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Geothermal Prospect of Padang Cermin Pesawaran Lampung Province, Indonesia

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ABSTRACT

Geothermal survey has conducted in September 2013 within Padang Cermin region Pesawaran Lampung Province Indonesia (517500 mE, 9383500 mN). Way Ratay Vilage (517465 mE, 9384356 mN). Data manifestation consists of 5 pieces of hot springs, the spread of loose soil (mud) and the appearance of vegetation. The hot springs are: the first hot spring is well hot water spout that causes by drilling pipe diameter 1 inc, located at coordinate (517722 mE, 9383456 mN), at an elevation of 15 meters, with a temperature of about 98 ^{o}C. The second hot spring is a natural manifestation located at coordinate (517387 mE, 9383524 MN), an elevation 37 meters with a temperature of about 85 ^{o}C. The third hot springs at coordinates (517402 mN, 9383542 mN), an elevation 33 meters, with a temperature of about 90 ^{o}C. The fourth hot spring at coordinates (517419 mN, 9383526 mN), elevation 29 meters, with the temperature 96 ^{o}C. The fifth hot springs located at coordinates (517526 mE, 9383566 mN), elevation 20 meters with a temperature of 85^{o}C. Geological data indicate some rock outcrops have experienced alteration. Some hot springs produce precipitated silica sinter. The spread of widespread manifestations identified with the discovery of rocks and vegetation are experiencing liquification degenerating. Based on early studies using analysis of geological, geophysical and geochemical, the Padang Cermin geothermal system is estimated to have quiet high reserves potential energy.

1. INTRODUCTION

Indonesia is located approximately 40 km southwest of Bandar Lampung and about 250 km northwest of Jakarta. Padang Cermin geothermal area is located at about the coordinates 517500 mE, 9383500 mU (Figure 1). Pesawaran District is one of many districts in Lampung Provins. The others districts in Lampung Province are: Districts Bandar Lampung, Metro, Lempung Selatan, Pringsewu, Tanggamus, Pesisi Barat, Lampung Barat, Lampung Tengah, Lampung timur, Lampung Utara, Way Kanan, Tulangbawang Barat, Tulangbawang and Mesuji. penelitian ini khusus studi tentang geothermal di area Padang Cermin Sub District of Pesawaran District, tepatnya di wilayah Padang Cermin, Way Ratai, Margodadi. Ketiga daerah tersebut masuk ke dalam wilayah Padang Cermin Sub District of Pesawaran District.

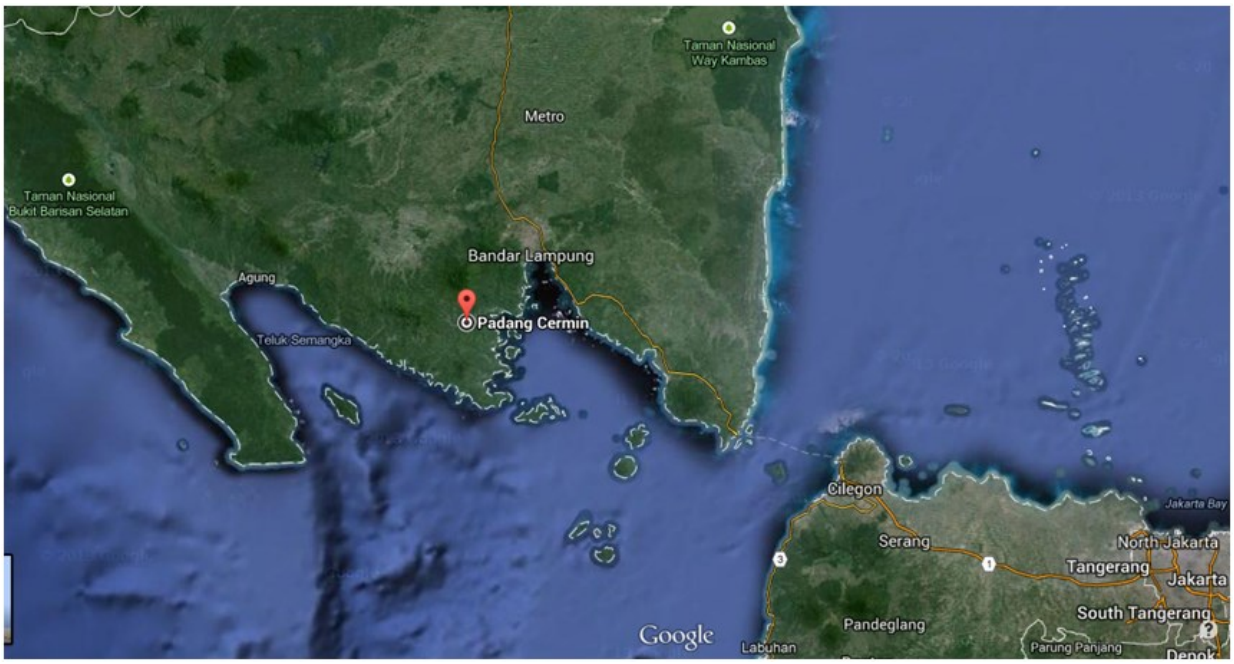

Figure 1: Padang Cermin Sub District of Pesawaran District, Lampung Province, Indonesia (Google Map, 2014)

2. MATERIAL

Padang Cermin gethermal Prospek, Sub District of Pesawaran District, Lampung Province, Indonesia located at Lembar Geologi Tanjungkarang (Mangga, 1994).

2.1 Pesawaran Regional Geology

Bedrock geology of the area is composed by the composer deposition of swamp deposits (Qs), alluvial (Qa), young volcanic deposit (Qhv), Lampung Formation (QTl), Hulusimpang Formation (Tomh), Sabu Formation (Tpos), Tarahan Formation (Tpot), Menanga Formation (Km), unconsolideted G.Kasih Complex, Way Galih Schist (Pzgs), Piabung Dacite, and Dulan Granodiorite.

2.2 Stratigraphy

Regional stratigraphy in this area is composed by rocks of Pre-Tertiary, Tertiary, and Quaternary sequences of runs to break rocks.

2.2.1 Pra-Tersier of runs

The oldest rocks are composed of metamorphic rocks of runs low-moderate degree, which consists of schist, genies, marble and quartzite, which includes Gunungkasih Complex. Gunungkasih complex consists of schist and quartz pelitik grafitik, marble and calcareous schist, quartzite sericite, injections migmatit, amphibole schist and ortogenes. Assuming that the spread of this lithology reflects the complex geological conditions, provide a strong presumption that runs, igneous metamorphic (Pzgs) is a remnant arc magmas and the remnants of Paleozoic sedimentary sequences to altered soil trenches or face associated with the arc. Another possibility is that the complex is part of a lump Gunungkasih alohton or "exotic" that acrasified the Sundaland continental margin in Late Paleozoic or Early Mesozoic, so it does not have the same history mathamorfism with other metamorphic rocks in Sumatera.

Menanga Formation handling bookin including pre-Tertiary rocks of Mesozoic age are not experiencing matamorphism. This Formation consists of tuffaceous mudstone-sandstone and calcareous, alternating with shale, limestone inserts, chert and basalt bit.

Figure 2: Regional Geology of Pesawaran area and surrounding. Modified from Mangga (1994).

2.2.2 Tersier of runs

Tertiary of runs Consists of sequences continental arc volcanic rocks and sediments deposited by arc volcanoes, which precipitated together extensively, namely the formation Sabu, Campang and Tarahan. All three Paleocene to Oligocene age. Sabu Formation were deposited in the environment fluviatil, not aligned sequences to override the pre-Tertiary and incongruent overlain by volcanic rocks formations Hulusimpang old Late Oligocene-Early Miocene . Sabu Formation consists of conglomeratic breccia and sandstone at the bottom , to the top turned into claystone and tuffaceous sandstones. Tarahan Formation consists of mainly tuff and tuffaceous breccia with little lava, andesite-basalt had to acquire. Campang Formation consists of mudstone, shale, klastika calcareous, tuff breccias and conglomeratic polimik. Formation unconformity between Sabu and Hulusimpang Formation represents a regional mid-Oligocene tectonic episodes Final observable throughout Sumatera. Hulusimpang Formation consists of alkaline andesite-basalt-limestone and andesite volcanic rocks and are interpreted to have formed by subduction processes near an active continental margins (Mangga, 1994; Amin, et al., 1994; Suharno, 2000; Suharno, 2003).

Tertiary of runs consisted of the oldest rocks, such as low-grade metamorphic debris-being, which consists of schist, genis, marble and quartzite, it is call unconsolidated Gunungkasih Complex. Kompleks Gunungkasih Comple which consists of schist, quartz pelitik grafitik, marble and calcareous schist, quartzite sericite, injections migmatit, amphibole schist and ortogenes. Assuming that the spread of this lithology reflects the complex geological conditions, provide a strong presumption that runs, igneous metamorphic (Pzgs) the remnants of the Paleozoic arc magmas of runs as well as the remnants of altered sediment or soil trench face associated with the arc (Browne, 1998; Suharno, et al, 1999).

2.2.3 Kuarter of runs

Kuarter of runs consists of Pleistocene lava, breccia and andesite-basalt tuff to get a structure in Barisan lane, lane basal Sukadana gap in Palembang, reef limestones and Holocene alluvium sediments.

2.2.4 Intrusion Rocks

In South Lampung district and East Lampung district, igneous plutons of alkaline-lime acquire a whole train was unveiled in the Barisan . Radiometric evidence and the court gives alleged existence of three major periods in his mid-Cretaceous plutonic activity Late, Early Tertiary and Miocene. Limestone is the largest breakthrough spreading and may be part of the most batholiths roofless which extends up Sheet Kotaagung. The breakthrough is made up of pluton-pluton Sulan, Sekampung-Kalipanas, Branti, Seputih and Kalimangan, with the age range of 113 ± 3 to 86 ± 3 million years old, and had to acquire diorite to granite. Although all of these plutons are Type-I, is related to the subduction, a volcanic arc granitoid or continental margins. History pluton in Lampung is very complex due to several breakthroughs have tercenangga rocks while others do not. Pentarikhan oldest 113-111 million years, originating from breakthrough rock Granodiorite is not tercenangga Sulan, a clear break Galina Way Complex metamorphic schists Gunungkasih . Branti breakthrough rock and Seputih in-biotite granodiorite lithology is very similar, rock breakthrough Branti age 86 ± 3 million years old, and not tercenangga. Biotite granodiorite dikes dikes-no terdaunkan that in some places cut the diorite Sekampung terdaunkan, in the field afanitik granodiorite facies interpreted as Branti. This is apparently due to the relative age and tektonikanya isotopes. Age Granite Kalimangan interpreted the same as the age of rocks and Seputih Branti breakthrough. Breakthrough Tertiary rocks in this area consist of Granite Jatibaru Eocene (?) And a variety of small rocks that are interpreted breakthroughs Middle Miocene Formation by its break with Hulusimpang.

2.3 Geology Structure

Regional geological structure, Sumatera located along the southwestern edge of the Sunda Shelf, on the extension of the Eurasian Plate to mainland Southeast Asia is part of the Sunda Arc. Oceanic crust that has lay a portion of the Indian Ocean and the Indian-Australian Plate, has menunjam tilted along the Sunda Trench off the west coast of Sumatra (Hamilton, 1979). Lane sloping meeting is included in the Sunda Arc trench system that stretched more than 5,000 miles from Burma to eastern Indonesia.

The location of the arc and trench contained now possible since the Miocene. The pressure caused by the oblique subduction periodically mirrored by parallel faults to the edge of the plate and proved in the Sumatra Fault System which runs along the island arc sequence and merentas. With respect to the arc magma, from west to east, Sumatra can be divided into four tectonic mandala (Manga, 1994), namely: Mentawai lane, lane or lane Bengkulu Fore Arc, Arc Magma lane or the lane and lane Barisan Rear arc or lane Jambi-Palembang.

2.4 Marphology

Regionally, the area of research in this lab is located on the island of Sumatra volcanic line (volcanic Sumatra) is a hill on the lane line. There are several volcanoes in this area are Mt. Betung and Mt. Pesawaran. The volcanism that occurred in the research area of Padang Cermin geothermal prospect in progress at the time indicated by the product tertiary volcanic mountain in the form of sediment Ratai young volcano like larvae and andesitic pyroclastics derived from tertiary volcanic.

3. METHODS

Based on Suharno 92013), The equipment that will be used in the conduct of research include: (1) The GPS (Global Positioning System) is a tool used to determine the height of a place that uses the help of satellites. (2) Compass geology and Stationery to record positional data and geological appearance of the surrounding area. Data colletion: It was first performed in this study is data collection. In this stage all the collected data used in this study, these data include: (1) Base Map (2) Data Geologi regional. Base map is a map that contains information about the location of the study. Geological data covering the research areas of data stratigraphic study area is used as a reference in the study. With these data can be selected based on the zone of interest to be investigated.

Research procedures: First the reseacher to prepare everything necessary in this experiment such as GPS (Global Positioning System), field clothing, shoes, backpack, map, camera and others. Once everything is ready then headed to the practitioner research purposes. For the first location we chose Earth Kedaton area to find out how altitude of the area. By using GPS (Global Positioning System) is then we will get the expected data. Still around Kedaton precisely in the area of Bumi Kedaton Tourism Park we stopped and started registering the height of the area. The study then proceeded to the location a bit further than the previous Padang Cermin geothermal Field. The target area is the village of Way Ratai. In this area we will observe about the resources contained geothermal manifestation. Results geothermal which is the focus of our observations this time. In this geothermal area we measured the diameter, long bursts and mineral content contained in the hot springs. Then look for potential contained from the hot springs.

4. RESULT

Manifestation I (Figure 3). The hot spring is well hot water spout that causes by drilling pipe diameter 1 inc, located at coordinate (517722 mE, 9383456 mN), with a temperature of about 98^{o}C.

5. DISCUSSION

From the observations made in the manifestation in Figure 1 shows that the well water spout at a specific time period. Based on the observation, As long eruption that is obtained for the first bursts of time during the 36 s and gained time for second bursts for 43 s. which have a height ranging from 15-90 cm. To calculate an estimate of the bursts can be calculated by experiment that has the principle organ pipes.

In this study, the observations made are observations on geothermal manifestations at the surface, where the study site on the surface of the visible manifestation is the hot springs and geysers. What is meant by hot springs here are down and the ground water in contact with magma so it will be heated and tends to rise to the surface through cracks in the rock and form the source of the hot

springs. While the definition here is a water geyser erupted ground as steam and hot water pools, formed by the presence of water-filled gap from getting all big crater where water accumulated in the gap the higher the vapor pressure of water pressing on it so that the water will be ejected out (Hochstein and Soengkono, 1997).

Figure 3: Manifestation I (foto Suharno, 2010). The left hand side is the fumarol that discharge at between 4 and 9 second bursts which have a height ranging from 15-90 cm. The right hand side is silica sinter.

Figure 4: Manifestation II. The second hot spring is a natural manifestation located at coordinate (517387 mE, 9383524 mN), with a temperature of about 85^{o}C (foto Suharno, 2010).

Figure 5: Mafestation III. The third natural hot springs at coordinates (517402 mN, 9383542 mN), with a temperature of about 90^{o}C (foto Suharno, 2010).

Figure 6: Manifestation IV. The fourth hot spring at coordinates (517419 mN, 9383526 mN), with the temperature 96 ^{o}C (foto Suharno, 2010).

Figure 6: Manifestation IV. The fourth hot spring at coordinates (517419 mN, 9383526 mN), with the temperature 96 ^{o}C (foto Suharno, 2010).

Figure 7: Manifestation 5. The fifth hot springs located at coordinates (517526 mE, 9383566 mN), with a temperature of 85^{o}C (foto Suharno, 2010).

Figure 8: Many other manifestations surrounding Pandang Cermin geothermal field. (foto Suharno, 2010)

On the surface manifestation of the hot water temperature is obtained which is almost close to the boiling point of pure water temperatures ranging from 85^{o} to 98 ^{o}C. The hot water is expected in addition to the type derived from meteoric water is also thought to have originated from seawater given study area is the coastal areas .

Geysers or hot springs that are found to have received empowerment has been given such a chimney made of pipes with a diameter of 6.5 cm and 1.5 cm thick pipe. As long eruption that is obtained for the first bursts of time during the 36 s and gained time for second bursts for 43 s. The hot springs issuing bursts but not for the hot springs have time to rest not issue a hose bursts or continuously called with a hose bursts. The first blast of the hose is a hose bursts of 47 s and the second measurement is 77 s. In this area there are small stones that encircle the outer pipe wall and as the observation that the rocks that are on the wall of the pipe contains a lot of sulfur deposition. This is the show that contains a lot of sulfur geysers. This can be illustrated as in Figure 3. It is clear as the picture Figure 3, the rocks surrounding holes yellowish green to indicate that these rocks have undergone alteration by fluids in the area around the blast (Yuzariyadi, 2010).

At the well site 1 contained silica sinter rocks which show a layered structure, it reflects changes in the structure and composition during the deposition. Silica sinters have look something like a sponge with travertine stone. Silica sinter is generally formed in a situation that is rich in silica heat then medinginkan very quickly. Cooling is too fast to allow the growth of large crystals or the formation of silica gel which would be a precursor variant of chalcedony. Sintered Silica can be found in hot wells in volcanic rocks and geysers for hot water at the surface cools rapidly.

While on another manifestation of his examples do not cause bursts as manifestations example in Figure 1, it is due to its countless other wells diameter large enough compared to wells in Figures 1 and just have a much smaller pressure than the wells in Figure 1. Though not of spitting but on the water wells also contain the same geothermal fluid.

At this location the 2nd region is lower than the location of the observation area into two. Diameter produced by hot springs is larger than the diameter of the hot springs before. The area around the geyser geyser hole, or rather above the green trees and curved just above the hot springs. To be more clear, it can be observed in the Figure 4. At the well site 2 is estimated temperature of about 80 ^{o}C with morphological regions in the north ± 300 m is coconut, the south also contained coconut, while on the west and east ± 300 m is hill.

At different locations finally found the hot springs that have a larger surface area. And the results found in the 3rd location is the same as the previous result on the first location. But of the area can be seen all around existing habitats. In the southeast ± 1 km there are palm trees. In the northeast ± 1000 m there is a mound, while in the south ± 500 m contained coconut. From the observation that the plants or plant acquired around the geysers seem a little more wilted than in plants that are a bit far from the geyser. Once finished with the second location.. In this third location is found the hot springs with a diameter much larger than before. When seen from the extensive there may be about 2 meters. Water source heat generated can be seen in the Figure 5.

The morphology of the region Padang Cermin divided into 3 groups, namely mountains, plains and beaches. Morphology Mountains located in the south and consists of fertile soil material. Morphology heights in the range between 29-300 m with a slope of 0-40%. Morphology is a layer of sedimentary rock with some igneous intrusions. The beach is located in the south and forms of precipitation aluvial. Energi natural geothermal heat stored in the earth's core, mantle and crust.

If in view of the higher topography can be seen by looking at the anomaly distribution of geothermal plants spread around. Area geothermal plants tend to have their own differences, such as the coconut tree. By using the compass, in the specified direction and in view of palm trees pesebaran boundary as the geothermal pesebaran approximate estimate. And in guessing that geothermal is reached pesebaran SSE manifestation limits ± 1 km away, to the Northeast ± 1000 m, and to the south ± 500 m.

In general, geothermal prospects in the Padang Cermin Pesawaran District according to the results of observations spread northward, heading toward Mt. Menagis and toward the West, toward Mt. Pesawaran the eastern and southern part of the beach in the limit in this case a Ratai bay, as for the extent or distribution of geothermal manifestations estimated size of ± 5 km². It is based landscape which allows well as growth and development of vegetation on the surface.

The identity of the hydrothermal minerals reflect the new environment in which these minerals are definitely on the rocks reservoir. Alterations include the replacement of primary phases and the results caused by rising hot fluids. There are some who have altered hydrothermally. Alkaline water with a pH near neutral chloride, silica sinter precipitate on the surface.

Present circumstances, the surface manifestation and is characterized by hot mud springs of boiling acid. Some places are silica sinter which is a sign that was once a source of water with a neutral pH. The presence of silica sinter in the study area, may be older than 20,000 years when the first time is known as quartz (Herdianita, et al., 2000). The existence of hydrothermal minerals that appear on the surface and on samples from drill holes and deposition of sinter past a sign of precipitation.

6. DISCUSSION

The Most of the rock surface weathering suffered because of the weather. Some who have altered hydrothermally occur at the surface. The identity of the hydrothermal minerals reflect the new environment in which these minerals are definitely on the rocks reservoir. Alterations include the replacement of primary phases and the results caused by rising hot fluids. Alkaline water with a pH near neutral chloride, silica sinter precipitate on the surface. Geochemical analysis should be done before, presentation.

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