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Interactive comment on "Klinkenberg effect for gas permeability and its comparison to water permeability for porous sedimentary rocks" *by* W. Tanikawa and T. Shimamoto

Anonymous Referee #2

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The title of the paper is for Klinkenberg effect. The theoretical approximation written as a correction to permeability is described. However, the paper deals with other processes in the flow of water and gas through rocks that are, at least, similar in importance.

Is effective pressure equivalent to confining stress in the context of rock mechanics?. The experimental results show permeabilities at different effective pressures. I have assumed that effective pressure is the difference between the external and the pore pressure (gas or water depending on the test), but this is not said in the paper.

Cycles of effective pressure variation measuring water permeability are performed after

cycles measuring gas permeability. When the fluid that is used in the tests is changed from gas to water, intrinsic permeability reduces significantly. Moreover, permeability reduces in an irreversible way and more during the water cycles than during the gas cycles (see Figure 2). The paper does not discuss about any possible mechanical effects related to deformation of the rock as wetting and further compression take place. Yet, the confining pressures are quite large, reaching 100 MPa, so mechanical effects can be expected. As an example to illustrate the possible mechanical explanation, the permeability evolution of Sample IVA418 in Figure 2 could be interpreted in the following way: Permeability (using gas) in the 1st and 2nd cycle changes by elastic deformations (reversible), wetting reduces permeability by collapse deformations, permeability (using water) in 3rd cycle changes by plastic deformations between 30 and 50 MPa (a preconsolidation stress of 30 MPa could explain this behaviour), permeability (using water) in the 4rd cycle changes again by elastic deformations. Note that permeability at the end of the 4rd cycle is much smaller than the value at the beginning of the 3rd cycle. In other words, the vertical axis could be changed to volumetric deformation and the plots would strongly resemble the plots corresponding to stress-strain tests.

Conclusion. The Klingkenberg effect is addressed in a standard way. The confining stress and differential pressure effects are explained throught the Bingham flow theory while other explanations could be found. Section 6.3 is difficult to follow (equations not described in sufficient detail). The last paragraph in section 6.3 leaves everything open regarding the water permeability variations. In any case the experimental data is interesting and should be published, so the paper should be reworked.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1315, 2006.