*NASA/CR-97-* 205786

**Proposal Title:** Mechanics of Lithosphere Deformation
**Principal Investigator:** Maria T. Zuber
**Grant:** NAG5-2223

## Objective

The objective of this study was to perform theoretical modeling of mechanical deformation of the Earth's lithosphere making use of analytical solutions as well as numerical computer simulations.

## Accomplishments

Our work during the funding period encompassed the development of theoretical solutions, numerical models and experiments to ascertain the response of the lithosphere to vertical and horizontal loading forces. Our accomplishments are best represented by the publications (listed below) that were produced during the funding period. Specific accomplishments include:

- Development of a formalism to predict the manner of faulting and fracture around volcanic surface loads on an elastic lithosphere by incorporation of tensile and shear failure criteria into previous models of lithospheric loading.

- Experimental verification of the above theory.

- Assessment of deformation mechanisms in the Tibetan plateau.

- Development of a formalism for macroscale localization of faulting in a rifting lithosphere.

- Analysis of the geoid signatures in fracture zones and assessment of implications for the thermal structure of oceanic lithosphere.

- Analysis of numerical models of finite amplitude folding of oceanic lithosphere as applied to intraplate seafloor in the Central Indian Ocean.

- Development of a model for the formation of mountain belt-fringed plateaus by synamic shortening of a variable thickness crust or lithosphere.

- Development of a formalism for the growth of extensional instabilities in a cooling lithospheric plate.

## Refereed Publications

Schultz, R.A., and M.T. Zuber, Observations, models and mechanisms of failure of surface rocks surrounding planetary surface loads, *J. Geophys. Res.,* *99,* 14,691-14,702, 1994.

Zuber, M.T., Folding a jelly sandwich, *Nature, 371,* 650-651, 1994.

Richardson, W.P., S. Stein, C. Stein, and M.T. Zuber, Fracture zone geoid data and the thermal structure of oceanic lithosphere *Geophys. Res. Lett.*, *22*, 1913-1916, 1995.

Neumann, G.A., and M.T. Zuber, A continuum approach to the development of normal faults, *Proc. 35th US Symposium on Rock Mechanics*, ed. J.J.K. Daemen and R.A. Schultz, 191-198, 1995.

Williams, K.K., and M.T. Zuber, An experimental study of incremental surface loading of an elastic plate: Application to volcano tectonics, *Geophys. Res. Lett.*, *22*, 1981-1984, 1995.

Zuber, M.T., and E.M. Parmentier, Formation of fold and thrust belts on Venus by thick-skinned deformation, *Nature, 377,* 704-707, 1995.

Zuber, M.T., and E.M. Parmentier, Finite amplitude folding of a continuously viscosity-stratified lithosphere, *J. Geophys. Res., 101,* 5489-5498, 1996.

Neumann, G.A., and M.T. Zuber, Diffuse extension and lithospheric boudinage, to be submitted to *J. Geophys. Res.,* 1997

Jin, Y., M.T. Zuber and M. McNutt, Deformation of Tibet by viscous lithospheric modeling, manuscript in preparation, 1997.

## Budget Summary

To be provided by Johns Hopkins University, where most of the work was performed.