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山东半岛早前寒武纪高级变质基底中超镁铁质岩的成因

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摘要:

山东半岛早前寒武纪高级变质基底广泛出露超镁铁质岩,它们呈大小不等的透镜体产于TTG片麻岩中,且与基性高压麻粒岩密切“伴生”。岩相学和矿物相转变分析、温压条件估算以及锆石原位U-Pb定年结果表明,山东半岛超镁铁质岩记录了十分复杂的演化历史,其中早期残留的原岩标志性的矿物组合(M<sub>1</sub>)以尖晶石(富Mg)+橄榄石(富Mg)+斜方辉石(富Mg)为特征,相应的岩浆结晶温压条件T=980~1050℃、P=1.55~1.65GPa;峰期高压麻粒岩相变质阶段(M<sub>2</sub>)的典型的矿物组合以尖晶石(富Fe)+橄榄石(富Fe)+斜方辉石(富Fe)为特征,相应的温压条件T=840~880℃、P=1.40~1.55GPa,此阶段形成的变质锆石记录的高压麻粒岩相变质时代为1858~1877Ma;峰后中低压角闪-麻粒岩岩相退变质阶段(M<sub>3</sub>)的矿物组合以斜方辉石+单斜辉石+橄榄石+角闪石(富(Na+K))+尖晶石+磁铁矿(富Cr)为特征,相应的温压条件T=760~820℃、P=0.55~0.65GPa,此阶段形成的变质锆石记录的退变质时代为1820~1840Ma;晚期低角闪岩相-绿片岩相变质阶段(M<sub>4</sub>),以形成角闪石(贫(Na+K))+磁铁矿(贫Cr)+蛇纹石±绿泥石±金云母的矿物组合为特征,相应的温压条件T=500~600℃、P=0.32~0.40GPa。超镁铁质岩的变质演化具有典型碰撞造山带顺时针P-T-t轨迹,指示山东半岛超镁铁岩是古老陆块之间碰撞造山的产物。该项成果对于进一步深入探讨华北克拉通东南缘早前寒武纪古老陆块的碰撞-拼贴及其演化的动力学过程具有重要科学意义。

英文摘要:

The ultramafic rocks as enclaves are widespread distributed in TTG gneisses from the Early Precambrian metamorphic high-grade basement of Shandong Peninsula, SE North China Craton (NCC). A combined study of petrography, mineral transformation, temperature-pressure estimation and in situ U-Pb dating of zircons provided insight into the evolutionary history of ultramafic rocks. In general, the relict minerals of olivine (Mg-rich)+orthopyroxene (Mg-rich)+spinel (Mg-rich) are identified as the early magmatic mineral assemblage of protolith (M<sub>1</sub>), which formed at 980~1050℃ and 1.55~1.65GPa. In contrast, the high-pressure (HP) granulite-facies mineral assemblage (M<sub>2</sub>), such as olivine (Fe-rich)+orthopyroxene (Fe-rich)+spinel (Fe-rich) is identified in the matrix of ultramafic rocks, yielding 840~880℃ and 1.40~1.50GPa. The metamorphic zircons formed at this stage record HP granulite-facies metamorphic ages of 1858~1877Ma. The middle- and low-pressure (MLP) amphibolite-granulite facies mineral assemblage for the post-peak retrogressive stage (M<sub>3</sub>), however, is mainly comprised by orthopyroxene, clinopyroxene, olivine, amphibole ((Na+k)-rich), spinel and magnetite (Cr-rich), which formed at 760~820℃ and 0.55~0.65GPa. The metamorphic zircons crystallized at this stage record retrogressive ages of 1820~1840Ma. The amphibolite- and greenschist-facies mineral assemblage for the late cooling stage (M<sub>4</sub>) is characterized by amphibole ((Na+k)-poor)+magnetite (Cr-poor)+serpentine±chlorite±phlogopite with P-T conditions of 500~600℃ and 0.32~0.40GPa. The clockwise P-T-t path for the ultramafic rocks indicates that the Early Precambrian high-grade metamorphic basement in Shandong Peninsula, SE North China Craton experienced a collisional orogenic process during Paleoproterozoic. This new result has very important significance for deeply discussing the geodynamic model of crust thickening followed by lifting in a continent-continent collisional orogen of North China Craton.

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