

U-Pb zircon dating, geochemical and Sr-Nd-Hf isotopic compositions of Early-Paleozoic intrusive rocks from the eastern Qilian orogen, NE Tibetan Plateau: Petrogenesis and tectonic significance

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A integrated study of U-Pb zircon dating, geochemical and Sr-Nd-Hf isotopic compositions was carried out for the Bamishan and Heishishan plutons in the Qilian orogen, northeastern Tibetan Plateau. The Bamishan pluton is composed of monzonitic granite, diorite and minor hornblendite. U-Pb zircon dating by LA-ICP-MS method shows that the granite, diorite and hornblendite have magma crystallization ages of 462 ± 2 Ma, 451 ± 3 Ma and 449 ± 3 Ma, respectively. The monzonitic granite exhibits adakitic geochemical signatures. The Sr-Nd-Hf isotopic data of the monzonitic granite suggest that its magma was derived from partial melting of the newly underplated basaltic lower crust. The diorite, with high Ba and Sr contents, probably originated from the partial melting of metasomatized lithospheric mantle. The hornblendite has extremely high Cr, Ni and Mg[#], indicating a cumulate origin. Petrographic and Sr-Nd-Hf isotopic data for the hornblendite indicate that its initial magma were generated by the hydrous partial melting of enriched lithospheric mantle. The Heishishan pluton consists of biotite granite, diorite and gabbro. Their magma crystallization ages are 440 ± 2 Ma, 442 ± 4 Ma and 438 ± 3 Ma, respectively. The biotite granite displays adakitic geochemical signatures and has relatively evolved Sr-Nd-Hf isotopic compositions, implying that it was derived from the partial melting of thickened mafic lower crust. The gabbro and diorite from the Heishishan pluton are characterized by evolved Sr and Nd isotopic compositions, indicating that they originated from partial melting of enriched lithospheric mantle. We proposed that the Early-Paleozoic magmatism in the eastern Qilian block probably resulted from northward subduction and collision in the southern margin of the Qilian orogen. Therefore, there may exist an early Paleozoic oceanic basin between the Qilian and West Qinling orogens. Furthermore, we infer that the ~460Ma magmatism in the eastern Qilian block formed in a continental arc setting, while the 450–430Ma magmatism was likely related to the break-off of subducted early Paleozoic oceanic slab.