



Geochemistry and hydrogeochemical modeling of the unsaturated zone of geolocial carbonate formation

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The aim of this study is to understand physico-chemical weathering processes in the unsaturated zone. The study combines hydrogeological and hydrogeochemical data on pore water with information about solid phase composition of the unsaturated zone.

A monitoring station in the vadose zone is established in the Oligocene Aquitain limestone : the soil (0.40 meter thick) is lies on the Oligocene limestone (30 meters thick). The water table is 19.80 m average. A borehole with a diameter of 0.8 m is instrumented with “Teflon-quartz” cells (for the sampling of the pore water), with TDR probes (Time Domain Reflectometry) and SP (Self-Potential) electrodes (to measure the water content of the porous rock) and that all along the unsaturated zone. Chemically, the pH, alkalinity and the content of cations and anions are measured.

The dephasing and amplitude attenuation of the hydraulic wave with the depth can be modelled and explained by the physical properties of the porous medium in an unsaturated zone. Six to seven months are necessary for the water transfer in the Oligocene limestone.

The contents of cations and anions show variations with the depth. Results of chemical water analysis show that the unsaturated zone can be devided in three zones where the equilibrium of the calco-carbonic system can be moved with the precipitation or dissolution of dominating phenomena. The shallow zone down to a depth of seven meters corresponds to a zone with a significant decrease of mineralization (calcium, magnesium, sulfate) and evapotranspiration dynamic water. The second zone between seven to sixteen meters displays a high stability. The third zone (zone of capillary fringe) between sixteen to twenty meter shows a rise of certain ionic concentrations.

The saturation index for the calcite calculated from PHREEQC program as a function of depth gives both dissolution/precipitation processes in the carbonate rock.