U-Pb and Lu-Hf isotope systematics of detrital zircons from the Upper Paleozoic to Mesozoic, western Qinling, central China: Implication for the provenance and paleogeography

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Western Qinling, linking the eastern Kunlun, Longmenshan, Qilian, Qinling, and Songpan-Ganzi orogens in central China, poses a key to understanding tectonic evolution of the Tethys and China. This area contains the Bailongjiang block, the Taohe depression and the central Qinling block, from south to north. A Paleo-tethyan Animaqen suture passes the area but the location remains an open question. In this study, we conducted field geologic mapping, sedimentary geology, and U-Pb geochronology together with Lu-Hf isotopic composition of 568 detrital zircons, in an attempt to provide constraints on the detrital provenances of sandstones and paleogeography during the late Paleozoic to the Mesozoic

The detrital zircons from Middle Caboniferous sandstones interbedded with the platform carbonates collected in the Bailongjiang block range from 500 to 1000 Ma in age, peaking at 800-900 Ma; these zircons have $\varepsilon_{Hf}(t)$ values ranging from -25 to 13 and T_{DM2} ages from 1 to 5.4 Ga, indicative of a distinct geographic affinity with the northern margin of the Yangtze craton. In contrast, the detrital zircons from Middle Caboniferous sandstones from Middle Qinling uplift exhibit an outstanding age population of 450~500 Ma, with two minor populations of 800-1000 Ma and 2400~2600 Ma; they have $\varepsilon_{Hf}(t)$ values varying from -10 to 12.5 and T_{DM2} ages from 1 to 5.4 Ga, indicating a possible derivation from the Qinling and Qilian orogens along the southern margin of the North China craton. The detrital zircons from the middle Permian siliciclastic rocks collected from the same locality are largely characterized in age by a population of 200 to 500 Ma or older than 1500 Ma, and most of them give negative $\varepsilon_{Hf(}t)$ values, with the T_{DM2} ages peaking at 2-4 Ga, which show a affinity with the North China craton and the Qinling and Qilian orogens.

Lower-Middle Triassic sandstones in the Taohe depression are mainly composed of feldspar greywacke and lithic feldspar greywacke, characterized by high matrix contents and low maturities in composition and texture. The detrital zircons collected from these Triassic sandstones exhibit a wide age spectrum with three major peaks at 200~600 Ma，1600~2000 Ma and 2400~2500 Ma, respectively, and their $\varepsilon_{Hf}(t)$ values vary from -20 to

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10 (most are negative), with a T_{DM2} age peak at 2.5~3.5 Ga. These facts indicate that the Triassic succession could have dominantly derived from the North China craton and the Qinling, Qilian and eastern Kunlun orogens.

Jurassic sandstones unconformally overlie Upper Paleozoic strata in the Bailongjiang block. Detrital zircons collected from these sandstones are characterized by an outstanding age population of 200-300 Ma and a minor population of 500 to 900 Ma; the $\varepsilon_{Hf}(t)$ values are largely negative for the zircons of <300 Ma, with the T_{DM2} ages ranging from 0.4 to 1.4 Ga (peak at 0.5-1.0 Ga). This reveals the sediments were dominantly derived from the Qinling and eastern Kunlun orogens, with minor sourced from the Yangtze craton.

Our U-Pb and Lu-Hf isotope systematics of detrital zircons from the upper Paleozoic to Mesozoic, western Qinling have important geographic and tectonic implications. Clearly, the Bailongjiang block have a distinct affinity with the Yangtze craton, and it should be a part rifted from the Yangtze craton (South China). Therefore, the Paleo-tethyan Animaqen suture should be north of the Bailongjiang block. Moreover, it is the first time that the North China craton was identified as a main source for the Triassic flysch sequence in central China. It is possible that the Bailongjiang block could have formed an obstacle to hinder the detritus from the North China craton into the main depositional basin in the Songpan-Ganzi area. In addition, the dominant derivation of the Jurassic sandstones in the area as revealed by the zircon isotope systematics indicates that the Qinling orogen could have being elevated during the Jurassic.

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Key words: zircon, U-Pb age, Lu-Hf isotope, provenance, western Qinling