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Prospecting and Developing Geothermal High-Enthalpy Fields for Power Production - Development of an FP7 Proposal for a Project in Turkey -

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2 Executive Summary

To support and increase the development of electricity production from geothermal sources, GGE (Applied Geophysics and Geothermal Energy) initiated and was instrumental in submitting a proposal in the EU's seventh Research Framework Programme (FP7). The final goal of the project was to build a geothermal power plant (of ~3 MWe) for a low-to-medium enthalpy reservoir in Turkey and demonstrate the viability of an economically working facility making use of optimized procedures for each phase of the installation.

The content of this project was the preparatory work to pave the way for the submission of a proposal to the EU. A consortium was brought together, research aspects were defined, a financial plan developed, and the proposal composed. The final proposal was submitted jointly by ZORLU Energji (Turkey) and E.ON Engineering (UK).

Turkey's rich geothermal resources are used only sparsely for electricity generation. Thus, Turkey is one of the most promising countries to develop, test, and apply new methodology for the exploration, development, and operation of geothermal reservoirs. The basic idea was to apply techniques developed in a separate ongoing research project to a reservoir in the Simav region, creating a universal approach applicable to many other locations in Europe.

Within the scope of this project, GeoPoT (Geothermal Power in Turkey), a strong and experienced consortium was composed consisting of partners from industry (E.ON Engineering (D/UK), Zorlu Enerji (TR), General Electric (USA/D/I), CAPD (TR), Geophysica (D)) and academia (TÜBITAK MRC (TR), BRGM (F), CNR (I), TUM (D), RWTH (D), see also table 1). The different main objectives were addressed in the fields of exploration, development, energy conversion, and field operation. However, common to all are the aspects of cost reduction and increase of efficiency of this technology to penetrate the market on a large scale. One major task was to reduce the high investment costs ahead of an economic production well as 50 % to 65 % of the costs of geothermal plants are associated with the drilling of the wells.

The overall aim of the project was to optimize the exploitation of geothermal reservoirs in all relevant aspects and develop an integral concept for the management of geothermal resources. Also important was strengthening of international cooperation among the partners of our conclusive multinational team. This EU-project was to form the perfect platform to make the general public aware of the potential of geothermal energy and to broadcast the key messages to policy and decision makers. Our industry partners had credible plans for exploitation and replication of the expected results and were to demonstrate their ability to exploit this potential.

Our approach was based on a novel strategy for exploration, using prognostic simulation tools with risk assessment capabilities. First, an initial model of the subsurface was to be set up using all available data. Then, numerical simulations were to optimize the locations of the exploration wells and quantify uncertainty. Using information from these wells to update the model, boreholes would have been optimized iteratively until sufficient certainty was obtained for locating and drilling production wells.

As there is also a lack of mature and standardized products and procedures to exploit a geothermal reservoir, the project also dealt with optimum power conversion. A laboratory experiment was to study heat transfer under supercritical conditions for a range of suitable working fluids, a major uncertainty for the design of heat exchangers. We planned to analyze the suitability of a number of software tools for modeling geothermal power conversion plants. This information was to allow decisions to be made for other potential sites.

Further, the group of Prof. Madlener (FCN) planned to optimize the plant economically by developing a generic economic-geo-engineering model for optimal extraction from a geothermal reservoir and optimal plant operation, and apply it to the Simav region.

Another topic was to develop and compare in view of economical aspects a site-specific and modular version of technical specifications.

Finally, since the reservoir is located in a seismically active region (see Figure below) it was essential to address seismic risk assessment, even though no active reservoir stimulation was intended.

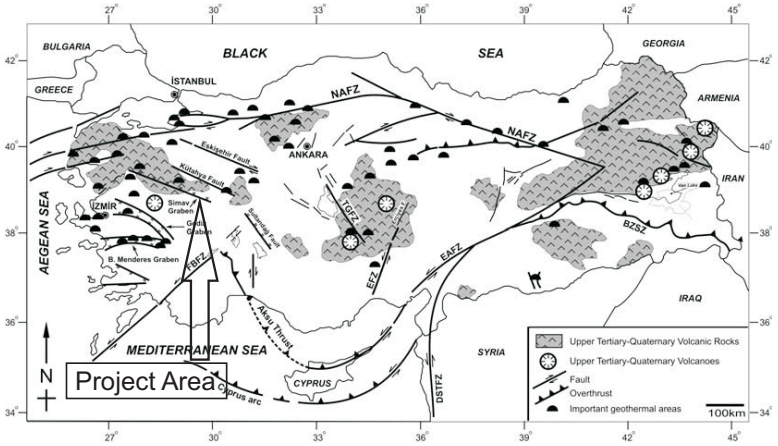

Fig. 1: Tectonic features of Turkey (Aydin et al., 2005)



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