

Provenance and tectonic implications of the Yanshi bauxite area in Western Henan, China

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Abstract. The bauxite layer in Western Henan supplies a large number of bauxite ores and is useful for studying tectonic movement. In this paper, the bauxite samples were selected to carry out LA-ICP-MS detrital zircons U-Pb dating and Hf isotope testing. The results indicated that the detrital zircons with the Early Paleozoic ages were mainly derived from the North Qinling Orogenic Belt. The detrital zircons of the Precambrian age may be derived mainly from the basement of the North China Block and the North Qinling Orogenic Belt. The results of this study support the opinion that the North Qinling Orogenic Belt has been uplifted at ~310 Ma, and the surface of the southern craton has an overall north-dipping topography at this time.

1 Introduction

The Yanshi County of Henan Province is located in the southern part of the North China Craton (NCC) and the eastern part of the Mesozoic Cenozoic Luoyang Basin. It is the earliest area found in the bauxite deposit and is a part of the metallogenic belt in Western Henan [1]. The occurrence horizon of bauxite is the upper Carboniferous Benxi Formation. The sedimentary provenance area can provide important information about the tectonic activities on the periphery of sedimentary basins, especially in the tectonic conversion period [2-10].

In this study, the LA-ICP-MS detrital zircon U-Pb dating of bauxite in Yanshi County, Henan Province, South China Craton was carried out. The provenance and properties of the ore-forming materials of bauxite in this area were analyzed. It is expected to help the genesis of the Benxi Formation bauxite and the mining of geological information carried by bauxite.

2 Geological background

Within the NCC, one of the most prominent features in the sedimentology since Phanerozoic is the parallel unconformity contact between the Upper Carboniferous-Lower Permian and its underlying carbonate layers of Lower Paleozoic. There is a hiatus of about 150 million years [2,11,12]. Except for the basal conglomerate with high compositional maturity and structural maturity

occurred in the northernmost part, in most area, the bottom of Upper Carboniferous-Lower Permian strata is dominated by bauxitic mudstone, with localized oolitic bauxite [13,14]. The bauxite represents the earliest re-deposited formation after the long depositional break of the NCC.

According to the detrital zircon of the original rock, the palaeozoic tectonics and orogeny, the bauxite in the NCC have two provenances: the Bayan Obo-Chifeng fault and adjacent to the Xingmeng Orogenic Belt; the Luanchuan Fault Zone is adjacent to the Qinling Orogenic Belt. It is composed of structural units that have formed in different periods and tectonic settings. The suture zone is the Shangdan Suture (Fault) Zone formed in the Early Paleozoic [13-16]. The north of the Shangdan Fault Zone belongs to the North Qinling Orogenic Belt (NQOB), with different stages and degrees of metamorphism of sedimentary strata.

3 Sample collection and testing

The pisolitic-oolitic bauxite (sample number ZK0008-43) and bauxitic mudstone (sample number ZK0008-44) selected in the study were located in Yanshi County, Western Henan, China (Figure 1).

Zircon U-Pb age measurements were completed at the Experimental Center of Resources and Environmental Engineering Institute, Hefei University of Technology. The laser ablation system used for zircon U-Pb LA-ICP-MS measurements was a GeoLas 2005.

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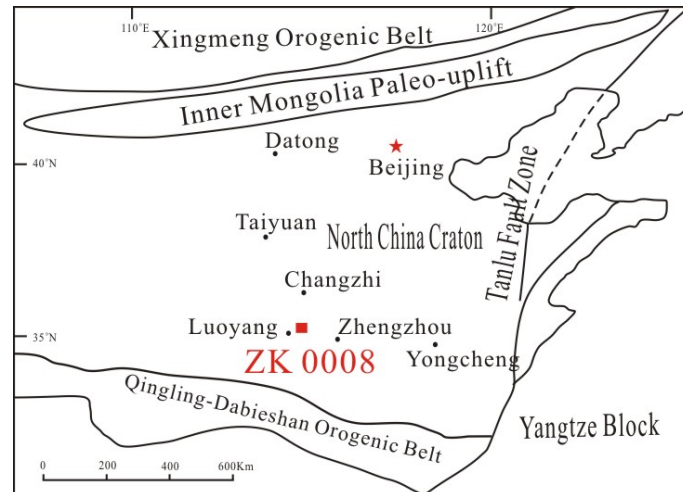


Figure 1. The location of the study area (The base map is modified from [17]).

4 Results

4.1 U-Pb ages

Ninety-three out of one hundred zircon grains [18] were analysed, and the concordant ages of ninety-three zircon grains (90% confidence) (Figure 2a) were divided into two groups. The first group included sixty-six zircon grains, accounting for 71% of the total, ages between 378 Ma and 544 Ma (mainly from the early Paleozoic), with a peak at ~444 Ma. The second group included twenty-seven zircon

grains, accounting for 29% of the total, which had ages between 629 Ma and 3116 Ma (from the Precambrian) (Figure 2b).

4.2 Hf isotopes

The detrital zircons with U-Pb ages of ca. 443 Ma have $^{176}\text{Hf}/^{177}\text{Hf}$ values from 0.282451 to 0.282878 and $\varepsilon_{\text{Hf}}(t)$ values from -1.8 to +13.0. The other detrital zircons of $^{176}\text{Hf}/^{177}\text{Hf}$ values and $\varepsilon_{\text{Hf}}(t)$ values (We classify and summarize the sample) are shown in Table 1 [18].

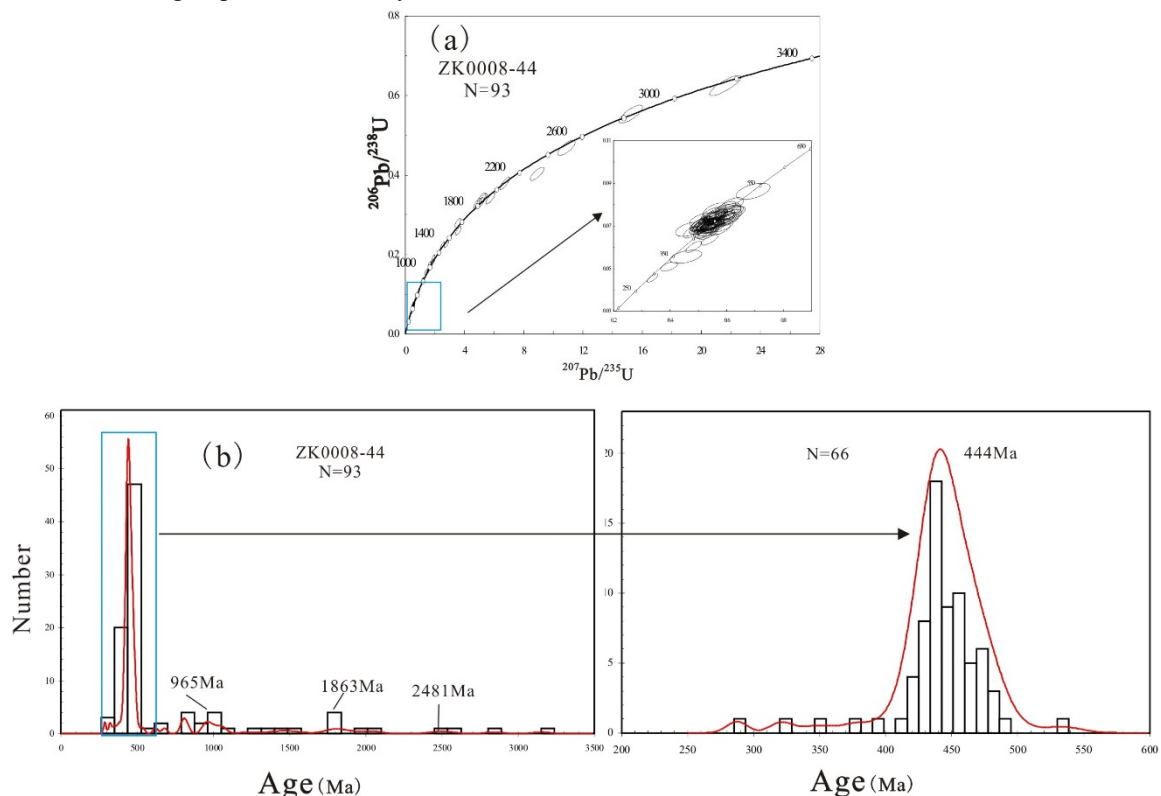


Figure 2. Concordia curve and age spectrum of detrital zircon in the study area.

Table 1. The detrital zircons Hf isotope data of sample ZK0008-43 in the study.

peak age of sample	number of zircon	$^{176}\text{Hf}/^{177}\text{Hf}$		$\varepsilon_{\text{Hf}}(t)$
443	15	0.282451~0.282878		-1.8~+13.0
992	4	0.281945~0.282212		-7.7~+1.4
1817	2	0.281519	0.281565	-6.5, -2.9
2500	2	0.281281	0.281295	+1.6, +3.4

The table modified from [18].

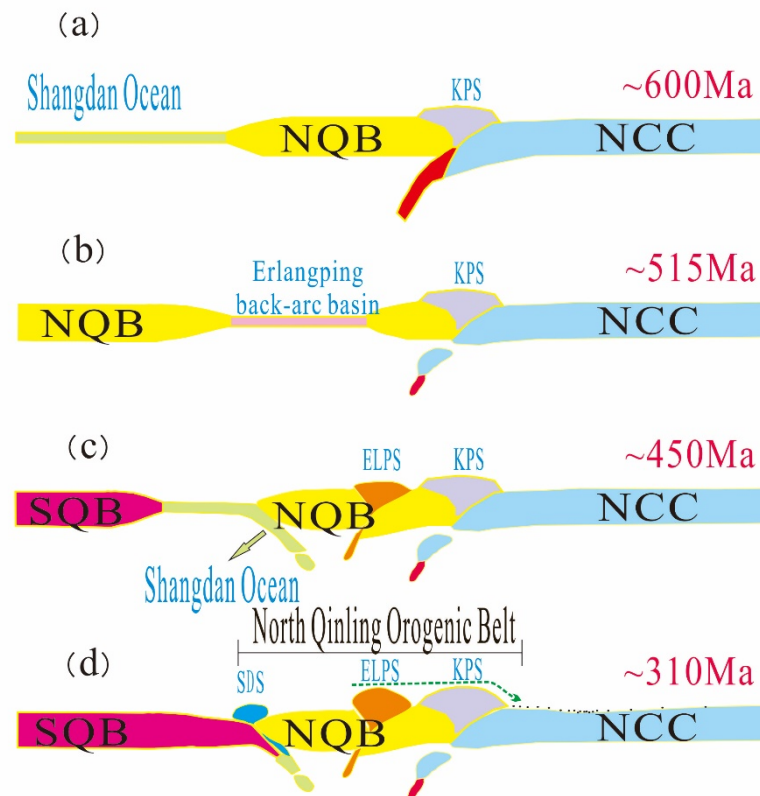


Figure 3. Schematic rendering of the Early Paleozoic and Precambrian [16].

NCC—North China Craton; KPS—Kuanping Suture; NQB—North Qinling Belt; ELPS—Erlangping Suture; SQB—South Qinling Belt.

5 Discussion

5.1 Provenance

The $\varepsilon_{\text{Hf}}(t)$ values fell within the range of $\varepsilon_{\text{Hf}}(t)$ values (age of ~450 Ma) of the NQOB. Therefore, the magmatic zircon with a peak at ~450 Ma was mainly derived from the NQOB.

The detrital zircon in the study area may not only have been provided by the basement of the NCC. It may be derived mainly from the metamorphic strata exposed in the North Qinling area.

5.2 Tectonic implications

There is a change in the provenance of detrital zircon and the material sources of the North China Craton [2,16].

According to the analyses of the provenance and the comparison diagram of the probability curves of the samples in the NCC, it indicates the tectonic movement.

At ~600 Ma, The Shangdan Ocean separated the South China Craton from the NCC (Figure 3a). At ~515 Ma, the Erlangping back-arc basin subducted toward the south, beneath the North Qinling terrane (Figure 3b). The Erlangping back-arc basin appeared because the Shangdan oceanic crust might have subducted, which would have occurred at ~540 Ma. Meanwhile, the North Qinling Belt island arc also appeared [16]. At ~450 Ma, the Erlangping back-arc basin was closed, and the Erlangping Suture began to form, while the Shangdan Ocean might still exist and continue to subduct (Figure 3c) [16]. At ~310 Ma, the Shangdan Ocean was already closed (Figure 3d). The formation and rapid uplift of the North Qinling Belt suggest that the surface has an overall north-dipping topography, which provides the material sources for the NCC. The results show that the provenance of the detrital

zircon in the southern NCC has changed [2].

6 Conclusion

The detrital zircons with the Early Paleozoic ages were mainly derived from the NQOB. The detrital zircons of the Precambrian age may be derived mainly from the NQOB and the basement of the North China Block.

In the sedimentary period, the surface had an overall north-dipping topography, which provided the material sources for the NCC. It caused the change in the provenance.

Acknowledgments

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