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华北克拉通基底主要构造单元变质作用演化及其若干问题讨论

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摘要:

华北克拉通基底可分为三个太古宙微陆块(东部陆块、阴山陆块和鄂尔多斯陆块)和三个早元古宙活动带(孔兹岩带、华北中部带和胶-辽吉带)。这些构造单元具有不同的变质作用时间和 $P-T$ 演化特征。东部陆块和阴山陆块晚太古宙基底岩系的变质作用发生在 $\sim 2.5\text{Ga}$, 变质演化以等压冷却(IBC)逆时针 $P-T$ 轨迹为特征, 反映变质作用的成因与大规模地幔岩浆底侵有关。孔兹岩带主期变质作用发生在 $\sim 1.95\text{Ga}$, 变质演化以近等温减压(ITD)顺时针 $P-T$ 轨迹为特征, 反映阴山陆块与鄂尔多斯陆块碰撞形成西部陆块的热构造过程。华北中部带变质作用发生在 $\sim 1.85\text{Ga}$, 变质演化同样以近等温减压(ITD)顺时针 $P-T$ 轨迹为特征, 反映了西部陆块和东部陆块最终碰撞形成统一的华北克拉通基底的构造过程。元古宙胶-辽-吉带变质作用表现“双变质带”特征: 西北带的北辽河群、老岭群和粉子山群的变质作用以中压顺时针 $P-T$ 轨迹为特征, 而东南的南辽河群、吉安群和荆山群的变质作用以低压逆时针 $P-T$ 演化为特征。华北克拉通基底变质作用演化地质图能更好地反映上述不同构造单元的变质作用演化特征。尽管岩浆弧、大陆裂谷和地幔柱模式都能解释东部陆块晚太古宙基底变质作用所具有的近等压冷却(IBC)逆时针 $P-T$ 演化特征, 地幔柱模式能够更合理解释东部陆块所存在的宽达800千米而时代近于相同的晚太古代火成岩带、大量科马提质超镁铁质岩石和双式火山岩、广泛发育的穹窿构造等。华北克拉通变质基底中具有石榴石-单斜辉石-斜长石-石英组合的高压基性麻粒岩和具有蓝晶石-钾长石组合的高压泥质麻粒岩的出露只局限在早元古宙华北中部带的北段和胶-辽-吉带的南端; 这些高压麻粒岩形成在俯冲和陆-陆碰撞的构造环境中。西部陆块孔兹岩带含假蓝宝石麻粒岩是碰撞后($\sim 1.92\text{Ga}$)拉伸引发地幔岩浆底侵导致局部地带发生超高温(UHT)变质作用的产物。

英文摘要:

The basement of the North China Craton consists of three micro-continental blocks (Eastern Block, Yinshan Block and Ordos Block) and three Paleoproterozoic mobile belts (Khondalite Belt, Trans-North China Orogen and Jiao-Liao-Ji Belt). These tectonic units are distinctly different in metamorphic time and $P-T$ evolution. Metamorphism of the Late Proterozoic basement rocks in the Eastern and Yinshan Blocks occurred at $\sim 2.5\text{Ga}$, characterized by anticlockwise $P-T$ paths involving isobaric cooling, suggesting the origin of the metamorphism related to the underplating of numerous mantle-derived magmas. The major metamorphic event of the Khondalite Belt occurred at $\sim 1.95\text{Ga}$, and its metamorphic evolution is characterized by clockwise $P-T$ paths involving near-isothermal decompression, which is interpreted as a result of collision between the Yinshan and Ordos Block to form the Western Block. The metamorphism of the Trans-North China Orogen occurred at $\sim 1.85\text{Ga}$, and is also characterized by clockwise $P-T$ paths involving near-isothermal decompression, reflecting the final amalgamation of the united Western Block and the Eastern Block to form the coherent basement of the North China Craton. The metamorphism of the Paleoproterozoic Jiao-Liao-Ji Belt is featured by paired metamorphic zones of which the northwestern zone consists of the North Liaohe, Laoling and Fenzishan groups, metamorphism of which is characterized by medium-pressure-type clockwise $P-T$ paths, whereas the southeastern zone consists of the South Liaohe, Ji'an and Jingshan groups, metamorphism of which is characterized by low-pressure-type anticlockwise $P-T$ paths. Compared with the traditional 1:4,000,000 metamorphic map of China published in 1986, the newly compiled metamorphic evolution map of the North China Craton can be better used to reflect metamorphic histories of different tectonic units in the craton. Although magmatic arc, continental rifting and mantle plume models can all be applied to interpretations of the metamorphism of the Eastern Block with IBC-type anticlockwise $P-T$ paths, the mantle plume model is favored because it can reasonably explain the presence of an 800km wide igneous province in which all rocks were nearly simultaneously emplaced at 2.60–2.50Ga, numerous komatiites or komatiitic rocks, banded volcanic rocks, domiform structures, etc. In the North China Craton, the exposures of typical high-pressure basic granulites with garnet-clinopyroxene-plagioclase-quartz assemblage and high-pressure pelitic granulites with kyanite-feldspar assemblage are only restricted to the northern segment of the Trans-North China Orogen and the southern segment of the Jiao-Liao-Ji Belt, and their formation was related to subduction and collision operative in these Paleoproterozoic mobile belts. The local ultrahigh temperature (UHT) metamorphism with anticlockwise $P-T$ paths in the Khondalite Belt, represented by sapphirine granulites in the Daqingshan and Jining Complexes, most likely resulted from underplating of mantle-derived magmas during the post-collisional extension at $\sim 1.92\text{Ga}$, as indicated by the sapphirine granulites which are always in direct contact with $\sim 1.92\text{Ga}$ basic dykes.

关键词: [太古宙](#) [早元古宙](#) [华北克拉通](#) [变质作用](#) [P-T轨迹](#) [地幔柱](#) [陆-陆碰撞](#)

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