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Mechanisms of Direct Transformation of Radial Tidal Deformations into Long Differential Motion of Planetary Layers

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Two mechanisms of direct transformation of radial tidal deformations into long differential motions of planetary substance were considered. The first one is a "complex loading of a granular substance"; the second mechanism is a "peristaltic motion of viscous substance". The following mechanical models were investigated: complex loading of a granular substance with a continuously rotating tensor deformation axes in two and three dimensional domains, and peristaltic motion of a viscous Newtonian material in a circular domain, imitating the tidal deformations in a planet. The other mechanical models considered are: peristaltic motion of a viscous Newtonian liquid in a plane channel, and peristaltic motion of a granular substance in a plane channel. Corresponding differential equations of motion were written, and numerical solutions were obtained. Rates of lateral displacements were estimated for amplitudes and deformation rates of the solid Earth tides. It was shown that "complex loading", and "peristaltic motion" can be considered as actual mechanisms of direct transformation of tidal deformations of a planet into a long, differentiated by rate, lateral displacements of planetary shells, such as the westward drift of the lithosphere and currents in the Earth's outer core. It is shown that dissipation of mechanical energy due to differential motion of layers can be a significant source of internal heating which can be transformed into other geodynamic events and processes.