Abstract

The unusually large thickness of the Tibetan Plateau generates lateral variations of gravitational potential energy per unit area (GPE). Thinning of the crust is caused by gravitational collapse. The gravitational collapse is thought to have started approximately 10 to 15 Ma ago. If current deformation rates are assumed constant since 10 to 15 Ma, then the crust would have thinned by approximately 5.5 to 8.5 km until today (**?**). Due to mass conservation, thinning of the crust implies horizontal spreading of the plateau towards the lower altitude surroundings. This spreading is documented by GPS velocities on the order of 2 cm/yr around the Tibetan plateau. The crustal flow of the Tibetan Plateau also generates differential stresses in and around the plateau.

To quantify the three-dimensional (3D) stress field in and around the Tibetan Plateau, we develop a new thermo-mechanical algorithm based on an Eulerian pseudo-transient finite difference method. The pseudo-transient approach allows an explicit solution of the Stokes equations. When the pseudo-transient time derivatives approach zero, a steady-state solution is obtained. We also use a pseudo free-surface method in which the topography represents vertical stresses, that are implemented as normal-stress boundary conditions on the flat top boundary of the Eulerian grid. Different initial setups are used in pseudo-2-D and 3-D. Real data geometry and density field are defined by **?** for pseudo-2-D and come from the CRUST1.0 dataset in 3-D.

The stress magnitudes are quantified, and regions of compression, extension and strike-slip deformation are identified. The stress magnitudes calculated by our 3D model are also compared with 2D model calculations applied to cross sections from India into Tibet.

Key words: Stress field, Tibetan Plateau, GPE variations, gravitational flow, 3-D modelling