

地球动力学★地震学★地磁学

热-流-固耦合方法模拟岩石圈与软流圈相互作用

陈建业^{1,2}, 杨晓松¹, 石耀霖²

1 中国地震局地质研究所地震动力学国家重点实验室, 北京 100029

2 中国科学院研究生院, 北京 100049

收稿日期 2008-8-19 修回日期 2009-2-18 网络版发布日期 2009-4-20 接受日期

摘要 岩石圈和软流圈的相互作用是现今地球动力学研究的热点问题之一. 本文针对岩石圈与软流圈的相互作用模型, 开发了新的基于热-流-固三场耦合方法的有限元程序. 岩石圈变形和对流的地幔之间的耦合方式为: 地幔在热驱动(或运动岩石圈的拖曳)下产生对流, 对流的地幔对耦合边界施加载荷并造成岩石圈的变形, 变形的岩石圈反作用于软流圈从而影响其地幔对流的状态. 温度场根据速度场和网格变形的结果适时调整, 如此反复推动整个系统的演化. 利用该耦合方法模拟了“地幔柱作用下地表隆升”地质过程, 其结果与实际地质资料和地质认识能很好的吻合, 验证了该方法模拟地幔与软流圈相互作用过程的有效性 & 处理复杂耦合问题的能力.

关键词 [地幔对流](#) [岩石圈-软流圈相互作用](#) [热-流-固耦合](#) [数值模拟](#)

分类号 [P541](#)

DOI: [10.3969/j.issn.0001-5733.2009.04.010](#)

A coupled thermal-fluid-solid approach for modeling the lithosphere-asthenosphere interactions

CHEN Jian-Ye^{1,2}, YANG Xiao-Song¹, SHI Yao-Lin²

1 State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China

2 Graduate University of Chinese Academy of Sciences, Beijing 100049, China

Received 2008-8-19 Revised 2009-2-18 Online 2009-4-20 Accepted

Abstract Lithosphere-asthenosphere interaction is now one of the hot issues in geodynamics. In order to model the interaction between lithospheric deformation and asthenosphere convection, a coupled thermal-fluid-solid approach is proposed and the corresponding finite element codes are developed. This new method avoids the deficiencies of pure mantle convection or pure solid mechanical systems. This approach describes the lithosphere-asthenosphere interactions, including the mantle movement driven by thermal heterogeneity (and/or dragged by the moving plate), the deformation of lithosphere caused by exerting force induced by the convective mantle on coupled boundary, the responses of mantle convection in shape to the deformed lithosphere. The multiple interrelated processes promote the evolution of lithosphere-asthenosphere system. This approach is used to simulate "topography uplift under a mantle plume" and the results are consistent to geological reality and conventional cognition, certifying its validity and capability to deal with complex coupled issues.

Key words [Mantle convection](#); [Lithosphere-asthenosphere interaction](#); [Thermal-fluid-solid coupling](#); [Numerical simulation](#)

通讯作者:

陈建业 chenjianye01002132@gmail.com

作者个人主页: 陈建业^{1,2}; 杨晓松¹; 石耀霖²

扩展功能

本文信息

▶ [Supporting info](#)

▶ [PDF \(4403KB\)](#)

▶ [\[HTML全文\] \(0KB\)](#)

▶ [参考文献](#)

服务与反馈

▶ [把本文推荐给朋友](#)

▶ [加入我的书架](#)

▶ [加入引用管理器](#)

▶ [引用本文](#)

▶ [Email Alert](#)

▶ [文章反馈](#)

▶ [浏览反馈信息](#)

相关信息

▶ [本刊中包含“地幔对流”的相关文章](#)

▶ 本文作者相关文章

• [陈建业](#)

•

• [杨晓松](#)

• [石耀霖](#)