STUDY ON ENHANCED GEOTHERMAL SYSTEM IN CHINA

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ABSTRACT

Chinese and Australian geothermal experts carried out cooperatively project of "Research on Geothermal Resources of Enhanced Geothermal System (EGS) in China" in recent years. Under the effect of "The Future of Geothermal Energy" research report completed by Massachusetts Institute of Technology, some national owned large Chinese energy enterprises have put EGS study and development into their programming, and as strategic reserved resources. Some private enterprises are also interested in EGS investment and development. Some of them had carried out feasibility study and geophysical survey. A new Sino-German cooperation project is actively prepared. Ministry of Land and Resources has arranged study fund. Ministry of Science and Technology has preliminarily approved a study project. Chinese geothermal workers will work hard for the EGS study and engineering implementation.

Keywords：Enhanced Geothermal System, EGS, study, China

1 INTRODUCTION

Massachusetts Institute of Technology completed the research report "The Future of Geothermal Energy --- Impact of Enhanced Geothermal System [EGS] on the United States in the 21st Century" in 2006. US Department of Energy organized the consequent report "An Evaluation of Enhanced Geothermal System Technology" in 2008. It summarized the great potential of EGS. It will provide 100 GWe of base-load electric-generating capacity by 2050 in US. The total EGS resource base is more than 13 million exajoules (EJ). The extractable portion exceeds 200,000 EJ or about 2,000 times the annual consumption of primany energy in the United States in 2005. Such attractive huge energy potential had caused attention of US DOE. The US President Obama had granted further research fund. Such impact had induced a new upsurge on EGS study worldwide. Of course the wave had also affected in China.

Geothermal Council of China Energy Society (GCES) and Petratherm Ltd (Australia) had completed a cooperation research project "Research on the potential of Enhanced Geothermal Systems (EGS) in China". It had selected work target for further research and test. Chinese large national-owned energy enterprises such as China National Petroleum Corp. (CNPC), Sinopec, State Grid, China Datang Corp. etc. had put EGS into their development programming as strategic reserves of energy. Some private enterprises had also been interested in EGS development. Some of them had carried out feasibility study for EGS resources selection. Some of them had carried out geophysical survey and intent to start test drilling. Ministry of Land and Resources had arranged fund to support EGS study. Ministry of Science and Technology will also approve application studies.

2 STUDY ON EGS RESOURCES POTENTIAL

Enhanced geothermal system (called as hot dry rocks before) had only individual scholar's study on data and references before. About several papers published in journals or conferences.

Petratherm Ltd managers followed their Australian Premier visited in China in 2006. Widespread contact and exchange were undertaken between Australian and Chinese experts. In 2007 a cooperation agreement was signed between Petratherm Ltd and Geothermal Council of China Energy Society. The research project is named "Research on Geothermal Resources of Enhanced Geothermal System in China". The cooperation project gained fund support from China Geological Survey (CGS) in meantime. Chinese geothermal experts came from GCES, CGS, China Institute of Geo-Environment Monitoring (CIGEM), Geology and Geophysics Institute of Chinese Academy of Science (CAGGI)

and so on institutions. Australian experts also included professor of Adelade University. At the beginning of the project both sides selected key areas of work. One is Tibet to western Yunnan province which belongs to the eastern section of Mediterranean-Himalaya geothermal zone. The other is southeastern coast area; say Fujian, Guangdong and Hainan etc.. Both sides collected, processed and analyzed a lot of concerned data, including geology, geophysics, geochemistry, heat flow detection, hot spring distribution and so on. We also collected granite samples for detection of U, Th and ^{40}K radioactive contents. Computer modeling and GIS mapping were used. Both sides investigated geothermal manifestations and drilling results. It is also to discuss and exchange with local geothermal experts. Finally we selected 4 piece of areas in Hainan, Guangdong and Fujian provinces (Fig.1). And it is also considered for Jiangsu province.

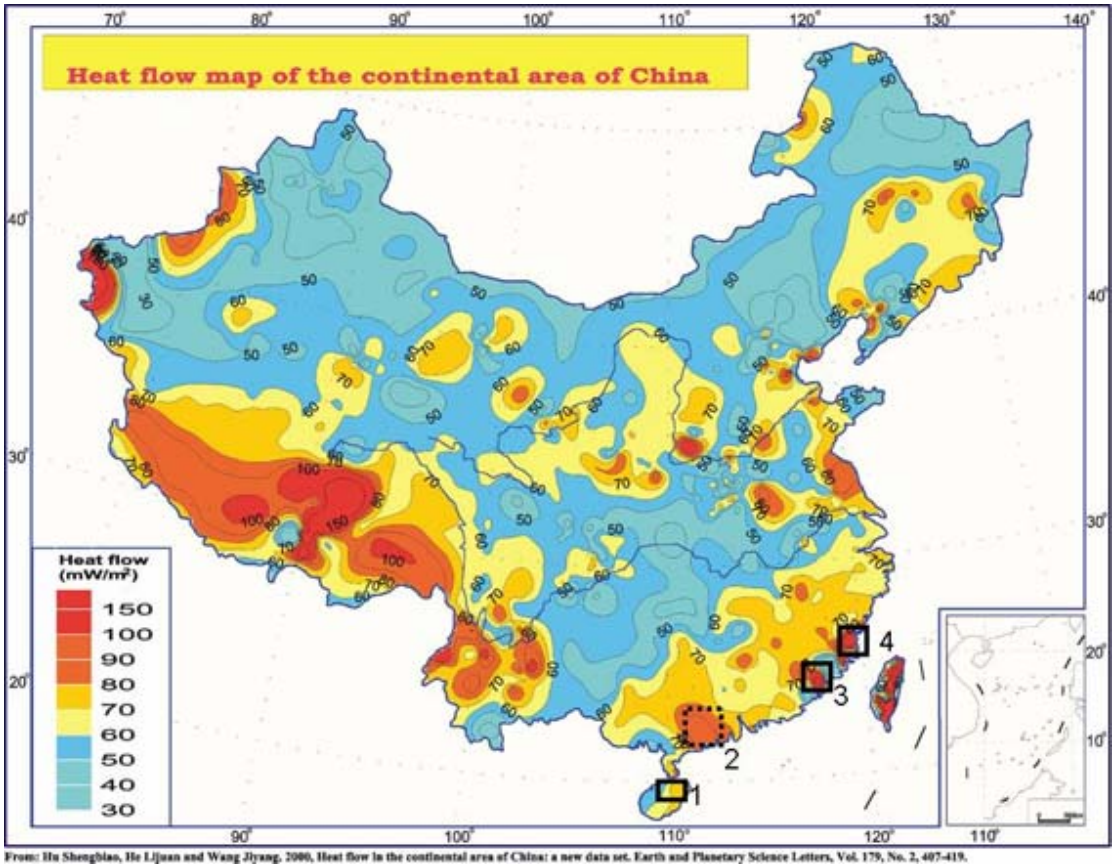

Fig. 1 Heat Flow Map of China with Selected EGS Potential Regions
(1-NE Hainan, 2-Yangjiang, 3-Zhangzhou, 4-Fuzhou)

Preliminary EGS study has been carried out in China. In 2007 Geothermal Council of China Energy Society (GCES) and Petratherm Ltd (Australia) signed a cooperation agreement to jointly undertake the project "Research on the potential of Enhanced Geothermal Systems (EGS) in China". In 2008 experts of both sides had carried out investigation in some potential areas. Further testing analysis and model studies combined with geological and geophysical data are also researched. In 2009 Chinese experts investigated Australian EGS projects, including 4,000 m well drilling and micro-audio monitoring by Petratherm Ltd, and EGS double wells circulation test by Geodynamics. This test had produced steam at temperature 175°C and 1 MW pilot plant had completed. Just due to accident of wellhead casing broken it didn't produce electricity. Such successful experience and undergone setback give us valuable reference. Australian scientists gave their huge result that the EGS potential is 26,000 time of primary energy use in 2008 in the country.

In April 2010 High-Technology Research and Development Bureau of Chinese Academy of Science hosted the EGS

Symposium for the first time in China. Experts and scholars from home and abroad carried out professional exchange and discussed feasibility of EGS development in China

3 PROGRESS OF EGS ENGINEERING IMPLEMENTATION

The great potential of EGS resources and the superiority of geothermal power generation (the maximum capacity factor in all renewable energies) have also extracted eyeballs of Chinese developers. They came to Geothermal Council of China Energy Society (GCES) for consulting. Some of them have carried out feasibility study for EGS resources selection. Some Chinese developers have been unable to hold themselves back. China Geothermal Power Generation Co. Ltd. and its branches have founded in 2010. Individual companies have selected working site to prepare test drilling. Fujian Tianhua Energy Science Co. Ltd. has carried out geophysical CSAMT survey in its base in Jinshui town of Jinjiang city. The survey report has passed demonstration by experts. The first exploration drillhole is preparing to start drilling.

German HarbourDom GmbH geothermal resources company and Bochum University had contacted GCES via International Geothermal Association (IGA). A new Sino-German EGS cooperation project has been preparing. Chinese delegation visited in German in April 2011. German side introduced the status of EGS study. Delegation visited EGS test in Landau and Soultz sites. The officer of MLR has written the “Letter of Interest” to German side to express support. German side will get support in international project of climate change in Ministry of Environment. German government will approve fund support for the cooperation.

4 NATIONAL EGS RESEARCH PROJECTS

Relevant institutions of research and exploration jointly submitted a project application to the China Geological Survey and the Ministry of Land and Resources. Based on Sino-Australia cooperation research we need a deepening study including geology, geophysics, deep well drilling, and artificial stimulation etc. topics. It is hoped that an evaluation report on EGS, such as "The Future of Geothermal Energy" in USA, can be completed within a few years to provide the country reference for energy policy and energy planning. In addition, deep geophysical survey and consequent drilling test should be carried out. This project application has passed demonstration by experts. It will be implemented during the 12^{th} Five-year Plan.

A geothermal union combined by university, institute, geological institution and private enterprise has also submitted a project application, named China key technology of EGS research, to Ministry of Science and Technology (MOST). The project has been passed expert’s review. It is possible to be commenced recently.

5 PROSPECTS OF EGS DEVELOPMENT IN CHINA

The project “Research on mid- and long-term energy development strategy in China” has been completed by the Chinese Academy of Engineering, in which more than 50 academicians of CAE participated. The report appointed out that the development of renewable energy in China is aimed at large-scale alternative to fossil fuels, reducing carbon emissions and reducing dependence on foreign energy. Strategic objectives are that for non-hydro renewable energy strategic positioning is: to be supplemental energy (around 2010), to provide 60 million tons of standard coal equivalent, accounting for around 2% of the total energy demand; to be an alternative energy sources (around 2020), to provide 180 million to 330 million tons of standard coal equivalent, accounting for 5-10% of the total energy demand; to be one of the mainstream sources of energy (around 2030), to provide 400 million to 800 million tons of standard coal equivalent, accounting for around 10-19% of the total energy demand; and to be one of the leading forms of energy (around 2050), to provide 880 million to 1,710 million tons of standard coal equivalent, accounting for around 17-34% of the total energy demand. For geothermal energy, geothermal power generation and direct heat use are included in this strategy (mainly for building heating).

Chinese Academy of Science has also completed the “Road Map on China Energy Science Development to 2050”.

Large scale renewable energy power generation has been programmed. It includes conventional geothermal power generation and EGS power generation.

All in all, based on imposing target of energy saving and emission reduction, renewable energies development including geothermal energy has been attached importance in China. In the 2011 Press Conference on Achievement for Replying Global Warming and Energy Saving & Emission Reduction, Ministry of Land and Resources (MLR) had declared that geothermal resources survey and research projects had been arranged. They include deep geothermal resources (EGS), conventional geothermal and shallow geothermal resources. Chinese geothermal workers will follow the world tide to contribute hard work to strive for successful EGS development.

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