

Interactive comment on “Granite micro-porosity changes due to fracturing and alteration: secondary mineral phases as proxies for porosity and permeability estimation” by Martin Staněk and Yves Géraud

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Received and published: 14 November 2018

General comments

This paper discusses the influence of fracture damage, alteration and how these two parameters link together to result in various porosity and permeability characteristics of a granite. The granite in question has been selected by the Czech Radioactive Waste Repository Authority as a research training site and knowledge of the influence of alteration and fracture damage on e.g. the rock integrity, storage and retardation properties are of interest to the wider public. The paper investigates different alteration

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facies in a granite drill core from surface level to 150 m depth. The alteration facies are described in terms of microstructural and chemical analyses and are linked with measurements of porosity and calculated permeability.

The work is of good quality and generally well written (although some sections could profit from more concise wording). The conclusions are generally justified by the presented data.

There are a few points where I could see improvements to the paper, which mainly involve suggestions for changes to improve the clarity – specific points are made below. Furthermore, it is mentioned in the Abstract (line 10 – 11), that the results of this paper could be of use in estimating permeability/porosity based on e.g. drill cuttings. It seems important to me that it is discussed/clarified somewhere, if such a usage of the data is considered to be only valid for the granite studied, or if this could be extrapolated to other granite bodies with similar alteration facies too.

— Specific Comments —

p 2, l 4: “elementary links” between what?

p 2, l 8-9: Please provide citation for impedance of permeability by gouge formation. It was also not quite clear to me at that stage of the paper, to what the term “aperture” is referring to – maybe use a different word or clarify what is meant with aperture here.

In **section 2.1 and 5.2**, abundant reference is made to what is called “Fracture sets 1 – 5”. These fracture sets are not really introduced in this paper but it is referred to previously published literature (Lexa & Schulmann, 2006 and Stanek, 2013). For me as a reader who is not familiar with these fracture sets, I didn’t have enough information/background/data to follow their structural relation and link them to the granite samples investigated in this paper.

From my point of view, the description of the regional setting has to either be expanded

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to give more data/description on these fracture sets, or, their discussion should be removed from the paper.

Alternatively, if the authors disagree with this suggestion, I would ask them to extend Figure 1 by (i) a schematic sketch of the different fracture sets and their structural relationship, and (ii) to add stereographic plots of the fracture set data to Figure 1. This then could also help to link the stereographic fracture data from the core samples in Figure 2 to the regional scale geological setting shown in Figure 1.

p 4, l 2: How was the fracture density measured?

Section 2.2: In the second paragraph, the different samples and their microstructure are described. You could refer to Figure 4 here as it shows all the samples. In that case change the Figure label of Figure 4 to (new) Figure 3 (causing the label of Figure 3 to become Figure 4).

Additionally, it is somewhat tedious to keep track with all the different microstructures that the different samples are associated with. To help clarity in this case, I would suggest changing the sample photographs in Figure 4 to schematic sketches of the cores, their alteration structures etc. and their relation to the sampling location (something along the lines of the figure attached at the end of this review)

p 5, l 16: I think the abbreviation MIP hasn't been introduced so far (only later on it's introduced on p 6, l 20).

In **section 3.2**, the term "throat" should be introduced somewhere at the beginning of the section (e.g. move sentence on page 6, line 3-4 to a place at the start of the section)

Section 4.4: To me the links between illitization and porosity/permeability are interest-

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ing. Could you give a bit of a longer discussion on it?

On **p 12, l 15-17** you mention that you try to use the chloritization degree as a proxy for porosity. Is it possible to correlate the porosity as a function of volume-% alteration products in a plot? Or is it less the amount of alteration and rather the specific spatial distribution (where exactly the alteration products occur rather than their volumetric abundance) that determines the link between porosity/permeability and alteration?

Conclusions: The way it is written, this is more a summary rather than individual conclusion points. Also the section could profit from a bit more specific statements, e.g. in lines 28-30, state the exact contrasting physical properties and which petrographic parameters are linked to individual void spaces.

— **Other comments** —————

p 1, l 23: change “characteristics” to “characterized” ?

p 2, l 25-28: Rephrase this sentence – it contains too many statements which do not provide any clear information.

p 4, l 2: change f. m-1 to f. m-1. And maybe also write out f. m-1 first as “fractures per meter (f. m⁻¹)” (or is it a standard abbreviation?)

In **section 4.2**, it is confusing to me to refer to similar types of fracture porosity as “same positions” (e.g. p 9, l 10-11). Maybe use different wording for that.

p 11, l 28: Make reference to Figure 11c at the end of the sentence.

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Section 5.1 could be written a bit more concise. Focus on the important links between types of alteration and physical process that caused it. (I would suggest that there's no need to repeat all the exact values of fracture density and orientation.)

p 14, l 22: add a “the” before “microscope”

p 16, l 5: change “corridor” to “corridors”. Add a “the” before “presence”

p 16, l 28: exchange uneasy with some other word, e.g. “difficult” or “not feasible”

p 17, l 9: add a “the” before “microscope”

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-107>, 2018.

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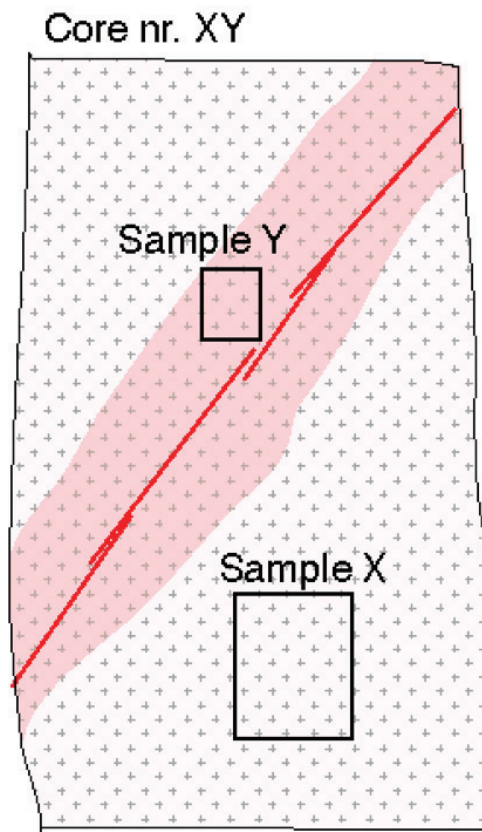


Fig. 1. Schematic sketch of rock core and sampled materials