A review of the petrophysical properties of the granite reservoir and overlying sedimentary units (Buntsandstein and Muschelkalk) from the Soultz-sous-Forêts geothermal site (France)

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Abstract

Geothermal energy projects within the Upper Rhine Graben, a 350-km-long and 50-km-wide Cenozoic rift valley, exploit anonymously high geothermal gradients (> 80 ∘C/km) that are attributed to crustal thinning and efficient large-scale hydrothermal convection. Indeed, more than fifteen geothermal wells have been drilled in the Upper Rhine Graben since the 1980s. The geology of the region consists of a fractured granitic basement overlain by a sequence of Permian and Triassic sedimentary rocks (Buntsandstein, Muschelkalk, and Keuper), Jurassic sedimentary rocks, and Tertiary to Quaternary graben fill. The petrophysical properties of the fractured granitic reservoir and the Buntsandstein and Muschelkalk units, sampled from exploration borehole EPS-1 at the Soultz-sous-Forêts geothermal site (France), has been the subject of a collection of recent studies. Such petrophysical data are of value for reservoir prospection, stimulation, and optimisation strategies at existing and prospective geothermal sites throughout the Upper Rhine Graben. We present here a review of the petrophysical properties of these rocks (e.g., density, porosity, permeability, P-wave velocity, Young's modulus, uniaxial compressive strength, thermal conductivity, and thermal diffusivity), and a detailed description of their microstructure and mineralogy, and outline methods available to upscale these laboratory measurements to scales more suited to large-scale modelling designed to better understand, for example, large-scale fluid circulation and borehole stability.

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