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Role of thermo-mechanical regime in the geometry of crustal detachment levels

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Despite that the role of thermo-mechanical regime in the generation of detachment levels inside the lithosphere has been largely discussed, a model that describe such dependency for the Southern Andes had never been estimated. In this sense, from a density model of the lithosphere beneath Central and Southern Andes proposed by Tassara & Echaurren (2012), we computed the thermo-mechanical regime beneath Southern Andes, assuming two different temperature distributions: one above the slab, and other one above the asthenosphere-lithosphere boundary, similar to Tassara and Morales (2013). For the mechanical regime, we simply assumed a brittle and a ductile behavior, where the last one, it is strongly dependant of the lithospheric composition (Burov & Diament, 1995).

To validate our results, we made a compilation of several balanced cross section along Southern Andes, to obtain a balanced model for the detachment surface inside the crust. Furthermore, we estimated this surface from the thermo-mechanical model, considering the proposal of Echaurren et al. (2016) and Giambiagi et al. (2014), which says that this level is obtained from all the points generated in the intersection between the rigid-ductile transition and a given maximum stress. With both surfaces, we made a statistics analysis to evaluate if detachment levels could be modeled from the thermo-mechanical regime, and also we compare some cross sections obtained from this model with earthquakes depths of the CSN catalog, to see if the geometry of detachment levels is consistent with this data.

Results shows that there is a clear dependency of geometry and depth of the detachment surface with the distribution of temperature and composition of the rocks inside the lithosphere. Moreover, earthquakes depths define a geometry that fits quite well the one of the rigid-ductile transition in different thermo-mechanical cross sections along Southern Andes. In this sense, it is possible to think that this kind of models describes how surface deformation it is rooted at deep crustal levels.

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