Presented at the GSA meeting in Denver, CO, October 27-30, 2002

VISCOUS CREEP OF SUBSTRATUM AND ITS TECTONIC EFFECT ON VISCOUS AND BRITTLE OVERBURDEN: APPLICATIONS TO SALT BASINS AND CONTINENTAL PLATEAUS

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Flow of a viscous substrate and the accompanying deformation of brittle (plastic) overburden under the effects of tectonic and gravitational forces is a general problem with specific geological applications. These applications include the tectonics of salt basins, where flow of salt leads to the deformation of overlying sedimentary strata, and channel flows of partially molten mid/lower crust beneath continental plateaus, where the flow may cause instabilities of the upper crust leading to the development of domes and core complexes.

We describe numerical plane-strain finite element experiments of viscous flows beneath viscous, cohesive and frictional overburden designed to determine the stability and finite deformation of the overburden. These experiments are compared with approximate theory for lubrication squeeze flows and analogue physical models.

In the case of salt basins with finite strength sedimentary overburden, we investigate models where the overburden thickness varies spatially and the associated differential gravitational forces control the system stability. Both stability estimates and finite deformation results are presented. In addition, models subject to regional tectonic forces as well as variable thickness overburden are investigated. Under these circumstances deformation of the overburden may be dominated by the differential gravitational loading, the tectonic forces, or both forces acting in combination. Additional factors, which influence the system response are the effects of surface processes which modify these geometries and the buoyancy forces that result from density differences between the overburden and the viscous substrate. These effects are investigated in the context of sediment progradation over salt and salt diapirism into a finite strength overburden.