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Mechanical behavior of poorly consolidated synthetic rocks

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The aim of this work is to study the role of cementation on the mechanical behavior of poorly consolidated granular rocks.

Samples of synthetic rocks were prepared in our laboratory by mixing various proportions of sand, Portland cement and water. A precompaction stress was applied to the mixture casted in a cylindrical mold. The sample was then left in a box at constant hygrometry for better cement setting.

Mechanical tests were run on a triaxial machine at various confining pressures so that brittle and ductile regimes could be determined. Experiments with dry or saturated samples were done to study the impact of fluid on the deformation process. We put also strain gages on some of them specially for hydrostatic tests to have precise information on the rock deformation.

Important parameters were determined like peak stress, Young's modulus, and porosity that describe the mechanical resistance, the rigidity and the storage capacity of the material.

There is an increase of both the critical axial deformation and the peak stress with increasing confining pressure and no clear dependence on Young's modulus. However as cement content increases, Young's modulus increases whereas porosity decreases.

A sufficiently broad range of confining pressures was used so that the failure mode transition from brittle to ductile could be observed. The failure envelope is determined for each cement content.

Work is in progress on a model for brittle, ductile and transition between both deformation regimes. The model is based on a 2-D pore crack geometry with inclined fissures, depends on crack length, pore radius, pore density, and takes into account the interaction with the cement microstructure.

A microstructural analysis will allow us to check the micromechanisms of deformation and the important microstructural parameters that we have to include in the mechanical modelling.