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Interactive comment on "Active tectonic field for CO_2 Storage management: Hontomín onshore study-case (SPAIN)" *by* Raúl Pérez-López et al.

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Letter to Dr. Graham Yielding, related to the interactive comment on "Active tectonic field for CO2 storage management: Hontomín onshore study-case (SPAIN)" by Pérez-López et al. The authors (4 February 2020)

Dear Dr. Yielding, Thank you very much for your time and effort in reviewing the manuscript under the open discussion of Solid Earth and your kind comments. You pointed accurately the main objective of the paper, "the reactivation of faults due to the injection of fluids and the potential for triggering earthquakes, within the vicinity of the CCS (Carbon Capture and Storage), and pilot plant facilities". According to the suggestion of anonymous reviewer #2, hereafter we refer to Geological Storage of CO2

(GSC) instead of CCS. We agree with you that the main goal of the paper was not the paleostrain evolution and global tectonic events recognized in the Basque-Cantabrian area and Duero and Ebro river basins (North part of Spain), but the role of the fault sets affecting the GSC by the present-day strain field. However, the high-quality outcrops in the near-field (<20 km) gave us a good chance to estimate different paleostrain local tensors affecting geological formations at different ages (the Ubierna Fault System and the south-eastward fault-end geometry with the Hontomín Fault). What we mean is we were able to calculate paleostrain tensors affecting Triassic, Cretaceous and Tertiary deposits and we were able to discriminate which of them worked in a particular time interval. Furthermore, the controversy related to the assignment of geological ages to the different strain tensor calculated in geological outcrop is still an open debate. We know well the problems to reconstruct paleostrain fields and how to match these results with large-scale tectonic events throughout the geological evolution of the basin. Of course, stress/strain axis rotations due to different paleogeographic constrain, magnetic field changes, among others, obviously difficult that reconstruction. As a matter of fact, the paleostrain reconstruction is always controversial, more if you take into account that all of our studies are on the local scale. This kind of analysis is always constrained by the quality of the outcrop and the ability to assign strain tensors to large-scale tectonic events affecting the studied area. We have indeed tried to match the paleostrain tensors calculated from slip fault data with those global tectonic events defined by other authors in the area. Perhaps, we have failed to suggest that this is only a local analysis. Consequently, we can accept that the paleostrain evolution could be removed from the final manuscript. Concerning the inclusion of the fault-slip data from the outcrop HTM17, as suggested by Dr. Yielding, we have included a new section. At the beginning of this work, it was a long discussion among the authors about the convenience either to describe this outcrop, having in mind the relevance of the site-effects, or to remove this outcrop from the huge amount of information we had to deal with. Despite that and rethinking from the Dr. Yielding' comment, we will include in the reviewed text the next figures and texts:

Cretaceous Outcrop HTM17 on the Hontomín Pilot Plant This outcrop is located on top of the geological reservoir, in a quarry of Upper Cretaceous limestones. The main advantage of this outcrop is the well-development of striation and carbonate microfibers which yields high-quality data. 105 fault-slip data were measured, with the main orientation striking N75°E; N-50°E; and a conjugate set with N120°E (±10°) trend (Fig. XX). The result of the strain inversion technique shows an extensional field featured by an ey trajectory striking N107°E (±24°) related to an extensional strain field (see the k' diagram in figure XX). Fault sets with ENE-WSW and E-W trend (Fig. XXX) could be reactivated as compressive faults (with lateral component) under the present-day stress field, and NE-SW faults as oblique ones. Minor fault sets with NNE-SSW and NNW-SSE striking could react as extensional faults.

FIG XX

FIG XXX

Besides, we are calculating how the present-day stress tensor affects to each strain tensor solution and fault sets as Yielding' suggestion. Sorry, we have not included it, it takes a while! Finally, we don't agree with Dr. Yielding with the idea concerning the document has to be drastically rewritten. Despite that, thank you very much for your kind comments, revisions, and suggestions, that were properly focused on the aim of the manuscript, the role of the present-day strain field for GSC operations, and which definitively will improve the final manuscript. REFERENCES Herraiz, M., et al. 2000. The recent (upper Miocene to Quaternary) and present tectonic stress distributions in the Iberian Peninsula, Tectonics, 19, 762–786, https://doi.org/10.1029/2000TC900006, 2000. Stich, D., et al. 2006. Kinematics of the Iberia-Maghreb plate contact from seismic moment tensors and GPS observations, Tectonophysics, 426, 295-317. https://doi.org/10.1016/j.tecto.2006.08.004, 2006.

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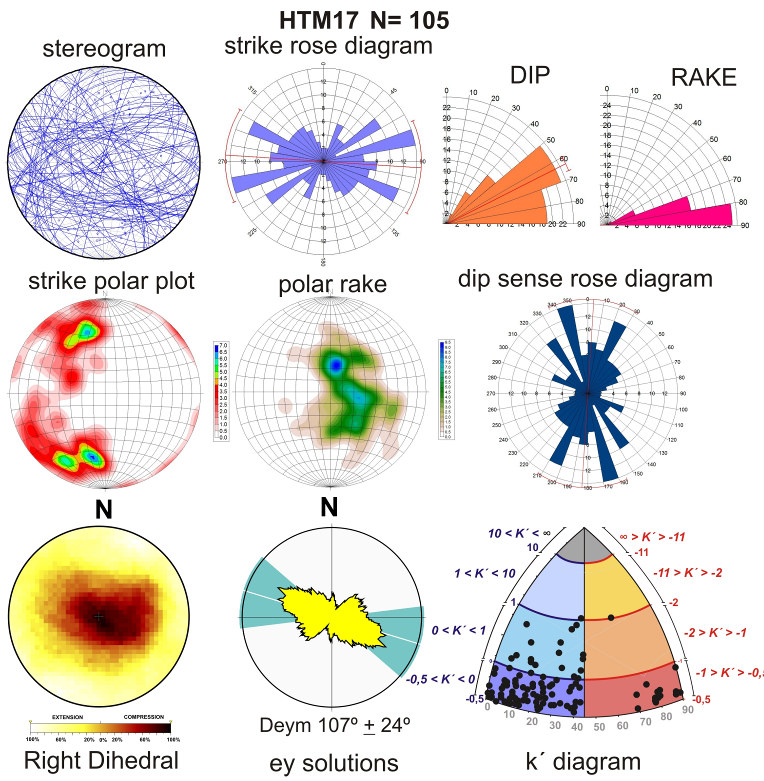

Fig. 1. Fault data from the outcrop HTM17 located on top of the HPP. See figure 5 for the geographical location. Stereogram plots is lower hemisphere and equal-area net.

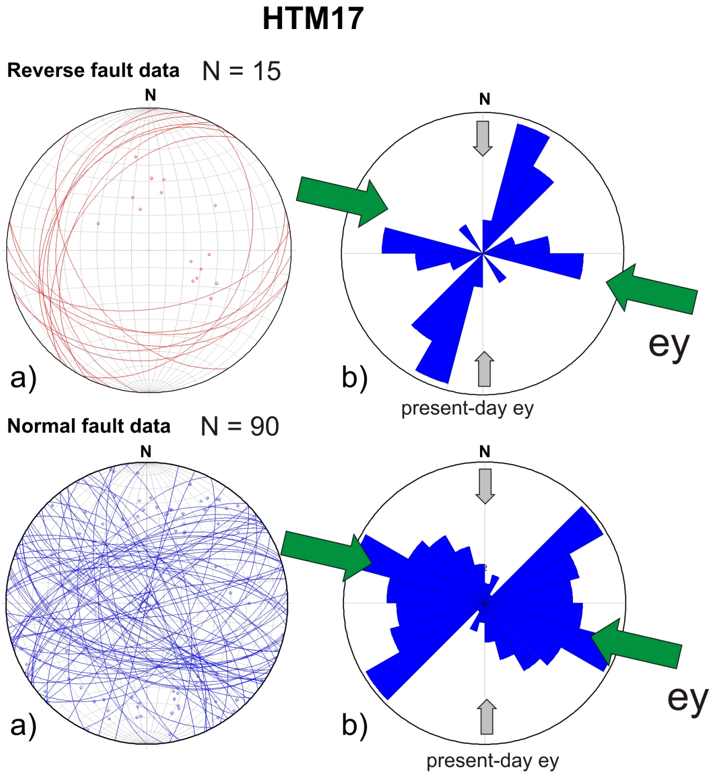

Fig. 2. Figure XXX. Normal and reverse faults stereograms (lower hemisphere and equal area net), and rose diagrams measured in HTM17. Green arrows indicate the orientation of the local paleostrain field. Grey