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Petrogenesis and geochronology of Cretaceous adakitic, I- and A-type granitoids in the NE Yangtze block: Constraints on the eastern subsurface boundary between the North and South China blocks: Reply

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ABSTRACT

We thank Zeng and Yan (2014) for their interest in our recent paper "Petrogenesis and geochronology of Cretaceous adakitic, I- and A-type granitoids in the NE Yangtze block: Constraints on the eastern subsurface boundary between the North and South China blocks". However, Zeng and Yan (2014) have misinterpreted some available data and literature regarding the basement in the Yangtze block. After carefully rechecking available isotopic data for the Precambrian basement and providing additional arguments, we show that their arguments are not correct, and confirm that our viewpoint on the source of the Chuzhou adakitic rocks and eastern subsurface boundary between the North and South China blocks remains valid.

1. Introduction

We thank Zeng and Yan (2014) for their comments on our recent paper (Su et al., 2013), as it gives us an opportunity to further clarify our viewpoints and discuss the subsurface boundary between the North China block (NCB) and South China block (SCB). Based on different evidence including Cenozoic basalts, granulite xenoliths and geophysical observations, several previous papers have discussed the nature of this boundary (Chung, 1999; Li, 1994; Yu et al., 2003). Interestingly, these original papers have also been commented upon by different groups (Lin, 1995; Zhang, 2004). The existence of so many comments and replies demonstrates that the boundary between the NCB and SCB is a very interesting topic for the geoscience research. In this reply, we first discuss the isotopic data for the Precambrian basement in the Yangtze block, and then provide some additional arguments, and finally confirm that our viewpoint on the source of the Chuzhou adakitic rocks and eastern subsurface boundary between the NCB and SCB remains valid.

2. Archean–Proterozoic rocks from northern and western Yangtze cannot fully represent the basement in the northeastern Yangtze block

Zeng and Yan (2014) suggested that the North China and Yangtze Precambrian basements have a distinct overlap in terms of Nd–Pb–Hf isotopes, and thus these isotopes cannot be employed to distinguish the derivation of the Chuzhou adakitic rocks from the North China block or Yangtze block (YB). However, they have misused some of the available data and literature to interpret the basement. Hf-isotope data for xenocrystic zircons from lamproite diatremes (Zheng et al., 2006) were used to reflect the basement beneath the Kongling terrain in the northern YB, whereas many samples such as Nx32 were not actually from the Kongling terrain. Zeng and Yan (2014) quote the Pb-isotope data for Junan granulite xenoliths within the Sulu metamorphic belt to infer the Pb-isotope characteristics of the NCB (Ying et al., 2010), which is not consistent with their argument that the Dabie–Sulu UHP rocks are a subducted part of the Yangtze block. They also use mafic rocks in the western Yangtze (Kangdian) (Li et al., 2002) and the Qinling orogenic belt (Yang et al., 2011) to infer the isotopic features of basement rocks (Zeng and Yan, 2014). However, the mafic volcanics in the Kangdian rift were derived from an OIB-like mantle source without appreciable crustal contamination (Li et al., 2002), and undoubtedly cannot be taken to reflect the basement.

Zeng and Yan (2014) use Archean–Proterozoic rocks from the northern Yangtze (Kongling), western Yangtze (Kangdian) and Qinling

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orogenic belt to define the Nd–Pb–Hf isotopes of basement rocks in the northeastern YB, where the Chuzhou adakitic rocks outcrop (Fig. 1 of Zeng and Yan, 2014). However, many studies have shown that the Kongling terrain is the only known exposed Archean microcontinent in the YB (Chen et al., 2013); the Kangdian area in the western YB represents a typical Neoproterozoic rift system (Li et al., 2002); and the tectonic affinity of the Qinling orogenic belt, the suture zone between the NCB and YB, is still controversial (Shi et al., 2013). These areas may have quite different evolutionary histories and tectonic positions from the northeastern YB.

A careful scrutiny of available isotopic data for the Precambrian basement in the YB makes it clear that the basements in the northern, western and northeastern YB show distinct zircon U–Pb ages and Hf-isotope features (Fig. 1). Chen et al. (2001) and Ling et al. (2001) also suggested that the basement rocks in different parts of the YB possess different Sr–Nd isotopic ratios and Nd model ages. Therefore, it is unreasonable to use the Archean–Proterozoic rocks from the northern and western YB and the Qinling orogenic belt to define the basement in the northeastern YB. Even the Archean–Paleoproterozoic rocks from the northern and western Yangtze do occur in the lower crust of the northeastern YB, zircon Hf isotopes of the Chuzhou adakitic rocks ($\varepsilon_{Hf}(t) = -26$ to -16) suggest their derivation from the southern NCB rather than YB, as most of the Archean–Paleoproterozoic zircons from the northern YB would have very negative $\varepsilon_{Hf}(t)$ values (<-30) when evolved to the Cretaceous (Fig. 15 of Shi et al., 2013), much lower than those for the Chuzhou adakitic rocks. Nd-isotope data also demonstrate that the Chuzhou adakitic rocks cannot be derived from the basement rocks in the northern and western YB (Fig. 2).

In our recent paper (Su et al., 2013), granulite xenoliths and inherited zircons in the northeastern YB and southeastern NCB were used to trace the Nd–Hf isotopes of the lower crust, and geochemical and isotopic comparisons between the Chuzhou adakites and nearby Cretaceous granitoids derived from the southeastern NCB and northeastern YB were used to discuss the source of the Chuzhou adakites. Considering that the basement beneath the YB is highly heterogeneous, we believe that the conclusions based on such an analysis must be more feasible than one that simply lumps together all available analysis. On the other hand, it is difficult to explain the obvious isotopic differences between the Chuzhou adakites and nearby YB-derived granitoids, if the Chuzhou adakites were derived from the lower crust of the YB.

3. Other evidence for the source of Chuzhou adakitic rocks and the eastern subsurface boundary between NCB and SCB

The Chuzhou volcanic rocks belong to the high-K calc-alkaline series (Ma and Xue, 2011), quite different from the shoshonitic series of the volcanic rocks from other basins such as the Luzong Basin in the northeastern YB (Wang et al., 2006). The Chuzhou volcanic rocks contain abundant old magmatic zircons with ages between 1800 Ma and 2600 Ma but none with Neoproterozoic ages (Xie et al., 2007),

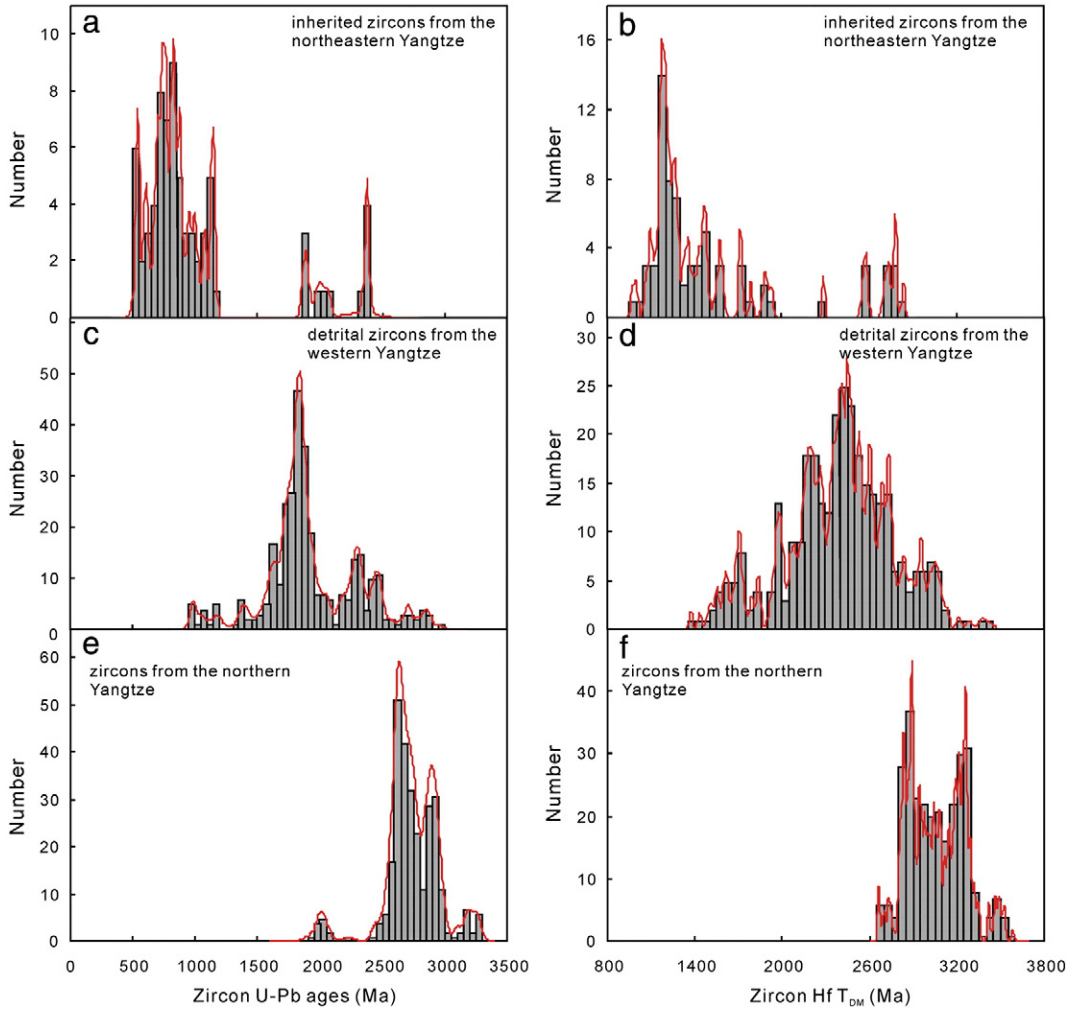

Fig. 1. Histograms of zircon U–Pb ages and Hf model ages for the Precambrian basements in the northeastern (a and b), western (c and d) and northern (e and f) YB. Inherited-zircon data in the northeastern YB are collected from Wu et al. (2012) and Yang and Zhang (2012); detrital-zircon data in the western YB are from Sun et al. (2009) and Zhao et al. (2010); zircon data for the Kongling terrain in the northern YB are from Chen et al. (2013).