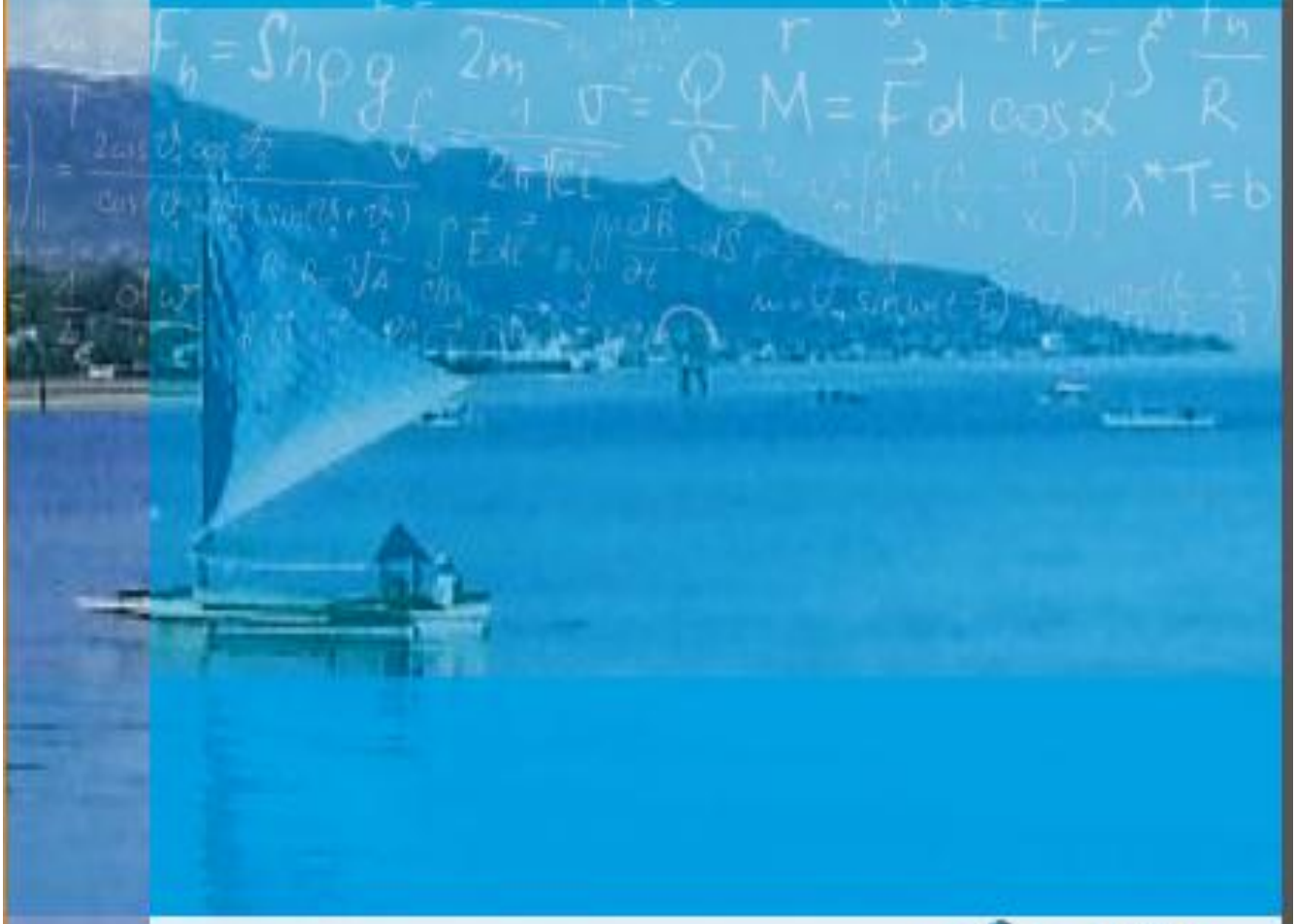
Basic Science
for Sustainable Marine Development

PROCEEDING
INTERNATIONAL SEMINAR 2015

Ambon, 3-4 June 2015



Organized by
Faculty of Mathematics and Natural Sciences
Pattimura University

PROCEEDINGS

1st International Seminar of Basic Science, FMIPA Unpatti - Ambon
June, 3rd – 4th 2015

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Mathematic and Natural Science Faculty
Pattimura University
Ir. M. Putuhena St.
Kampus Poka-Ambon
Pos Code 97233
Email:fmipa_unpatti@gmail.com

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Welcoming Address by The Organizing Committee

The honorable, the rector of Pattimura University

The honorable, the vice rector of academic affair, Pattimura University

The honorable, the vice rector of administration and financial affair, Pattimura University

The honorable, the vice rector of planning, cooperation and information affair, Pattimura University

The honorable, all the deans in Pattimura University

The honorable, the key note speakers and other guests.

We have to thank The Almighty God for the blessings that allow this International seminar can be held today. This is the first seminar about MIPA Science in which the Faculty of MIPA Pattimura University becomes the host. The seminar under the title Basic Science for Sustainable Marine Development will be carried out on 3 June 2015 at Rectorate Building, the second floor. There are 250 participants from lecturers, research institute, students, and also there are 34 papers will be presented.

This International seminar is supported by the amazing people who always give financial as well as moral supports. My special thanks refer to the rector of Pattimura University, Prof. Dr. Thomas Pentury, M.Si, and the Dean of MIPA Faculty, Prof. Dr. Pieter Kakissina, M. Si. I also would like to express my deepest gratitude to Dr. Kotaro Ichikawa, the director of CSEAS Kyoto University, Prof. Bohari M. Yamin, University of Kebangsaan Malaysia, Prof. Dr. Budi Nurani Ruchjana (Prisident of Indonesian Mathematical Society/Indo-MS), Dr. Ir. A. Syailatua, M.Sc (Director of LIPI Ambon), and Hendry Ishak Elim, PhD as the key note speakers. We expect that this international seminar can give valuable information and contribution especially in developing basic science for sustainable marine development in the future.

Last but not least, we realize that as human we have weaknesses in holding this seminar, but personally I believe that there are pearls behind this seminar. Thank you very much.

Chairman

Dr. Netty Siahaya, M.Si.

Opening Remarks
By Dean of Mathematic and Natural Science 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 17th anniversary of MIPA Faculty, Pattimura University. The theme of the anniversary is under the title Basic Science for Sustainable Marine Development. 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.

Dean of Mathematic and Natural Science Faculty

Prof. Dr. Pieter Kakisina, M.Si.

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Characteristics Interpretation of Alteration Minerals of Waiyari Geothermal Manifestation Area, Central Maluku

Helda Andayany

Geophysic Laboratory, Faculty of Mathematic and Natural Sciences, Pattimura University
Email: heldaandayany2014@gmail.com

Abstract

Petrographic analysis to rock samples located at Waiyari geothermal was dominated by feldspathic greywacke. Another alteration mineral types of the rocks in this area are quartz, opaque, lithic, and feldspar minerals. The interpretation of alteration minerals show that the mineral types of the origin rock is sandstone tuff. Petrographic analysis is supported by the XRD method that indicates that the alteration minerals present are generally dominated by the presence of clays such as illite-chlorite with particle size of < 0,03 mm, the abundance of 55% and the spread evenly. Alteration minerals which is generally dominated by illite-chlorite clays show that reservoir temperature of Waiyari geothermal area is 175^{o}C and pH of fluid is neutral. In addition, illite deposited directly with the temperature between (190-220)°C is closely related to the rock more permeable. This gives the sense that the illite zone associated with the peak zone which is permeable reservoir where the fluid flow convection, so that the temperature in this zone is relatively homogeneous. Precipitate of silica can also be used as a good indicator for the presence with the reservoir temperature of >175^{o}C. Our result show that Waiyari geothermal area is mainly from water heated reservoir that contains silica and is located on the outflow area through fractures.

Keywords: XRD, petrography, sandstone tuff, alteration minerals.

INTRODUCTION

Waiyari, Central Maluku is the hot springs manifestation area with the surface temperature of the hot water about 60°C. Hot springs manifestation of this area are related with presence of fractures of the volcanic tuff unit. The exit of the hot springs from volcanic tuff fractures to causes the volcanic tuffs experienced changes both of the surface and the fragment. The physical circumstances around of the Waiyari hot springs surface are reddish brown material with indications about rock alteration.

Depth of research about characteristics of alteration minerals based on rock samples from the Waiyari hot springs using by petrographic method for describe the texture of rocks, so that can know the types of origin rock and alteration processes that occurs in rocks. Petrographic methods is supported by the XRD method with bulk analysis (analysis of powder and clay analysis). The results of XRD analysis can explain the alteration minerals from research area, so it can be known about spread and characteristics of alteration rocks on the surface of Waiyari hot springs. Moreover, the results of analysis of rock samples can be known linkages both of reservoir temperature and alteration minerals, so it can be known geothermal systems of Waiyari, Central Maluku.

LITERATURE REVIEW

Central Maluku based on geological maps (sheet of Masohi, Maluku P3G 2003) is located at volcanic arc. Tectonic processes in this area led to elongated island, while the secondary fault can be cut or parallel to the main fault, forming some valleys, rivers, hills and mountains block. In general, in Central Maluku scattered of Ambon volcanic rocks include are lava, volcanic breccia, tuff breccias, and tuff with upper Pliocene (upper Tertiary / upper Cenozoic). Moreover, scattered precipitates terrace are conglomerate, red chert, fillit schist, sandstone, sandy clay lateritic, and limestone reefs which crossed fingers with limestone coral (coral) aged Holocene (upper Quaternary / upper Cenozoic).

The main cesarean such as faults down to the general direction of the Northeast-Southwest in Central Maluku region can be expected as media that gave rise to geothermal manifestations such as hot springs and alteration minerals. Alterasion minerals that are the result of alteration hydrothermal. Alteration hydrothermal is a process that occurs as a result of the reaction between the rocks of origin with the geothermal fluid. The process of alteration hydrothermal occurs due to the reaction between the rocks by the water kind chloride derived from reservoirs geothermal that are far below the surface (deep chloride water) that can lead to precipitation (e.g quartz) and the exchange of elements of rock with fluid, producing minerals such as chlorite, adularia, epidote. Acidic water, which is found in relatively shallow depths and relatively high elevation change the original rock into clay minerals and other minerals apart. Alteration minerals depends on several factors, but the main one is the temperature, pressure, type of origin rock, composition fluid (especially pH) and duration of response. Alteration minerals produced in the surface zone typically is kaolin, alunite, sulfur, silica residue and gypsum (Browne, 1984).

To determine the patterns and characteristics of alteration minerals, the field description and sampling was conducted. Further the mineralogical constituent of alteration minerals described using by petrographic method for describe the texture of rocks, so that can know the types of origin rock and alteration processes that occurs in rocks. This method is supported by the analysis of X-ray diffraction (XRD). XRD method used to identify clay minerals. The characteristics of clay minerals by XRD analysis can be described as follows: (1) smectite (montmorillonite) gray, brown, medium birefringence, changing the basic mass or plagioclase; (2) bright green chlorite, fibrous, generally change pyroxene, forming smooth muscle, sometimes pleokroik; (3) illite with small spots on a mass basis and change plagioclase, medium-high birefringence.

Minerals such as smectite clays, chlorite, and illite can be used as an indicator of the reservoir temperature. Smectite, has a temperature below (140-150)°C, based on the crystal structure is divided into dioctahedral (montmorillonite, beidellite, nontronite) and trioctahedral (stevensite, saponite, hectorite and ghassoulite) smectite. Smectite-Chlorite. Based on results of research from several authors in the different field obtained of temperature variation for these minerals. For example trioctahedal smectite (saponite) does not appear when the temperature reaches (85-95)°C, then chlorite-smectite (corrensite) begin to form (Iijima & Utada, 1971 in Harvey,1998).

Tomasson & Kristmannsdottir stated that the change of iron-rich saponite into mixed-layer clays in Iceland geothermal field occurs at a temperature of 160^{o}C. According Kristmannsdottir (1976), the change process of smectite into chlorite gradually, and ends at a temperature of 270^{o}C. Chlorite formed at a temperature that is sufficiently long interval. According (Cahtelineau, 1988 in Harvey, 1998) that the chlorite formed between temperature (100-140)°C.

Harvey and Browne (1991) to get a CONCLUSIONS that illite is deposited directly on the temperature (190-220)°C is closely related to the rock more permeable. Whereas illite formed through several stages of temperature likely to occur in rocks that have low temperatures.

In addition to alteration mineral, silica sinter can also be used as an indicator in determining the reservoir temperature. Silica sinter derived from hydrothermal fluid enough to get a structure containing alkaline silica, precipitated when saturated fluid, amorphous silica cooled from 100°C to 50°C. These deposits can be used as a good indicator for the presence of reservoir temperature > 175^{o}C (Herman, 2006). In addition, Hochstein, 1990 (in Saptadji, 2009) suggests that the reservoir having medium temperature type between 125^{o}C to 225^{o}C interpret that the reservoir system of Waiyari geothermal area having a high content of sulphate ions.

METHODS

The collection of primary data of Waiyari geothermal area, among others things: measurements of temperature at the surface hot water, colors of hot water, color of alteration rocks, and rock sampling around the hot springs in the Waiyari area. Analysis of rock samples was performed using with petrographic methods for describe the texture of rocks, so that can know the types of origin rock and alteration processes that occurs in rocks. Petrographic methods is supported by the XRD method with bulk analysis (analysis of powder and clay analysis). The results of XRD analysis can explain the alteration minerals from research area, so it can be known about spread and characteristics of alteration rocks on the surface of Waiyari hot springs.

RESULTS AND DISCUSSION

Geothermal manifestation in this area described of hot water temperatures with ranging from 60°C and acid-neutral pH that ranges between (6.9 to 7.2). Rocks that is around hot springs are white and reddish brown are believed to be precipitated of silica sinter. This indicates the occurrence of alteration rocks around the hot springs in the area. Petrographic analysis of fragments are quartz, opaque, lytic, and feldspar (Figure 1) shows that the mineral types of the origin rock is sandstone tuff. A small portion of the feldspar group has also been transformed into clay minerals. Petrographic analysis is supported by the XRD method that indicated that the alteration minerals present are generally dominated by the presence of clays such as illite-chlorite with particle size of < 0,03 mm, the abundance of 55% and the spread evenly. This uniform distribution shows the intensity of alteration rock is medium levels.

Alteration minerals which is generally dominated by illite-chlorite clays show that reservoir temperature of Waiyari geothermal area is 175^{o}C and pH of fluid is neutral. In addition, illite deposited directly with the temperature between (190-220)°C is closely related to the rock more permeable. This gives the sense that the illite zone associated with the peak zone which is permeable reservoir where the fluid flow convection, so that the temperature in this zone is relatively homogeneous. Precipitate of silica can also be used as a good indicator for the presence with the reservoir temperature of >175^{o}C. Type of geothermal with medium temperatures of Waiyari geothermal area can interpret that the reservoir system of Waiyari geothermal area having a high content of sulphate ions.

Our result show that Waiyari geothermal area is mainly from water heated reservoir that contains silica and is located on the outflow area through the fractures (Hochstein and Browne, 2000). In this system will produce energy from meteoric water that goes very deep

below the surface and then heated and brought to the surface through fractures. At first the high temperature, but in the course of time undergo cooling. At this geothermal system, fluid from recharge area into the reservoir and then out towards the surface through the outflow area through the fractures. The fluid reacts with the surrounding rock to produce alteration alteration minerals such as illite-chlorite.

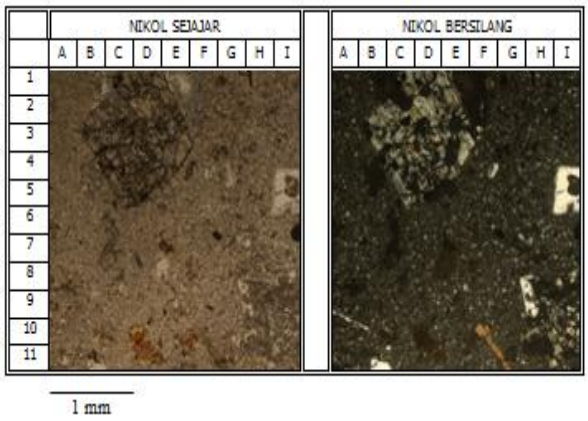

Figure 1. Incision thin of feldspathic greywacke. The Feldspathic greywacke precipitate on the sandstone tuff

CONCLUSIONS

Alteration minerals which is generally dominated by illite-chlorite clays show that reservoir temperature of Waiyari geothermal area is 175^{o}C and pH of fluid is neutral. Characteristic interpretation of alteration minerals show that pH of Waiyari geothermal area between (7,1-7,2). pH of hot water to get near neutral this indicated that types of the geothermal reservoir is sulphate. In addition, illite deposited directly with the temperature between (190-220)°C is closely related to the rock more permeable. This gives the sense that the zone of illite associated with the peak zone which is permeable reservoir where the flow of fluid is convection, so that the temperature in this zone is relatively homogeneous. Precipitate of silica can also be used as a good indicator for the presence with the reservoir temperature of >175^{o}C. Type of geothermal with medium temperatures of Waiyari geothermal area can interpret that the reservoir system of Waiyari geothermal area having a high content of sulphate ions.

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