Geophysical Research Abstracts
Vol. 21, EGU2019-5123, 2019
EGU General Assembly 2019
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A new method for determining the onset of dilatancy in fully saturated rocks

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Understanding the hydro-mechanical behavior of rocks under stress is of vital importance for many applications such as oil and gas extraction or nuclear waste deposition. For applications that require the rock mass to provide an effective seal against advective fluid transport, a more precise knowledge on the onset of dilatancy is of vital importance as new fluid pathways form in the dilatant regime.

A common method to detect the onset of dilatancy in fully saturated rocks is by means of triaxial experiments in consolidated and undrained conditions (CU tests). During the increase of the differential stress, the fluid pressure within the sample is monitored. The fluid pressure is expected to increase until the onset of dilatancy when the formation of new cracks leads to an increase in the sample's volume. This in turn results in a drop in fluid pressure. Thus, the detection of the maximum pore pressure acts as an indicator for the onset of dilatancy.

In this study, I propose a new method for the detection of the onset of dilatancy. For the new method, the confining as well as the differential stress are kept constant throughout and only the fluid pressure is actively regulated. This way, the possible influence of leakage within the system on the measured data is avoided and more accurate results are achieved.

The results indicate that the new approach is more sensitive to the onset of dilatancy than common maximum pore pressure measurements. The new measurements return smaller differential stress values at which the onset of dilatancy is observed.