Geophysical Research Abstracts
Vol. 15, EGU2013-9219, 2013
EGU General Assembly 2013

Rock thermal conductivity as key parameter for geothermal numerical models

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The geothermal energy applications are undergoing a rapid development. However, there are still several challenges in the successful exploitation of geothermal energy resources. In particular, a special effort is required to characterize the thermal properties of the ground along with the implementation of efficient thermal energy transfer technologies. This paper focuses on understanding the quantitative contribution that geosciences can receive from the characterization of rock thermal conductivity.

The thermal conductivity of materials is one of the main input parameters in geothermal modeling since it directly controls the steady state temperature field. An evaluation of this thermal property is required in several fields, such as Thermo-Hydro-Mechanical multiphysics analysis of frozen soils, designing ground source heat pumps plant, modeling the deep geothermal reservoirs structure, assessing the geothermal potential of subsoil.

Aim of this study is to provide original rock thermal conductivity values useful for the evaluation of both low and high enthalpy resources at regional or local scale. To overcome the existing lack of thermal conductivity data of sedimentary, igneous and metamorphic rocks, a series of laboratory measurements has been performed on several samples, collected in outcrop, representative of the main lithologies of the regions included in the VIGOR Project (southern Italy). Thermal properties tests were carried out both in dry and wet conditions, using a C-Therm TCi device, operating following the Modified Transient Plane Source method.Measurements were made at standard laboratory conditions on samples both water saturated and dehydrated with a fan-forced drying oven at 70 ˚C for 24 hr, for preserving the mineral assemblage and preventing the change of effective porosity. Subsequently, the samples have been stored in an air-conditioned room while bulk density, solid volume and porosity were detected.

The measured thermal conductivity values of rocks and loose materials have been validated by comparison with data published in the international literature.