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瑞利数对热对流的影响——在地幔柱中的应用

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The influence of Rayleigh number on thermal convection ——application to mantle plume

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摘要 本文分别在直角坐标系和柱坐标系下,研究瑞利数从10^4逐渐增大到10^7对热对流的影响,数值计算结果表明:瑞利数越大,地幔柱越窄,地幔柱上升速度也越快;源自上地幔的地幔柱半径的范围为90到210 km.根据峨眉山内带的半径推算出地幔的黏性系数约为3.8×10^{21} Pa·s,地幔柱平均流动速度为2.5 cm/a.

关键词: 瑞利数 热对流 热边界层 地幔柱半径 峨眉山

Abstract: In this paper, we simulate increasing Rayleigh number from 10^4 to 10^7 to observe its influence on thermal convection in Cartesian and cylindrical coordinate respectively. The numerical examples prove that the range of radius of mantle plume is from 90 to 210 kilometer and the larger the Rayleigh number, the narrower and faster the mantle plume. Our results suggest that the viscosity of mantle is about 3.8×10^{21}Pa·s and the speed of mantle plume is about 2.5 cm/a, according to the radius of Inner Zone of Emeishan mantle plume.

Keywords: Rayleigh number Thermal convection Thermal boundary layer Radius of mantle plume Emeishan

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