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A tool for 3D numerical modeling of lithospheric deformation with elasto-visco-plastic rheology.

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Numerical modeling is a powerful tool for studying lithospheric deformation. It can take into account extreme strains, presence of both brittle and ductile flow regimes, wide range of length scales and many other complexities. Currently, however, there are very few tools in geodynamical modeling community capable to handle lithospheric deformation with realistic elasto-visco-plastic rheology in 3D. Their development and application is essentially in progress.

In this presentation we describe our own numerical tool (SLIM3D) for three-dimensional lithospheric-scale modeling of solid state deformation including strain localization processes. Code includes coupled thermo-mechanical treatment of deformation process and allows elasto-visco-plastic rheology with diffusion, dislocation and Peierls creep mechanisms and Mohr-Coulomb plasticity. We present certain aspects of physical model as well as details of numerical implementation. Applicability of the code to lithospheric-scale modeling is demonstrated by a number of benchmark problems including triaxial compression test, initiation of shear bands in brittle crust and lithospheric transpressional deformation. Finally we discuss possible directions of further development of our technique and demonstrate its application to geological evolution of San Andreas Fault System in central and northern California.