Two episodes of subduction and collision events at the northern foot of Dabie Mountains: Evidence from petrology and structural geology of granitoid rocks

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Abstract  The intrusive bodies studied include Mafan diorites ((462.7±1.5) Ma, \(^{40}\text{Ar}/^{39}\text{Ar}\) amphibole plateau age), Duhudian granites ((293±12) Ma, U-Ph zircon age) and Suxianshi granites ((146.2±0.9) Ma) in Beihuaiyang area at the northern foot of Dabie Mountains, central China. Petrological studies indicate that all of them belong to I-type granitoid rocks. Among them, the Mafan and Duhudian stocks were formed by arc magmatism, while the Suxianshi pluton is a post-collisional granitic body. Three intrusive bodies have distinctive characteristics of structural deformation. The Mafan stock has a rather complicated structure pattern resulting from polyphase deformation during the Caledonian and Mesozoic, the Duhudian stock has been pronouncedly deformed during the Hercynian-Yanshanian events, while regional foliation is not pronounced within the Yanshanian Suxianshi stock. Combination of regional stratigraphic, regional structural and geochronological data shows that the Yangtze plate has experienced two episodes of subduction northward beneath the North China plate during the Paleozoic and following collisional events. The first phase of collision at about 400 Ma resulted in the formation of the Beihuaiyang crystalline basement and the Caledonian high-pressure metamorphism in Dabie orogenic zone, and a late phase of continent-continent collision (~230 Ma) is responsible for the Triassic ultrahigh- and high-pressure metamorphism in Dabie Mountains and for orogenic uplift of the Dabie Mountains. It is suggested that the Beihuaiyang tectonic belt at the northern foot of the Dabie Mountains is a multicyclic suture.

Keywords: Dabie Mountains, Beihuaiyang tectonic belt, granitoids, polyphase collision.

In recent years, Dabie Mountains has been regarded as a Triassic collisional orogen between the North China and Yangtze plates because of the discovery of high-pressure and ultra-high-pressure metamorphic rocks. The Beihuaiyang tectonic belt (BTB) at the northern foot of Dabie Mountains was formed by polyphase collisions. An understanding of the structural evolution and granitoid origin of the belt is critical for understanding tectonics of the Dabie collision orogen. However, Paleozoic structural evolution of the belt has been poorly studied. In this study we present new data of petrochemistry and structure geology for three granitoid plutons with different isotopic ages in the BTB. This study indicates that the BTB has experienced two episodes of subduction and collision between North China and Yangtze plates since the Paleozoic.
1 Geological setting

The BTB at the northern foot of Dabie Mountains is bounded to the west by Nanxiang basin, and to the east by a strike-slip fault called the Tan-Lu fault. The Tongbai-Tongcheng fault to the south separates the Dabie ultrahigh-pressure orogenic zone and the BTB, and the Minggang-Feizhong fault to the north is a boundary between the North China plate and the BTB (fig.1). An Archean-Proterozoic metamorphic complex called the Dabie complex outcrops in the core portion of the Dabie Mountains on the south of the Tongbai-Tongcheng fault. The eastern part of the BTB is mainly composed of Sinian-Devonian metamorphic rocks previously called the Lu-zhenguan group\(^1\), Jurassic pyroclastic rocks and Cretaceous red basin sediments; and the middle-west part of the BTB is made of Sinian-Cambrian metasedimentary rocks previously called the Fuziling group, lower Paleozoic metamorphic complex\(^2\), and Carboniferous coal-bearing clastic rocks. A Devonian metasedimentary suite, which had been taken to be part of the Xinyang and Sujiahe groups\(^3\), is also present in the middle Beihuaiyang belt. The BTB is intruded by an early Paleozoic (Caledonian) Mafan pluton, a few late Paleozoic plutons including Duhudian, Qingshuitang and Huangjiawan stocks, and abundant late Jurassic-early Cretaceous (Yanshanian) granitic plutons.

Fig. 1. A geological sketch of the middle section of the Beihuaiyang tectonic belt. Fault zones: F\(_1\), Tongbai-Tongcheng fault; F\(_2\), Minggang-Feizhong fault; F\(_3\), Guishan-Meishan fault; and F\(_4\), Zhoudang-Shangcheng fault. Plutons: ① Mafan pluton; ② Duhudian pluton; ③ Huangjiawan pluton; ④ Qingshuitang pluton; and ⑤ Suxianshi pluton. Other symbols: γ\(_3\), the Yanshanian granites; Ar-Pt, Archean-Proterozoic Dabie complex; Pt\(_t\), Paleoproterozoic metamorphic complex; Z-∈, Sinian-Cambrian metasedimentary rocks; Pz\(_t\), early Paleozoic metamorphic rocks, D\(_1\)-2, Devonian metasedimentary rocks; and K-Q, Cretaceous-Quaternary sediments.

2 Geochemistry of three epochs of intrusive rocks and tectonic setting under which they formed

2.1 The Caledonian Mafan pluton

The Mafan pluton, having an outcrop area of about 52 km\(^2\), is located in the middle part of the BTB. It consists of quartz diorites and monzodiorites. We obtain a \(^{40}\text{Ar}/^{39}\text{Ar}\) hornblende plateau age of (462.7±1.5)Ma on a quartz diorite, agreeing well with K-Ar whole-rock ages of 469—475 Ma dated by the Third Team of Geology in Henan Province (1987, unpublished data). Al-in-hornblende barometry gives an average crystallization pressure of 2.9 kb, corresponding to a