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Petrogeochemistry, geochronology and its geological significance of the granite from Baishipo Ag deposit, Dabie orogen

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1 Introduction

Granitoid magmas have been widely used as a natural probe for tracing the crustal evolution process (Martin et al., 2005). Mesozoic granitoids are widespread in the Dabie Orogen. Comprehensive investigations of these granitoids represent a promising opportunity to obtain deeper insight into the petrogenesis, mechanism of magma formation, geodynamic evolution and metallogeny of the associated mineral deposits. The Dabie Orogen contains tens of granitic complexes, which occur either as individual plutons with an areal extent of tens to hundreds of km^2 or as small stocks (generally of <1 km^2) (Liu et al., 2017). The Mesozoic granitoids in the Dabie Orogen are of particular geological interest as indicators for Mesozoic lithospheric evolution.

The Baishipo Ag deposit is located in Luoshan County, Henan Province, China. In this paper, we report the geochronology and geochemistry data to define the timing of magmatism, origin of the magmas, and geodynamic setting.

2 Timing of magmatism

Intrusions are widely distributed in the eastern Dabie Orogen along the NW- and NNE-trending faults. The intrusive rocks are composed of granitoid plutons and minor mafic-ultramafic rocks. The Yanshannian granitoids consist of deep-seated granite batholiths, such as the Shangcheng, Xingxian and Lingshan intrusions, and other small stocks, such as those at Shapinggou, Tangjiaping, Qian'echong, Yaochong, Dayinjian, Mushan, and Xiaofan. The large range of chronometric ages indicates that those stocks can be divided into an early stage (143–130 Ma) and a late stage (130–113 Ma) (Liu et al., 2017).

To constrain the timing of the Baishipo granite, we report the zircon U–Pb dating. Zircons from the Baishipo granite yield the weighted average U-Pb ages of 135 ± 2.0 Ma (MSWD = 1.18), we propose that magmatism were formed in the Early Cretaceous.

3 Genetic type and magma source

The Baishipo granite have high SiO_2 values, and low $Mg^{\#}$, Ni, and V contents, suggesting that they were origined from crustal materials. According to following evidence, We propose that the Baishipo granite is the A-type granite which have high $K_2O + Na_2O$, Ga/Al, and low CaO, Ba, Sr, and are enriched in Zr, Zn, Nb, and REE (Halen et al., 1987). It is generally accepted that A-type granites are origined from relative high-temperature magmas compared with I- and S-type granites (Patino, 1997). The calculated T_{Zr} of the Baishipo granite samples vary from 804 to 821 °C, with an average of 810 °C, Which is similar to those of typical A-type granites (Miller et al., 2003). As discussed above, we conclude that the Baishipo granite belongs to A-type granite.

The Baishipo granite have relatively high HREE values, indicating garnet as the main residual phase (Defant et al., 1990). Additionally, the samples have high Rb/Ba ratios and low Sr contents, consistent with middle to upper continental crust (Rudnick et al., 2003). Therefore, the source region of the Baishipo granites might be relatively shallow (probably < 30 km). Experiment indicate that partial melting of calc-alkaline tonalite to granodiorite can produce peraluminous A-type

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granitic melts on the condition of P = 0.4 GPa, T = 950 °C, which would lose A-type geochemical features as pressure increased up to > 0.8 Gpa (Patina, 1997). Therefore, we propose that the primitive magma of the Baishipo A-type granite was origined from intermediate felsic rocks under the condition of 0.4–0.8 GPa pressures and ca. 14–28 km depths (Gao et al., 2016).

4 Geodynamic setting and its implications

Zircons U–Pb age confirm that the Baishipo granite was formed in the Early Cretaceous. The Dabie Orogen is a Triassic collision zone between the North China Craton and Yangtze Block, the coesite and diamond inclusions in eclogites suggest that the continental crust subducted into mantle depthes (Ames et al., 1993). Geophysical data show that the Dabie Orogen is average crust, rather than the thickened crust (Gao et al., 1998), which indicates that it has a significant thinning of the lithosphere. The Izanagi Plate (or Paleo-Pacific) started to subduct beneath the Eurasian continent in a NWW direction in the late Jurassic-Early Cretaceous period (Niu et al., 2003), which led to the transformation of tectonic regime in the Dabie Orogen. The geodynamic setting of mineralization in this period has been a NE-SW direction extension. After this period, the Izanagi Plate underwent NE-directed subduction parallel to the Eurasian continental margin, which led to large-scale continental extension (Mao et al., 2013). Therefore, the Early Cretaceous granites may have formed in a extensional setting triggered by the oblique subduction of the Izanagi Plate (Ling et al., 2009; Mao et al., 2008).

It is generally accepted that A-type granites formed in extensional environments (Alirezaei et al., 2012). We infer that the Baishipo granite were formed in the post-collision extension setting combination with the regional tectonic setting and geochemical data. The thinning of the lithosphere and upwelling of asthenosphere had taken place during this extension. The direct heating effect of the asthenosphere caused the partial melting of the crust by thermal and chemical erosion. Therefore, the formation of the Baishipo A-type granite fromed in the extensional setting in the Dabie orogen.

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