

Geothermal Research and Current Development of Geothermal Energy in Vietnam

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ABSTRACT

In Vietnam, geothermal energy has been researched since the 1980s. There were some geothermal projects carried out to estimate the geothermal potential in the areas of northwest Bac Bo, north Trung Bo and south Trung Bo of Vietnam. Geological, hydro geological, and geochemical methods were applied for these investigations. Some geothermal sources such as those in Na Hai and Pomlot in the Dienbien province were studied in more detail using methods of geophysics to locate faults and determine the scale of geothermal sources. As a result of these projects, potential geothermal sources for generating heat and electricity were estimated and classified.

Current geothermal development in Vietnam discussed in this paper is primarily for direct use and not for electricity generation.

1. INTRODUCTION

At present, Vietnam is a developing country in the Southeast Asia. As is the case all over the world, the energy demand in Vietnam is growing, and energy production is not meeting this demand. Therefore, in addition to traditional energy sources such as coal, oil, gas and hydropower, the Vietnamese government supports the study of renewable energy sources including geothermal energy. Geothermal investigations allowed the selection of prospective geothermal sources and the suggested uses for these sources.

2. GEOTHERMAL RESEARCH IN VIETNAM.

There are 273 thermal water sources in Vietnam. These thermal water sources have been known since the 1920s. At that time, surveys and investigations of thermal water sources were carried out with the purpose of using them for mineral water and medical treatment. The results of those surveys and investigations showed some preliminary characteristics of the sources: superficial geological formations, fault systems, physical characteristics of the hot water and some of its chemical components (mainly anions HCO_3^- , SO_4^{2-} , Cl^- and cations K^+ , Na^+ , Ca^{++} , Mg^{++}). The geothermal manifestations can be divided into two categories: hot water sources exposed at the surface in mountainous regions and sources discovered by drilling wells in the plains at the depths of 40-1300 m with temperatures up to 155°C.

Since the 1980s, the Government of Vietnam has increasingly investigated new sources of energy such as wind, solar, and geothermal energy. Some foreign specialists such as A. Dadaia from France and Koenig J from the United States were invited to evaluate the geothermal potential in Vietnam.

In 1984, the Vietnamese government funded its first geothermal project, named "Evaluation of geothermal sources serving as the basis for their exploitation and utilization for energy purposes in some prospective areas." The project was carried out by compiling existing data with preliminary surveys at Hoi Van and My Lam geothermal sources.

On the basis of the tectonic regions, the authors of this project divided Vietnam into 6 geothermal regions: North West Bac Bo, North East Bac Bo, Bac Bo plain, North Trung Bo, South Trung Bo and Nam Bo.

From 1993 to 2005, the Vietnam Institute of Geosciences and Mineral Resources worked on 4 geothermal projects:

- Evaluation of geothermal potential in the territory from Quang Nam – Da Nang to Ba Ria – Vung Tau
- Evaluation of geothermal potential in the North West Bac Bo region
- Evaluation of geothermal potential in the North Trung Bo region
- Evaluation of the feasibility of geothermal development in specific sites for industrial scale projects

The project teams investigated the thermal water sources in the areas of interest as superficial manifestations of the deep-seated geothermal systems.

During field investigations, rock and water samples were taken for analysis. These activities explained the geological conditions, tectonic systems, magma, and geochemistry in these geothermal areas. Temperatures in these geothermal systems were determined using Na - K (Fourier, Giggenbach), SiO_2 (Fourier and Potter), and Na - K - Ca (Fourier and Truesdell) geothermometers in the range 95–210°C.

The origin of geothermal fluid in the geothermal sources was determined to be meteoric. Geothermal fluids of almost geothermal systems plotting in diagram of Cl , SO_4 , HCO_3 (Giggenbach, 1988) are in the area of peripheral water. Some geothermal sources located near the sea have positions in the area between mature and volcanic water. The values of δD and $\delta^{18}\text{O}$ for the geothermal water samples taken and analyzed are shown in Figure 1. As can be seen in this figure, their positions are near the meteoric line.

The dimensions of geothermal systems were determined on the sites of prospective sources to a depth 100 m using geophysical methods. As a result of this geothermal research, prospective geothermal sources in Vietnam were chosen, as shown in Tables 1 and 2.

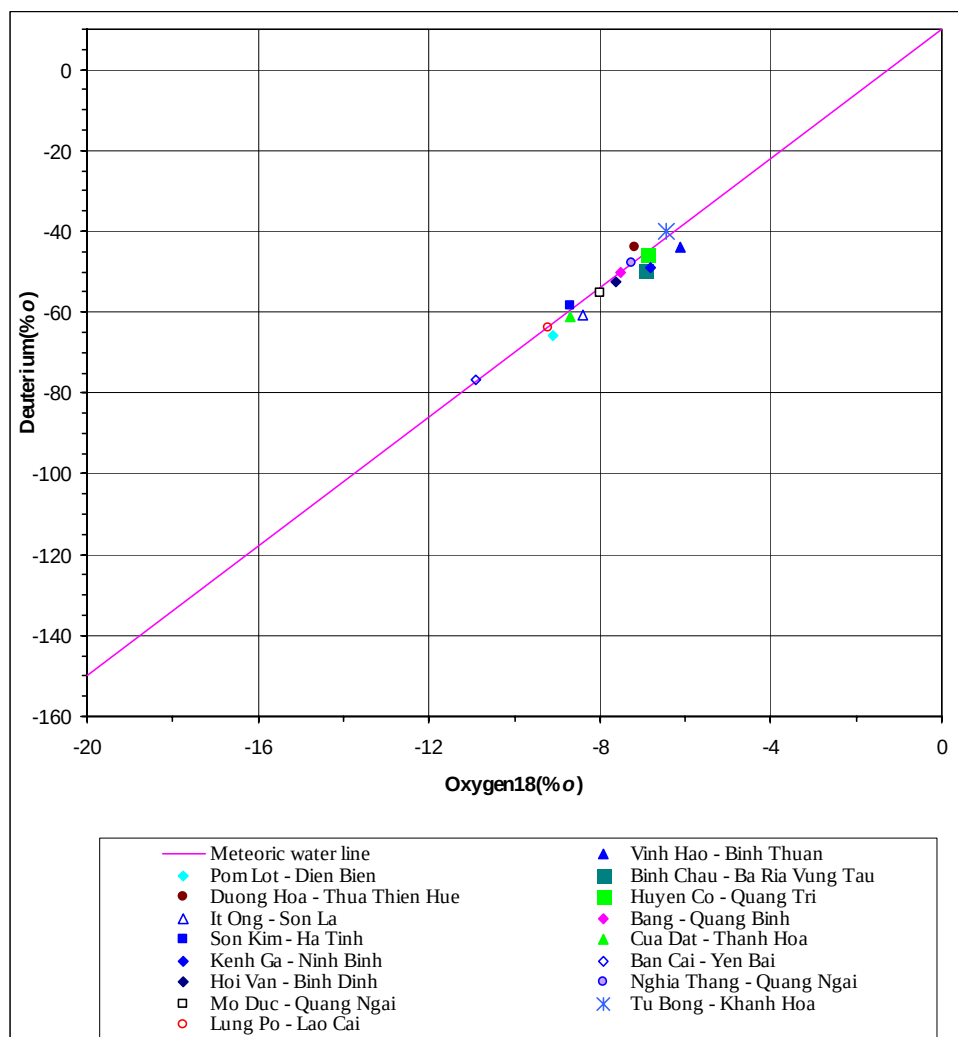


Figure1: δD and $\delta^{18}O$ of water samples in some geothermal sources

For the purpose of the promotion of geothermal energy, the Vietnamese government accepted investments from ORMAT for the exploration and exploitation of geothermal energy sources in the Trung Bo area for electricity generation. On the basis of data from geothermal projects and the results of the sampling, field investigations were carried out at 6 geothermal sources: Bang, Tu Bong, Hoi Van, Danh Thanh, Mo Duc, and Nghia Thang. ORMAT determined the total output of geothermal factories of these sources to be 112.7 MW.

In recent years, German and Vietnamese scientists evaluated the possibility of the use of geothermal sources (mainly in Trung Bo region) and suggested using the Hoi Van geothermal source for electricity generation.

3. UTILIZATION AND CURRENT DEVELOPMENT OF GEOTHERMAL ENERGY

In Vietnam, the utilization of geothermal energy is still small in scale. In 1983, research was performed on using geothermal energy in the My Lam geothermal source in the Tuyen Quang province for the drying of agricultural products such as sliced cassava, tea, etc. The results obtained were very encouraging. After 1.5 hours of drying, the water content of fresh tea was reduced by 13%, meeting the

requirement of the tea processing technology. After 26 hours of drying, the water content of sliced cassava was reduced from 60% to 25%.

Table1: Prospective geothermal sources in Vietnam by region.

Geothermal regions	Number of geothermal sources	Temperature calculated using geothermometers	Number of prospective geothermal sources
NW Bac Bo	82	103-200	10
NE Bac Bo	12	95-146	2
Bac Bo plain	17	100-150	5
North Trung Bo	42	120-210	4
South Trung Bo	67	110-200	14
Nam Bo	53	150	-
Total	273		35

The experimental drying of many kinds of agricultural products such as bananas, coconuts, and medicinal herbs were also carried out at the Hoi Van geothermal source in the Binh Dinh province. After 5 -10 hours drying, all products were well dried, meeting the requirements for long term conservation.

Although investigations of geothermal energy utilization at the My Lam and Hoi Van geothermal sources were carried out without proper facilities and finance (i.e. using defective, locally produced drying equipment), they have demonstrated the enormous potential of using geothermal energy for processing different products, especially agricultural and forestry products in Vietnam.

For example, an iodized salt factory was constructed in 1997 based on an experiment of the use of the geothermal energy from the Hoi Van source. In this factory, which now produces 7000 t/year of iodized salt, geothermal heat is used to evaporate the iodized solution, thus saving large amounts of money in energy expenses every year.

Currently, many geothermal sources such as those in Pomlot, Son Kim, Bang, and Binh Chau are used to provide hot water for balneal purposes and medical treatment, which attracts tourism.

The Vietnam Institute of Geosciences and Mineral Resources is currently planning a new geothermal project to study the geothermal potential in the East Bac Bo plain from 2010 to 2012.

4. CONCLUSION

Studies of geothermal potential and development in Vietnam are still in their beginning stages. Research was mainly carried out using geological and geochemical methods rather than geophysical methods and drilling wells. These studies led to the following conclusions:

- The origin of geothermal fluid was determined to be meteoric.

- Temperatures of geothermal systems calculated by geothermometers are in the range 95 – 210°C.

- Some prospective geothermal sources were evaluated for potential electricity generation.

In general, for the development of geothermal energy in Vietnam to succeed, more research must be performed.

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Table 2. Characteristics of some prospective geothermal sources

Geothermal source	Location (province)	Geothermal region	Spring temperature (°C)	Type of geothermal water	TDS (mg/l)	pH	SiO ₂ (mg/l)
Pomlot	Dien Bien	NW Bac Bo	74	HCO ₃ - Na - Ca	510	6.8	67.0
Na Hai	Dien Bien	NW Bac Bo	78	HCO ₃ - Na	410	7.3	126.0
Bang	Quang Binh	N Trung Bo	105	HCO ₃ - Na	531	8.1	101.0
Son Kim	Ha Tinh	N Trung Bo	78	HCO ₃ - Na	225	7.9	63.0
Mo Duc	Quang Ngai	S Trung Bo	80	Cl - Na - Ca	4907	7.5	134.0
Hoi Van	Binh Dinh	S Trung Bo	85	Cl - HCO ₃ - Ca	525	7.0	103.0
Binh Chau	Ba Ria-Vung Tau	S Trung Bo	83	Cl - Na - Ca	3638	7.7	121.0
Thach Bich	Quang Ngai	S Trung Bo	65	Cl - HCO ₃ - Na	449	7.8	134.0
Nghia Thang	Quang Ngai	S Trung Bo	78	Cl - HCO ₃ - Na	620	7.0	108.0