to 30–40 km at ca. 110 Ma. The crustal thickening (70–89 km) during the Late Jurassic to Early Cretaceous was probably induced by the westward subduction of the Paleo-Pacific slab. Chemical erosion led to decratonization beneath the Jiaodong Peninsula. This study also highlights that the zircon Eu/Eu ∗ proxy is suitable for estimating the crustal thickness, whereas whole-rock La/Yb proxy could not be used as a result of amphibole fractionation.

Goryachev and Fridovsky performed an overview of the geological and genetic features of the Early Cretaceous Au mineralisation from the Verkhoyansk-Kolyma Au province within the eastern margin of the Siberian Craton, Russia, aiming to clarify their common features, differences and genetic nature of orogenic Au-As and relatively shallow Au-Sb deposits. This study argues that the formation of Au-related mineralisation is correlated with the dehydration of slab and local upwelling in the mantle. The fertility of the pre-collision lithospheric mantle was crucial for the formation of the Late Jurassic to Early Cretaceous collision-related orogenic Au deposits. The fluids and components of the Early Cretaceous subduction-related orogenic Au deposits were formed during slab devolatilization related to oceanic subduction. Additionally, an ore-forming model is also proposed for polychronous orogenic Au-As and relatively shallow Au-Sb deposits in orogens globally.

Li et al. carried out whole-rock geochemistry, and zircon U-Pb dating and trace element analyses on the Linglong, Yashan, and Nansu granitic plutons in the Jiaodong Peninsula of the eastern North China, in order to address the origin and petrogenesis of the Mesozoic magmatism and provide insights into related Au mineralisation. Zircon U-Pb dating results constrain the emplacement ages of the plutons at ca. 161–118 Ma. The plutons have adakitic geochemical affinities and were formed during partial melting of the thickened lower crust associated with the subduction of the Paleo-Pacific Plate. The physicochemical conditions of the pre-mineralisation magma source may be favorable for Au-bearing sulfide accumulation. This study also suggests that the upwelling adakitic crust-mantle mixed oxidized magma promote the migration and Au-bearing sulfide mineralisation during the Early Cretaceous.

Liu et al. compiled 1,202 low-temperature thermochronological data based on joint kernel density estimation and linear inversion approaches to address the spatio-temporal exhumation pattern of the entire southeastern Tibetan Plateau. The compiled ages are grouped into the six episodes of rapid cooling at ca. 61–58, 38–35, 32–23, 18–13, 11–6, and 4–3 Ma, which suggest that the SE Tibetan Plateau underwent inhomogeneous exhumation throughout the Cenozoic. The cooling episodes may be derived by the lateral extrusion and continuous India-Eurasia convergence. The climate changes including intensified Asian summer monsoon and glacial processes play a non-negligible role in shaping the landscape since the Miocene within the SE Tibetan Plateau.

Ma et al. carried out geological mapping, elevation transect sampling, low-temperature thermochronological studies, and 3D modeling of the Kangmar Dome in southern Tibet, with the major aim to reveal the cooling histories between the southern and northern portions of the dome. The study proposes that the core-cover contact fault of the Kangmar Dome was part of the South Tibetan Detachment Structure, and the doming event at ca. 12.2 Ma was dominated by thrust stacking of the southward mid-crustal channel flow. Two phases of rapid cooling in the Miocene and the

Pleistocene are suggested at the dome, which are derived by regional structural extension and enhanced glacial activity, respectively. The present landscape was shaped by the incision of the Nianchu River, with concomitant increased glacial activity during the Pleistocene.

Author contributions

FY: Conceptualization, Funding acquisition, Visualization, Writing–original draft, Writing–review and editing. CL: Writing–review and editing. XS: Writing–review and editing. LB: Writing–review and editing. LZ: Writing–review and editing. GJ: 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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