Acoustic monitoring of damages in cemented granular materials under uniaxial loading

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Earthquakes or fault core sliding occur naturally in response to long-term deformation produced by plate tectonics ; they may also be triggered by human activities related to natural resource extraction by affecting the stress field and damaging the rocks. However, the way the damage and the cohesiveness of the rocks control the frictional slip is not well understood. It involves materials in very different states : from almost purely granular state in the highly damaged fault core [1] or in highly cracked materials close to injection or extraction sites, to almost completely cohesive state in distant host rocks. To address this issue, we perform controlled laboratory experiments and develop new numerical models of damage to study the transition from cohesive to granular states of synthetic rocks under various loadings, including direct shear [2]. Our rock models are made of cemented granular materials in which the packing density (glass beads or sand) and the nature and content of cements are tunable [3,4]. Here we present the results obtained in a uniaxial loading test where we focus on the fracture process that is spatially diffused without shear band. The fracturing of the rock samples to a purely granular state is acoustically monitored using both the passive detection of acoustic emission (fig. (a)) [5] and active ultrasonic measurements to study the macroscopic viscoelastic properties, e.g. with coherent waves (fig. (b)) [2,3]. The FEM modelling of damage and wave propagation is also made in 2D dense cemented disk packings with various cement contents and elasto-visco-plastic properties. The comparison between experiments and simulations will be discussed.

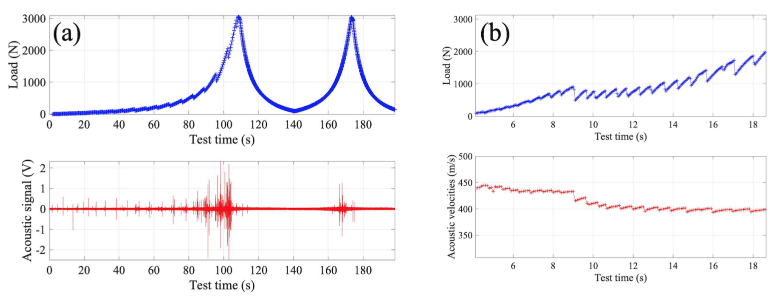

Figure 1. (a) Acoustic emission (bottom) in a cemented granular material during two cycles of loading and unloading (top) in oedometric configuration. (b) Acoustic monitoring of the material damage : stress drop (top) and related velocity decrease (bottom).

Références

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