Solid Earth Discuss.,
doi:10.5194/se-2016-92-RC1, 2016

Solid Earth
Discussions
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Interactive comment on "A multi-stage 3D stress field modelling approach exemplified in the Bavarian Molasse Basin" *by* Moritz O. Ziegler et al.

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Received and published: 20 July 2016

The paper presents first a method for modelling the regional stress field as determined from data gathered in the world stress map. It is used then to evaluate the criticality of the loading of faults susceptible to be reactivated by human exploitation of local fluids in domains where no local stress measurement is available. The objective is to take advantage of stress measurements to define first a regional stress field that fits observations and then to use the model, through a locally refined mesh, for evaluating the criticality of the faults of concern. The regional model concerns a 70 km x 70 km x 10 km volume located in the vicinity of Munich, in the Bavarian Molasse Basin. It assumes an elastic behavior for the various geomaterials involved and a classical friction law for the stability of faults. This modelling procedure is quite classic and rests on the validity of a few basic hypotheses that need to be better discussed. Indeed, authors

assume that vertical direction is a principal direction throughout the modelled volume. But a recent paper by Maury et al. (Geophysical Journal Int., 2014, vol. 199, pp 1006-1017) have suggested that in this area the stress field at depth is controlled by the fossil Alpine subduction. More precisely the steeply dipping Lithosphere-Asthenosphere contact encountered around 50 to 70 km in this area supports only a pressure so that along this contact none of the principal directions are vertical. This applies to a depth of the same order of magnitude as the horizontal extensions of the domain of interest. In addition, authors should better document the topography of the sediment-basement contact at the 70 km x 70 km scale, for it is likely not horizontal. In other words, in order to be credible, the model should extend much deeper than 10 km, given its 70 x 70 km horizontal extent. Another important issue concerns the validity of an elastic hypothesis for modelling the present day stress field. Indeed, recent GPS measurements (Nocquet, 2012, Tectonophysics, vol. 579, pp 220-242) show no present day measurable displacement in this area so that the displacement considered by authors as boundary conditions are likely to be associated with the Alpine tectonics. But this tectonic activity ceased being active some 4 to 5 million years ago. It is most likely, as suggested by the discussion by Gunzburger and Cornet, 2007, (referenced in text) that the equivalent elastic parameters used for modeling the long term deformation of such visco-elastic materials are much softer than those described in table 1. This needs a detailed discussion. Also of import are the stress discontinuities observed at the limits between the various geomaterials. Is there no limit to the maximum "stress jump" described on figure 8 ? Finally, the classical proposition that the criticality of faults is well described by a Coulomb type failure mechanism requires also a better discussion. Indeed, some not so recent work (Sulem et al., 2004, C.R. Geosciences, vol. 336, pp 455-466, Sulem, 2007; Tectonophysics vol. 442, pp 3-13) suggests that the mechanical behavior of faults is not properly represented by a Coulomb failure criterion. The role of long term stress relaxation in the gauge material should be discussed. In summary, the model described in this paper follows classically accepted hypotheses. But "not so recent" results on the role of geomaterial rheology have shed some doubts on these hypotheses and a modern publication cannot ignore these developments. Only after these various points have been discussed properly, may I recommend publication of this paper.

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