

WANG Xinguo and William E. HOLT, 2013. Stress Fields in the Lithosphere for the Mantle Convection (S40RTS) with Varying Viscosity. *Acta Geologica Sinica* (English Edition), 87(supp.): 159.

Stress Fields in the Lithosphere for the Mantle Convection (S40RTS) with Varying Viscosity

WANG Xinguo^{1,2,3} and William E. HOLT³

1 Key Laboratory of Continental Collision and Plateau Uplift, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China

2 State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing 100083, China

3 Department of Geosciences, Stony Brook University, Stony Brook, NY 11794, USA

Stress fields (shear tractions) in the mantle (depth 100km) are studied in the degree-40 shear-velocity model (S40RTS) of mantle convection with variable radial viscosity. The calculations are carried out for six different structures of the radial viscosity: (a) an iso-viscous model of (10^{21} Pa*s); (b) a viscosity in the upper mantle two orders of magnitude smaller than in the lower mantle (0-660km, 10^{21} Pa*s; 660-2890km, 10^{23} Pa*s); (c) a three-layer viscosity (the first layer: 0-100km, 10^{23} Pa*s; the second layer: 660-1750km, 10^{22} Pa*s; the third layer: 1750-2890km, 10^{23} Pa*s), (d) a four-layer viscosity (the first layer: 0-660km, 10^{21} Pa*s; the second layer: 660-1750km, 10^{22} Pa*s; the third layer: 1750-2890km, 10^{23} Pa*s; the four layer, 10^{21} Pa*s); (e) a three-layer viscosity (the first layer: 0-100km, 10^{23} Pa*s; the second layer: 100-660km, 10^{21} Pa*s; the third layer: 660-2890km, 10^{23} Pa*s); and (f) another three-layer viscosity (the first layer: 0-100km, 10^{23} Pa*s; the second layer: 100-660km, 10^{20} Pa*s; the third layer: 660-2890km, 10^{23} Pa*s). The results show that the former four models (a, b, c, d) have similar stress patterns, but distinctly different from the latter two models (e, f). The similarity of stress patterns for the former four models (a-d) indicates that the lower mantle viscosity does not have a strong control on the patterns of stress. That is, the structure of the radial viscosities for the first four models is different in the lower mantle but the

same in the upper mantle. The differences between the former four cases (a-d) and the latter two cases (f and g) further shows that a lower viscosity channel, sandwiched between a strong lithosphere and strong lower mantle, has a significant influence on the pattern of stress. More models will be investigated to further test the influence of the upper mantle low viscosity channel along with the role of lower mantle viscosity structure. Because of the importance of these processes for impacting lithospheric stress and plate motions, constraining the sensitivity to radial viscosity structure is an important problem in geodynamic studies.

Key words: seismic tomography, mantle convection, stress field, radial viscosity

References

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* Corresponding author. E-mail: wxg@itpcas.ac.cn