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Towards a new thermomechanical model of subduction channel

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Subduction is known to be a major process in most collision zones, and the subduction channel is one of the key elements in the subduction process.

In the last years the key-role of the subduction channel was thoroughly studied by many authors. From a mechanical point of view, its properties are highly determined by the friction coefficient, which depends on many factors, and the rheology that is set up. Despite of being a few kilometers wide, and small compared to the big subduction picture, its effects can propagate far away from the trench. For example, that was demonstrated by Sobolev and Babeyko (Geology, 2005) by means of a numerical model focused at the evolution of the Central Andean Subduction Zone. The model was based on a finite-element/finite-difference explicit code called LAPEX-2D (Babeyko et al., EPSL, 2002).

Here, we present a new and enhanced 2-D thermomechanical model developed to study this type of tectonic setting. The main ideas of the technical implementation are based on the work published by Popov and Sobolev (PEPI, 2008). The domain is modeled by means of the Finite Elements Method with an implicit approach. The rheology is considered to be elasto-visco-plastic and the viscosity is temperature- and stress-dependent. Diffusion, Dislocation and Peierls types of creep and Mohr-Coulomb plasticity are included. Topography evolution is naturally tracked by a Lagrangian mesh. A particle technique similar to the particle-in-cell method was used to minimize diffusion during remeshing.

One of the improvements added in this work, compared to the previous models, is a non-uniform mesh, which allows two main benefits. First, the study of specified regions of interest with more detail by means of the concentration of elements (like subduction channel), and second, the capability to define more realistic and smooth interfaces between different materials without distorsions related to mesh orientation.

Also, the remeshing process includes basic automatic tracking of specified parts of the domain to improve the remeshing, by using there a denser mesh.

Another implementation improvement is related to the use of parallel-solvers that allow us to refine significantly the studied domain, obtaining more precise results.

Finally, a porous flow model is coupled to the mechanical one in order to model more precisely the effects of the fluid presence in the subduction channel.

We will show first results for an Andean type subduction zone which also took place on the initial stages of the Tibetan continent-continent collision.