Pb-Sr-Nd isotopes and trace elements of granitoids in the Qinling orogenic belt, Central China: Implications for evolution of deep crust composition and continental subduction

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The nature of deep crust can be gained from the direct studies of exposed crust sections and crustal xenoliths. In areas where such materials cannot be sampled directly, the nature of deep crust can also be probed through elemental and isotopic studies of crustally derived granitic rocks which were generated in deep crust. The Qinling orogenic belt in central China provided an excellent opportunity to undertake such an excise. The belt, which connects with the Dabie ultra-high-pressure metamorphic belt to the east, was formed by collision between the North China craton and the Yangtze (South China) craton (Zhang *et al.*, 1995). It is generally agreed that the Qinling orogenic belt can be divided into North Qinling and South Qinling tectonic segments (Gao *et al.*, 1996). The former was an active continental margin of the North China craton, whereas the latter was a passive margin and constitutes the northernmost part of the Yangtze craton (Fig. 1). This abstract mainly discusses the compositional change of North

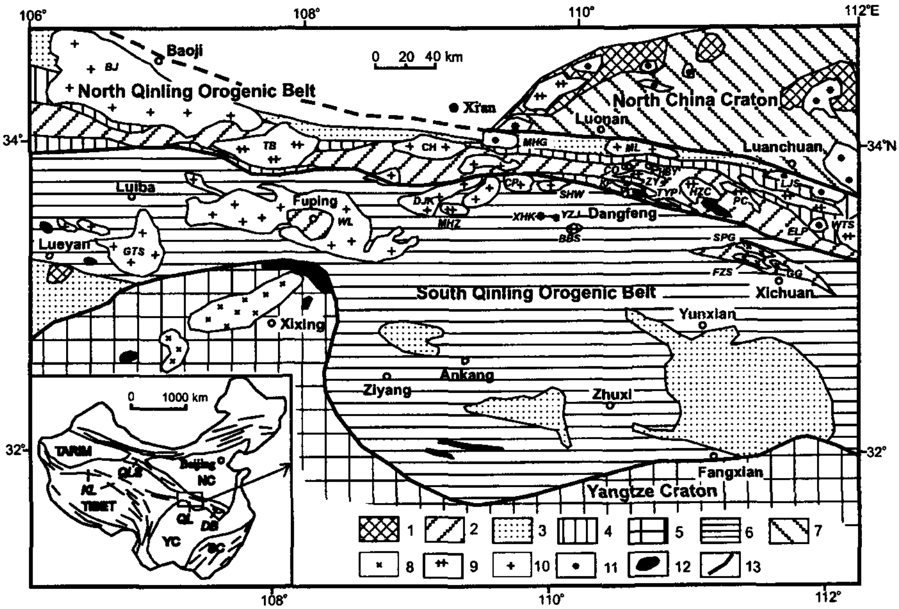

FIG. 1. Simplified geological map of Qinling orogenic belt and its adjacent areas. Inset shows location of the study area. 1: Archaean; 2: Early Proterozoic; 3: Middle-Late Proterozoic; 4: Late Proterozoic-Early Palaeozoic; 5: cover of Yangtze craton; 6: cover of South Qinling belt; 7: cover of North China craton; 8: Late Proterozoic granitoid; 9: Early Palaeozoic granitoid; 10: Late Palaeozoic to Early Mesozoic granitoid; 11: Late Mesozoic granitoid; 12: mafic and ultramafic intrusives; 13: Fault.

Qinling deep crust at the time of transition between the Early Palaeozoic and Late Palaeozoic from the study of source of granitoids. Its tectonic implications are also discussed.

Pb isotope

Feldspar separates of granitoids were used for Pb isotope analysis. Neoproterozoic to Mesozoic granitoids from South Qinling have a fairly uniform Pb isotopic composition, which is similar to that of the South Qinling basement. They are characterized by low radiogenic Pb isotopic composition. In contrast, the Pb isotopic composition of granitoids from the North Qinling belt displays a clear temporal evolution and can be divided into two groups(Zhang *et al.*, 1997). The Neoproterozoic and Early Palaeozoic (670–383 Ma) group has a more radiogenic Pb isotopic composition, which is indistinguishable from that of the North Qinling basement rocks. However, the Late Palaeozoic and Mesozoic (345–102 Ma) group is markedly less radiogenic and falls within the range of South Qinling basement and overlaps the South Qinling granitoids.

Sr and Nd isotopes

Corresponding changes in Sr and Nd isotope compositions of granitoids are also evident. The Early Palaeozoic granitoids of North Qinling have complex sources, which were predominantly derived from the North Qinling basement. For example, The $\varepsilon_{Nd}(t)$, $\varepsilon_{Sr}(t)$ and T_{DM} values of the Piaochi batholith (482 Ma) and Tabei batholith (485Ma) are very close to those of Qinling Group gneisses and amphibolites at the time of emplacement. The $\varepsilon_{Nd}(t)$, $\varepsilon_{Sr}(t)$ and T_{DM} values of the Huicizi (383Ma) and Zaoyuan (444 Ma) granites are distinctly different from those of above two batholiths. Their source may contain recycled Qinling palaeo-oceanic crust material (Zhang, *et al.*, 1996). On the other hand, the Late Palaeozoic granitoids of North Qinling, such as the Cuihuanshan (345 Ma), Manling (291 Ma) and Baoji (262 Ma) granites, are distinct in Sr and Nd isotopic composition from the Early Palaeozoic granitoids and basements of North Qinling. However, they exhibit close similarities to the Late Palaeozoic-Early Mesozoic granitoids and volcano-sedimentary basements of South Qinling. The results strongly suggest an important change in the deep crust composition of North Qinling at the transition between Early and Late Palaeozoic.

Trace element ratios

Incompatible trace element ratios U/Th, Rb/Ba, Ba/La, Nb/La, Zr/Hf, Th/Zr and Sc/Co of Neoproterozic-Early Palaeozoic and Late Palaeozoic-Mesozoic granitoids from North Qinling are also different. The Late Palaeozoic-Mesozoic granitoids show no clear distinctions with the South Qinling Late Palaeozoic-Mesozoic granitoids in these ratios. This further supports that both the South Qinling and the North Qinling Late Palaeozoic-Mesozoic granitoids have an identical source, that is, the South Qinling middle-low crust.

Tectonic implicatios

The above isotopic and trace element changes evidenced by the two groups of the North Qinling granitoids require a change in granitoid source with time. The changes are best explained by the northward continental subduction of the leading edges of the South Qinling belt beneath the North Qinling belt, which resulted in corresponding changes of deep crustal composition and the source in the subsequently emplaced North Qinling ganitoids. The chronology of granitoids leads us to infer a Devonian time of collision between the two cratons.

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