



Geothermal assessment: a regional approach, available tools and research frontiers

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Keywords: geothermal assessment, multi-disciplinary approach, resource potential, data organization

ABSTRACT

Geothermal energy is seldom considered in energy planning at national and regional levels in Europe and worldwide. Principal reasons are the relative lack of specific incentives and the rather difficult and lengthy regulation, which add to the risk related to the development of a project. A fundamental aspect of any energy policy and investment is the certainty around assessment of the energy resources, including geothermal. Therefore, a key requirement for further exploiting geothermal energy by increasing the number of projects as well as the variety of uses is to clearly identify and rank resources and opportunities.

To minimize the exploration risk and the cost for reservoir development on one hand, and to maximize the profitability and the reservoir sustainability on the other hand are key objectives of the Sub program "Assessment of Geothermal Resources" in European Energy Research Alliance – Joint Program on Geothermal Energy (EERA-JPGE).

The assessment of geothermal resource is a recursive and scale-based process. The integration of existing data allows to identify the most perspective areas, on which exploration activities have to be consequently carried out to obtain new and more detailed data. Therefore, a new and refined resource evaluations guarantee a higher accuracy level of the geothermal resource knowledge. The same recursive approach can be applied from the continental scale up to the local (lease area) scale of investigation. Naturally, different scales imply different data typology and detail.

The investigation and assessment of geothermal resources rely not only on direct underground geological data, mainly from wells, but also require their integration, with indirect sources, from geological, geochemical and geophysical surveys and remote sensing data. The integrated analysis and visualization of multiple types of datasets, also in a tri-dimension way, improve and constrain the exploration.

Historically, maps of terrestrial heat flow and of temperature distribution at different depths were used to pinpoint areas potentially important for geothermal development. Recently a more accurate resource mapping is required not only by stakeholders for the preparation of feasibility study and the documentation for research and permit leases or to compare technical reports but also by administrations and associations for preparing regulations and dissemination of information and opportunities.

Mainly at continental and regional scale, Geographical Information Systems (GIS) software provide tools for the spatial analysis of multiple parameters to assist selection of prospective sites, based on pre-defined criteria. The concept of *favourability* is currently widely used in literature as a fully integrated analysis able to classify the most interesting prospecting areas. In applying GIS tools, the conceptual model plays a crucial role in the choice of layers (parameters) that will be involved in the favourability map computation. The layers are usually ranked and weighted using statistical criteria or estimated on the basis of expert opinion, referred to as "data-driven" or "knowledge-driven" models respectively. Favourability maps should be not confused with the geothermal potential maps, which provide a quantitative assessment of the geothermal resources.

Various approaches, taking into account data from deep regional reservoirs (e.g., temperature, petrophysical parameters and flow properties) based mainly on hydrocarbon industry data, have been used to calculate the geothermal potential and to provide a major resource base of geothermal energy for direct heat and power production. Currently, the geothermal community is working on defining a common protocol to estimate performance by using coded parameters and to reduce mining risk.

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Data access is an important step to help scientists, stakeholders, investors and geothermal developers, and the basis for a more accurate resource assessment and feasibility studies. Although many initiatives in Europe collect and organize geothermal data for different purpose and at different scale, usually this information is not easily accessible for different reasons (i.e., authorizations and licences, format and data type, ...). For example, scientists, operators or consultants organize and use geothermal databases, which contain underground data and provide maps (e.g. temperature and heat flow distributions), which are seldom accessible to the public. Regional, national and European administrations produce, collect and organize regulations, documents, reports, descriptions and maps of geothermal leases and authorizations, together with energy production values. Promote the access to geothermal information at the European level via the development of an Information Platform, creation of standard and common data model at EU level and harmonization of national data to speed up data discovery and mining is considered a priority for the next future.