Coeval mantle-derived shoshonitic and calc-alkaline plutons from the North China Craton: the 1.96 Ga continental arc magmatism?

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This work presents mantle-derived shoshonitic and coeval calc-alkaline magmatic rocks formed prior to regional high-pressure metamorphism, which represents the subduction-related continental arc magmatism in an ancient orogenic belt (the Paleoproterozoic Khondalite belt, North China Craton). The Wudangzhao monzodiorites are mafic to intermediate and possess remarkably high K_2O (3.0–4.9 wt.%), plotting in the field of shoshonitic series. In contrast, the Yebaigou meta-gabbros have more mafic compositions and are sodium-rich ($Na_2O/K_2O>2$), belonging to the low-K calc-alkaline series. Different magmatic evolution trends in plots of MgO vs other major elements, suggest they were derived from two distinct series of magma. SIMS zircon U–Pb data show both shoshonitic and calc-alkaline plutons formed at 1.97–1.96 Ga, and subsequently experienced high-grade metamorphism at 1.94–1.92 Ga. The shoshonitic mozodiorite and calc-alkaline meta-gabbro have similar Nd–Hf–O isotopic compositions, but distinct trace element compositions. The former shows strongly enriched LREE with negative Eu anomaly, and depleted HFSE with clearly negative anomalies at Nb, Ta, P, Zr and Ti. The latter displays much lower LREE with obviously positive Eu anomaly, similar HFSE patterns but much lower absolute abundances and without negative Ti anomaly. Our observations lead to the notion that the former has experienced intense crystal fractionation of plagioclase, pyroxene and olivine with small degree of melting. In contrast, the latter has experienced accumulation of plagioclase and pyroxene with high degree of partial melting. High Ba/Th, U/Th, Sr/Th and low $^{87}Sr/^{88}Sr_i$ indicate that both of their mantle source has been metasomatized by fluids released from the subducted slab. Collectively, this work shows that the coeval shoshonitic and calc-alkaline pluton may occur in the deep arc. Those arc magmatism with similar isotopic signature may have distinct geochemistry features. This process was strongly controlled by different degrees of partial melting, different crystal fractionation and accumulation, and different minerals presented in their source.
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