Geophysical Research Abstracts, Vol. 9, 09772, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09772

Pore space heterogeneity and compaction localization in sandstone in light of X-ray computed tomography

L. Louis (1,2), T.-f. Wong (1) and P. Baud (3)

(1) State University of New-York at Stony Brook, USA, (2) Now at Université de Cergy-Pontoise, France (laurent.louis@u-cergy.fr), (3) Institut de physique du globe de Strasbourg, France

We present recent advances in the use of X-ray computed tomography (CT) for studying pore space heterogeneity and compaction localization in sandstone. X-ray CT images are essentially density maps that can be used as is to describe density contrasts in rocks due to compositional layering, heterogeneities or porosity changes due to non homogeneous deformation. This technique is versatile in terms of image resolution as voxel size can be set to values ranging from a few mm down to the order of the micron. For a voxel size larger than a couple of grains (say some hundreds of microns) and in the specific case of dilatant strain localization, the increase in porosity within the shear bands significantly lowers X-ray attenuation, and these areas are usually well resolved on X-ray CT images which can therefore readily be used for simple observation or 3D damage reconstruction. For compaction localization features such as discrete compaction bands, the technique proves far less straightforward and additional processing needs to be carried out. In this case in order to highlight areas where compactive damage occurred we calculated the local changes in density distribution associated with grain crushing and pore collapse. As a porous rock undergoes compactive deformation, pore collapse tends to smoothen the original density heterogeneity and neighboring voxels tend to show X-ray attenuation values considerably closer to one another. This principle has been used to successfully image compaction bands that had formed in a triaxially deformed sample of Diemelstadt sandstone at 140 MPa confining pressure and 10 MPa pore pressure.

Conversely, changing the resolution of a set of X-ray images can produce similar effects by homogenizing the attenuation values. In particular, since objects such as pores and grains have defined size ranges, standard deviation calculated over neigh-

boring voxels while changing the resolution is expected to be highly sensitive to their presence.

In this study, we propose to address the interplay between density homogeneity changes due to localized deformation and the ones due to resolution change. More specifically, we will show that this spatial property of a natural material such as sandstone can potentially be used to measure its pore throat diameter and cross section, optimize the observation of strain localization, and even tentatively relate the local density distribution pattern to the tortuosity of the propagating compaction bands.