Geophysical Research Abstracts, Vol. 9, 08035, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08035

Glacially Induced Faulting and the Tectonic State of Stress: Implications for the Large Endglacial Faults of Northern Scandinavia

B. Lund (1), M.D. Zoback (2)

(1) Dep. of Earth Sciences, Uppsala University, Villav. 16, 752 36 Uppsala, Sweden (bjorn.lund@geo.uu.se), (2) Dep. of Geophysics, Mitchell Building, Stanford University, Stanford, CA 94305-2210, USA

Glaciation and deglaciation are well known to have large effects on the stability of faults in the crust. Emplacement of large ice caps often quells earthquake activity, as in Greenland, and deglaciation is known to trigger large earthquakes, as the up to magnitude 8 events in northern Scandinavia. The change in stability for a particular fault depends, however, not only on variations in the loading conditions but also on the prevailing tectonic, or background, state of stress.

The effect of different tectonic stress fields on fault stability during a glacial cycle has been investigated using finite element modelling. We use two-dimensional Earth models with varying, both laterally and in depth, rheological properties based on the classic concept of an elastic plate overlying a Maxwell viscoelastic half-space. The model includes pore pressure, either as a simple static pressure or using poroelasticity. A simple elliptic cross-section ice load, with a simple ramp history, is used to evaluate the influence of the tectonic background stress. We show how periods of decreased fault stability occurs during different stages of the glacial period depending on the state of the tectonic stress. We also show how the magnitude of the instability varies significantly for different stress states.

Using a three-dimensional model of the Weichselian ice load history for Scandinavia we extract a two-dimensional NW-SE profile through northern Scandinavia in order to model the known endglacial faults in the area. We use realistic Earth models, pore pressure and various model for the background stress state to study the initiation of fault instability. Our models are compared to existing endglacial fault locations and times of rupture. Also, data on uplift rates, such as GPS, tide-gauge and strand lines, are used to constrain the models.