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Geological and thermal exploration for an evaluation of the geothermal potential of Luxembourg

Tom Schintgen and Andrea Förster

Deutsches GeoForschungsZentrum GFZ, Section 4.1 Reservoir Technologies Telegrafenberg 14473 Potsdam, Germany (tom.schintgen@gfz-potsdam.de)

In 2010, work has commenced on the evaluation of the geothermal potential of Luxembourg. The concept of this evaluation comprises several steps. Given the limited amount of geological data and the lack of petrothermal data as well as on crustal heat flow, in-depth studies are needed that allow a comprehensive insight into the shallow as well as deep thermal subsurface structure and thus to make temperature prognoses for the use of geothermal energy. Here we report the geological structure of the Mesozoic Trier-Luxembourg Basin (TLB) with its various lithological units as well as the geology of the underlying basement units. The thickness of the Mesozoic section increases from 400-500 m in the northeastern part of the basin to a maximum of 1100 m in the southern part of Luxembourg. New data on thermal parameters, such as the thermal conductivity (TC), radiogenic heat production (RHP) and porosity are presented for the major lithotypes of the TLB as well as of the underlying Paleozoic basement. These data originated from core samples (Mesozoic formations) and from sampling of outcrops of Luxembourg's surroundings (Paleozoic formations). Thus data are now available for an up to 13-km-thick succession of the upper crust, comprising the Lower Cambrian to the Middle Ordovician, the relatively thick Lower Devonian and the Triassic to Liassic of the TLB. For the remainder of the crust down to the Moho thermal properties are determined by translating seismic velocities into rock types and using average values for TC and RHP for these metamorphic and igneous rocks. Based on the new values of TC and a temperature log measured under thermal equilibrium in a 300-m deep borehole, surface heat flow was determined. These data form the basis for modeling the subsurface temperatures along two regional crustal cross sections, which cover most of the Rhenohercynian Zone of the Variscan orogenic belt. They extend from the Lower Paleozoic Stavelot Massif in the Belgian Ardennes in the north-west to the Saar-Nahe (or Saar-Lorraine) Basin in the southeast. The results obtained from the thermal model will provide basic information for future geothermal exploration and different types of geothermal use.