DETERMINING POTENTIAL AND MODEL OF RIANIATE GEOTHERMAL BASED ON THE GEOHYDROLOGY AND GEOCHEMIST

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Abstract

This research was conducted to determine potency of Rianiate geothermal as an alternative source and determine the types of Rianiate geothermal that was begun with the position's measurement by using GPS (Global Position System). Then, the measurement or direct observation characteristics of chemist and physics such as pH, surface's temperature, color etc. The following step is taking sample in four water source in which its other chemical nature to be measured by titrimetric method, chromatography and by using the equipment of mercury's analyzer (AAS), XRD and also Chromathology gas. In analyzing the data, the counting of temperature of subsurface was done by using geothermometer and ended by potency's counting. The position of the four water source are in about N: 02^0 31,852' and E: 098^0 44, 021' where the height from sea's surface (dpl): 958 m. The highest surface's temperature is 80^0 C and the temperature under soil is about $130,5^0$ C describing the average geothermal. The calculation of the content's amount of Chloride ion, Sulfate, Bicarbonate, includes the chloride. The trilateral diagram Na/1000 – K/100 - √Mg of hot water is in the area of immature water. From the calculation of Indonesia's Standardized Geothermal, it can be obtained that the estimated back up potency of Rianiate geothermal is 2,68 MWe.

Keywords: Potential, Gheothermal, Geohidrology and Geochemist

Introduction

The Estimation of geothermal energy potential is based on geological, geophysical and reservoir technic. Geological studies are more emphasized on volcanic systems, geological structures, ages of rocks, type and variety of rocks changing in relation on geothermal systems. Geochemical studies are emphasized on the type and level of water mature, the sourcing hot water of hydrologic models and fluid systems. Geophysical studies produce physical parameters of rocks and subsurface structures of geothermal systems. The reservoir engineering study result a technical phase that defines the reserve classification including the physical properties of rocks and fluids as well as the removal of fluids from the reservoir.

The way of exploration geothermometer system has been carried out by Cristina that she executed the research in Dolok Marawa in 2010. From geothermometer measurement datas can be developed

by knowing the content of hot water elements such as Na, K, Mg, Ca, and SiO2. Geothermometers that conform of requirements of physics and chemistry indicated the Dolok Marawa area has a reservoir temperature of about ± 187^0C (Cristina, 2010).

Literally, geothermal (Indonesian called "panas bumi") comes from the word of geo which means earth and thermal is mean heat. So that can be interpreted as heat contained naturally in the earth. According to Indonesian Dictionary (1995) that geothermal is source of energy such as hot water, hot steam, and other gases contained in the bowels of the earth, while the scientists define geothermal energy as the amount of heat that coming from the earth and sufficient close of the earth surface so can be used economically.

Deeply of the earth surface has a very high heat so that all of rocks and things turn into liquid. The liquid rock that was high temperature was called "magma". Since the occurrence of the earth, the magma always heat the earth's crust which is the outermost part of the earth up to depth of 15 km (radius of the earth: 6371 km). The crust contains water that has been heated. If the water can penetrate the earth surface and free of pressure that was caused its depth, it will turn into hot steam, hot mud puddles or some of hot wellspring. (Miryani, 1992).

Basically, the geothermal system is formed as a result of heat transfer from heat source to its surroundings which was occurred by conduction and convection. Transferring of heat by conduction was occurred through rocks, whereas Transferring of heat by convection was occurred because there was contact between water with heat source. The occurrence of geothermal energy sources in Indonesia and its characteristics was described by Hazuardi (1992) as follows: There are three plates interacting in Indonesia are Pacific plate, Indian-Australian plate and Eurasian plate. The collision between three of tectonic plates had provided a very important role for the formation of geothermal energy sources in Indonesia. The collision between the India-Australia plate in south and the Eurasia plate in north produced subduction zones at depth of 160 - 210 km under Java-Nusa tenggara and at depth of about 100 km under the island of Sumatra (Herdianita, 2006). Based on the type of fluid production and type of the main fluid content, the hydrothermal system was divided into two were one-phase system or two-phase system. Compared with oil reservoir temperature, geothermal reservoir temperature is relatively very high reaching of 350^0 C. Based on magnitude of temperature, Ralph (1985) distinguishes the geothermal system into three are:

1. Low temperature geothermal system is a system that reservoir contained fluid with temperature smaller than 125^0C.
2. Medium temperature geothermal system is a system that reservoir contained fluid with temperature between 125^0C and 225^0C.
3. High temperature geothermal system is a system that reservoir contained fluid with temperature above 225^0C

The geochemical methods in geothermal exploration activities were intended to identify the types of manifestations and chemical characteristics of manifestations and forecasting of subsurface

temperatures. Distribution of anomalous lateral chemical compounds such as pH, Hg of soil and CO_2 of soil air on investigation area. The geothermal chemical analysis of soil samples, hot water, cold water, and gases for analyzed of content such as pH, electrical conductivity, SiO_2, Al, Fe, Ca, Mg, K, Na, Li, NH_4, B, Cl, SO_4, HCO_3, As, F, Hg, CO, CH_4, H_2, O_2, N_2, NH_3, SO_2, CO_2, H_2S and HCl by Titrimetric and chromatography method and using mercury analyzer equipment, Gas Chromatography and other equipment. Data processing was plotting data on the triangle diagram: Cl-SO_4 hot water classification, HCO_3, relative Na/1000, K/100, Mg, Cl/100-Li-B/4 pH, Hg, and CO_2 and making of distribution map. Estimation of subsurface temperature based on geothermometry calculation.

Materials and Methodology

Place and time of research

The study was conducted in Rianiate village, Pangururan sub-district administrative of Samosir district government that positioned geographically positioned is $98^0$42 '- $98^0$47' East Longitude and $2^0$32 '- $2^0$45' North Latitude, This area is 121.43 km^2 with boundaries as follows:

1. The North side is Simanindo Sub-district.
2. The South side is Palipi Sub-district.
3. The West side is the Sianjur Mulamula Sub-distric
4. The East side is Ronggur Nihuta sub-district.

Design of Research

A. Geohydrological Study

Geohydrological study are in addition to measuring water discharge and the number of springs, also study of water absorption, groundwater runoff and pop-up, electrical conductivity, and surface flow.

B. Geochemical Study

This geochemical study includes:

Analysis of content such as pH, Hg and CO_2, SiO_2, Al, Fe, Ca, Mg, K, Na, Li, NH_4, B, Cl, SO_4, HCO_3, As, F, Hg, CO, CH_4, H_2, O_2, N_2, NH_3, SO_2, CO_2, H_2S and HCl by titrimetric methods using mercury analyzer equipment, Gas Chromatography and other equipment that will determine the water type of the inquiry area (chloride type, sulfate type or carbonate type).

Research Findings and Discussions

This research was conducted in Rianaiate Village (Geothermal Rianiate) that steep soil toward lake Toba and there are consisted of three water flow craters. Based on observations and measurements

using global Position System (GPS), thermometer, litmus paper and pH meter obtained the following results:

1. Wellspring-1 (Sample of S.1.1 and Sample of S.1.2.).
   The wellspring-1 is gushing water that has passed through the rock gap away from the source the real. The gushing water is at the coordinates of N: 02^0 31,852' and E: 0980 44, 021' with the elevation from mean sea level (msl): 958 m, there are air temperatures of 26^0 C and hot water surface temperature of 43^0 C with pH of 6.2. Water in acidic conditions is seen from changing of blue litmus paper color to be a red and the red litmus paper unchanged when was immersed into the sample.

2. Wellspring-2 (Sample of S.2.1 and Sample of S.2.2).
   The wellspring-2 is at the coordinates of N: 02^0 31.813 'and E: 098^0 44,014' with the elevation from mean sea level (msl): 946 m, there are air temperatures of 26^0 C and hot water surface temperature of 77^0 C with pH of 6.3. Water in acidic conditions is seen from changing of blue litmus paper color to be a red and red litmus paper unchanged when was immersed into the sample.

3. Wellspring-3 (Sample of S.3.1).
   The wellspring-3 is at the coordinates of N: 02^0 31, 785 'and E: 098^0 44, 045' with the elevation from mean sea level (msl): 977 m, there are air temperatures of 26^0 C and hot water surface temperature of 79^0 C with pH of 6.5. Water in acidic conditions is seen from changing of blue litmus paper color to be a red and red litmus paper unchanged when was immersed into the sample.

4. Wellsprings-4
   The wellspring- is at the coordinates of N: 02^0 31, 759 'and E: 098^0 44, 060 " with the elevation from mean sea level (msl): 930 m, there are air temperatures of 27^0C and hot water surface temperature of 80^0 C with pH of 6.4. Water in acidic conditions is seen from changing of blue litmus paper color to be a red and red litmus paper unchanged when was immersed into the sample.

Conclusions

Based on the results of data processing, analysis and interpretation of this study obtained some conclusions:

1. Calculation of reservoir temperature that using three types of geothermometer, there are closest of calculation is geothermometer of SiO2. The calculation of estimated reservoir temperature is 130.5^0 C.
2. Based on the trilinear diagram of chloride ion content, sulfate and bicarbonate of hot water type of Rianiate belong chloride type. From the element comparison of Na / 1000, K/100 and √Mg can be concluded that the four of hot water were entered to area of immature water, it is mean the hot water has been contaminated by surface water.
3. Measurement of mineral deposits of rocks through XRD, the rocks from geothermal of Rianiate contained low calcite. That was seen from contraction pattern that appears for minerals calcite were low and intensity was small.
4. The catchment area is only 20%. There are rainwater seeps into the earth through the permeability of rocks (feed-zone), and the other flowed into lake Toba through a small river contained in three craters.
5. Potential reserves of geothermal of Rianiate estimated at 2.68 MWe.

Recommendation

Based on the results of the research that has been obtained was suggested the further research for the preparation of exploration.

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