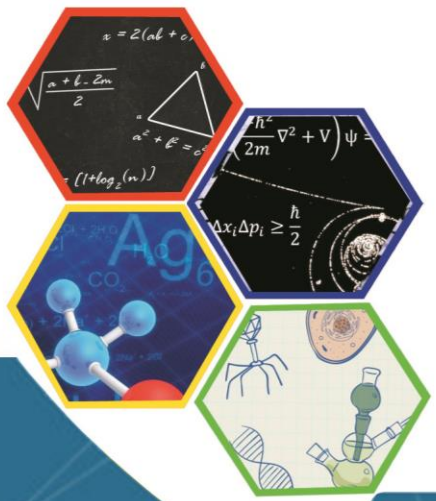
PROCEEDING

The 2nd International Seminar of Basic Science

Natural Science For Exploration The Sea-Island Resources

Ambon, May 31st 2016



Organized by

Faculty of Mathematics and Natural Science

Pattimura University

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The 2nd International Seminar of Basic Science

"Natural Science for Exploration The Sea-Island Resources"

Poka-Ambon, 31st May 2016

Mathematic and Natural Science Faculty
Universitas Pattimura
Ambon
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2nd edition

Welcoming Address By The Organizing Committee

Today, We have to thank the The Almighty Allah SWT for the implementation of this international seminar. This is the second seminar about Basic Science in The Faculty of MIPA Pattimura University. The seminar under the title “Natural Sciences for Exploration the Sea-Island Resources” will be carried out on May 31st 2016 at Rectorate Building, Pattimura University. There are 200 participants from lecturers, research institute, students, and also there are 34 papers will be presented.

My special thanks refer to the rector of Pattimura University and the Dean of MIPA Faculty, Prof. Dr. Pieter Kakissina, S.Pd., M.Si. I also would like to express my deepest gratitude to Prof. Amanda Reichelt-Brushett, M.Sc., Ph.D. ; Kazuhiko Ishikawa, Ph.D. ; Nicolas Hubert, Ph.D. ; Prof. Dr. Kirbani Sri Brotopuspito ; Prof. Dr. Marjono, M.Phil. ; Gino V. Limon, M.Sc., Ph.D. as the keynote speakers.

The last, We hope this international seminar usefull for all of us, especially Mollucas People and very sorry if any mistake. Thank you very much.

Dr. La Eddy, M.Si.
Chairman of Organizing Committee

Opening Remarks
By Dean of Mathematic and Natural Sciences Faculty

I express my deepest gratitude to The Almighty God for every single blessing He provides us especially in the process of holding the seminar until publishing the proceeding of International Seminar in celebrating the 18th anniversary of MIPA Faculty, Pattimura University. The theme of the anniversary is under the title "Natural Sciences for Exploration the Sea-Island Resources". The reason of choosing this theme is that Maluku is one of five areas in Techno Park Marine in Indonesia. Furthermore, it is expected that this development can be means where the process of innovation, it is the conversion of science and technology into economic value can be worthwhile for public welfare especially coastal communities.

Having the second big variety of biological resources in the world, Indonesia is rich of its marine flora and fauna. These potential resources can be treated as high value products that demand by international market. Basic science of MIPA plays important role in developing the management of sustainable marine biological resources.

The scientific articles in this proceeding are the results of research and they are analyzed scientifically. It is expected that this proceeding can be valuable information in terms of developing science and technology for public welfare, especially people in Maluku.

My special thanks refer to all researchers and reviewers for your brilliant ideas in completing and publishing this proceeding. I also would like to express my gratefulness to the dies committee-anniversary of MIPA Faculty for your creativity and hard working in finishing this proceeding, God Bless you all.

Prof. Dr. Pieter Kakisina, S.Pd., M.Si.
Dean of Mathematic and Natural Sciences Faculty

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Hotel Mutiara Ambon

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INTERPRETATION OF GEOTHERMAL RESERVOIR TEMPERATURE IN THE NALAHIA NUSALAUT, CENTRAL OF MOLUCCAS

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ABSTRACT

This study interprets of geothermal systems in Nalahia Nusalaut areas by monitoring the temperature of hot water, pH and electrical conductivity at the surface to determine the characteristics of the geothermal surface manifestations. In addition, to determine the characteristics of the geothermal fluid in the reservoir as the nature of heat flow and temperature of geothermal reservoir in Nalahia Nusalaut area. The study also will estimate the heat loss (heat loss) shown by geothermal manifestations in the study area to identify opportunities utilization of geothermal energy potential in the region Nalahia Nusalaut, Central of Moluccas.

The method proposed in this research is descriptive analysis method. This method includes: (1) the primary data collection in the areas of research, such as: measurement of temperature, pH, electrical conductivity measured on the surface at each measurement point by monitoring for 1 x 24 hours; (2) data processing surface temperature, pH and electrical conductivity to determine the characteristics of Nalahia Nusalaut hot springs (including alteration of rocks) and the characteristics of the geothermal fluid in the reservoir.

The results of the measurement of surface temperatures, pH, electrical conductivity, and the debit flow in Nalahia Nusalaut area, respectively (77-81)°C, 7.8, (0,1654- 1.7383) µS/m, and (6.73 to 9.76) L/min. This suggests that the nature of heat flow on the type of geothermal Nalahia Nusalaut is the flow of water to the upper reservoir (upflow) and is a type of domination reservoir of hot water (water heated reservoir). Furthermore, the type of geothermal area in Nalahia Nusalaut is a type of high-temperature, namely 225°C, thereby potentially as geothermal field. These conditions give rise utilization of geothermal energy in the Nalahia Nusalaut area, Central of Moluccas as an alternative energy-fired power plant in Central of Moluccas.

Keywords: geothermal, upflow , water heated reservoir, reservoir temperature.

INTRODUCTION

Nalahia Nusalaut hot Springs located at 3.653 LS and 128.784 BT is an area of geothermal prospects that formed as a result of normal fault movement activity (Tjokrosapoetro et. Al, 2003). The area is believed to be the media that led to geothermal manifestations, such as the hot springs that were found in this area. The surface temperature of the hot water ranges between (77-81)^{o}C.

This study investigated the geothermal system in the Nalahia Nusalaut area with monitoring hot water temperature, pH and electrical conductivity at the surface to determine the characteristics of the geothermal at surface manifestations. In addition, to interprets the characteristics of the geothermal fluid in the reservoir as the nature of heat flow and reservoir temperature in Nalahia Nusalaut area. The study also estimated heat loss (heat loss) shown by geothermal manifestations in the study area to identify opportunities utilization of geothermal energy potential in the Nalahia Nusalaut, Central of Moluccas.

Benefits of the research is to provide information about the type of geothermal reservoir based on the high temperature in Nalahia Nusalaut area, so it can be determined whether or not the prospect of Nalahia Nusalaut area as area of potential geothermal energy that can be utilized as the Regional Government of Central Maluku Steam Power Plant; provide information about the relationship between temperature, pH and electrical conductivity measured at the surface with a temperature geothermal reservoir is estimated; and provide information on opportunities utilization of geothermal energy potential Nalahia Nusalaut to meet power shortages in the region of Central of Moluccas.

Previous Study

Changes in temperature causes the pH of the water changes and changes in the water depending on the type of sediment akuifernya. The water is acidic (pH<7) are in areas with volcanic deposits, whereas the water is alkaline (pH>7) are in areas with ultramafic rocks. The reaction between the water with ultramafic rocks forming serpentinite. The hot water has a low pH because of the concentration of H^+ ions in a larger system. Increasing the dissolved ions causes the conductivity of water increases, along with the increasing water temperature.

Low pH water usually indicates the fluid heat comes from geothermal system dominance pH neutral water vapor and usually indicates the fluid heat comes from geothermal system dominance of water, which usually contains silica. If the hot water flow rate is not too large, it is generally around the hot water is formed terraces kepekahan colored silica (silica sinter sinter terraces or platforms). The flow rate is the amount of water flowing in a unit volume per time. The electrical conductivity or electrical conductivity (specific conductivity is a measure of the ability of a substance conduct electricity under certain temperature stated in mikroSiemens (µS) per centimeter.

Measurement of electrical conductivity aimed at measuring the ability of ions in the water to conduct electricity as well as predict the mineral content in the water. Measurements were carried out based on the ability of cations and anions to conduct electrical current flowed in a water sample can be an indicator, where the greater electrical conductivity values shown in konduktivitimeter means the greater the ability of cations and anions present in the water to conduct electricity. This indicates that more and more minerals in hot water can interpret that the temperature below the surface (reservoir) is a high temperature (Puradimaja, 2005).

One area that is neutral geothermal prospects, namely is Akesahu hot springs area with a pH between (7.4 to 7.9) which is largely chloride-type water such as Akesahu, Gulohi, Tanjung severed, Tomadou, Gamgao, Sare and Tosahu with surface temperatures are relatively high, especially in Akesahu, Tomadou and Tanjungputus hot springs between (43.9 to 45.1)°C and in the hot springs found their hot water deposits or sinter whitish, brown iron oxide, This indicates that the hot water system that appeared in Akesahu geothermal area lies in zone "upflow" and is a type of domination reservoir of hot water (water heated

reservoir). symptom appearance on the type of geothermal hot water reservoir domination characterized by the presence of sintered silica (SiO2) in Akesahu area (Sulaiman, 2007).

Marini and Susangkyono (1999) estimates that the geothermal system in the area Hatuasa, Ambon is located in the zone of "upflow" and is a type of domination reservoir of hot water ("water heated reservoir"), it is supported by the very high chloride concentration is 14000 ppm. In addition to using the Na-K obtained geotermometer reservoir temperature 230^{o}C to 245^{o}C which indicates the type of geothermal energy in Hatuasa area is a high temperature by the appearance of the average temperature at the surface is 70°C.

Andayany (2011) says that the Talang Haha, hot Springs area in Ambon has a low level of acidity or pH neutral range between (7.1 to 7.9) and is supported by the value of the ratio of Na / K under 15. It is also supported by the high chloride concentration value, which ranges (14800-19500) ppm. This shows that the Talang Haha area is subject to the flow of water to the top reservoir (upflow) and is a type of domination geothermal hot water (water heated reservoir).

Relations debit of heat flow with alteration mineral hot rocks are hot bantang the hot water flowing laterally directly at the reservoir. In this area in general, reaction occurs between the hot water, groundwater and the surrounding rocks in near the surface. Shifting between meteoric water and hot water indicates that, a geothermal system in the study area are old, so the bedrock has interacted very intensively with the geothermal fluid and reach equilibrium. This is shown to us by Nicholson (1993) occurred in wairekei, New Zealand.

Geothermal manifestations on the surface is expected to occur due to the propagation of heat from below the surface or due to fractures-fractures that allow the geothermal fluid (steam and hot water) to flow to the surface. Compared with the oil reservoir temperature, the temperature of the geothermal reservoir is relatively very high, can reach 350^{o}C. Based on the high temperature, Hochstein (1990) in Saptadji (2009) distinguishes three types of geothermal, namely: types of geothermal heat at a lower temperature, which is a type of geothermal reservoir containing fluid at a temperature of less than 125^{o}C; type of medium temperature geothermal, which is a type of geothermal reservoir containing fluid at temperatures between 125^{o}C and 225^{o}C; types of geothermal with high temperatures, which is a type of geothermal reservoir containing a fluid with a temperature above 225^{o}C.

Type geothermal often also classified based on the type of fluid enthalpy enthalpy of low, medium and high. The criteria used as the basis of classification is in fact not based on the value of enthalpy, but based on the temperature given the enthalpy is a function of temperature. Type geothermal geothermal system consists of dry steam, wet steam geothermal systems and geothermal hot water system. Domination geothermal hot water present in the area or reservoir with a relatively low temperature and pressure. In the area or reservoir through which water flows to the earth's surface is not too deep reservoir. The process is almost the same with the wet geothermal steam domination.

MATERIALS AND METHODS

The method proposed in this research is descriptive analysis method. This method includes: (1) the primary data collection in the areas of research, such as: measurement of temperature, pH, electrical conductivity measured on the surface at each measurement point by monitoring for 1 x 24 hours; (2) data processing surface temperature, pH and electrical conductivity to determine the characteristics of Nalahia Nusalaut hot springs (including

alteration of rocks) and the characteristics of the geothermal fluid in the reservoir. In addition, flow discharge measurements at surface of Nalahia Nusalaut area.

The primary data in the area of Nalahia Nusalaut hot springs, among others: measurement of temperature, pH and electrical conductivity measured at the surface is done by monitoring for 24 hours with intervals of 30 minutes. The tools used to measure the temperature of the surface water in the Nalahia Nusalaut hot springs is Xplorer GLXl. It is equipped with a temperature measuring sensor PS-2153 models. The accuracy of this sensor is ± 0.5℃. Temperature measurement is done by monitoring for 24 hours with 30-minute intervals to determine whether there is influence of environmental temperature or solar activity. In addition, to determine the relationship of the surface temperature of the water with a temperature of reservoir in Nalahia Nusalaut area.

The tools used to measure the pH of the surface water in the Nalahia Nusalaut hot springs namely pH meter PT-370. The accuracy of these tools is ± 0.01/0.02. Measurement of pH is done by monitoring for 24 hours with intervals of 30 minutes. PH measurements aimed to determine the pattern of spread of the acidity of surface water around the site of research, the relationship with the pH of the water reservoir temperature in Suli hot springs and types of geothermal systems in Nalahia Nusalaut areas.

The tools used to measure the electrical conductivity of the surface water in the Nalahia Nusalaut hot springs Xplorer GLX is equipped with a sensor measuring conductivity model of PS-2116A. The accuracy of this sensor is < 20 µs / cm. At any temperature and pH measurements of hot water made direct measurements of electrical conductivity values to determine the relationship between the value of the electrical conductivity of the time, temperature, and pH were measured at the surface, and to know the relationship between the electrical conductivity with temperature reservoir hot springs Nalahia Nusalaut.

RESULTS AND DISCUSSION

The results that the surface temperatures, pH, electrical conductivity, and the debit flow in Nalahia Nusalaut area, respectively (77-81)°C, 7.8, (0,16-1.73) µS/m, and (6.73 to 9.76) L/min. The physical condition of the hot water is somewhat turbid, sulfurous, there are gas bubbles, and a sediment rocks around a reddish yellow mixed with organics.

Results of pH measurement Nalahia Nusalaut hot water was 7.8. This indicates that the hot water Nalahia Nusalaut neutral (pH>7). neutral pH is also supported by the deposition by the pool in the form of silica sinter. Results of pH measurement is nearing the measurement of pH by Andayany (2011) in the Talang Haha Hot Springs. This indicates that hot springs in the Talang Haha area and hot springs in the Nalahia Nusalaut area is subject to the flow of water to the top reservoir (upflow) and is a type of domination geothermal hot water (water heated reservoir).

The results of measurements of electrical conductivity average corrected ranges (0,1654- 1.7383) µS/m. This shows that the greater the ability of cations and anions contained in Nalahia Nusalaut hot water to conduct electricity. Moreover, it can indicate that a growing number of alteration minerals contained in Nalahia Nusalaut area. Mineral alteration of the surface hot springs can interpret that the temperature below the surface (reservoir) is a high temperature. The results of the debit flow measurements on the surface of the hot springs Nalahia Nusalaut average ranges between (6.73 to 9.76) L/min. This indicates that

Nalahia area is Neutral pH and than debit flow in this area indicates that the hot water flow is not too big so it also supported by the deposition of sinter silica.

Based on table 1, the results of measurements of the hot water temperature at the surface average is very high range (77-8)^{o}C. Characteristics of hot water in the Nalahia Nusalaut area also supported by the pH is 7.8, the electrical conductivity ranges (0,1654-1.7383) µS/m and the discharge flow range (6.73-9.76) L/minute. Thus , the temperature of the geothermal reservoir Nalahia Nusalaut range 225°C . The results of temperature calculation is nearing temperature calculations by Marini and Susangkyono (1999) in the Hatuasa area and Andayany (2011) in the Talang Haha area. Thus, based on the high temperature, the type of geothermal Nalahia Nusalaut is a type of geothermal energy with a high temperature, ie the temperature is 225°C. Thus, a geothermal reservoir in Nalahia Nusalaut potential as geothermal field .

Table 1 shows the relationship between temperature, pH, and conductivity measured on the surface of hot water with the interpretation of reservoir temperature geothermal area in Nalahia Nusalaut.

Table 1 The relationship between temperature, pH, electrical conductivity and discharge flow measured at the surface of the hot water with the interpretation of reservoir temperature geothermal area in Nalahia Nusalaut.

Position of measurement Station	The average measurement for one day with interval 30 minutes				Reservoir Temperature, T (°C)	Geothermal Type
	Temperature, T (°C)	pH, (± 0,01)	Konduktivity, (µS/m)	debit flow, (L/min)		
3,651 LS 128,784 BT	(77-81)	7,8	(0,1654-1.7383)	(6.73-9.76)	(225)	high temperature

CONCLUSION

The results of the measurement of surface temperatures, pH, electrical conductivity, and the debit flow in geothermal area Nalahia Nusalaut, Maluku respectively (77-81)°C, 7.8, (0,1654- 1.7383) µS/m, and (6.73 to 9.76) L/min. With the appearance of the hot water temperature and electrical conductivity at the surface is high which is also supported with a neutral, but the debit flow is not too large can interpret that the geothermal reservoir in Nalahia Nusalaut area is high geothermal temperature type about 225°C. Thus, a geothermal reservoir in Nalahia Nusalaut area are potential as geothermal field.

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