

Interactive comment on “Assessing accuracy of gas-driven permeability measurements: a comparative study of diverse Hassler-cell and probe permeameter devices” by C. M. Filomena et al.

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Author answer to review No.1 of reviewer Haakon Fossen

Thank you very much for your constructive comments on our manuscript! In the following you will find some answers to your questions and suggested corrections to the final version of the manuscript. I hope this meets your expectations.

1.) Sample description: Comment of H. Fossen, Referee No. 1: “The poor description of the samples. They should be described with respect to depositional environment,

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mineralogy, sorting, rounding, porosity, lithification/burial depth and age. Are these correlations relevant for someone working on carbonates, for example? Line 22 is one place where this needs to be addressed + Table 1”

I suppose you mean line 22 on page 1167 (Chapter 2.1)? To provide a comparable sample set, we selected well sorted, fine to medium grained sandstones (as described in lines 5-6, page 1167). Concerning mineralogy, the dominant grain type in all samples is quartz, feldspar occurs only subordinately. Some fine grained sandstones have also a minor amount of pore-filling clay minerals. I would indicate these slightly clayey sandstones with an asterisk in Table 1. The Buntsandstein and Keuper samples are from fluvial depositional environments, mainly braided to meandering channel deposits. The Bentheim sandstone and the sample from the Dibsiyah Formation are both of shallow marine origin. I would add this information to the sample description (Chapter 2.1).

This study is based on sandstone samples, however, I’m sure that the presented results are also very interesting for someone working with carbonates. As soon as outcrop and lab-based measurements are applied, we recommend to perform comparability tests for the individual devices.

2.) Sample size: Comment of H. Fossen, Referee No. 1: “How can you measure permeability at the end of a 1-inch plug and compare it with outcrop measurements? Holding the miniperm against a more or less planar outcrop surface forces the air to move through a much longer path/larger volume of rock. This needs to be discussed. It would be interesting to know how much of a difference this makes for rocks with different porosity/permeability values. The difference may be different for low-perm and high-perm rocks/samples.”

We totally agree to this comment. The possible paths the air takes through the sample volume during miniperm measurements are displayed in Fig. 2. It is also correct, that one may assume that the flow paths are longer, when measured on an outcrop wall

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(=larger rock volume) than on a plug sample. However, these flow paths are theoretical and cannot directly be proven during the measurement procedure.

To discuss this problem, I would add following sentences in the discussion part (section 3.3): "The application of mini-permeameters to different sample sizes may additionally influence the measuring results. Flow paths in sample plugs as illustrated in Fig. 2 may differ from those in unconfined samples, such as outcrop walls. As the TinyPerm II is the only field-applicable device tested here and as it is applied in several other field studies (e.g. Torabi and Fossen, 2009; Huysmans et al., 2008), possible discrepancies between large and small sample volumes are tested. Unconfined outcrop measurements were simulated by four 10x10x10 cm rock blocks, representing permeability orders of 1, 10, 100, and 1000 mD. A 1-inch sample plug was then drilled from the measuring point at the centre of each block and measured again. As a result, TinyPerm-measurements are 34-41% lower on plug samples than on the larger rock block, but they still remain within the same permeability order."

I hope this addresses the problem sufficiently at this point, however, I'm sure that this aspect alone is worth a separate study.

3.) Comment by H. Fossen: "Compare with data presented by Fossen et al. 2011, where we drilled continental sandstones at the exact locations where TinyPerm measurements were first taken. The relatively well-established correlation is given in our paper. Perhaps plot this data in your diagram"

I have carefully studied your publication Fossen et al. 2011, documenting that the TinyPerm tends to show higher permeabilities than plug measurements do. As most of our data points are <2 Darcy and most of yours are much higher, it would be a very good contribution to our diagram. Though, it is difficult to estimate the numerical values from the cross-plot (Fig. 10a in your publication). May you provide the data points as Excel file? Then I could plot them in my diagram much easier.

4.) Thank you for indicating the missing citations in the reference list. Checking the

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manuscript I realized that one citation (Torabi and Fossen, 2009) was not linked to the list and thereby it was not updated correctly. I have further eliminated a typing error in the citation of Huysmans et al 2008.

5.) You have mentioned a separate pdf in your review, talking about detailed comments. Unfortunately it was not provided online.

Kind regards, Claudio Filomena

Interactive comment on Solid Earth Discuss., 5, 1163, 2013.