

Interactive comment on “The response of Opalinus Clay when exposed to cyclic relative humidity variations” by Katrin M. Wild et al.

Anonymous Referee #1

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This is an interesting contribution, investigating the evolution of strength, volumetric strains in Opalinus Clay (OPA) subjected to experimental cyclic variations of relative humidity (RH). Authors show that after 4.5 cycles of RH variations (cycles between 66% and 93% RH) OPA displays irreversible volumetric strains mostly perpendicular to the specimen's bedding. Surprising, fabric's damages induced by cyclic variation of RH have only very minor effect on the strength of the material.

The paper is a valuable scientific contribution, concise and well-written I recommend publishing it.

However, I have the following comments:

(1) In introduction (Section 1), many contributions are cited about RH cycling experiments on shale but some recent contributions (mostly from the LMS laboratory at Ecole

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Polytechnique, Orsay, France) including the following of dehydration damages based digital image correlation are not mentioned though they are very relevant for the topic:

Wang L. L., Bornert M., Chancole S., Heripré E., Yang S. (2015). Micromechanical experimental investigation of mudstones. *Géotechnique letters* 4, 306-309.

Wang L. L., Bornert M., Chancole S., Yang S., Heripré E., Tanguy A., Caldemaison D. (2013). Micro-scale experimental investigation of the swelling anisotropy of the Callovo-Oxfordian argillaceous rock. *Clay Minerals*, 48: 391–402.

Yang, D. S., Bornert, M., Chanchole, S. et al. (2012). Dependence of elastic properties of argillaceous rocks on moisture content investigated with optical full-field strain measurement techniques. *Int. J. Rock Mech. Mining Sci.* 53, 45–55.

(2) About sampling (Section 2.2): authors indicate that samples were immediately sealed in vacuum-evacuated Al-foil after core extraction. But when sample were drilled? And when experiments were performed? Desbois et al. (2014) showed that clay-rich geomaterials can be water de-saturated even when they are preserved in vacuum-evacuated Al-foil. Could you discuss about the original hydric state of your specimen at the date of experiment? Desbois G., Urai J.L., Hemes S., Brassinnes S., De Craen M., Sillen X. (2014). Nanometer-scale pore fluid distribution and drying damage in preserved clay cores from Belgian clay formations inferred by BIB-cryo-SEM. *Engineering Geology*, 170:117-131.

(3) In Section 4.2 (Strain and damage), authors write that macroscopically detectable fissuring was observed. Do you have examples you can show? How thick are these fissures? Do they run through the entire specimen? Strength measurement does not show significant change but macroscopic damages are visible. This is rather contra-intuitive, but measurements are here to demonstrate it. Ok, but could you try to explain why strength does not change significantly though the presence of severe macroscopically damages?

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(4) In Section 5 (Conclusion), the last sentence is interesting “The experimental study demonstrates that environmental variations, in particular long-term variations in RH can lead to irreversible volumetric strains that contribute to long term deformations of underground excavations and favour processes that are considered to control self-sealing in Opalinus Clay.” But I think it is a bit overlooked because long-term deformation and self-sealing are not studied in this contribution. May I suggest to the authors to rewrite the sentence with a more hypothetical form?

Interactive comment on Solid Earth Discuss., doi:10.5194/se-2016-171, 2016.

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