Geophysical Research Abstracts
Vol. 12, EGU2010-2122-2, 2010
EGU General Assembly 2010

Determination of paleostresses from stylolite morphologies in the limestones of Bure-sur-Meuse

Alexandra Rolland (1,2), Renaud Toussaint (2), Jean Schmittbuhl (2), Patrick Baud (2), and Nathalie Conil (1)

(1) Andra, Parc de la Croix, 1-7 rue Jean Monnet 92298 Châtenay Malabry (alexandra.rolland@etu.unistra.fr, Nathalie.Conil@andra.fr), (2) Institut de Physique du Globe de Strasbourg (UMR CNRS 7516, EOST/UdS), Strasbourg, France (Renaud.Toussaint@eost.u-strasbg.fr, Jean.Schmittbuhl@eost.u-strasbg.fr, Patrick.Baud@eost.u-strasbg.fr)

In order to demonstrate the feasibility of a radioactive waste repository (HLW) in clay-stone formation, the French national radioactive waste management agency (Andra) started in 2000 to build an underground research laboratory (URL) at Bure in the south of the Meuse district. The target horizon for the laboratory is a 135 m thick layer of argillaceous rock (Callovo-Oxfordian claystone) that lies between about 420 and 555 meters below the surface at the URL site. The argillite layer (COX) is surrounded by limestones from the Dogger and the Oxfordian ages (respectively 164,7 to 175,6 Ma and 161,2 to 164,7Ma). Numerous stylolites were found present in the cores of these limestones, from around 378 m depth for the Oxfordian age and 719 m depth for the Dogger age. They were sampled and their morphology was precisely quantified with different techniques. Recent studies (Schmittbuhl et al., 2004; Ebner et al., 2008, 2009) suggest that paleotresses can be determined from the stylolites morphologies. The goal of this study is to obtain estimates of the paleostress field during the appearance of these stylolites, and thus constraints on the deformation kinematics of these formations.

Several stylolites were samples in the Dogger and Oxfordian formations. First, the trace of the stylolites along the core sides is investigated: high resolution photographs (at 47 microns resolution) are shot, digitalized and analyzed. From these photographs, the exact shape of the inner part of stylolites was extracted, and 1D function describing the stylolites boundaries is obtained. Next, 3D profilometry is performed to obtain a complete coverage at roughly micrometric resolution of the whole surface of the sides of opened stylolites spanning through the cores. The 1D and 2D geometries of the stylolites are analysed with correlation techniques as the Fourier Power Spectrum, the Average Wavelet Coefficient.

We look for scaling laws of the elevation of the stylolite height above its mean plane. The presence of different scaling laws at small and large length scales reflect the fact that elastic and surface tension forces are important respectively at large and small scales. The cut-off scale between two scaling regimes depends on the intensity of the elastic interactions, and thus on the stress imposed on the stylolite during its formation, and on the elastic properties of the material. The precise quantification of these scaling laws in the morphology, and the elastic properties allow to determine this formation stress. We will present the results from the application of these techniques to stylolites of the Dogger and Oxfordian formations in the cores of Bure.

Schmittbuhl, J., Renard, F., Gratier, J. P. & Toussaint, R. 2004. Roughness of stylolites: Implications of 3D high resolution topography measurements. Physical Review Letters 93, 238501

Ebner, M., Koehn, D., Toussaint, R., Renard, F., Schmittbuhl, J., 2008. Stress sensitivity of stylolite morphology. Earth and Planetary Science Letters, 277, 394

Ebner, M., Koehn, D., Toussaint, R. and. Renard, F., 2009. The influence of rock heterogeneity on the scaling properties of simulated and natural stylolites", J. Struct. Geol., 31, 72