

Interactive comment on “Active tectonic field for CO₂ Storage management: Hontomín onshore study-case (SPAIN)” by Raúl Pérez-López et al.

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Received and published: 27 January 2020

This manuscript presents a structural analysis of fault data collected at outcrop in the vicinity (<20km) of a potential CO₂ storage site. Such data collection is extremely valuable in the context of storage site monitoring, for 2 reasons: 1. Faults within the reservoir and within its overburden may be reactivated by the present-day stress field, allowing fluids to migrate up the fault surfaces and out of the site. A leak of CO₂ to the surface could be a serious safety concern. 2. Faults at a greater distance, not directly inside the reservoir location, may be reactivated in the present-day stress field and produce sizeable earthquakes, which could damage the site facilities and also change the stress balance on small intra-reservoir faults, leading to leakage as noted at point 1.

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So, data collection of the type undertaken here is very commendable.

However, the bulk of the paper is taken up with an irrelevant (and probably incorrect) attempt to reconstruct the tectonic strain (in tensor form) for numerous periods in the geological past. Such analysis is irrelevant because it has no bearing on the present-day site stability. The strain field (or the causative stress) in the Early Cretaceous has no influence on the susceptibility of faults to slip at the present day. It has been well known for many decades that the orientation of fault planes within the IN SITU stress field is the critical relationship that controls fault reactivation and associated fault permeability (Bott, 1959; Barton et al, Geology, 1995; Morris et al, Geology, 1996). Whilst the fault orientation data is clearly of use here, the authors should concentrate on the present-day (active) stress state, not the "strain field" in the Cretaceous. The present-day stress state is not well constrained in this area: Herraiz et al 2000 suggest SHmax close to N-S, and a quick look at the World Stress Map (Heidbach et al 2016) shows SHmax roughly NE-SW but based on only 3 readings.

For some reason I do not understand, outcrop data collected above the location of the site (HTM17), which comprises almost a quarter of all the data, is "removed". Surely it is the station which is most relevant to the site conditions?

The construction of "strain fields" through geological time is probably incorrect for several reasons. Firstly, by definition, faults which affect a particular stratigraphic unit must be younger than that unit, unless the fault is demonstrably a sedimentary growth fault. Thus faults recorded in Early Cretaceous outcrop might have any age between Early Cretaceous and the present day. The authors appear to partially recognise this because they attribute some strain fields to be superposed "modern paleostrain field" (Fig.9) - but the way this is done seems completely arbitrary. Secondly, the analysis assumes that a fault orientation recorded today is the same as when the fault slipped in the past - but it is well known that rotation about vertical axes is significant in fault systems with a strike-slip component (e.g. Lamb, JSG, 1988; Ron et al, Geology, 1986; and many others). So the inversion results obtained from present-day orientations may

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themselves be rotated from their original direction.

For the purpose of contributing to CO₂ storage management (as in the manuscript title), I suggest the paper be radically re-written: - The 447 fault data from 32 field stations is excellent - but please include detailed discussion of the data at the site itself (HTM17). - Drop the palaeostrain analysis completely. - Concentrate on the present-day stress field data, and assess the amount of uncertainty in its constraint. - Resolve the present-day stress tensor onto the fault plane orientation data, to illustrate which fault trends have higher slip tendency and hence higher reactivation/leak potential.

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Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-196>, 2020.