

Recycling of sediment into the mantle source of K-rich mafic rocks: Geochemical evidence from the Fushui complex in the Qinling orogen

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K-rich mafic igneous rocks are viewed as being derived from partial melting of enriched mantle source, but it is extremely controversial about which processes cause the mantle enrichment. The Fushui intrusive complex is the largest early Paleozoic K-rich intrusive complex in the eastern Qinling orogen, which plays an important role in determining the onset time of subduction of the Paleotethyan Ocean beneath the North Qinling microcontinent. Therefore, detailed studies on the Fushui complex can contribute not only to understanding of the petrogenesis of K-rich mafic igneous rocks, but also to unraveling the evolution of the Paleotethyan Ocean. In this study, we provided an integrated investigation of *in situ* zircon U-Pb dating and Hf-O isotopes, in combination with whole-rock major and trace elements as well as Sr-Nd isotopes for the Fushui intrusive complex. *In situ* zircon SIMS/LA-ICPMS methods revealed that different rock types of the Fushui complex had identical formation ages of 488-484 Ma, confirming the late Cambrian-early Ordovician magmatic activities. The Fushui complex belongs to shoshonitic series, and is characterized by extreme LILE enrichment (e.g. Ba, Pb and Sr), depletion of HFSEs (e.g. Nb, Ta, Zr, Hf, P and Ti), high initial Sr isotopic ratios (0.709969-0.715126), negative $\epsilon_{\text{Nd}}(t)$ (-3.97 to -5.68) and $\epsilon_{\text{Hf}}(t)$ values (-2.85 to 0.34), positive $\Delta\epsilon_{\text{Hf}}$ values (3.85-5.37) as well as high zircon $\delta^{18}\text{O}$ values (6.86 ± 0.13 ‰). These geochemical features indicate that the mantle source has been metasomatized by fluids derived from subducted oceanic sediments. A simple two end-members mixing model constrained the amount of subducted sediments in the Fushui mantle source to ~6 %. The Fushui complex originated from 1-6 % equilibrium melting of a phlogopite-bearing garnet lherzolite by a model of non-modal melting. As shoshonitic magmas have been discovered in modern nascent arcs, we suggest that the generation of the Fushui complex was induced by the subduction of the Paleotethyan Ocean when it jumped from the northern to the southern boundary of the North Qinling microcontinent.