



Numerical modeling of the transient hot disk method for rock thermal property measurements

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The transient hot disk (TPS) method developed by the Swedish physicist, Prof. Gustafsson (1991), can measure thermal conductivity, thermal diffusivity, and volumetric heat capacity on various samples including rock samples. In the TPS method, the hot disk sensor produces heat as a source and measures temperatures to calculate thermal properties. The main advantages of the TPS method include wider thermal property ranges, wide ranges of material types (solid, liquid, and powder), fast measurement, and high accuracy.

In this study, we conducted a series of numerical modeling of the TPS using COMSOL Multiphysics to evaluate applicability of the TPS method to rock samples that are heterogeneous. If the diameter of the cylinder-like sample is greater than 3 times of the diameter of the hot disk sensor, relative errors are less than 2% in thermal conductivity, less than 4% in thermal diffusivity, and less than 6% in volumetric heat capacity. In addition, if the length of the sample is greater than 4 cm, relative error of thermal conductivity is less than 3%; that of thermal diffusivity is less than 2% and relative error of volumetric heat capacity is less than 1%. The numerical modeling study also proved that the TPS method can measure thermal properties on composite rock samples with acceptable accuracy. As the result, the TPS method can be applied for thermal property measurements on various heterogeneous rock samples.