frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 10 July 2023
DOI 10.3389/feart.2023.1247797



OPEN ACCESS

EDITED AND REVIEWED BY
Michel Grégoire,
UMR5563 Géosciences Environnement Toulouse (GET), France

*CORRESPONDENCE
Zhuang Li,
lizhuangcc@pku.edu.cn
Hafiz Ur Rehman,
hafiz@sci.kagoshima-u.ac.jp

RECEIVED 26 June 2023
ACCEPTED 04 July 2023
PUBLISHED 10 July 2023

CITATION
Li Z and Rehman HU (2023), Editorial: Tracing magmatic system evolution with geochemical, geophysical, and numerical modeling perspectives.
*Front. Earth Sci.* 11:1247797.
doi: 10.3389/feart.2023.1247797



# Editorial: Tracing magmatic system evolution with geochemical, geophysical, and numerical modeling perspectives

Zhuang Li[1]* and Hafiz Ur Rehman[2]*

[1]College of Geosciences, China University of Petroleum, Beijing, China, [2]Graduate School of Science and Engineering, Kagoshima University, Kagoshima, Japan

KEYWORDS

**magma evolution, metallogeny, geochronology, geochemistry, numerical modeling, magmatic-hydrothermal fluids, geophysical**

Editorial on the Research Topic
Tracing magmatic system evolution with geochemical, geophysical, and numerical modeling perspectives

Magmatism acts as a window to monitor the nature of mantle and crustal sources and also provides detailed records of the anatexis process and magma evolution, crust–mantle interaction, metallogenesis, and crustal growth and reworking events (Li et al., 2016; Li et al., 2019; Li et al., 2020). In the last few decades, our understanding has been significantly extended regarding the specific tectonic settings and associated polymetallic deposits (e.g., Cu ± Mo ± Au mineralization) and their potential economic benefits (Li et al., 2021). The origin, characteristics, and evolution of magmatic systems are therefore of great importance to our society.

Over the last two decades, a wide range of approaches has been carried out on the magmatic rocks to unravel the magma system evolution. Whole-rock and constituent minerals major, trace elements, and mult-isotope studies (e.g., Re–Os, Lu–Hf, and Sm–Nd), coupled with U–Pb dating and *in-situ* Lu–Hf–O isotope analyses of accessory phases (such as zircon, monazite, rutile, and/or titanite) shed lights on firm evidence regarding the emplacement or eruption ages, source magmas, and their geodynamic evolution (e.g., Li and Chen, 2014; Li and Chen, 2021; Li and Wei, 2017; Li et al., 2022). Moreover, the mineralization genetically related with the magmatic rocks has extended our views from an indication of tectonic setting further to prospective for porphyry polymetallic deposits as their potentially economic benefits (Li et al., 2021).

The Research Topic aimed to collect articles related to the themes of magma system evolution with emphasis on geochemical and geophysical perspectives along with numerical modeling. In addition, the focus of the issue was targeted to the topics that enhance the understanding of the geoscience community regarding the processes of magma mixing, fractional crystallization, crustal contamination, and fluid-rock interaction during the magma generations, colling, and related to the pre-eruptive unrest of volcanoes. In response to the Research Topic, six articles were submitted, peer reviewed, and eventually accepted for final publication to make the Research Topic. The articles collected in this Research Topic undoubtedly contribute to the fundamental fields of petrology, mineralogy, and economic geology. Guest editors hope that some of the

methods proposed and the findings obtained could help inspire future research in geosciences. More articles related to this Research Topic would highly benefit geoscience community in general, and young researchers and students I the relevant fields in particular.

Below, a brief summary of the published articles is presented for readers.

The first article, by Zhao et al., on the petrogenesis of early-middle Paleozoic granitoids in the Qilian Block, northwest China, proposes a tectonic model for the granitoid intrusions that were generated in post-collisional extensional regime and were triggered by the break-off of the northward subducting South Qilian Oceanic slab beneath the Qilian Block during the *ca.* 450–415 Ma. Their study was based on zircon U–Pb ages, and whole-rock Sr–Nd isotopes, major and trace element compositions of the biotite granite and muscovite-bearing granite intrusions. They interpreted that the granitoids have been formed from the partial melting of meta-greywacke and meta-pelitic sources.

Second article of the Research Topic, by Wei et al., is related with the fluid mineralization of the Dongtongyu gold deposit in the southern margin of North China craton. This study provides new petrographic, microthermometric, and synchrotron radiation X-ray fluorescence analyses of fluid inclusions of the deposit. The authors, based on their extensive geochemical analyses, suggest that fluid immiscibility is an important mechanism to result gold mineralization during the fluid evolution process. They recognized four structural stages of gold mineralization in their study within the specific temperature ranges, and presence of $H_2O$-$CO_2$-NaCl components.

Third article by Wu et al. performs inversions of Molybdenite Re–Os dating, zircon U–Pb dating and geochemical data of the Shanagen hydrothermal vein-type Mo deposit in Derbugan metallogenic belt of the NE China. The authors identified that the Shanagen hydrothermal vein-type Mo deposit was developed in a sericitized zone along the alkali-feldspar granite and interpreted that the mineralization was associated with the partial melting of lower crustal rocks. They conclude that the Mo deposit was formed in the extensional environment after the closure of the Mongol-Okhotsk Ocean.

Another case study, that represents the fourth article of the Research Topic, is on the central North China Craton, by Xue et al., and is focused on the Laiyuan complex in Northern Taihang Mountains. From the perspectives of spatio-temporal and geochemical relationship of the complex, the authors document their common features of enrichments in LREEs and LILEs and depletions in HFSEs. The results demonstrate that the slow and gradual thermal-mechanical erosion occurred at the central North China Craton, whereas the rapid and intense lithospheric delamination occurred at the eastern North China Craton contributing to different lithospheric evolution.

Fifth article of the Research Topic, by Liao, is based on analytical and numerical simulations that allowed the author to test variety of concepts on solid/fluid mechanics, thermodynamics, and link multiple observations. With sequential data assimilation, the physics-based models help to track the current evolution of magmatic systems and forecast their future unrest. Liao study constructed an analytical model that explored the characteristics of transport of melt, pressure, and heat through an idealized crystal mush layer/column under uniaxial strain condition. His study elaborates some intrinsic differences between the bottom-up *versus* the top-down triggering mechanisms for the magmatic unrest. Furthermore, he highlights the importance of further exploration for a more complete description of the transport properties in the crystal mush.

Sixth and final article of the Research Topic, by Zhu et al., investigated the Shuangjianzishan super-large Ag-Pb-Zn deposit in the southern Great Xing'an Range, a part of the Central Asian Orogenic Belt. Their study was based on field geology, mineralogical study, and geochemical analyses of host slates. Their comprehensive field and analytical data helped them to constrain the metallogenic episodes of epithermal magmatic-hydrothermal conditions that were active in the study area during the Mesozoic. They suggest that the host slates were deposited during the post-orogenic extensional tectonic settings and their hydrothermal alteration resulted in epithermal metallogenic deposits.

## Author contributions

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

## Funding

This research is supported by the National Natural Science Foundation of China (42002238 and 41872057).

## Acknowledgments

The authors would like to express gratitude to all the authors who contributed their work to the Research Topic as well as chief and associate editors for providing comprehensive comments and reviewing the submissions to this Research Topic.

## 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.

## Publisher's note

# References


Li, Z., Chen, C. J., Chen, B., and Cai, H. A. (2021). Early cretaceous crust–mantle interaction in the middle-lower yangtze river metallogenic belt, east China: Li–Nd–Sr isotopic and elemental constraints. *Lithos* 398-399, 106308. doi:10.1016/j.lithos.2021.106308

Li, Z., and Chen, B. (2014). Geochronology and geochemistry of the Paleoproterozoic meta-basalts from the jiao-liao-ji belt, North China Craton: Implications for petrogenesis and tectonic setting. *Precambrian Res.* 255, 653–667. doi:10.1016/j.precamres.2014.07.003

Li, Z., Chen, B., and Wang, J. L. (2016). Geochronological framework and geodynamic implications of mafic magmatism in the Liaodong Peninsula and adjacent regions, North China Craton. *Acta Geol. Sin. Engl. Ed.* 90, 138–153. doi:10.1111/1755-6724.12647

Li, Z., and Chen, B. (2021). Tracing crustal contamination of the Cenozoic basalts with OIB-affinity in northern marginal region of North China Craton: An Os perspective. *China Geol.* 4, 593–599. doi:10.31035/cg2020052

Li, Z., Wei, C. J., Chen, B., Fu, B., and Gong, M. Y. (2020). Late Neoarchean reworking of the Mesoarchean crustal remnant in northern Liaoning, North China Craton: A U–Pb–Hf–O–Nd perspective. *Gondwana Res.* 80, 350–369. doi:10.1016/j.gr.2019.10.020

Li, Z., Wei, C. J., Chen, B., Yang, F., Zhang, X., and Cui, Y. (2022). Late Neoarchean high-grade regional metamorphism in the eastern North China Craton: New constraints from monazite dating in northern Liaoning. *Precambrian Res.* 373, 106625. doi:10.1016/j.precamres.2022.106625

Li, Z., and Wei, C. J. (2017). Two types of Neoarchean basalts from qingyuan greenstone belt, North China Craton: Petrogenesis and tectonic implications. *Precambrian Res.* 292, 175–193. doi:10.1016/j.precamres.2017.01.014

Li, Z., Wei, C. J., Zhang, S. W., Yang, C., and Duan, Z. Z. (2019). Neoarchean granitoid gneisses in eastern hebei, North China Craton: Revisited. *Precambrian Res.* 324, 62–85. doi:10.1016/j.precamres.2019.01.020