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Finite Element Simulation of Impact of Soft Lower Crust on the Uplift and Movement of Tibetan Plateau

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The Tibetan plateau is the most spectacular geologic feature of our planet at present time. Two end-members of model have been proposed to explain the uplift of the Tibetan Plateau. One end-member suggests that regional deformation is distributed through a continuously deforming viscous sheet; the other interprets deformation as constrained by slip on major discontinuities at the lithospheric scale. The rheology of the plateau is, however, much more complex than the simple end-members. The plateau is characterized by a complex rheological structure: an extreme ductile lower crust being sandwiched by the strong upper crust and upper mantle lithosphere. We investigate the deformation of plateau with such structure. Maxwell model is employed. Our primary calculation shows that the ductile lower crust plays an important role in the active tectonics of the plateau. Unlike the viscous sheet model, in which uplift first occurs at the south boundary and gradually advances to the north, in our Maxwell model with ductile lower crust, the entire plateau uplifts as a whole under the India plate's indentation, in agreement with the geological observations. The model also shows that the ductile lower crust flow horizontally northeast ward and eastward beneath the main plateau and turns to southeastward beneath the southeastern plateau, drag the upper crust to move differentially cut by a number strike slip faults and to produce an overall clockwise rotation around the eastern Himalayan Syntax, as revealed by GPS measurements. The east-Himalayan syntax is a location of stress concentration, and uplifts at very fast rate. Ecolgite has been found in the area. The model suggests that horizontal velocities vary in different rheological layers. The mantle asthenosphere moves most fast, and the upper crust most slow. The basal shear from the ductile lower layer to the brittle upper crust may be responsible for the extensional features of the plateau.