Evolution of paleostresses with depth in the limestone formations at Bure (east of France) inferred from stylolite morphologies

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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 in these limestones. Recent studies show that paleotresses can be inferred from the stylolites morphologies. The aim of this work is to study the evolution of these paleostresses with depth in the Dogger and Oxfordian formations.

A wide range of stylolites are sampled in the Dogger and Oxfordian formations. The morphology analysis is done on stylolites at various depths, starting from the Oxfordian formation at a depth of 158 meters to the Dogger formation at a depth of 747 meters. No stylolites are found in the intermediate Callovo-Oxfordian claystone formation. We analyze 1D profiles taken on the outer part of the cores. The profiles are digitized by a simple reconstruction of high resolution photographs. We select the Fourier power spectrum method to analyze the frequency content of the stylolites. In agreement with theoretical predictions, we always observe two regimes for small and large scales separated by a cross-over length. The corresponding paleostresses are then inferred from this cross-over length and from the elastic properties of the rocks.

Considering several scenarios for the geological evolution of the area, we discuss the variation with depth of the inferred paleostresses in the Dogger and Oxfordian formations.