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Earthquake Potential at the Boundary of the Yangzte Platform due to Water and Sediment Load During Inundation of the Three Gorges Dam, China: Implications for Deep Stress Loading

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The preliminary statistics on the seismicity rate and spatial distribution following the initial hydrological loading of the Three Gorges River Dam in China show many of the same characteristics seen in other regions where such large scale loading and porous-elastic diffusion has occurred in the past. There are many characteristics of the Three Gorges River Dam, however, that make it unique. First is its enormity, and secondly its narrow shape. Although this region of China is relatively aseismic, the loading occurs along 1000 km of crust at the boundary of the Yangzte cratonic platform. There has been at least on earthquake of surface wave magnitude exceeding 4.0 at moderate depth in the crust (20 km). These deep quakes occur at depths exceeding the porous diffusive length scale, and hence are telling us something about brittle frictional behavior of the crust at the onset of surface loading. Here we model the Coulomb and Mogi- von Mises fracture stresses to assess the role played by the gravitational/stress caused by water empoundment. It is found that fracture stresses are generated at a fraction of one MPa and that these quickly penetrate to mid-crustal and deep crustal (40-50 km) depths. These stresses may easily account for magnitude 4 and greater earthquakes during Phase 2 loading (initiated in 2001). We also predict the eventual final stress state in 2009 upon the completion of Phase 3 loading. GPS constrained vertical motion data is found to aid in constraining the primarily elastic deformations,

but more sophisticated, laterally varying models with constrainable permeability parameters are a key to correctly describing the vertical motion data.