Deep-crustal compositions and architecture from accretion to collision: examples from the Central Asian Orogenic Belt and Qinling-Dabie orogen

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Orogens can be generally divided into two types: accretionary and collisional orogens. What are fundamental differences in deep-crustal compositions and architecture from accretion to collision and how to identify them have not been well understood. This study attempts to discuss these problems by juvenile compositions defined by Nd-Hf isotopic mapping of granitoids in the southwestern segment of the Central Asian Orogenic Belt (CAOB), a typical and the world's largest Phanerozoic accretionary orogenic belt, and in the Qinling-Dabie Orogen, a typical subductional-collisional orogen.

The CAOB, bounded by the Siberian Craton to the north and the Tarim-North China Craton, is the most important site of Phanerozoic continental growth on the Earth (e.g., Şengör et al., 1993; Jahn et al., 2000; Kovalenko et al., 2004), even if the growth was probably overestimated (Kröner et al., 2013). The southwestern CAOB, comprising the Altai, Junggar, Tianshan and Beishan orogens, is a typical area for the CAOB. The Paleozoic and Mesozoic granitoids of the central Altai show $\varepsilon_{Nd}(t)$ = -5 to +2 with T_{DM} = 1.6 - 1.1 Ga, the Western Junggar $\varepsilon_{Nd}(t)$ = +3 to +9 with T_{DM} = 0.8 to 0.4 Ga, the Eastern Junggar $\varepsilon_{Nd}(t)$ = +2 to +8 with T_{DM} = 0.9 to 0.5 Ga and the Tianshan and Beishan with large ranges of $\varepsilon_{Nd}(t)$ values and T_{DM} ages (Wang et al., 2009, 2014). These data suggest that the central Altai has a remnant of a reworked (old) continental terrane, the Junggar terrane a juvenile accretionary complex (mélange), the Tianshan and Beishan orogens with both juvenile and old recycled crust.

The Qinling-Dabie Orogen is one of the main orogenic belts in Asia and mainly consists of four distinct blocks or terranes. These are, from north to south, the North China Craton (NCC), the North Qinling Belt (NQB), the South Qinling Belt (SQB) and the South China Craton (SCC). Voluminous Paleozoic and Mesozoic granitoids in the southern margin of the NCC have $\varepsilon_{Nd}(t)$ values from −21.9 to −10.9, from −14 to +5.4 in the NQB, from −10 to −1.8 in the SQB and from −6.5 to -3.2 in the northern margin of the SCC, respectively. Correspondingly, Nd model ages (T_{DM}) vary from 2.82 to 1.47 Ga，2.38 to 0.73 Ga，1.79 to 1.13 Ga and 1.52 to 1.25 Ga, respectively (Wang et al., 2015*)*. These results indicate the southern margin of the NCC with old basement rocks, the SQB and the northern margin of the SCC with slightly older basement rocks and the NQB with more complex basement rocks. Mesozoic granitoids in the Dabie Orogen show $\varepsilon_{Nd}(t)$ values ranging from −22 to −8, corresponding T_{DM} from 1.8 to 2.0 Ga (Hong et al., 2003). It suggests old basement rocks, being similar to those of the NCC, for the Dabie Orogen.

All these signatures indicate that the granitoids in the CAOB have significant differences in Nd isotopic compositions from collisional orogens such as Qinling-Dabie Orogen in the central China (Hong et al. 2003; Wang et al., 2015), suggesting different deep crustal compositions for them. Compared with the general orogens, the CAOB has much juvenile compositions and more crustal growth (juvenile materials) during Phanerozoic time, distinct from a typical collisional orogen. This study reveals that isotopic compositions of magmatic rocks can trace deep compositions of orogens and provide significant information for understanding compositions and evolution stages (from juvenile accretionary, subductional to collisional) of orogens.

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