

Research Advances

A Discovery of ~3.1 Ga Basement in the Bohai Bay Basin

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Objective

The North China Craton (NCC) is one of the oldest continental fragments, which underwent multistage crust growth during the early Precambrian from >3.8 Ga to 1.8 Ga. In previous studies, many zircon ages have been obtained from the exposed basement rocks. However, we know little about the hidden basement because of Phanerozoic to Cenozoic strata coverage. The drill holes provided a rare opportunity to obtain the basement rocks beneath the Bohai Bay Basin (BBB). In this study, we carry out SHRIMP U-Pb dating analysis on two samples from the basement of the BBB, and discuss the geological significance and its relationship with the exposed basement around the BBB.

Methods

Zircons were separated from crushed samples using heavy liquids and a Frantz magnetic separator at Langfang Geological Survey Institute, Hebei Province. The zircons were imaged using cathodoluminescence (CL) to examine internal structures at Chinese Academy of Geological Sciences (CAGS). Zircon U-Pb dating was performed using SHRIMP II at the Beijing SHRIMP center, CAGS.

Results

Two samples were obtained from two boreholes that penetrated into the basement in the Chengning uplift in the BBB (Fig. 1a). The Chgu14 and Ch916 samples are from boreholes of Chenggu14 and Cheng916, respectively (Fig. 1b). The petrographic features and zircons ages are summarized below.

(1) Sample Chgu14 is tonalite, which is dark gray and medium to coarse grained and shows a slight gneissic

structure and epidotization, consisting of plagioclase (~60%), quartz (~30%), biotite (~8%) hornblende (<1%) and accessory mineral (<1%). Sample Ch916 is diorite, which is dark gray and shows a slight gneissic structure and chloritization and carbonation, consisting of plagioclase (~70%), hornblende (~25%), quartz (~4%) and accessory minerals (<1%).

(2) The zircons from these two samples show euhedral crystal shapes and oscillatory zoning with most having a length to width ratio 2:1 and high Th/U ratios, which are typical features of zircon crystallized from a melt. Some crystals show a little partial recrystallization with small rim (Fig. 1e, 1f).

(3) For the Chgu14 sample, 14 analyses from 14 magmatic zircons yield a discordia line with an upper intercept age of 3131 ± 23 Ma (MSWD=0.93) (without spot 11.1), in which the most concordant analyses has a $^{207}\text{Pb}/^{206}\text{Pb}$ age of 3133 ± 16 Ma, nearly the same age with upper intercept age. For Ch916, 14 analyses from 14 magmatic zircons yield a discordia line with an upper intercept age of 3106 ± 94 Ma (MSWD=15) (Fig. 1c, 1d).

Conclusions

In this study, we first dated two magmatic rocks from hidden basement in the BBB. The two samples have emplacement ages of 3131 Ma and 3106 Ma, respectively. Our two new ages coincide with some rocks (~3.1 Ga) exposed in the Anshan and Caozhuang old crustal nucleus. Additionally, a large number of ~3.1 Ga detrital and inherited zircons have been found in Neoproterozoic to Mesozoic rocks around the BBB, such as Jiaodong, Wutai, Linglong, Wulian and so on. Therefore, it is evident that there was ~3.1 Ga magmatism in the eastern block of the NCC. There is much more likelihood of finding more Paleoproterozoic-Mesoproterozoic rocks in the basement beneath the BBB, even in other basins in the NCC.

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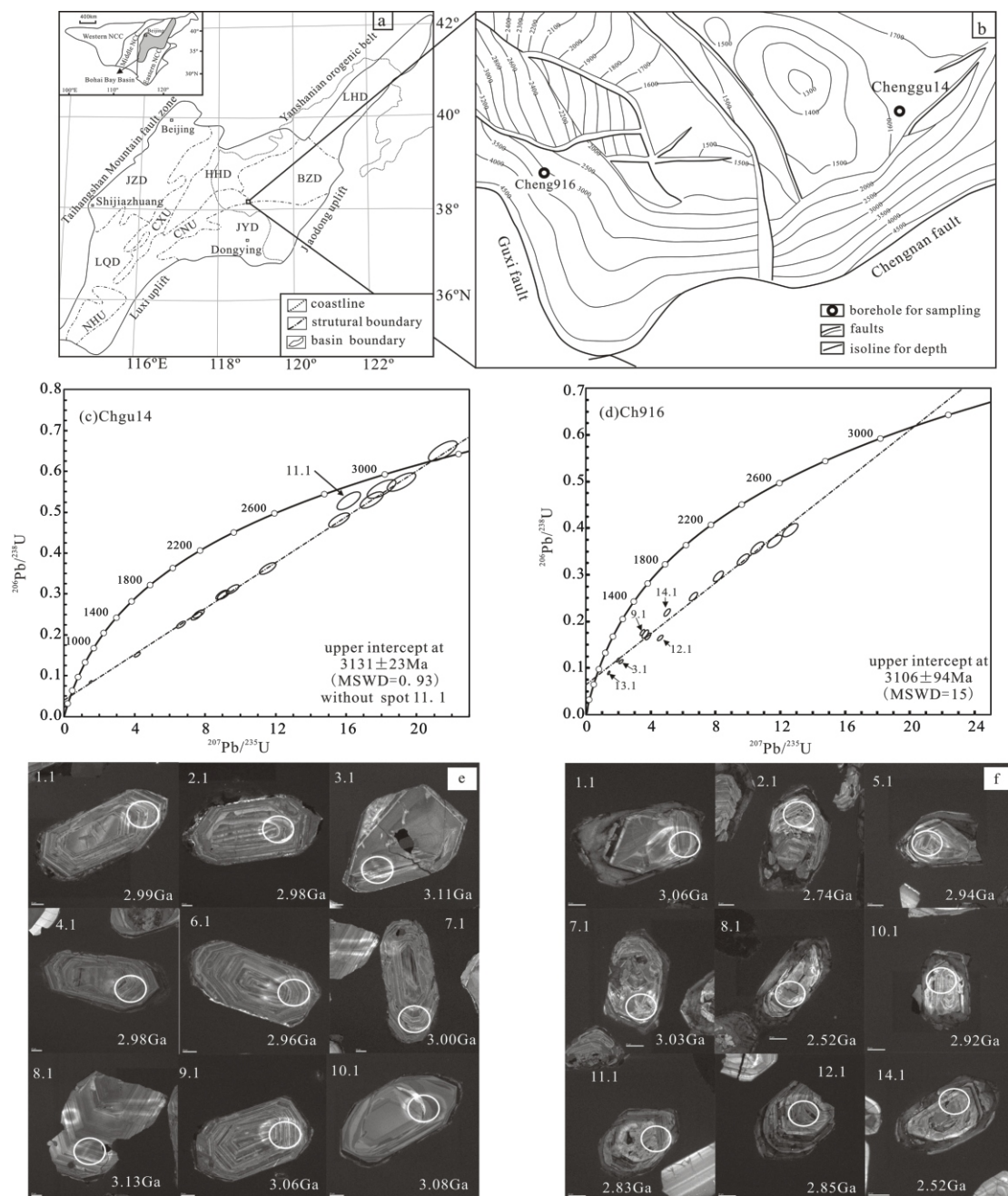


Fig. 1. (a) Geological sketch map of the North China Craton and structural units in the Bohai Bay Basin; (b) Top of the Archean structure and locations of boreholes for sampling in the Chengning uplift; (c) Concordia diagrams showing SHRIMP U-Pb data for zircons from gneissic tonalite (Chgu14); (d) Concordia diagrams showing SHRIMP U-Pb data for zircons from gneissic diorite (Ch916); (e) Representative cathodoluminescence (CL) images of zircons from sample Chgu14; (f) Representative cathodoluminescence (CL) images of zircons from sample Ch916
LQD-Linqing depression; JYD-Jiyang depression; JZD-Jizhong depression; HHD-Huanghua depression; LHD-Liaohu depression; BZD-Bozhong depression; NHU-Neihuang uplift; CXU-Cangxian uplift; CNU-Chengning uplift

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