Paleoweathering profile developed on homogenous sedimentary basement: an integrated approach from the CDB1 deep borehole (Rennes Basin, France).

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Weathering profiles are mostly studied on their upper part (crust, saprolite) where leaching and concentration/precipitation of valuable element occur. For water resource and hydrocarbon purpose, the transition between saprolite and fresh basement is of utmost importance. Here is found the fissured layer, a highly fissured bedrock that it favorable for aquifer/reservoir properties. Such aweathering profile model is well known on igneous and metamorphic rocks, but curiously very poorly documented on sedimentary, non-metamorphic, basement.

On behalf the CINERGY project, a 675m-long borehole (CDB1) was cored through the sedimentary infill (405 m), then the weathered basement (110 m) and finally the fresh bedrock (160 m). The basement is made of the “brioverianschists”, which actually are epimetamorphicshales and fine grained sandstones, highly folded and cleaved.

Here is presented an integrated (well-logging, mineralogy, petrography) study of the weathering profile that has been preserved under the sedimentary infill of the Rennes Basin.

The well logging tools include Gamma-Ray, long and short resistivity, neutron porosity, gamma-gamma density, Pef, Full wave Sonic, BHTV and caliper. The cores were regularly sampled for total rock and clay mineralogy and some petrographic control were realized on specific facies and fracture fillings.

The core description gives a first visual sequence of the weathering profile. From up to bottom, we observe a 1 m-thick interval of massive ochrish clays, followed by 0.7 m-thick of structured ochrish clays, becoming greyish downward. The clays tend to become harder downward, and from around 422 m to ~470 m, the shales look highly fractured. From 470 m to the bottom of the core, the rocks look very hard.

When looking at the physical parameters from the well logging, the interval boundaries do not look the same, and especially the saprolite/fissured layer boundary is very hard to point out, as the parameters show a gradual change all along the weathered profile. It is only towards 520 m that parameters (GR, sonic, resistivity) seem to reach a steady state, highlighted by the very monotonous lithology of the basement.

The clay mineralogy is made of kaolinite, illite and chlorite. Chlorite is dominant below 510 m whereas kaolinite becomes more abundant from this depth upward; illite looks quite constant throughout the core.

Petrographic control on the fracture fillings shows a polyphased precipitation of chloritic quartz, followed by carbonated (calcitic and dolomitic) and pyritized fillings. Oxidization of pyrite into goethite is observed even deep into the weathering profile (480 m).

These first results show that the classic model of weathering profile is not suitable for sedimentary basement, which is in this case made of argillaceous sediments which did not develop a real fissured layer and so did not allow the aquifer/reservoir layer to take place.

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