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数值模拟华北克拉通岩石圈减薄的一种可能机制 ——下地壳榴辉岩重力失稳引起的拆沉

乔彦超<sup>1,2</sup>, 郭子祺<sup>1</sup>, 石耀霖<sup>2\*</sup>

1. 中国科学院遥感应用研究所, 北京 100101;
2. 中国科学院研究生院, 北京 100039

Numerical simulation of a possible thinning mechanism of the North China Craton —Gravitational instability delamination induced by lower crust eclogite

QIAO Yan-Chao<sup>1,2</sup>, GUO Zi-Qi<sup>1</sup>, SHI Yao-Lin<sup>2\*</sup>

1. Institute of Remote Sensing Application Chinese Academy of Science, Beijing 100101, China;
2. Graduate University Chinese Academy of Sciences, Beijing 100049, China

摘要

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摘要

通过数值模拟研究, 论证了中生代华北克拉通岩石圈受挤压, 下地壳玄武岩相变为密度较大的榴辉岩, 榴辉岩重力失稳能够引起下地壳的拆沉, 造成岩石圈的大规模减薄的可能性。通过对比不同规模的榴辉岩减薄方式发现, 当榴辉岩规模较大时可能发生双管道拆沉, 而规模小时发生单管道拆沉。计算结果表明当榴辉岩的水平尺度为100 km, 200 km, 300 km时, 岩石圈拆沉减薄后厚度分别可达92 km, 105 km, 136 km。对比中生代华北克拉通岩石圈热侵蚀减薄和拆沉减薄机制, 从力学机制上都能造成岩石圈减薄, 但它们的结果对应着不同的地表地质特征。热对流减薄, 中心区域变热变薄, 中心区域是一个伸展区域, 发展一个大的变质核杂岩区, 岩浆的发展时序是从中心向两侧对称分布, 并且向两侧减弱拆沉减薄结果中, 中心区域受到挤压加厚, 反而变冷。在中心区域的两侧发生两个减薄伸展区域, 可能对应两个变质核杂岩区域, 岩浆的发展时序是从两侧向中心减弱发展。

关键词 华北克拉通, 岩石圈减薄, 拆沉, 榴辉岩

Abstract:

We carried out numerical simulation to show the possibility that basalt in the thickened lithosphere may subject to phase transition and produce eclogite extensively in the lower crust, the eclogite of high density then may induce gravitational instable delamination, resulting in the thinning of North China Craton lithosphere. The extent of eclogite affects the mode of delamination. Large width of eclogite coverage tends to induce two-channel delamination, while small scale of eclogite can produce a single sinking channel only. The results show when the width of eclogite is 100 km, 200 km, and 300 km, the lithosphere thickness is 92 km, 105 km, and 136 km, respectively after delamination thinning. The different bottom temperature influences are small compared to the eclogite gravity instability. Numerical simulation suggests that both thermal convection and delamination are possible cause of the North China Craton thinning, but they have different geological consequences which may be recognized on the earth surface. Thermal convection is characterized by a heated and thinned central extension area of metamorphic core complex, with magmatism beginning from the central area and expanding to both sides; while single channel delamination is characterized by a central area of compression of thickened and cold crust, with two extension areas of core complex beside the central zone, and the magmatism develops from both sides of the central zone, but not at the central zone.

Keywords North China Craton, Lithosphere thinning, Delamination, Eclogite

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About author: 乔彦超,男,吉林省吉林市人,1985年生,助理研究员,研究方向:岩石圈变形的数值模拟,E-mail:oliver.qiao@gmail.com

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