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The role of variable viscosity in the modeling of global stress fields in the Earth's mantle and in floating continents

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In numerical two-dimensional experiments we investigate the evolution of spatial field of viscous over lithostatic horizontal stresses in the mantle and in moving continent. A continent moves self-consistently with the time-varying mantle forces which act from viscous mantle. A continent is modeled by the set of numerous markers, which transfer the high viscosity area. We compare two model laws for viscosity: the first, simplest variant - isoviscous mantle case; and the second, exponential p,T-dependent viscosity case. For these two models we analyze how a form of viscosity law in the mantle can change the horizontal stress fields in the mantle and continent and the stress evolution in the course of movement of a continent. Inclusion of variable viscosity gives the possibility to take into account, in given framework of purely viscous statement, the presence of oceanic lithosphere and the difference in viscosity values of upper and lower mantle. It is found at 10^7 Rayleigh number that the horizontal tensile stresses observed at the initial stages (above ascending mantle flow) are succeeded by the compressive stresses, especially at the leading continental edge (up to 40 Mpa when the continent thrusts onto subduction zone). It is obtained also that the distribution of horizontal stresses along the continent distinctly points to the locations of upward and downward flows in the subcontinental mantle. The stresses in the major portion of the mantle are in the range plus minus 5 MPa (50 bars). This work was supported by the Russian Foundation for Basic Research, Project No. 09-05-00319-a.