Geophysical Research Abstracts
Vol. 17, EGU2015-5183-1, 2015
EGU General Assembly 2015

Permeability enhancement by shock cooling

Luke Griffiths (1), Michael Heap (1), Thierry Reuschlé (1), Patrick Baud (1), and Jean Schmittbuhl (2)

(1) Équipe de Géophysique Expérimentale, Institut de Physique de Globe de Strasbourg (UMR 7516 CNRS, Université de Strasbourg/EOST), 5 rue René Descartes, 67084 Strasbourg cedex, France (heap@unistra.fr), (2) Équipe de Sismologie, Institut de Physique de Globe de Strasbourg (UMR 7516 CNRS, Université de Strasbourg/EOST), 5 rue René Descartes, 67084 Strasbourg cedex, France

The permeability of an efficient reservoir, e.g. a geothermal reservoir, should be sufficient to permit the circulation of fluids. Generally speaking, permeability decreases over the life cycle of the geothermal system. As a result, is usually necessary to artificially maintain and enhance the natural permeability of these systems. One of the methods of enhancement—studied here—is thermal stimulation (injecting cold water at low pressure). This goal of this method is to encourage new thermal cracks within the reservoir host rocks, thereby increasing reservoir permeability. To investigate the development of thermal microcracking in the laboratory we selected two granites: a fine-grained (Garibaldi Grey granite, grain size = 0.5 mm) and a course-grained granite (Lanhelin granite, grain size = 2 mm). Both granites have an initial porosity of about 1%. Our samples were heated to a range of temperatures (100-1000 °C) and were either cooled slowly (1 °C/min) or shock cooled (100 °C/s). A systematic microstructural (2D crack area density, using standard stereological techniques, and 3D BET specific surface area measurements) and rock physical property (porosity, P-wave velocity, uniaxial compressive strength, and permeability) analysis was undertaken to understand the influence of slow and shock cooling on our reservoir granites. Microstructurally, we observe that the 2D crack surface area per unit volume and the specific surface area increase as a result of thermal stressing, and, for the same maximum temperature, crack surface area is higher in the shock cooled samples. This observation is echoed by our rock physical property measurements: we see greater changes for the shock cooled samples. We can conclude that shock cooling is an extremely efficient method of generating thermal microcracks and modifying rock physical properties. Our study highlights that thermal treatments are likely to be an efficient method for the "matrix" permeability enhancement of granitic geothermal reservoirs.