

Localization, characterization and dating of water circulations in the soil-saprolite system of the Strengbach watershed: petrological, hydro-geophysical and geochemical evidences.

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The characterization of the critical zone along depth profiles remains a major scientific issue for understanding and modelling the response of continental surfaces to climatic, tectonic and anthropogenic forcings. Besides characterization it requires the modelling of the water circulations within the substratum of the critical zone. A series of boreholes drilled along the north and the south slopes of the Strengbach watershed makes it possible to characterize the critical zone to depths of ≈ 100 to 150 m within this critical zone observatory. In this study we attempt to combine mineralogical and petrological observations of the cores recovered through the drilling with chemical data of waters collected in each of these wells and hydro-geophysical data in order to characterize processes of water-rock interactions, visualize the water arrivals within the boreholes and bring new information on the deep water circulations within the watershed.

Mineralogical, petrological and hydrogeophysical data suggest that deepwater circulation in the watershed likely occurs along fractures, concentrated in relatively narrow areas, several centimeters wide, interspersed with areas where the granite is much less fractured. This points to the occurrence of deep waters circulating in a network of more or less independent conduits, which could extend over several tens to hundreds of meters deep. The hydrochemical data from the boreholes, show contrasting characteristics for surface waters collected at 10 to 15 m depth and the deeper waters collected between 50 to 80m depth; the surface waters are very similar to those of the spring waters collected in the watershed (Pierret et al., 2014), and the deeper waters collected between 50 to 80m depth. The residence times of the circulating waters are also very variable, with ages of up to a few months for surface and subsurface waters and ages exceeding several decades for the deep waters. These differences suggest that the subsurface circulation systems are quite different from the deeper circulation ones. They also point to the importance to focus future studies on deep-water circulations in order to properly characterize the functioning of the critical zone in watersheds, especially in mountainous areas, such as the Strengbach watershed.