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Editorial: Accessory mineral geochemistry and its application in mineral exploration

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Editorial on the Research Topic
Accessory mineral geochemistry and its application in mineral exploration

Accessory minerals are common in igneous rocks of intermediate to felsic composition. Their ability to incorporate a wide range of geochemically important trace elements, as well as their physical-chemical durability and resistance to alteration, makes these ideal minerals for fingerprinting granitoid fertility and tracing magma evolution (Zhong et al., 2019; Zhong et al., 2021; Zhu et al., 2022). In contrast, some studies show that those 'robust' accessory mineral compositions sometimes exhibit signatures that are counter-indicative to their igneous host, particularly regarding regional fertility of granitoids (Rezeau et al., 2019). In this regard, it is of great importance and necessity to address the systematics of accessory mineral geochemistry in the field of granitic petrogenesis and its application in mineral exploration.

This Research Topic aims to underscore 1) advances in the understanding of isotopic and trace element signatures in accessory minerals, as they pertain to magmatic evolution in fertile and barren terranes; and 2) textural and petrological factors affecting accessory mineral compositions that may lead to indeterminate classification of plutonic suites and incorrect assessment of magmatic fertility. The Research Topic will provide useful guides on how to successfully apply accessory mineral geochemistry in assessing intrusion-centered magmatic-hydrothermal systems as well as develop some novel geochemical classifiers/tools.

The Kalmakyr deposit in Uzbekistan is one of the world's largest gold-rich porphyry Cu deposits, and is characterized by multiple intrusive phases. It is suggested that porphyry Cu mineralization is associated with the latest granodiorite porphyry, but it is still unclear which features of these ore-bearing intrusions are crucial for the enormous metal enrichment and how they correlate with magmatic fertility. Liu et al. address these questions by comparing the petrological and *in situ* major and trace element geochemistry of apatite for the ore-bearing and ore-barren intrusions. By comparing their new data with the published dataset from porphyry Cu–Mo and Mo-only deposits in the world, they suggest that the high Cl content and low F/Cl ratio in magmatic apatite might be an important indicator to prospect for gold-rich porphyry Cu deposits.

Liu et al. analyze the *in situ* major and trace elements and Nd isotope content of apatite from a Cu mineralized pluton (Hongshan) and three non-mineralized plutons (Cilincuo, Rongyicuo, and Hagela) in the Yidun Terrane, SW China. They aim to provide new insights into the identification of the magmatic features of Cu-mineralized plutons. Based on apatite δCe values and halogen compositions, they find that the parental magma of the Cu mineralized pluton was more oxidized and contained more Cl than those of the non-mineralized plutons. They also suggest that the four plutons were the products of partial melting of ancient lower crust mixed with mantle-derived melts, and that the Cu-mineralzied Hongshan pluton was derived from a deep magma source. They finally propose an index system consisting of apatite δCe, Sr/Y, and F/Cl values, which can be used to distinguish the Cu-mineralized and non-mineralized plutons.

In contrast, Tan et al. study hydrothermal apatite from the Huayuan orefield, SW Yangtze Block (SW China), which is a world-class Pb-Zn orefield with over 20 million tonnes (Mt) metal reserve. They aim to reveal the Pb-Zn ore fluid source and evolution in the Huayuan orefield. Based on the compositions of hydrothermal apatite, they suggest that the apatite was formed in an environment with decreasing oxygen fugacity, and that the ore-forming fluid is relatively F-rich, Cl-poor, and REE-poor. They also proposed that mixing of fluids with different origins might trigger significant metal ore deposition in the Huayuan orefield.

Finally, Hao et al. examine the petrogenesis and geodynamic settings of the Xinchenggou area, Xingmeng orogenic belt, NE China based on detailed whole-rock major and trace element compositions. They suggest that syenogranite and monzogranite from the Xinchenggou area are I-type granite and emplaced in a continental arc setting, which was related to the subduction of the Paleo-Pacific Plate beneath the Eurasian Plate during the Late Triassic to Early Jurassic.

The guest editors would like to thank all the authors and reviewers for their work and devotion to the Research Topic and hope that it can inspire further research about how to guide mineral exploration using accessory minerals.

Author contributions

SZ has provided an initial draft of this Editorial which was revised and approved by all the authors. All authors contributed to the article and approved the submitted version.

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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.

Publisher's note

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