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# 大陆造山带岩石圈拆沉过程的数值模拟

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# Numerical simulation of lithosphere delamination at the continental orogenic belts

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**摘要** 岩石圈拆沉作用是指部分岩石圈由于重力不稳定性而沉入软流圈中的过程,与造山带的演化密切相关.本文基于非牛顿流体近似的有效黏度模型对岩石圈拆沉的过程进行了数值模拟,着重分析了岩石圈的黏度结构对拆沉作用的影响.数值模拟显示,下地壳控制着地壳与岩石圈地幔的耦合程度,对拆沉作用的过程和形态有很大的影响;在一定的初始重力不稳定性条件下,当岩石圈地幔相关的有效黏度在$10^{22}$~$10^{24}$Pa·s时,拆沉作用有可能在5~30 Ma时间范围内发生.从拆沉的形态看,在上述岩石圈地幔有效黏度范围内,黏度越大,重力不稳定性发展越慢,岩石圈剥离(peel away)范围越大.从拆沉的结果看,当拆沉块体与上部岩石圈完全断离时,造山带完成了从挤压构造到伸展构造的转化过程.最后,结合秦岭—大别—苏鲁造山带的岩浆事件和构造演化,讨论了岩石圈拆沉在该地区的应用.

**关键词:** 拆沉 非牛顿流体 对流减薄 有效黏度 剥离

Abstract: Lithosphere delamination is a geodynamic process that part of lithosphere sinks into the asthenosphere because of its gravity instability. Based on Non-Newtonian fluid approximation, we perform numerical simulation of lithosphere delamination, and the effects of the lithospheric viscosity structure on this process are analyzed emphatically. Our numerical simulations show that: The lower crust plays an important role in the process and pattern of lithosphere delamination as its viscosity controls the degree of coupling between crust and mantle lithosphere; With certain initial gravity instability condition, when the effective viscosity of surrounding mantle lithosphere is between $10^{22}$~$10^{24}$Pa·s, the delamination process may take place within a short time period from 5 Ma to 30 Ma. The lithosphere delamination also shows different patterns with different viscosity structures. Within a suitable viscosity range($10^{22}$~$10^{24}$Pa·s), the higher the viscosity is, the slower the gravity instability develops, and so, the larger area of lithosphere would peel away and sink. As a result of lithosphere delamination, the orogenic belt transforms from compressive tectonic regime to extensional tectonic regime once the delamination slab detaches completely from the upper lithosphere. At last, the possible lithosphere delamination at Qinlin-Dabie-Sulu orogenic belts and its effect on the igneous activity and tectonic evolution are discussed.

Keywords: Delamination Non-Newtonian fluid Convective thinning Effective viscosity Peel away

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