



Heat-energy storage through semi-opened circulation into low-permeability hard-rock aquifers

Marie Pettenati (1), Olivier Bour (2), Jean-Yves Ausseur (3), Jean-Raynald de Dreuzy (2), Jérôme de la Bernardie (2), Eliot Chatton (2), Hervé Lesueur (1), Lorine Bethencourt (2), Bruno Mougín (4), Luc Aquilina (2), Florian Koch (4), Benoit Dewandel (5), Alexandre Boisson (1), Jean-François Mosser (6), and Hélène Pauwels (1)

(1) BRGM, Water, Orléans, France (m.pettenati@brgm.fr), (2) Géosciences Rennes - OSUR, University of Rennes 1, Rennes, France (olivier.bour@univ-rennes1.fr), (3) ANTEA GROUP, Olivet, France (jean-yves.ausseur@anteagroup.com), (4) BRGM, Direction Régionale Bretagne, Rennes, France (b.mougín@brgm.fr), (5) BRGM, Nouvelles Ressources en Eau et Economie, Montpellier, France (b.dewandel@brgm.fr), (6) SOLETANCHE BACHY, Rueil Malmaison cedex, France (jean-francois.mosser@soletanche-bachy.com)

In low-permeability environments, the solutions of heat storage are still limited to the capacities of geothermal borehole heat exchangers. The ANR Stock-en-Socle project explores the possibilities of periodic storage of sensitive heat¹ in low-permeability environments that would offer much better performance than that of borehole heat exchangers, especially in terms of unit capacity. This project examines the storage possibilities of using semi-open water circulation in typically a Standing Column Well (SCW), using the strong heterogeneity of hard-rock aquifers in targeting the least favorable areas for water resources.

To solve the main scientific issues, which include evaluating the minimum level of permeability required around a well as well as its evolution through time (increase and decrease) due to water-rock interaction processes, the study is based on an experimental program of fieldwork and modelling for studying the thermal, hydraulic and geochemical processes involved. This includes tracer and water-circulation tests by injecting hot water in different wells located in distinct hard-rock settings (i.e. granite and schist) in Brittany, Ploemeur (H+ observatory network) and Naizin. A numerical modelling approach allows studying the effects of permeability structures on the storage and heat-recovery capacities, whereas the modelling of reactive transfers will provide an understanding of how permeability evolves under the influence of dissolution and precipitation. Based on the obtained results, technical solutions will be studied for constructing a well of the SCW type in a low-permeability environment. This work will be completed by a technical and economic feasibility study leading to an investment and operations model. This study aims to describe the suitability of SCW storage for shallow geothermal energy. In order to reach these objectives, Stock-en-Socle is constructed around a public/private partnership between two public research organizations, Géosciences Rennes and BRGM, and two companies, Antea Group and Soletanche Bachy, experts in groundwater and geothermal energy.

¹Sensitive heat: modifies the temperature of water and its surrounding solids without modification of physical properties, as opposed to latent heat that causes a phase change, such as vaporization.