REVISION OF THE BLOCK-SLIDER MODEL TO ACCOUNT FOR THE NORMAL ELASTIC DEFORMATION OF THE SURROUNDING ROCK: EFFECTS ON EARTHQUAKE NUCLEATION AND COSEISMIC SLIP

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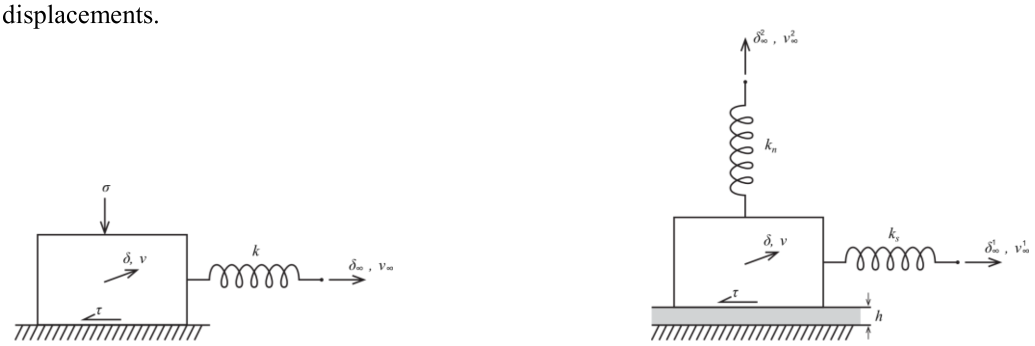
Three major types of faults exist in the earth crust, i.e. reverse faults, normal faults and strike slip faults. Faults accommodate large seismic slip during earthquakes. Multiphysical procedures such as thermal or chemical pressurization and chemical decomposition are nowadays quite well known mechanisms that control both earthquake nucleation and coseismic slip. The dissipated energy is strongly affected by these multiphysical procedures that occur and evolve at different scales, i.e. from the nano-metric to centi-metric scale [1-4].

The classical, conceptual model used for modeling faults is the block-slider system, depicted in Figure 1. The sliding of the block represents the co-seismic slip at the fault plane. A rate dependent constitutive friction law is usually adopted [5,6]. Even though simple, this model leads to very interesting conclusions regarding earthquake triggering, recurrence and energy dissipation at the fault plane. Nevertheless, this model has two important limitations. The first one is that in reality the co-seismic slip does not take place into a plane but to a zone of finite thickness. The second drawback is that it considers only the shear elastic deformation of the surrounding rock and not the normal elastic deformation. Therefore, this model is better adapted to strike-slip type of faults rather than normal or reverse faults, which can be quite devastating. Here we remove these two assumptions and we extent the existing approaches by considering that a) the energy is dissipated inside a layer of finite thickness (i.e. the fault gouge) and b) that the surrounding, healthy rock can accumulate elastic energy both due to progressive shearing and normal to the fault gouge compaction. This allows us to model properly the aforementioned multi-physical couplings and the orientation of the fault relative to the direction of the tectonic displacements.



(a) (b)

Figure 1. (a) Classical block-slider model; (b) Extended block-slider system. The thickness of the localization zone is h. The vertical spring repesents the normal elastic deformation of the surrounding rock.

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