岩石学报
ACTA PETROLOGICA SINICA

任荣,韩宝福,张志诚,李建锋,杨岳衡,张艳斌. 2011. 北京昌平地区基底片麻岩和中-新元古代盖层锆石U-Pb年龄和Hf同位素研究及其地质意义. 岩石学报, 27(6): 1721-1745

北京昌平地区基底片麻岩和中-新元古代盖层锆石U-Pb年龄和Hf同位素研究及其地质意义

作者	单位	E-mail
任荣	北京大学地球与空间科学学院 造山带与地壳演化教育部重点实验室,北京 100871	
韩宝福	北京大学地球与空间科学学院 造山带与地壳演化教育部重点实验室,北京 100871	bfhan@pku.edu.cn
张志诚	北京大学地球与空间科学学院 造山带与地壳演化教育部重点实验室,北京 100871	
李建锋	北京大学地球与空间科学学院 造山带与地壳演化教育部重点实验室,北京 100871	
杨岳衡	中国科学院地质与地球物理研究所 岩石圈演化国家重点实验室,北京 100029	
张艳斌	中国科学院地质与地球物理研究所 岩石圈演化国家重点实验室,北京 100029	

基金项目：本文受国家自然科学基金项目(J0730533)资助.

摘要：

本文通过对北京昌平地区燕辽裂陷槽内出露的基底密云群片麻岩及其上覆沉积盖层底部长城系常州沟组和顶部青白口系长龙山组砂岩的锆石LA-ICP-MS U-Pb年龄和Hf同位素组成的研究,对华北克拉通新太古代-元古宙期间的沉积与地壳演化进行探讨。锆石的LA-ICP-MS U-Pb年代学研究表明,密云群含辉石角闪斜长片麻岩的原岩形成时代为2500±8.4Ma。常州沟组下部层位的石英砂岩具有单峰式的碎屑锆石U-Pb年龄谱(峰值为2.50Ga),而长龙山组石英砂岩具有双峰式的碎屑锆石U-Pb年龄谱(峰值分别为2.50Ga和1.80Ga),这些锆石大多为岩浆成因锆石,指示 ~2.50Ga和 ~1.80Ga是华北克拉通岩浆活动广泛发育的两个时期。结合区域资料,常州沟组开始沉积的时间应在1.68~1.80Ga之间,长龙山组砂岩沉积应在1.36Ga之后。锆石Hf同位素研究表明,密云群片麻岩的锆石$\varepsilon_{Hf}(t)$值为+1.7~+4.9,介于球粒陨石和亏损地幔生长线之间,指示基底片麻岩可能是古老地壳与新生物质混合的结果。结合砂岩碎屑锆石的Hf同位素显示,新太古代晚期(~2.50Ga)华北克拉通以年轻地壳生长和古老地壳改造的同时存在为特征($\varepsilon_{Hf}(t)$=0~+7.9),而古-中元古代(~1.80Ga)主要表现为新太古代地壳物质的循环和改造($\varepsilon_{Hf}(t)<0$,$t_{DM2}<2.80$Ga),并且局部存在古-中太古代地壳物质的循环和改造($\varepsilon_{Hf}(t)_{min}$=-15.3,$t_{DM2}>3.00$Ga)。$\varepsilon_{Hf}(t)$的这种变化特征与华北克拉通岩石圈地幔在古-中元古代期间随时间变新而逐渐富集的演化趋势基本一致。现有资料进一步指示,中-新元古代盖层碎屑锆石的年龄分布及沉积演化与裂谷作用紧密相关。常州沟组下部地层沉积于初始裂谷阶段,仅简单地以 ~2.50Ga的基底岩石为源区。但随着裂谷作用的发展,在常州沟组上部地层沉积时,物源已经开始发生明显变化,具有显著的古-中元古代组分(~1.80Ga)的加入,而长龙山组则含有更多的古-中元古代物质。整体上,在中-新元古代地层中,~1.80Ga的年轻物质所占比例具有随着地层变新而逐渐升高的趋势。

英文摘要：

Zircon LA-ICP-MS U-Pb and Hf isotopic studies of the Neoarchean basement gneiss of the Miyun Group and overlying Meso-Neoproterozoic sandstones of the Changzhougou Formation of the Changcheng System and Changlongshan Formation of the Qingbaikou System from the Yan-Liao aulacogen in the Changping area, Beijing, are carried out in order to investigate the sedimentary and crustal evolution of the North China Craton (NCC). Zircon U-Pb dating on a pyroxene-bearing hornblende-plagioclase gneiss yields a protolith age of 2500±8.4Ma for the basement gneiss. A quartz sandstone sample from the lower part of the Changzhougou Formation is characterized by a unimodal spectrum of detrital zircon ages, with a peak age of ca. 2.50Ga, and this is in contrast with a bimodal age spectrum of a quartz sandstone sample from the Changlongshan Formation, with peak ages of ca. 2.50Ga and 1.80Ga, respectively. These results, mostly yielded on oscillatory zoned domains, reveal two distinct magmatic pulses in the NCC during the Neoarchean and Paleoproterozoic times. Combined with regional data, the Changzhougou Formation had its first sediments at 1.68~1.80Ga, and the Changlongshan Formation was deposited after 1.36Ga. The basement gneiss has zircon $\varepsilon_{Hf}(t)$ values of +1.7~+4.9, intermediate between the chondrite and depleted mantle growth lines, implying a mixture of old and juvenile materials. This, combined with detrital zircon Hf isotopes of the sandstones, indicates that the Late Neoarchean (~2.50Ga) is characterized by simultaneous occurrence of juvenile crustal growth and old crustal reworking ($\varepsilon_{Hf}(t)$=0~+7.9), while the Paleo-Mesoproterozoic (~1.80Ga) is dominated by recycling and reworking of the Neoarchean crust with $\varepsilon_{Hf}(t)$ <0 and t_{DM2}<2.80Ga, locally with involvements of the Paleo-Mesoarchean materials with $\varepsilon_{Hf}(t)_{min}$=-15.3 and t_{DM2}>3.00Ga. This is consistent with gradual enrichment of the lithospheric mantle of the NCC with the decreasing time during the Paleo-Mesoproterozoic. The available data further suggest that the age distribution and sedimentary evolution of the Meso-Neoproterozoic sedimentary rocks are closely related to the rifting process. The lower part of the Changzhougou Formation was deposited during the initial rifting stage and thus had a simple provenance of ~2.50Ga basement rocks. As the rifting developed, the provenance for the upper part of the Changzhougou Formation includes both of the basement and Paleo-Mesoproterozoic rocks, and the Changlongshan Formation contains more Paleo-Mesoproterozoic components, showing an increasing trend of the younger components in the Meso-Neoproterozoic sedimentary rocks from bottom to top.

关键词：华北克拉通 前寒武纪 燕辽裂陷槽 碎屑锆石 沉积与地壳演化

投稿时间： 2010-07-14 最后修改时间： 2011-03-11