ESTIMATION OF SPATIAL TREND AND UNCERTAINTY OF CLAY CONTENT IN THE CALLOVIAN-OXFORDIAN CLAY FORMATION FROM A 3D HIGH RESOLUTION IMPEDANCE CUBE

Béatrice YVEN (Andra), Jean-Baptiste MATHIEU (KIDOVA), Michel H. GARCIA (KIDOVA)

The French National Radioactive Waste Management Agency (Andra) studies the Callovian-Oxfordian clay formation (COX) as potential host rock for a deep geological repository of radioactive waste. The clay content is the key parameter that controls the porosity, the texture as well as the main thermo-hydro-mechanical-chemical properties of the rocks. Until now, only the vertical variability of claystone parameters and properties has been thoroughly studied from available well and core data. The 3D characterization and modelling of rock properties is essential, however, to perform safety assessment of the repository and its geological environment, based on numerical simulations of expected flow, transport, mechanical and thermal phenomena.

This paper presents the methodology and the results that were obtained to estimate the clay content of the COX formation and the associated uncertainty from the available 40 km^2 3D seismic impedance cube that covers the potential location of a future repository. The particularity of this study is that no well, hence no rock data, are available within the zone where the clay content must be estimated. Relationships can be established, however, between the seismic impedances (P-waves and S-waves) and the clay content from faraway wells where both types of data are present.

The devised methodology addresses the following aspects:

1. Change of support issues to relate large scale seismic impedance data to small scale clay content data.

2. Multivariate statistical analysis issues to derive and extrapolate a “geophysical” estimate of the clay content from the 3D seismic impedance.

3. Bivariate statistical issues to infer and extrapolate a bivariate distribution model that fully and properly describes the non linear relationship between the “geophysical” estimate and the clay content. To do so, an innovative regression-based bivariate histogram smoothing method developed by KIDOVA was used.

4. Uncertainty estimation issues to quantify local uncertainty about clay content from previous bivariate distribution model.