

Responses to Topical editor recommendations

Virginia Toy (Topical editor)

Received and published: 22 May 2021

Ref: se-2012-4-EC1

I have read over the referee comments, and your responses, and also checked the changes you made to the manuscript. I mostly think you've done a good job of addressing their concerns, and I find the manuscript to be scientifically sound and worthy of publication.

Response: We thank the Topical editor Virginia Toy for her recommendations, which are reasonable and helpful. In the following, we provide a point-by-point response to each comment, where comments are in black, and our responses are in red. In addition, the changes regarding "author responses to Topical editor recommendations" are highlighted in red in the marked revised manuscript, while the previous changes related to the reviewers' comments are highlighted in blue.

However, there are a couple of places where I recommend you do a little bit more work to adequately address the reviewer's comments and further improve the manuscript, as follows:

I would re-write your revised intro sentences as follows:

"Hence, the objective of this study was to investigate the hydro-mechanical properties of the EDZ in the Opalinus Clay of the Mont Terri URL from in situ measurements on the exposed rock surface. We carried out a nondestructive and holistic determination of hydraulic and mechanical parameters of the fractured rock mass around a small tunnel, by combining transient-flow air permeametry, photomicroscopy, and needle penetration tests. We characterised bulk rock properties of the claystone, and quantified mechanical and hydraulic apertures of different fracture types of the EDZ, since these discontinuities can significantly control the overall material behavior. We have also explored alteration of a non-lined niche that was directly exposed to air for several years *and then say WHY and HOW you did this.*

Response: We agree. Thank you for the suggested changes to the introductory sentences of the manuscript. We have mostly adopted the wording given above and have expanded it accordingly:

"Hence, the objective of this study was to investigate the hydro-mechanical properties of the EDZ in the Opalinus Clay of the Mont Terri URL from in situ measurements on the exposed rock surface. We carried out a nondestructive and holistic determination of hydraulic and mechanical parameters of the fractured rock mass around a small tunnel niche, by combining transient-flow air permeametry, photomicroscopy and needle penetration tests. We characterized bulk rock properties of the claystone, and quantified mechanical and hydraulic apertures of different fracture types of the EDZ, since these discontinuities can significantly control the overall material and flow behavior. We have also explored the alteration of the non-lined niche that was directly exposed to air for several years. By using the water content of the claystone, we compared the determined physico-mechanical parameters with data from other studies to assess the effect of desaturation directly on-site at the tunnel wall."

Reviewer 1 criticised inclusion of discussion of the P and S wave velocity. You did not respond to their comment. Please provide some sort of response.

Response: We already addressed this point in our response to comment (1) of reviewer #1. Here we have outlined that the empirical relations we used to estimate the P- and S-wave velocities are existing published equations, which led to satisfactory results in the study of Aydan et al. (2014) and can in principle also be used for the investigated claystone.

In agreement with reviewer #1, however, we also found that the estimation procedure based on the needle penetrometer tests is less suitable for determining P- and S-wave velocities in the Opalinus Clay than for the geomechanical rock parameters, which we discussed in the manuscript (page 23, lines 465-467 in the marked manuscript):

“As ultrasonic velocity is explicitly dependent on the internal structure of the rock, such as cementation, anisotropy and porosity structure (Jaeggi and Bossart, 2014; Schuster et al., 2017), it can be assumed that the relationship of ultrasonic velocity and NPI is probably rather weak.”

However, since these are published equations, we find it important to show and evaluate the results for the estimated geophysical parameters in addition to the geomechanical parameters.

Reviewer 2 criticises the statistical basis of the conclusions you reach about the EDZ fractures because your analyzed dataset is very small. You don't acknowledge this small dataset well enough in the current conclusions. Please add a statement about this.

Response: We agree that the analyzed EDZ fracture dataset is rather small due to the limited number of accessible measurement points in the niche, but we are fully convinced that the data and the conclusion is still important for the reader. However, we agree that this point should also be addressed in the conclusion and we have therefore revised the respective text passage and added a statement as requested (page 24, lines 513-514 in the marked manuscript):

“Due to the smaller mean mechanical aperture of the artificially induced unloading fractures compared to the investigated tectonic fractures, conversion was most appropriate for the EDZ fractures. Tectonic fractures on average exhibit a higher variance of measured distances along imaged fracture traces, which can be explained by a higher degree of mismatch between the fracture surfaces due to the reactivation of fault planes during excavation. However, the statistical significance of the observed differences between the different fracture types would have to be tested based on a larger dataset.”

In addition, we have already included a statement on the small size of the EDZ fracture data set in Section 3.1.3, as stated in our response to comments of reviewer #2 (page 18, lines 374-376 in the marked manuscript):

“While EDZ fractures seem to better correspond to the general model concept of an “ideal plane-parallel fracture”, tectonic fractures are most probably characterized by a different a_m - a_h -relation. While implied by the presented measurement data, this issue should still be examined based on larger data sets.”

THMC at line 47. The reviewer's point was that you never define the full term, just go straight to the acronym. You must give the full version here too.

Response: We agree and therefore inserted the full term in addition to the acronym at this point (page 2, line 47 in the marked manuscript):

"[...] and to examine the behavior of the Opalinus Clay when exposed to short- or long-term THMC (thermal, hydrological, mechanical and chemical) impacts (Bossart et al., 2017; Pearson et al., 2003)."

Line 142: I don't find your revision clear enough. Why not just clearly say 'within the first 1.3 m depth into the niche'?

Response: We agree and have changed the corresponding sentence in the manuscript as suggested (page 5, line 145 in the marked manuscript):

"Excavation-induced unloading joints (EDZ fractures) that are related to the construction of Gallery 04 are present within the first 1.3 m depth into the EZ-B niche (Nussbaum et al., 2005)."
