6TH ITB INTERNATIONAL GEOTHERMAL WORKSHOP 2017

March, 22nd – 23rd

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PROCEEDING BOOK

"THE RISE OF GEOTHERMAL DEVELOPMENT IN INDONESIA. Resource Transformation Strategy towards 7000 MWe Capacity"

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PREFACE

ITB International Geothermal Workshop (IIGW) is an annual event organized by *Prodi Teknik Panas Bumi, Fakultas Teknik Pertambangan dan Perminyakan (FTTM),* ITB. The workshop celebrated its 6th anniversary this year. It was held on March 20–24, 2017 and has become a special moment in supporting the geothermal development acceleration program in Indonesia.

The objective of the workshop was to create a knowledge sharing forum among the key stakeholders in energy and extractive resource sectors on the status of geothermal development in Indonesia. It focused on the latest condition after the approval of new regulation of geothermal energy law No 2014. The conference featured distinguished speakers, scientists, engineers, financiers, and other key players in geothermal and energy sectors worldwide.

Participants benefit the exchanges of view, knowledges and experiences on latest technologies and researches by bringing together scientists, engineers, academicians, experts, and industrial stakeholders involved in geothermal studies and developments.

As part of this year commitment, selected papers are published as open access volume of *IOP Conference Series: Earth and Environmental Science*. Other papers are published in the conference proceeding in print version. We hope wider geothermal communities will gain the same benefits as our conference attendees.

WORKSHOP WELCOME REMARKS

Held on March 22nd – 24th 2017 in Bandung, Indonesia, 6th ITB International Geothermal Workshop 2017 was considered successful. Over 300 delegates attended and participated in six days pre-workshop, workshop, mid-workshop, exhibition, field trip, and field camp, which brought together managers, geologists, engineers, experts, and students from several countries involved in all aspects geothermal knowledge and technology.

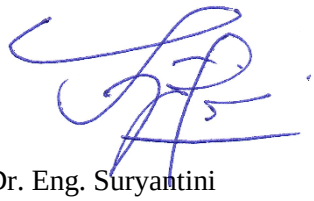
The theme of this year's event was "**The Rise of Geothermal Development in Indonesia: Resource Transformation Strategy Towards 7000 MWe Capacity**". It brought new information about current research, innovation, exploration results and engineering activities regarding geothermal developments. The chairman of 6th ITB International Geothermal Workshop 2017 welcomed delegates prior the Workshop officially opened by Prof. Dr. Ir. Ridho Kresna Wattimena, Vice Dean of Academic of Faculty of Mining and Petroleum Engineering ITB.

High quality technical papers were presented with topics of geothermal from geochemistry, geophysics, geology, integrated exploration, utilization, reservoir engineering, production engineering, socio-economic, environment, international collaboration, drilling, and education.

Overall, the event was divided into 6 main parts: *Pre-Workshop Courses, Workshop (*technical and panel sessions*), Mid-Workshop, Exhibition, Field Camp, and Field Trip*. Workshop Plenary sessions were attended by many distinguish speakers in geothermal such as Abadi Poernomo as Chairman of Indonesian Geothermal Association (INAGA), Ridwan Djamaluddin as Deputy III Division of Infrastructure Coordination Ministry for Maritime Affairs, Eben Ezer Siahaan from Pertamina Geothermal Energy, Anton Wahjosodibjo from PEN Consulting, Bambang Roesdyoko from Supreme Energy, Reza Adiprana from Indonesia Power, William Lajousky from Sarulla Operation Ltd., Rosalin Archer from University of Auckland, Radikal Utama from Supreme Energy, Julfi Hadi from Hitay Daya Energy, Michael Reading from KS Orka Renewables Pte Ltd., and Ricardo G. Barcelona from Barcino Adivisers.

We would like to give our best regard for all the support that has been given for this event, from Geothermal Technology Magister Program Staff to all Chair Persons, Authors, Presenters, Paper Reviewers and all workshop Sponsors and Exhibitors for their assistances and cooperations.

Sincerely,



Dr. Eng. Suryantini
Chairman of the ITB International Geothermal Workshop (IIGW) 2017

WORKSHOP EVENTS

Geothermal Technology Master Program of Institut Teknologi Bandung continue to contribute development of geothermal industry by future enhancing the contents of Workshop and providing an excellent setting for business interest. This year, 6th ITB International Geothermal Workshop 2017 was divided into 6 main parts: *Pre-Workshop Courses, Workshop (*technical and panel sessions*), Mid-Workshop, Exhibition, Field Camp, and Field Trip* from Monday, March 20th to Saturday, March 24th 2017.

Event visitors were mostly academia and industry. Participants from academia delegates are Institut Teknologi Bandung, Universitas Trisakti, Universitas Negeri Manado, Universitas Padjadjaran, Universitas Pembangunan Nasional "Veteran" Yogyakarta, Akita University, and Fukuoka University. Industry delegates are PT. Pertamina Geothermal Energy, Supreme Energy, PT. Geo Dipa, PT. Kwarsa Hexagon, and Hitay. Several participants from the government of Indonesia also attended this event.

ABSTRACTS OF IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SERIES

Available at http://iopscience.iop.org/issue/1755-1315/103/1

SLIM HOLE DRILLING AND TESTING STRATEGIES

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Abstract.

The financial and geologic advantages of drilling slim holes instead of large production wells in the early stages of geothermal reservoir assessment has been understood for many years. However, the practice has not been fully embraced by geothermal developers. We believe that the reason for this is that there is a poor understanding of testing and reservoir analysis that can be conducted in slim holes. In addition to reservoir engineering information, coring through the cap rock and into the reservoir provides important data for designing subsequent production well drilling and completion. Core drilling requires significantly less mud volume than conventional rotary drilling, and it is typically not necessary to cure lost circulation zones (LCZ). LCZs should be tested by either production or injection methods as they are encountered. The testing methodologies are similar to those conducted on large-diameter wells; although produced and/or injected fluid volumes are much less. Pressure, temperature and spinner (PTS) surveys in slim holes under static conditions can used to characterize temperature and pressure distribution in the geothermal reservoir. In many cases it is possible to discharge slim holes and obtain fluid samples to delineate the geochemical properties of the reservoir fluid. Also in the latter case, drawdown and buildup data obtained using a downhole pressure tool can be employed to determine formation transmissivity and well properties. Even if it proves difficult to discharge a slim hole, an injection test can be performed to obtain formation transmissivity. Given the discharge (or injection) data from a slimhole, discharge properties of a large-diameter well can be inferred using wellbore modeling. Finally, slim hole data (pressure, temperature, transmissivity, fluid properties) together with reservoir simulation can help predict the ability of the geothermal reservoir to sustain power production.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012001/pdf

GEOTHERMAL RESERVOIR SIMULATION OF HOT SEDIMENTARY AQUIFER SYSTEM USING FEFLOW®

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Abstract.

The study presents the simulation of hot sedimentary aquifer for geothermal utilization. Hot sedimentary aquifer (HSA) is a conduction-dominated hydrothermal play type utilizing deep aquifer, which is heated by near normal heat flow. One of the examples of HSA is Bavarian Molasse Basin in South Germany. This system typically uses doublet wells: an injection and production well. The simulation was run for 3650 days of simulation time. The technical feasibility and performance are analysed in regards to the extracted energy from this concept. Several parameters are compared to determine the model performance. Parameters such as reservoir characteristics, temperature information and well information are defined. Several assumptions are also defined to simplify the simulation process. The main results of the simulation are heat period budget or total extracted heat energy, and heat rate budget or heat production rate. Qualitative approaches for sensitivity analysis are conducted by using five parameters in which assigned lower and higher value scenarios.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012002/pdf

DEVELOPING A FRAMEWORK FOR ASSESSING THE IMPACT OF GEOTHERMAL DEVELOPMENT PHASES ON ECOSYSTEM SERVICES

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Abstract.

The 2014 Indonesian National Energy Policy has set a target to provide national primary energy usage reached 2.500 kWh per capita in the year 2025 and reached 7.000 kWh in the year 2050. The National Energy Policy state that the development of energy should consider the balance of energy economic values, energy supply security, and the conservation of the environment. This has led to the prioritization of renewable energy sources. Geothermal energy a renewable energy source that produces low carbon emissions and is widely available in Indonesia due to the country's location in the "volcanic arc". The development of geothermal energy faces several problems related to its potential locations in Indonesia. The potential sites for geothermal energy are mostly located in the volcanic landscapes that have a high hazard risk and are often designated protected areas. Local community low knowledge of geothermal use also a challenge for geothermal development where sometimes strong local culture stand in the way. Each phase of geothermal energy development (exploration, construction, operation and maintenance, and decommissioning) will have an impact on the landscape and everyone living in it. Meanwhile, natural and other human-induced drivers will keep landscapes and environments changing. This conference paper addresses the development of an integrated assessment to spatially measure the impact of geothermal energy development phases on ecosystem services. Listing the effects on the ecosystem services induced by each geothermal development phases and estimating the spatial impact using Geographic Information System (GIS) will result in an overview on where and how much each geothermal development phase affects the ecosystem and how this information could be included to improve national spatial planning.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012003/pdf

SMART GEO-ENERGY VILLAGE DEVELOPMENT BY USING CASCADE DIRECT USE OF GEOTHERMAL ENERGY IN BONJOL, WEST SUMATERA

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Abstract

West Sumatera is a province which has a huge geothermal potential - approximately 6% of Indonesia's total geothermal potential which equals to 1,656 MWe. One of the significant reserves located in Bonjol subdistrict which accounts for more than 50 MWe. The energy from geothermal manifestation in Bonjol can be utilized prior to indirect development. Manifestation at the rate 3 kg/s and 87 ^{o}C will flow to cascading system consisting several applications, arranged in order from high to low temperature to efficiently use the excessive energy. The direct use application selected is based on the best potential commodities as well as temperature constraint of heat source. The objective of this paper is to perform a conceptual design for the first cascade direct use of geothermal energy in Indonesia to establish Bonjol Smart Geo-Energy Village which will be transformed as the center of agricultural, stockbreeding, tourism as well as cultural site. A comprehenssive research was performed through remote survey area, evaluation featured product, analysis of heat loss and heat exchange in cascade system. From potential commodities, the three applications selected are cocoa drying and egg hatching incubation machine as well as

new tourism site called *Terapi Panas Bumi*. The optimum temperature for cocoa drying is 62ºC with the moisture content 7% which consumes 78 kW for one tones cocoa dried. Whereas, egg incubation system consists of two chamber with the same temperature 40ºC for each room and relative humidity 55% and 70%. For the last stage, *Terapi Panas Bumi* works in temperature 40ºC. Based on the result technical and economical aspect, it exhibits cascade direct use of geothermal energy is very recommended to develop.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012004/pdf

STUDY OF SUSTAINABLE PRODUCTION IN TWO-PHASE LIQUID DOMINATED WITH STEAM CAP UNDERLYING BRINE RESERVOIR BY NUMERICAL SIMULATION

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Abstract.

The main issue in the management of the two-phase liquid-dominated geothermal field is rapid decline pressure in the reservoir so that the supply of steam to the power plant cannot be fulfilled. To understanding that, modelling and numerical simulation used reservoir simulators. The model is developed on liquid-dominated geothermal fields are assessed in various scenarios of production strategies (focusing only steam cap, brine reservoir and a combination) and injection strategies (deep and shallow injection, centered and dispersed injection), with the calculation using separated steam cycle method. The simulation results of the model for sustainable production are production 25% from steam cap + 75% from brine reservoir, dispersed and deep reinjection with make-up wells from steam cap results 9 make-up well number. The implementation of production-injection strategy needs to be planned right from the beginning of exploitation so that the strategy can adapt to changes in reservoir characteristics.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012005/pdf

BASIC OVERVIEW TOWARDS THE ASSESSMENT OF LANDSLIDE A ND SUBSIDENCE RISKS ALONG A GEOTHERMAL PIPELINE NETWORK

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Abstract.

An operating geothermal power plant consists of installation units that work systematically in a network. The pipeline network connects various engineering structures, e.g. well pads, separator, scrubber, and power station, in the process of transferring geothermal fluids to generate electricity. Besides, a pipeline infrastructure also delivers the brine back to earth, through the injection well-pads. Despite of its important functions, a geothermal pipeline may bear a threat to its vicinity through a pipeline failure. The pipeline can be impacted by perilous events like landslides, earthquakes, and subsidence. The pipeline failure itself may relate to physical deterioration over time, e.g. due to corrosion and fatigue. The geothermal reservoirs are usually located in mountainous areas that are associated with steep slopes, complex geology, and weathered soil. Geothermal areas record a noteworthy

number of disasters, especially due to landslide and subsidence. Therefore, a proper multi-risk assessment along the geothermal pipeline is required, particularly for these two types of hazard. This is also to mention that the impact on human fatality and injury is not presently discussed here. This paper aims to give a basic overview on the existing approaches for the assessment of multi-risk assessment along geothermal pipelines. It delivers basic principles on the analysis of risks and its contributing variables, in order to model the loss consequences. By considering the loss consequences, as well as the alternatives for mitigation measures, the environmental safety in geothermal working area could be enforced.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012006/pdf

PROBABILISTIC APPROACH OF RESOURCE ASSESSMENT IN KERINCI GEOTHERMAL FIELD USING NUMERICAL SIMULATION COUPLING WITH MONTE CARLO SIMULATION

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Abstract.

The Kerinci geothermal field is one phase liquid reservoir system in the Kerinci District, western part of Jambi Province. In this field, there are geothermal prospects that identified by the heat source up flow inside a National Park area. Kerinci field was planned to develop 1×55 MWe by Pertamina Geothermal Energy. To define reservoir characterization, the numerical simulation of Kerinci field is developed by using TOUGH2 software with information from conceptual model. The pressure and temperature profile well data of KRC-B1 are validated with simulation data to reach natural state condition. The result of the validation is suitable matching. Based on natural state simulation, the resource assessment of Kerinci geothermal field is estimated by using Monte Carlo simulation with the result P10-P50-P90 are 49.4 MW, 64.3 MW and 82.4 MW respectively. This paper is the first study of resource assessment that has been estimated successfully in Kerinci Geothermal Field using numerical simulation coupling with Monte carlo simulation.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012007/pdf

AERATED DRILLING CUTTING TRANSPORT ANALYSIS IN GEOTHERMAL WELL

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Abstract.

Aeratad drilling widely used for geothermal drilling especially when drilled into predicted production zone. Aerated drilling give better performance on preventing lost circulation problem, improving rate of penetration, and avoiding drilling fluid invasion to productive zone. While well is drilled, cutting is produced and should be carried to surface by drilling fluid. Hole problem, especially pipe sticking will occur while the cutting is not lifted properly to surface. The problem will effect on drilling schedule; non-productive time finally result more cost to be spent. Geothermal formation has different characteristic comparing oil and gas formation. Geothermal mainly has igneous rock while oil and gas mostly sedimentary rock. In same depth, formation pressure in geothermal well commonly lower than oil and gas well while formation temperature geothermal well is higher. While aerated drilling is applied in geothermal well, Igneous rock density has higher density than sedimentary rock and aerated drilling fluid is lighter than water based mud hence minimum velocity requirement to transport cutting is larger than in oil/gas well drilling. Temperature and pressure also has impact on drilling fluid (aerated) density. High

temperature in geothermal well decrease drilling fluid density hence the effect of pressure and temperature also considered. In this paper, Aerated drilling cutting transport performance on geothermal well will be analysed due to different rock and drilling fluid density. Additionally, temperature and pressure effect on drilling fluid density also presented to merge.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012008/pdf

APPLICATION OF EXPERIMENTAL DESIGN IN GEOTHERMAL RESOURCES ASSESSMENT OF CIWIDEY-PATUHA, WEST JAVA, INDONESIA

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Abstract.

The successful Ciwidey-Patuha geothermal field size assessment required integration data analysis of all aspects to determined optimum capacity to be installed. Resources assessment involve significant uncertainty of subsurface information and multiple development scenarios from these field. Therefore, this paper applied the application of experimental design approach to the geothermal numerical simulation of Ciwidey-Patuha to generate probabilistic resource assessment result. This process assesses the impact of evaluated parameters affecting resources and interacting between these parameters. This methodology have been successfully estimated the maximum resources with polynomial function covering the entire range of possible values of important reservoir parameters.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012009/pdf

MAKE-UP WELLS DRILLING COST IN FINANCIAL MODEL FOR A GEOTHERMAL PROJECT

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Abstract.

After commissioning of a power plant, geothermal reservoir will encounter pressure decline, which will affect wells productivity. Therefore, further drilling is carried out to enhance steam production. Make-up wells are production wells drilled inside an already confirmed reservoir to maintain steam production in a certain level. Based on Sanyal (2004), geothermal power cost consists of three components, those are capital cost, O&M cost and make-up drilling cost. The make-up drilling cost component is a major part of power cost which will give big influence in a whole economical value of the project.

The objective of this paper it to analyse the make-up wells drilling cost component in financial model of a geothermal power project. The research will calculate make-up wells requirements, drilling costs as a function of time and how they influence the financial model and affect the power cost. The best scenario in determining make-up wells strategy in relation with the project financial model would be the result of this research.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012010/pdf

PROBABILISTIC APPROACH: BACK PRESSURE TURBINE FOR GEOTHERMAL VAPOR-DOMINATED SYSTEM

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Abstract.

Geothermal bussiness nowadays needs to be accelerated in a way that profit can be obtained as soon as reasonable possible. One of the many ways to do this is by using one of geothermal wellhead generating unit (GWGU), called backpressure turbine. Backpressure turbine can be used in producing electricity as soon as there is productive or rather small-scale productive well existed after finished drilling. In a vapor dominated system, steam fraction in the wellhead capable to produce electricity based on each well productivity immediately. The advantage for using vapor dominated system is reduce brine disposal in the wellhead so it will be a cost benefit in operation. The design and calculation for backpressure turbine will use probablistic approach with Monte Carlo simulation. The parameter that will be evaluated in sensitivity would be steam flow rate, turbine inlet pressure, and turbine exhaust pressure/atmospheric pressure. The result are probability for P10, P50, and P90 of gross power output which are 1.78 MWe, 2.22 MWe and 2.66 Mwe respectively. Whereas the P10, P50, and P90 of SSC are 4.67 kg/s/MWe, 5.19 kg/s/MWe and 5.78 kg/s/MWe respectively.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012011/pdf

A NEW IDEA: THE POSSIBILITIES OF OFFSHORE GEOTHERMAL SYSTEM IN INDONESIA MARINE VOLCANOES

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Abstract.

High temperature geothermal systems in Indonesia are commonly associated with volcanic systems. It is believed that volcanoes are acting as the heat source for a geothermal system. Right now, most of the operating geothermal fields in the world are assosiating with volcanic settings which known as the conventional geothermal system. Volcanoes are created in active tectonic zone such as collision zone and MOR (mid oceanic ridge). The later is the one which formed the marine volcanoes on the sea floor. The advances of today's technology in geothermal energy has created many ideas regarding a new kind of geothermal system, including the ideas of developing the utilization of marine volcanoes. These marine volcanoes are predicted to be hotter than the land system due to the shorter distance to the magma chamber. Seamounts like NEC, Banua Wuhu, and Kawio Barat in Indonesia Sea are good spots to be studied. Methods such as remote sensing using NOAA images, sonar, and MAPR are commonly used, eventhough these would be more accurate with more detailed techniques. This has become the challenge for all geothermal scientists to overcome for a better study result.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012012/pdf

ENHANCEMENT OF SUBSURFACE GEOLOGIC STRUCTURE MODEL BASED ON GRAVITY, MAGNETOTELLURIC, AND WELL LOG DATA IN KAMOJANG GEOTHERMAL FIELD

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Abstract.

Geophysical methods such as gravity and magnetotelluric methods commonly used in conventional and unconventional energy exploration, notably for exploring geothermal prospect. They used to identify the subsurface geology structures which is estimated as a path of fluid flow. This study was conducted in Kamojang Geothermal Field with the aim of highlighting the volcanic lineament in West Java, precisely in Guntur-Papandayan chain where there are three geothermal systems. Kendang Fault has predominant direction NE-SW, identified by magnetotelluric techniques and gravity data processing techniques. Gravity techniques such as spectral analysis, derivative solutions, and Euler deconvolution indicate the type and geometry of anomaly. Magnetotelluric techniques such as inverse modeling and polar diagram are required to know subsurface resistivity charactersitics and major orientation. Furthermore, the result from those methods will be compared to geology information and some section of well data, which is sufficiently suitable. This research is very useful to trace out another potential development area.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012013/pdf

GEOMORPHOLOGICAL CLASSIFICATION OF POST-CALDERA VOLCANOES IN THE BUYAN–BRATAN CALDERA, NORTH BALI, INDONESIA

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Abstract.

A landform of the post-caldera volcanoes (Lesung, Tapak, Sengayang, Pohen, and Adeng) in the Buyan–Bratan caldera on the island of Bali, Indonesia can be classified by topographic interpretation. The Tapak volcano has three craters, aligned from north to south. Lava effused from the central crater has flowed downward to the northwest, separating the Tamblingan and Buyan Lakes. This lava also covers the tip of the lava flow from the Lesung volcano. Therefore, it is a product of the latest post-caldera volcano eruption. The Lesung volcano also has two craters, with a gully developing on the pyroclastic cone from the northern slope to the western slope. Lava from the south crater has flowed down the western flank, beyond the caldera rim. Lava distributed on the eastern side from the south also surrounds the Sengayang volcano. The Adeng volcano is surrounded by debris avalanche deposits from the Pohen volcano. Based on these topographic relationships, Sengayang volcano appears to be the oldest of the post-caldera volcanoes, followed by the Adeng, Pohen, Lesung, and Tapak volcanoes. Coarse-grained scoria falls around this area are intercalated with two foreign tephras: the Samalas tephra (1257 A.D.) from Lombok Island and the Penelokan tephra (ca. 5.5 kBP) from the Batur caldera. The source of these scoria falls is estimated to be either the Tapak or Lesung volcano, implying that at least two volcanoes have erupted during the Holocene period.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012014/pdf

CL/B RATIO OF GEOTHERMAL FLUID AROUND SLAMET VOLCANO, JAWA TENGAH, INDONESIA

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Abstract.

Geothermal manifestations occurred in four areas surrounding Slamet Volcano, such as Guci, Baturraden, Paguyangan, and Bantarkawung. These areas are located of about 7.5 km, 8 km, 25 km and 33 km from the summit of Slamet volcano, respectively. We analyzed the chemical composition of cold and hot hater in order to understand the genesis and hydrological the relationship of the hot springs. The plot on HCO_3-Cl-SO_4 ternary diagram classified the hot water into four water types i.e. chloride-bicarbonate water (Bantarkawung), chloride water (Paguyangan), sulfate-chloride water (Baturraden), and bicarbonate water (Guci). The Cl/B ratio values indicate that the southern part of the Slamet volcano (Baturaden) hot springs have high Cl/B ratio compared to that of the northern hot springs (Guci area). While the hot springs in the western part (Paguyangan and Bantarkawung) are classified into high and low Cl/B ratio. This indicates that the hot springs in Paguyangan and Bantarkawung are the outflow of Baturraden and Guci.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012015/pdf

GEOTHERMAL SYSTEM BOUNDARY AT THE NORTHERN EDGE OF PATUHA GEOTHERMAL FIELD BASED ON INTEGRATED STUDY OF VOLCANOSTRATIGRAPHY, GEOLOGICAL FIELD MAPPING, AND COOL SPRINGS CONTAMINATION BY THERMAL FLUIDS

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Abstract.

Patuha Geothermal System is a volcanic hydrothermal system. In this type of system, the boundary of the system is often determined by low resistivity (10 ohm.m) anomaly from Magnetotelluric (MT) or DC-Resistivity survey. On the contrary, during geothermal exploration, the system boundary often need to be determined as early as possible even prior of resistivity data available. Thus, a method that use early stage survey data must be developed properly to reduce the uncertainty of the geothermal area extent delineation at the time the geophysical data unavailable. Geological field mapping, volcanostratigraphy analysis and fluid chemistry of thermal water and cold water are the data available at the early stage of exploration. This study integrates this data to delineate the geothermal system boundary. The geological mapping and volcanostratigraphy are constructed to limit the extent of thermal and cold springs. It results that springs in the study area are controlled hydrologically by topography of Patuha Volcanic Crown (complex) or so called PVC, the current geothermal field and Masigit Volcanic Crown (complex) or so called MVC, the dormant volcano not associated with active geothermal system. Some of the cold springs at PVC are contaminated by subsurface steam heated outflow while others are not contaminated. The contaminated cold springs have several characteristics such as higher water temperature than ambient temperature at the time it was measured, higher total disolved solid (TDS), and lower pH. The soluble elements analysis support the early contamination indication by showing higher cation and anion, and positive oxygen shifting of stable isotope of these cool springs. Where as the uncontaminated spring shows similar characteristic with cool

springs occur at MVC. The boundary of the system is delineated by an arbitrary line drawn between distal thermal springs from the upflow or contaminated cool springs with the cool uncontaminated springs. This boundary is more or less in agreement with low resisitivity boundary derived from MT and DC resistivity survey. The area defined as part of geothermal area from this method is also validate with drilling data that give high temperature gradient. It suggests that the method use in this study is applicable and reliable.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012016/pdf

PRELIMINARY DETERMINATION OF GEOTHERMAL WORKING AREA BASED ON THERMAL INFRARED AND SYNTHETIC APERTURE RADAR (SAR) REMOTE SENSING

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Abstract.

Remote sensing is one of the methods for geothermal exploration. This method can be used to map the geological structures, manifestations, and predict the geothermal potential area. The results from remote sensing were used as guidance for the next step exploration. Analysis of target in remote sensing is an efficient method to delineate geothermal surface manifestation without direct contact to the object. The study took a place in District Merangin, Jambi Province, Indonesia. The area was selected due to existing of Merangin volcanic complex composed by Mounts Sumbing and Hulunilo with surface geothermal manifestations presented by hot springs and hot pools. The location of surface manifestations could be related with local and regional structures of Great Sumatra Fault. The methods used in this study were included identification of volcanic products, lineament extraction, and lineament density quantification. The objective of this study is to delineate the potential zones for sitting the geothermal working site based on Thermal Infrared and Synthetic Aperture Radar (SAR) sensors. The lineament-related to geological structures, was aimed for high lineament density, is using ALOS - PALSAR (Advanced Land Observing Satellite - The Phased Array type L-band Synthetic Aperture Radar) level 1.1. The Normalized Difference Vegetation Index (NDVI) analysis was used to predict the vegetation condition using Landsat 8 OLI-TIRS (The Operational Land Imager – Thermal Infrared Sensor). The brightness temperature was extracted from TIR band to estimate the surface temperature. Geothermal working area identified based on index overlay method from extracted parameter of remote sensing data was located at the western part of study area (Graho Nyabu area). This location was identified because of the existence of high surface temperature about 30°C, high lineament density about 4 - 4.5 km/km2 and low NDVI values less than 0.3

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012017/pdf

TOPOGRAPHIC MAP ANALYSIS TO DETERMINE ARJUNO-WELIRANG VOLCANOSTRATIGRAPHY AND IMPLICATION FOR GEOTHERMAL EXPLORATION

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Abstract.

Volcanostratigraphy study is used for supporting geothermal exploration on preliminary survey. This study is important to identify volcanic eruption center which shows potential area of geothermal heat source. The purpose of volcanostratigraphy study in research area is going to distinguish the characteristics of volcanic eruption product that construct the volcanic body. The analysis of Arjuno-Welirang volcanostratigraphy identification are based on topographic maps of Malang sheet with 1:100.000 scale, 1:50.000 scale, and a geological map. Regarding to the delineation of ridge and river, we determine five crowns, three hummocks, one brigade and one super brigade. The crowns consist of Ringgit, Welirang, Arjuno, Kawi, and Penanggungan, the hummocks comprise of Kembar III, Kembar II, and Kembar I, the brigade is Arjuno-Welirang, and the super brigade is Tengger. Based on topographic map interpretation and geothermal prospect evaluation method analysis, shows that Arjuno-Welirang prospect area have good geothermal resource potential.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012018/pdf

PRELIMINARY STUDY OF NEAR SURFACE DETECTIONS AT GEOTHERMAL FIELD USING OPTIC AND SAR IMAGERIES

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Abstract.

Current remote sensing technologies shows that surface manifestation of geothermal system could be detected with optical and SAR remote sensing, but to assess target beneath near the surface layer with the surficial method needs a further study. This study conducts a preliminary result using Optic and SAR remote sensing imagery to detect near surface geothermal manifestation at and around Mt. Papandayan, West Java, Indonesia. The data used in this study were Landsat-8 OLI/TIRS for delineating geothermal manifestation prospect area and an Advanced Land Observing Satellite(ALOS) Phased Array type L-band Synthetic Aperture Radar (PALSAR) level 1.1 for extracting lineaments and their density. An assumption was raised that the lineaments correlated with near surface structures due to long L-band wavelength about 23.6 cm. Near surface manifestation prospect area are delineated using visual comparison between Landsat 8 RGB True Colour Composite band 4,3,2 (TCC), False Colour Composite band 5,6,7 (FCC), and lineament density map of ALOS PALSAR. Visual properties of ground object were distinguished from interaction of the electromagnetic radiation and object whether it reflect, scatter, absorb, or and emit electromagnetic radiation based on characteristic of their molecular composition and their macroscopic scale and geometry. TCC and FCC composite bands produced 6 and 7 surface manifestation zones according to its visual classification, respectively. Classified images were then compared to a Normalized Different Vegetation Index (NDVI) to obtain the influence of vegetation at the ground surface to the image. Geothermal area were classified based on vegetation index from NDVI. TCC image is more sensitive to the vegetation than FCC image. The later composite produced a better result for identifying visually geothermal manifestation showed by detail-detected zones. According to lineament density analysis high density area located on the peak of Papandayan overlaid with zone 1 and 2 of FCC. Comparing to the extracted lineament density, we interpreted that the near surface manifestation is located at zone 1 and 2 of FCC image.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012019/pdf

PRELIMINARY STUDY OF SONGA-WAYAUA GEOTHERMAL PROSPECT AREA USING VOLCANOSTRATIGRAPHY AND REMOTE SENSING ANALYSIS

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Abstract.

Songa-Wayaua geothermal prospect area is located on Bacan Island, Northern Molluca Province. Geothermal systems in this area associated with three Quartenary volcanoes, such as Mt. Pele-pele, Mt. Lansa, and Mt. Bibinoi. Based on literature study, five surface manifestations such as hot springs and alteration occurred within this area. The active manifestations indicate that Songa-Wayaua area has potential geothermal resource. This study objective is to evaluate Songa-Wayaua geothermal system on preliminary study stage by using volcanostratigraphy and remote sensing analysis to delineate the boundary of geothermal system area. The result of this study showed that Songa-Wayaua prospect area has four heat sources potential (e.g. Pele-pele Hummock, Lansa Hummock, Songa Hummock, and Bibinoi Hummock), controlled by geological structure presented by Pele-pele Normal Fault, and had three places as the recharge and discharge area which are very fulfilling as a geothermal system.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012020/pdf

REVIEW OF SUBDUCTION AND ITS ASSOCIATION WITH GEOTHERMAL SYSTEM IN SUMATERA-JAVA

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Abstract.

Java and Sumatera have the largest geothermal resources in Indonesia, in which mostly are spatially associated with volcanoes of subduction zones. However, those volcanoes are not distributed in a regular pattern due to the difference of subduction position. Subduction position in java is relatively more perpendicular to the trench than in Sumatera. In addition, Java has a concentration of large productive geothermal field with vapour dominated system in the western part of Java, which may be caused by the various subduction dip along the island. In order to understand the relationship between the subduction process and geothermal system in the subduction zone volcanoes, we examined several kinematic parameters of subduction that potentially relevant to the formation of geothermal system in overriding plate such as slab dip, subduction rate, and direction of subduction. Data and information regarding tectonic setting of Sumatera and Java and productive geothermal field in Sumatera and Java have been collected and evaluated. In conclusion, there are three condition that caused the geothermal fluid to be more likely being in vapour phase, which are: the subduction is in an orthogonal position, the slab dip is high, and rate of subduction is high. Although there are plenty researches of subduction zone volcanoes, only a few of them present information about its formation and implication to the geothermal system. The result of this study may be used as reference in exploration of geothermal field in mutual geologic environment.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012021/pdf

IDENTIFICATION OF NATURAL FRACTURES AND IN SITU STRESS AT RANTAU DEDAP GEOTHERMAL FIELD

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Abstract.

Rantau Dedap Area is a geothermal field which is located in Great Sumatra Fault (GSF). The fault and fracture are main factor in the permeability of the geothermal system. However, not all faults and fractures have capability of to flow the fluids. Borehole image log is depiction of the borehole conditions, it is used to identify the natural fractures and drilling induced fracture. Both of them are used to identify the direction of the fracture, direction of maximum horizontal stress (S_{Hmax}), and geomechanics parameters. The natural fractures are the results of responses to stress on a rock and permeability which controlling factor in research area. Breakouts is found in this field as a trace of drilling induced fracture due to *in situ* stress work. Natural fractures are strongly clustered with true strike trending which first, second, and third major direction are N170°E – N180°E (N-S), N60°E – N70°E (NE-SW), and N310°E – N320°E (NW-SE), while the dominant dip is 80° –90°. Based on borehole breakout analysis, maximum horizontal stress orientation is identified in N162°E – N204°E (N-S) and N242°E (NE-SW) direction. It's constantly similar with regional stress which is affected by GSF. Several parameters have been identified and analyzed are S_{Hmax}, S_{Hmin}, and S_y. It can be concluded that Rantau Dedap Geothermal Field is affected by strike-slip regime. The determination of in situ stress and natural fractures are important to study the pattern of permeability which is related to the fault in reservoir of this field.

http://iopscience.iop.org/article/10.1088/1755-1315/103/1/012022/pdf

LIST OF IIGW 2017: ORAL PRESENTATION

The committee of 6th ITB International Geothermal Workshop 2017 was consisted of lecturer and students of ITB Geothermal Master Degree Program. There were 25 committees in total which responsible to the steering committee. There was also reviewer team whose job to review papers submitted in the workshop. The committee and reviewer list can be seen below:

Steering Committee	Sutopo and Staffs of Geothermal technology Study Program FTTM- ITB
Chairman	Suryantini
Vice Chairman	Teguh Rahat Prabowo, Muhamad Firdaus Al Hakim, Ichwan Agusta Elfajrie
General Secretary	Yuniar Zhafira Abdillah, Nanda Hanyfa Maulida, Yutty Hendrawati
Treasurer	Lestari Apriani, Almas Ghasani SFU, Qanitah
Sponsorship	Riviani Kusumawardhani, Mohamad Imbar Fitriadi, Bramono Prabowo, Yuniar Zhafira Abdillah, Jonathan Sharon Widiatmo
Creative, Publication and Media	Reza Syahputra Mulyana, Indra Agoes Nugroho, Nanda Hanyfa Maulida, Rhamadhana Sultan, Citra Aulian Chalik, Immanuel Lumban Gaol, Riviani Kusumawardhani, Ribka Firtania Asokawaty
Pre & Mid Workshop	Immanuel Lumban Gaol, Ribka Firtania Asokawaty
Technical Paper and Scientific	Jonathan Sharon Widiatmo, Beta Kurniawahidayati, Ribka Firtania Asokawaty, Indra Agoes Nugroho, Muhammad Hafidz, Rhamadhana Sultan, Lestari Apriani, Bramono Prabowo, Milki Fabian, Hendro Wibowo, Dimas Taha Maulana, Nurita Putri, Heru Berian Pratama
Field Trip	Faisal Ahmad, Muhamad Imbar Fitriadi, Immanuel Lumban Gaol
Field Camp	Joshua Satriana, Muhammad Hafidz
Logistic and Accommodation	Indra Agoes Nugroho, Citra Aulian Chalik, Joshua Satriana, Muhammad Hafidz, Milki Fabian, Faisal Ahmad, Muhamad Imbar Fitriadi, Bramono Prabowo, Jonathan Sharon Widiatmo
Exhibition	Beta Kurniawahidayati, Almas Ghasani SFU, Faisal Ahmad, Reza Syahputra Mulyana, Qanitah

IV. Pre & Mid Worskhop

Pre Workshop Courses is one of ITB International Geothermal Workshop 2017 event series which started in the beginning of this event. There were two pre courses; Pre Workshop Course 1 (LeapFrog 3D Modeling for Geothermal Project, by ARANZ Geo Ltd.) and Pre Workshop Course 2 (Method and Techniques in Geothermal Power Plant Inspection, by GEOCAP), In addition, there was a mid-course workshop during the second day of workshop, the topic was Geothermal for Everyone. It was divided into four section; exploration, engineering, economic and environmental issue and financial aspects of geothermal project. The mid-course workshop speakers were Dr. Suryantini, Dimas Taha, Heru Berian, Agus Danar and Dr. Ricardo Barcelona.

IV.1 Pre Workshop 1 LeapFrog for Geothermal Project

Pre Workshop Course 1 was held on 20 to 21 March 2017 in CRCS 2nd Floor, Institut Teknologi Bandung. On the first day, the speakers were Jeremy O'Brien and Clare Baxter from ARANZ Geo Ltd, which discussed about an existing project of using LeapFrog in geothermal industry, introduction of LeapFrog interface and simple geological modeling (covering importing data, editing geological data etc.,). On the second day, the speakers were Jeremy O'Brien and Clare Baxter from ARANZ Geo Ltd and John O'Sullivan were discussed about additional complex data for 3D modeling (covering adding fault and dynamic updating of model, adding MT and temperature data, well planning and communicating and adding stucture geology). Additional brief course from John O'Sullivan discussed about reservoir modeling in LeapFrog.

Pre-Workshop 1 Agenda		
venue	**CRCS 2nd Floor, Institut Teknologi Bandung**	
Day 1		
07:00-08:00	**Registration**	Comm
08:00-08:15	**Pre Course Test**	Comm
08.15-10.00	**Introduction – Viewing an existing project of using LeapFrog**	ARANZ Geo
10.00-10.30	*COFFEE BREAK*	
10.30-12:00	**Importing data, Geological Modeling**	ARANZ Geo
12:00-13:15	*LUNCH BREAK*	
13:15-15:00	**Editing geological data**	ARANZ Geo
15.00-15.30	*COFFEE BREAK*	
15.30-17.00	**Adding fault and dynamic updating**	ARANZ Geo

venue	**CRCS 2nd Floor, Institut Teknologi Bandung**	
Day 2		
07:00-08:00	**Re-registration**	Comm

08:00-10.00	**Adding MT data**	ARANZ Geo
10:00-10.30	*COFFEE BREAK*	
10:30-12:00	**Adding temperature data**	ARANZ Geo
12:00-13:15	*LUNCH BREAK*	
13:15-15:00	**Well planning and communicating**	ARANZ Geo
15:00-15:30	*COFFEE BREAK*	
15.30-17.00	**Structural geology**	ARANZ Geo
17.00-17.30	**Reservoir modeling in LeapFrog**	John O'Sullivan
17:30-18:00	**Closing and giving certificate**	Comm – ARANZ Geo

IV.2 Pre Workshop 2 Method and Techniques in Geothermal Power Plant Inspection

This pre workshop was lasted for two days, from March 20th-21st 2017 and located at Patrajasa Hotel, Bandung. The course was started from 8 A.M to 6 P.M. This pre-workshop was arranged by 6th ITB International Geothermal Workshop in conjunction with GEOCAP and PPSDM-EBT. The topic of this pre workshop was "Method and Techniques in Geothermal Power Plant Inspection Training". The speakers of this event was:

- Mr. Kees van den Ende (DNV GL)
- Mr. Frank Rasing (DNV GL)
- Mr. Jooned Hendrarsakti (ITB)
- Mr. Theo Van der Meer (TNO)

This pre workshop was discussed all about the power plant, start from the Introduction of Power Plant component, the tools, the processes, and the methods applied to the Power Plant. The course was followed by 25 participants, most of them are from university, and 7 participants from industry. Each session of the course was started with course material and then discussion. In this course the participant was also recommended to bring their laptop but they also got hard copy materials the course. Goodie bags were distributed after lunch on the first day and certificates on the end of second day.

Pre-Workshop 2 Agenda		
Venue	**Patrajasa Hotel**	
Day 1		
08:00-09:00	**Registration**	Committee
09:00-09:30	**Introduction of the workshop**	Kees van de Ende
09:30-10:00	**Opening**	Tisnaldi
10:00-10:15	*COFFEE BREAK*	
10:15-12:00	**Overview Power Plant Design**	Theo van de Meer
12:00-13:00	*LUNCH BREAK*	
13:00-15:15	**Introduction of Power Plant Components (*session 1*)**	Jooned Hendrarsakti

15:00-15:30	*COFFEE BREAK*	
15:30-17:30	**Introduction of Power Plant Components (*session 2*)**	Jooned Hendrarsakti

Venue	**Patrajasa Hotel**	
Day 2		
09:00-10:00	**Standard of Geothermal Power Plant Design**	Jooned Hendrarsakti
10:00-10:15	*COFFEE BREAK*	
10.15-11:15	**Tools in Power Plant Operation**	Jooned Hendrarsakti
11:15-12:15	**Basic of maintenance and reliability in geothermal power plant**	Jooned Hendrarsakti
11:00-13:15	*LUNCH BREAK*	
13:15-15:00	**Inspection techniques, Sampling and reporting *(session 1)***	Frank Rasing
15.00-15.30	*COFFEE BREAK*	
15.30-18.00	**Inspection techniques, Sampling and reporting *(session 2)***	Kees van de Ende

IV.3 Mid Workshop

Mid Workshop Course 3 was held on March 23, 2017 in CRCS 3rd floor. Speakers at the Pre Workshop Course 3 were Dr. Suryantini, Dimas Taha Maulana, Heru Berian, Agus Danar and Dr. Ricardo Barcelona, which discussed the topic of Geothermal for Everyone covering geothermal system, geothermal manifestation and exploration, engineering and exploitation of geothermal energy, an introduction of geothermal investment decision (by Agus Danar) and financial aspect and investment evaluation of a geothermal project (by Ricardo Barcelona).

Mid Workshop Course Agenda		
Venue	**CRCS 3nd Floor, Institut Teknologi Bandung**	
07:00-08:00	**Registration**	Committee
08:00-08:45	**Geothermal system**	Dr. Suryantini
08:45-09:30	**Geothermal manifestation and exploration**	Dr. Suryantini
09:30-09:45	*COFFEE BREAK*	
09:45-10:30	**Engineering and exploitation of geothermal energy**	Dimas Taha – Heru Berian
10:30-11:15	**An introduction to geothermal investment decision**	Agus Danar
11:15-12:15	*LUNCH BREAK*	
Venue	**Exploration Room, Energy Building 2nd Floor**	
12:15-14:15	**Financial aspect and investment evaluation of a geothermal project**	Ricardo G. Barcelona
14:15-~~	*CLOSING*	

V. Plenary and Technical Session

V.1 Plenary Session

ITB International Geothermal Workshop 2017 was lasted for 2 days (22-23 March 2017) and located at CRCS Building, Institut Teknologi Bandung. This workshop was divided into two parts, namely the Plenary Session and Technical Session. Plenary session was divided into opening session and three plenary sessions. The opening was keynote speeches from INAGA and Deputy III Division of Infrastructure Coordination. The first plenary session topic was "Integrated Exploration Breakthrough", the next session discussed about "Innovation and Breakthrough in Geothermal Technology", and the last session topic was "Geothermal Financing Breakthrough".

Schedule of plenary sessions were attached below:

1st Day; 22nd March 2017, Plenary Session		
Opening and Keynote Speaker		
08.25-08.30	**Welcoming Remark** from the Chairman of IGW2017	**Suryantini** (Chairman of IIGW 2017)
08.30-08.45	**National Anthem** : Indonesia Raya	
08.45-08.55	**Opening Speech** of the IGW2017 by the Rector of Institut Teknologi Bandung	**Prof. Dr. Ir. Ridho Kresna Wattimena** (Wakil Dekan Akademi)
08.55-09.10	**Rampak Kendang Performance**	
09.10-09.20	**Keynote Speech-1** : Update and Current Status of Geothermal Development Plan within National Energy Council Road Map: Government Role in Realizing the Goal?	**Abadi Poernomo** (Chairman of INAGA, Member of National Energy Council (DEN))
09.20-09.40	**Keynote Speech-2:** Government of Indonesia Energy Policy for Infrastructure and Engineering: Supporting Geothermal Resource Transformation towards 7000 MWe Capacity	**Ridwan Djamaludin** (Deputy III Division of Infrastructure Coordination, Coordinating Ministry for Maritime Affairs, Chairman of ITB Alumni)
9.40-09.50	Coffee Break	
Plenary Session 1 Integrated Exploration Breakthrough		
09.50 -10.20	Overview of Indonesian Geothermal System ; The Resources Beyond High Enthalpy Magmatic/Volcanic Systems	**Suryantini** (ITB)
10.20-10.50	Exploration Strategy, Method and Design; Lesson Learned from various types of geothermal system	**Eben Ezer Siahaan** (Pertamina Geothermal Energy)
10.50-11.20	Nontechnical Aspects of Geothermal Exploration: Barrier and Solution	**Anton Wahjosoedibjo** (PEN Consulting)

11.20-11.50	Question and Answer	**Moderator: Asrizal Masri** (Star Energy)
11.50-12.00	Exhibition & Poster Opening	
12.00-13.00	Lunch Break	
Plenary Session 2 Innovation and Breakthrough in Geothermal Technology		
13.00-13.30	Drilling Procurement Savings	**Bambang Roesdyoko** (Supreme Energy)
13.30-14.00	Geothermal Power Plant: Lesson Learned from PT Indonesia Power	**Reza Adiprana** (Indonesia Power)
14.00-14.30	Geothermal Turbine Breakthrough: Comparing Geothermal Turbine from Conventional Flash– Binary – Wellhead	**William Lajousky P. E.** (Sarulla Operation Limited)
14.30-15.00	Efficient Use of Geothermal Energy: Lesson Learned from Triple Flash Geothermal Power Plant – New Zealand	**Rosalind Archer** (University of Auckland/Mercury)
15.00-15.30	Question and Answer	**Moderator: Riza Pasikki** (Chevron Geothermal Indonesia)
15.30-15.45	Coffee Break	
Plenary Session 3 Geothermal Financing Breakthrough		
15.45-16.15	Financing Challenges of Geothermal Business	**Radikal Utama** (Supreme Energy)
16.15-16.45	Technical Aspects in Geothermal Project Finance: Lesson Learnt	**Julfi Hadi** (Hitay Energy Holdings)
16.45-17.15	Financing the Incremental Geothermal Development Model	**Michael Reading** (COO - KS Orka Renewables Pte Ltd.)
17.15-17.45	The New Energy Ministry's Regulations and Its Influence on Geothermal Investment and Development in Indonesia	**Dr. Ricardo G Barcelona, Ph.D.** (Managing Director, Barcino Advisers)
17.45-18.15	Question and Answer	**Moderator: M. Ikbal Nur** (PT Geo Dipa Energi)
18.15-20.00	Gala Dinner	**All participants are invited**

Plenary Session succeed attract participants from various affiliations such as professional from industries, students, researcher in university, government and general public. There are 227 participants, excluding speakers, lecturer, and invited guest whom registered both via online and on the spot registration.

V.2 Technical Session

Technical Session is part of Workshop in ITB International Geothermal Workshop 2017 and held on March 23, 2017 on the second day of workshop session. The program in this session included oral and poster presentation. Technical paper and poster session located in CRCS building, floor 2 and 3. There are 85 papers submitted categorized to three fields: exploration, engineering and multi-discipline topics. The submitted papers divided into 7 topics: Geology, Geochemistry, Geopysics, Drilling, Reservoir Engineering, Direct Use, and Production. Also

there are presentations from BAGUS Satrep Project, the collaboration between ITB and Kyoto University. Then, 45 papers were presented in oral presentation sessions, while 40 papers were presented in poster sessions. This session lasted for 7 and a half hours, from 09.00 – 16.30 WIB.

ORAL PRESENTATION SESSIONS				
TIME	ROOM A	ROOM B	ROOM C	ROOM D
SESSION	**GEOLOGY** Chairperson: Arif Susanto & Angga Bakti Pratama	**BAGUS SATREPS COLLABORATION** Chairperson: Syafrizal & M. Mirza Aquario	**RESERVOIR** Chairperson: Zuher Syihab & Famela Nurlaela	**GEOPHYSICS** Chairperson: Ferry Rahman Aries & Reyno Rivellino
09.00 – 09.20	Topographic Map Analysis to Determine Arjuno-Welirang Volcano Stratigraphy and Implication for Geothermal Exploration (Reza Syahputra Mulyana, Lestari Apriani, Citra Aulian Chalik, Indra Agoes Nugroho - Geothermal ITB)	Research Progress of the BAGUS Project by Kyoto University Team (Katsuaki Koike)	Application of Experimental Design in Geothermal Resources Assessment of Ciwidey-Patuha, West Java, Indonesia (Ali Ashat, Heru Berian Pratama)	Recent Technologies and Application of Geophysics in Geothermal (Invited Speaker: Yunus Daud -- Universitas Indonesia)
09.20 – 09.40	Geothermal Heat Loss Calculation: An Android Mobile Application in Geothermal Exploration (Allen Haryanto L, Qodri Syahrur Ramadhan,Rizki Trisna Hutami, Dimas Taha Maulana)	Research Progress of the BAGUS Project by ITB Team (Sudarto Notosiswoyo, Muhammad Nurheryawan)	Coupling Flow-Geomechanical Model for Stimulation of Fractured Geothermal Fields (Pizzocolo, F., Fokker, P.A.)	
09.40 -10.00	Permeability Zone Analysis Based on Electrical Borehole Image Log, A Case Study of Vertical Fault at a Transtensional Structure Pattern Geothermal Field Muara Laboh, West Sumatera (Friska Agustin, Benyamin Sapiie, Dayinta Adi Dyaksa, Mauliate Agustinus, Chalid Idham Abdullah)	Characterization of Fracture System in the Wayang Windu Area Using Radon-Gas Concentration and Remote Sensing Analyses (Taiki Kubo)	Reservoir Modelling: Use and Limitation (Invited Speaker: John O'Sullivan -- University of Auckland)	Mode and Orientation Comparation of Magnetutelluric Data Inversion for Structures Identification Volcanic Area: A Study Case-Mt. Tangkuban Parahu (Nur Rochman Muhammad,Imam Gazali,Firman Syaifuddin,Sugeng Triyono)
10.00 – 10.20	The Occurrences of Hot Spring Manifestations in Pohon Batu Area, West Ceram (Airiza Rahman Hakim, Windi Anarta Draniswari, Dede Iim Setiawan)	Spatial Correlation Between Soil Magnetic Susceptibility in Horizontal and Vertical Direction to the Surface Geological Condition at Wayang Windu Area, West Java (Mohamad Nur Heriawan, Benny Sumaryono, Budi Septafiandra, Satria Bijaksana)	Reservoir Modelling: Use and Limitation (Invited Speaker: John O'Sullivan -- University of Auckland)	Subsurface Seismic and Anisotropy Structure Revealed By Using Delay Time and Shear Wave Splitting Tomography in “KHP” Geothermal Field (Kadek Hendrawan Palgunadia*,, Andri Dian Nugrahab, M. Rachmat Sulec, Riskiray Ryannugrohoa, Philippe Joussetd, Kemal Erbasd, Yosep Kusnadie)

10.20 – 10.40	COFFEE BREAK			
SESSION	**GEOLOGY** Chairperson: Fikri Adam Dermawan & Rizki Trisna Hutami	**DIRECT USE** Chairperson: Nursanty Elisabeth Banjarnahor & Gugun Abdurrahman	**RESERVOIR** Chairperson: Sutopo & Ichwan Agusta Elfajrie	**GEOPHYSICS** Chairperson: Alessandro Putera & Qodri Ramadhan
10.40 – 11.00	Remote Sensing Study to Determine Geothermal Working Area Using Optic and Synthetic Aperture Radar Satellite Products in Merangin, Jambi, Indonesia (Indra Agoes Nugroho, Beta Kurniawahidayati)	The Geothermal Direct Use Utilization to Develop Sustainable Shore Economy in Parangtritis (Rizqi Mahfudz Prasetyo, Istifari Husna Rekinagara)	Reservoir Simulation to Optimize Development of Chevron's Geothermal Fields (Invited Speaker: Riza Pasikki -- Chevron Geothermal Indonesia)	Application of MT and CSAMT for Geothermal Exploration in Indonesia (Hendra Grandis, Prihadi Sumintadireja)
11.00 – 11.20	Reassessment of Geothermal System on the Southern Slope of the Buyan-Bratan Caldera, Bali, Indonesia (Sachihiro Taguchi, Koki Okamura, Eiki Arita, Ryuichi Itoi, Agung Harijoko, I Wayan Warmada, Koichiro Watanabe)	Smart Geo-Energy Village Development by Using Cascade Direct Use of Geothermal Energy in Bonjol, West Sumatera (Defry Erwinsyah, Umra Lubis)		Enhancement of Subsurface Geologic Structure Model Based On Gravity, Magnetotelluric, and Well Data in Kamojang Geothermal Field (Muhammad Yustin Kamah, Adilla Armando, Dinda Larasati Rahmani)
11.20 – 11.40	Determining Normalized Different Vegatation Index (NDVI) Threshold Value to Identify Surface Manifestations, Case Study; Cimanggu Area, West Java (Joshua Satriana, Lestari Apriani, Muhammad Hafidz, Reza Syahputra Mulyana, Citra Aulian Chalik)	Study of Geothermal Utilization for Thermophilic Operation in Biogas Production in Pangalengan, Indonesia (Syarifudin, Nur Muhamad Isnan Kurnia, Mahdi Nurianto Ahmad)	Probabilistic Approach of Resource Assessment in Kerinci Geothermal Field Using Numerical Simulation Coupling with Monte Carlo Simulation (Iki Hidayat, Sutopo, Heru Berian Pratama)	Micro-earthquake Observation Using Dense Seismometer Network around Geothermal Field in Southern Bandung, West Java, Indonesia. Current Status: Geotomographic Inversion to Delineate 3D Seismic Velocity (Invited Speaker: Andri Dian Nugraha – ITB)
11.40 – 12.00	Preliminary Study of Songa-Wayaua Geothermal Prospect Area Using Volcanostratigraphy and Remote Sensing Analysis (Ribka Asokawaty, Joshua Satriana, Indra Nugroho, Muhamad Hafidz)	Study of Geothermal Utilization for Curing Process in Lightweight Concrete Production in Pangalengan, Indonesia (Nur Muhamad Isnan Kurnia, Syarifudin, Mahdi Nurianto Ahmad)	A New Geothermal Modelling Workflow Using Leapfrog and TOUGH2 (John O'Sullivan, Rosalind Archer, Mike O'Sullivan, Thomas Krom, Brennan Williams)	
12.00 – 13.00	**LUNCH BREAK**			
SESSION	**GEOCHEMISTRY** Chairperson: Betseba Sibarani & Juni Sianipar	**DRILLING** Chairperson: Bonar Marbun & Sanjaya	**PRODUCTION** Chairperson: Nenny Miryani Saptadji & Rangga Aji Nugraha	**GEOLOGY** Chairperson: Prihadi Sumintadireja & Evanda Eko Putra Maris
13.00 – 13.20	Cl/B Ratio of Geothermal Fluid around Slamet Volcano, Jawa Tengah, Indonesia (Agung Harijoko, Saefudin Juhri)	Commercial Issue and Field Management of Ijen Geothermal Field (Invited	Study of Sustainable Production in Two-Phase Liquid Dominated With Steam Cap Underlying Brine Reservoir	A New Idea: The Possibilites of Offshore Geothermal System in Indonesia Marine Volcanoes (Fithriyani Fauziyyah, Teguh

		Speaker: Wisnu Subroto -- Medco Energy)	by Numerical Simulation (Heru Berian Pratama, Nenny Miryani Saptadji)	Rahat Prabowo, Suryantini, Sutikno Bronto)
13.20 – 13.40	Elevated Mercury Content from Geothermal Sources in Wae Sano Area, Manggarai Barat Regency, Nusa Tenggara Timur Province, Indonesia (Fajar Rizki Widiatmoko, Mocahamad Nur Hadi, Dedi Kusnadi, Yo-Ho Chang)		Reassessment of ITB Research Contribution to Power Plant Performance Improvement (Jooned Hendrarsakti , Nugroho Y. B. A, Nurshanty Elisabeth Banjarnahor, Angga Alfandi and Gugun Abdurrachman)	Conceptual Model of "EM-AFS" Geothermal Field Based On Geological, Geochemical and Geophysical Data (Evi Muharoroh, Aziz Fajar Setiawan)
13.40 – 14.00	A Mineral Analysis Workflow for Drill Cuttings at the Wellsite: Applications to Geothermal Resource Exploration, Appraisal and Development (P. Joseph Hamilton, Sigrid Hillier, Carmen Harris)	Slim Hole Drilling and Testing Strategies (Dennis L. Nielson, Sabodh K. Garg, Colin Goranson)	The Future of Geothermal Energy Utilization and Technology of Low and Medium Enthalpy (Invited Speaker: Taufan Surana – BPPT)	Study of Rock Microstructure Based On SEM-EDX and XRD Characterization to Evaluate Arjuno-Welirang Geothermal Potential (Husnia Nur Annisa, Almira Mahsa, Silvia Veronica, Nuha Malihati)
14.00 – 14.20	Fluid-Rock Geochemical Interaction for Modelling Calibration in Geothermal Exploration in Indonesia (Fiorenza Deon, Auke Barnhoorn, Caroline Lievens, Riskiray Ryannugroho, Tulus Imaro)	Innovative Casing Drilling Technology Improved the Ability to Set the Casing Deeper Through the Problematic Zone in Indonesia Geothermal Operation (Bonar Noviasta)		Determining Volcanic Material Distribution, Geological Structure and Surface Manifestation Using Optical and Sar Remote Sensing in Papandayan Geothermal Field (Beta Kurniawahidayati, Indra A. Nugroho, Reza Syahputra Mulyana)
14.20 – 14.40	**COFFEE BREAK**			
SESSION	**GEOLOGY** Chairperson: Fiorenza Deon & Anggie Rengganis	**DRILLING** Chairperson: Dimas Taha & Waldy Afuar	**PRODUCTION** Chairperson: Heru Berian Pratama & Hutra Guswinanda	
14.40 – 15.00	Geothermal Well Targetting Approaches in the Exploration Stage (Invited Speaker: Herwin Azis -- Supreme Energy)	Drilling Fluid Density Modelling for Predicting Equivalent Static Density in Geothermal Well (Aris Wakhyudin, Deni Setiawan, Oscar Dwi Marjuan)	Probabilistic Approach: Backpressure Turbine for Geothermal Vapor-Dominated System (Angga Alfandi Ahmad, F.X. Guwowijoyo)	
15.00 – 15.20	Geothermal Well Targetting Approaches in the Exploration Stage (Invited Speaker: Herwin Azis -- Supreme Energy)	The First "Point The Bit" Rotary Steerable System Application Worldwide in a Geothermal Field in Indonesia (Bonar Noviasta)	An Evaluation of ORC Bottoming Units for Single Flash Geothermal Power Plants (Baran Kaypakoglu, Ugo Barbon)	
15.20 – 15.40	Review of Subduction and Its Association with Geothermal System in Sumatera-Java (Ayuta Fauzia Ladiba, Lia Putriyana, Betseba br. Sibarani, Hari Soekarno)	Geothermal Deep Slim Hole Drilling (Invited Speaker: Bayu Cahyo Nugroho -- Integra Oilfield Services)	Geothermal Well Productivity Characterization Using PTS Flowing Survey: A Case Study of Vapour Dominated Geothermal Field in West	

			Java, Indonesia (Iqbal Kurniawan,Mahdi Nurianto Ahmad, Muhammad Nizami)	
15.40 – 16.00	Preliminary Study of Non-Volcanic Geothermal Potential as Transition from Petroleum to Geothermal Exploration at Cipari Area, Central Java (Kiddy Nahli, Vicco Orizavica, Daniel Radityo)	Geothermal Deep Slim Hole Drilling (Invited Speaker: Bayu Cahyo Nugroho -- Integra Oilfield Services)	Collaborative Project Management Changes the Delivery of Geothermal Wells (Matthew Kelley, Thomas Jenkins, Jose Villarreal, Shannon Slocum, Colton Thomas)	
16.00 – 16.20	Identification Natural Fractures and Stress at the Rantau Dedap Geothermal Field (Andika Artyanto, Benyamin Sapiie, Chalid Idham Abdullah, Ridwan Permana)	Optimized Practices Avoided Stuck Pipe Associated with Drilling Paleosol (Dimas Radityo Widianto, Joni Sofian, Matthew Kelley, Jim Hanson)	Make-Up Wells Drilling Cost in Calculation in Financial Model for a Geothermal Project (Fitri Oktaviani Purwaningsih, Rully Husnie, Waldy Afuar, Gugun Abdurrahman)	
16.20 – 16.40			A Comparative Exergetic Analysis of Various Configurations for ORC Geothermal Power Plants (Saeid Mohammadzadeh Bina)	
16.20 - Finish	**COFFEE BREAK**			

List of Invited Speaker

Speaker	Topic	Room	Time
Herwin Azis Supreme Energy	Geothermal Well Targetting Approaches in the Exploration Stage	Room A	14.40-15.20
Wisnu Subroto Medco Energy	Commercial Issue and Field Management of Ijen Geothermal Field	Room B	13.00-13.40
Bayu Cahyo Nugroho Integra Oilfield Services	Geothermal Deep Slim Hole Drilling	Room B	15.20-16.00
John O' Sullivan University of Auckland	Reservoir Modelling: Use and Limitation	Room C	09.40-10.20
Riza Pasikki Chevron Geothermal Indonesia	Reservoir Simulation to Optimize Development of Chevron's Geothermal Fields	Room C	10.40-11.20
Taufan Surana BPPT	The Future of Geothermal Energy Utilization and Technology of Low and Medium Enthalpy	Room C	13.40-14.20
Yunus Daud Universitas Indonesia	Recent Technologies and Application of Geophysics in Geothermal	Room D	09.00-09.40
Andri Dian Nugraha Institut Teknologi Bandung	Micro-earthquake Observation Using Dense Seismometer Network around Geothermal Field in Southern Bandung, West Java, Indonesia. Current Status: Geo-tomographic Inversion to Delineate 3D Seismic Velocity	Room D	11.20-12.00

The selected papers will be further reviewed to be submitted to "The open access IOP Conference Series: Earth and Environmental Science (EES)" and others will be printed in IIGW 2017 (ITB International Geothermal Workshop 2017) regular proceeding.

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VI. Field Trip to Patuha

Background

The Patuha geothermal system is a vapor-dominated reservoir located about 40 kilometers southwest of Bandung on western Java, Indonesia. The geothermal system consists of a cap rock, an underlying steam cap and a deep liquid-dominated reservoir. The reservoir is provided with heat by a main heat source below Kawah Putih and the Patuha volcano. The flow of fluid takes place through fault zones and in the low permeability reservoir rock. . The first Unit (55 MW) at Patuha was completed in 2014 and since 2015 it has been producing at full capacity (with an availability rate of over 98%).

This one full day field trip to Patuha Geothermal Plant provides an introduction to geothermal resources and their utilization. The trip may include visits to Patuha Power Plant, Steam Field, Surface Facilities and observations to the surface features/manifestations of the Patuha thermal areas.

Resume

Field Trip technical meeting was held on March, 23rd 2017 at 13:00 GMT+7 in Image Room, Energy Building 2nd floor. Technical meeting was held in about one hour. At that time, participants were informed about preparation before departure, field trip rundown, what items that should they bring, and PPEs (Personal Protective Equipment) were borrowed to participants. PPEs that were borrowed to the participants were safety helmet and safety shoes. Some participants brought their own PPE for field trip. Also there was a participant that his shoes size is too big, so his PPE would be provided by PT Geodipa Energi.

Departure was scheduled (at committee rundown) at 6:00 GMT+7, but committees informed to participants (at technical meeting) that field trip would depart at 5:30 GMT+7. It should be done to prevent participants came late. Actually, field trip start to depart at 6:00 GMT+7. We arrived at Patuha Geothermal Power Plant at 8:40 GMT+7. 4 cars that carried out committees and participants were guided by Security team of PT Geodipa started from village road. Transportation that committee prepared for all 26 participants (including committees) are 2 units minibus with

each capacity 15 seats and 1 unit MPV with capacity 6 seats. Unfortunately, there was no more space for committee to put our logistics in 3 cars. So, finally one of committee car was used to carry out logistics.

Field trip opening started at 8:45 GMT+7, then continued with safety induction, presentation of Plant Overview. After that, there were also presentation about geoscience of Patuha Field and Improvement Sharing before Jumat Pray. Plant tours were held after Jumat Pray. Participants were divided into two groups for plant tours. First group did plant tour to power plant area and control room first, then to well pads area. For the second group, went to well pads area first then to power plant area and control room. Closing field trip was held at 15:30 GMT+7 and took picture together (committees, participants and PT Geodipa team) before went back to ITB at 16:00 GMT+7. All of participants arrived back to ITB at 19:00 GMT+7.

Participants

Total Participants of Field Trip to Patuha Field was 36 People. They consist of 1 ITB Representatives, 7 Committees and 28 Registered Participants. Registered Participants came from university students (Universita Negeri Manado, Tokyo Institute of Technology, Dong Hwa University, etc), university staff from Twente University, international organization/consultant (ARANZ GEO and DNV GL), and Industry (Kwarsa Hexagon, Supreme Energy, Atlas Copco, etc).

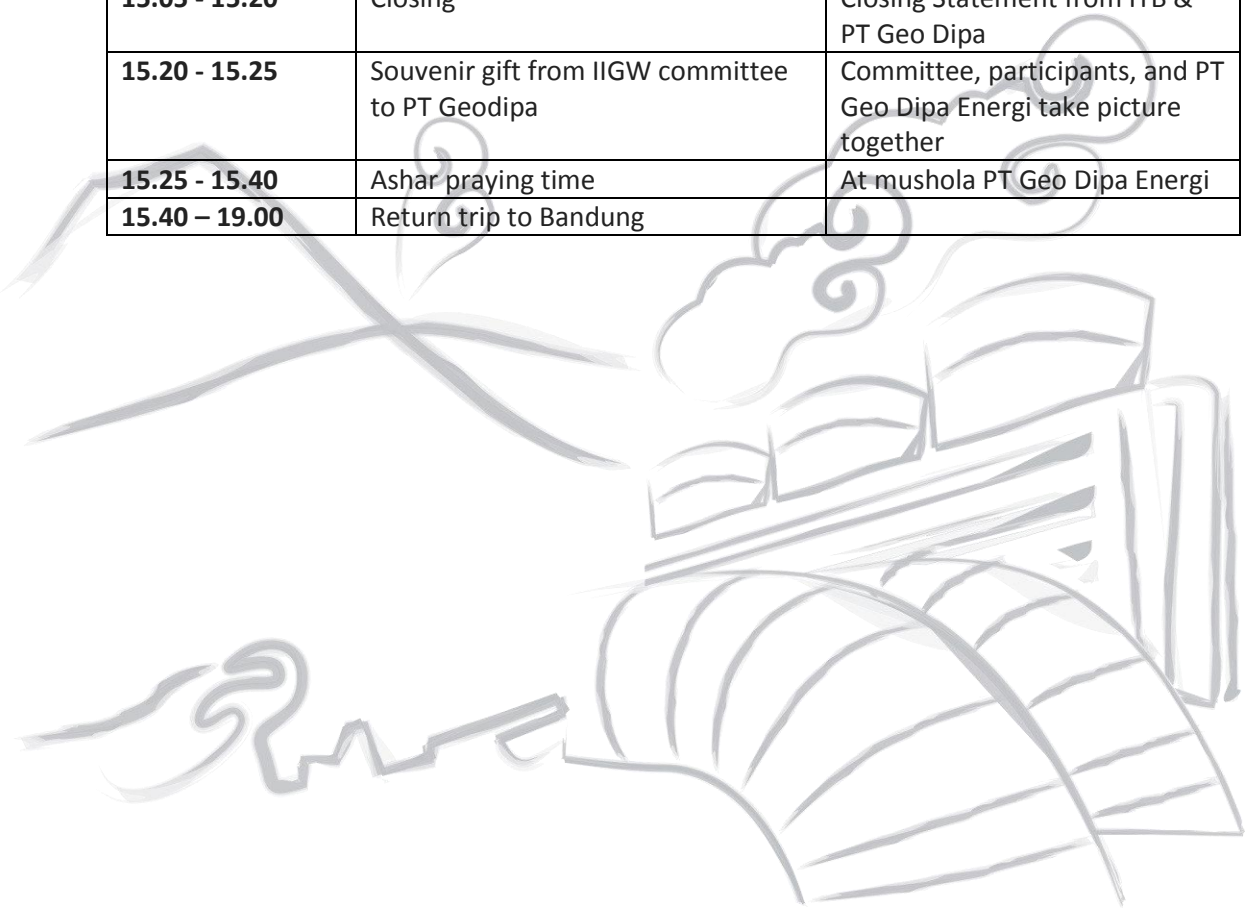
Agenda

Rundown of field trip can be seen at Table 1. Departure from ITB to Patuha at 6:00 GMT+7 and arrive in ITB at 19:00. Departure and arrival were on time with schedule.

Table 1. Rundown Agenda of Field Trip

Field Trip to PT Geo Dipa Energi Unit Patuha Agenda		
Time	**Activity**	**Remark**
05.00-05.30	Gathering of Participant	At ITB Main Gate
05.30 - 09.40	Trip to Patuha Site	Breakfast for participants will be provided
09.40 - 10.10	Welcome speech, Safety Induction (+welcome snack)	Welcome speech from ITB and PT Geo Dipa

10.10- 10.50	Plant Overview (from well to Power Plant)	
10.50 - 11.20	Sharing Best Practice 1st session	
11.20 - 13.15	Friday pray and lunch	
13.15 - 14.4	Plant Tour	Divided into 2 groups:
		Group 1 – Power Plant+Control Room, Well Pad
		Group 2 – Well Pad, Power Plant+Control Room
14.45 - 14.50	Taking pictures with power plant background	
14.50 - 15.05	Coffee Break	
15.05 - 15.20	Closing	Closing Statement from ITB & PT Geo Dipa
15.20 - 15.25	Souvenir gift from IIGW committee to PT Geodipa	Committee, participants, and PT Geo Dipa Energi take picture together
15.25 - 15.40	Ashar praying time	At mushola PT Geo Dipa Energi
15.40 – 19.00	Return trip to Bandung	



VII. Field Camp to Tangkuban Perahu

Background

The geothermal field camp was held in the incredible geological settings and features of Tangkuban Perahu Volcano & its surrounding areas. This program provided opportunity for participants to be introduced to geothermal field works, characterization of geothermal systems and basic concepts of geothermal fluid sampling. Total of 13 participants from Graduate School of ITB Geothermal Engineering were participate in this program. The field camp started on March 24th, 2017 and finished on the same day at afternoon. Evening class lecture and practical theory of geochemistry sampling were held before field activity. On the next day, field activity were held in Domas Crater.

In particular, the goal of geothermal field camp is to provide participants with basic knowledge and practical field techniques of geothermal exploration, especially in geology and geochemistry. These skills would be complemented by basic data collection, sampling & using laboratory instruments, and theoretical data analysis that are fundamental for any interpretation and assessment of reservoir potential.

All exercises were completed in Domas Crater, in which these fields allow the integration of observation and sampling of geothermal fluids.

Resume

The activity was carried out at 24th March 2017. Total number of participants, including organizers, instructors, and Thermochem Field Team who participated in the field camp were 20 people.

The activity began with class at Energy Building on Thursday Evening (23rd March 2017). Instructor for this session was Mahesa Pradana Saputra as representative of Thermochem Team. On the next morning, participants gathered on ITB main gate at 6.00 a.m. After short briefing, the group went to Tangkuban Perahu, Lembang and arrived at 9.30 a.m.

Participants went to the field, visited Kawah Domas for 2 hours. At this location, participants practiced how to sampling gas and water at geothermal field. This activity was ended at 11 a.m.

due to Friday Pray and lunch time. Around 1 p.m. the group started to discuss and evaluate about geochemistry field activity with answer and question session. After that, the representative of IIGW 2017 comitte closed the field camp program and the group went back to ITB Campus.

Agenda

Field Camp to Mt. Tangkuban Perahu		
Time	**Activity**	**Remark**
19.00-21.00	Night course about Sampling Prochedure	
21.00-21.30	Briefing for tomorrow activity	
06.30-08.00	Trip to Tangkuban Perahu	
08.00 - 08.30	Arrived at Tangkuban Perahu then travel to Domas Crater	Breakfast for participants will be provided
08.30 - 11.00	Practical-water and gas geochemistry sampling	Sampling practice, demonstrated and mentored by PT Thermochem Indonesia
11.00 - 12.30	Friday pray and lunch	At Masjid Tangkuban Parahu
12.30 - 13.00	Field Activity: Discussion and Evaluation	
13.00 - 14.30	Trip to ITB	

VIII. Limited Exhibition

In this year, 6th ITB International Geothermal Workshop 2017 has exhibition as part of the Workshop, from March 22nd to March 23st 2017 in 3th floor of CRCS Building, ITB. Exhibition aims to promote activities and programs related to geothermal by relevant agencies. Exhibition consists of several booths that were filled by Dirjen EBTKE, PSDMBP, GEOCAP, BNI, Petroenergy and GEOTHERMAL ITB. At each booth there are usually several posters, magazines, and banner stands associated with geothermal and displayed to the visitors.

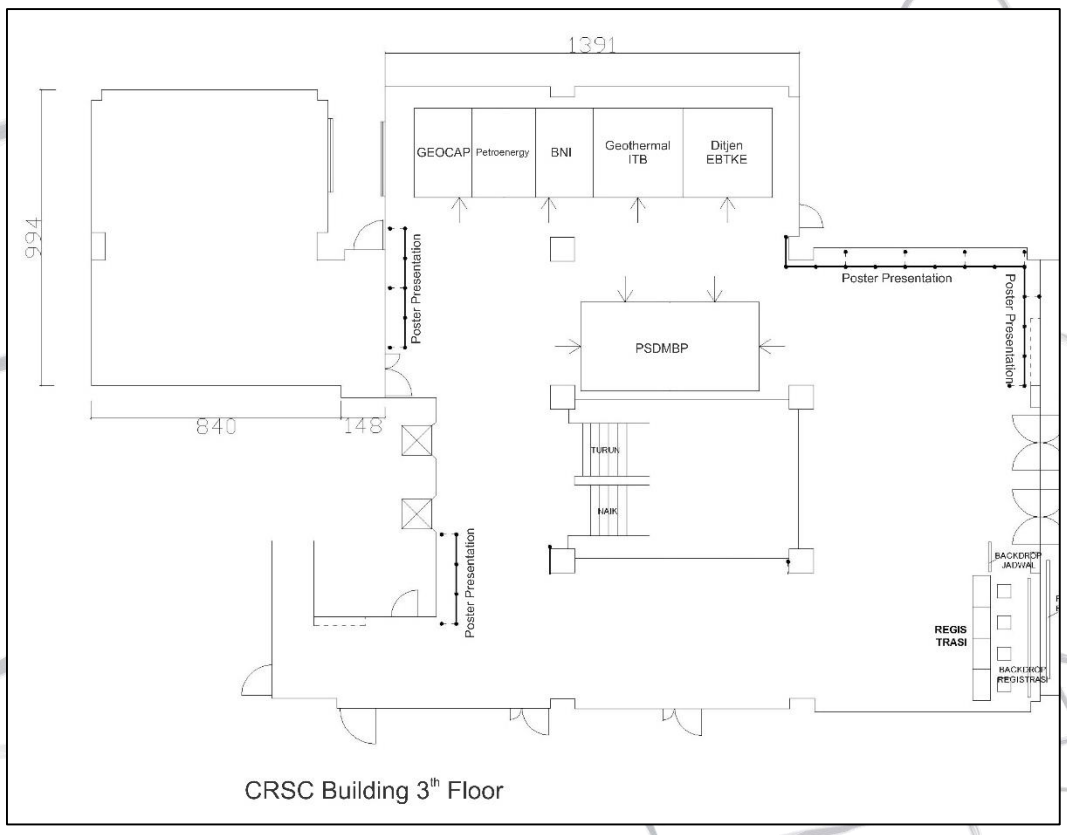


Figure 1. IIGW 2017 Limited Exhibition Map

Poster presentation from IIGW Technical Session also displayed in the exhibition. Poster session took place at 2nd and 3th floor of CRCS Building, ITB. There was 40 Posters divided into two fields including geothermal exploration and engineering.

Poster Presentation :

No	Paper Title
1	Assessment Of Kamojang Geothermal Power Plant Based On Heat And Mass Balance Analysis (**Puspita Wahyuningsih**)
2	Identification Of Geothermal Reservoir Guci Central Java Field Using Geochemistry And Magnetotelluric Methods (**Dedi Yuliansyah, Ahmad Zaenudina, Rustadia, Nanda H. Maulidaa, Eddy Z. Gaffarb**)
3	Top Resevoir Determination Based On Resistivity Response Using Bostick And Occam Audio Magnetotelluric Inversion In Batangtoru, South Tapanuli, North Sumatera (**MD Deni Setia Gunawan, Fahriansyah, Fandi Budi Stiyawan, Mirza Putra Andista**)
4	Geothermal Reservoir Simulation In Hot Sedimentary Aquifer System Using FEFLOW® (**Hardi Nur Hidayat, Maximillian Gala Permana**)
5	Characteristic Of Non-Volcanic Geothermal System In South Bangka Regency, Bangka Belitung Islands (**Riska Nurafifah, Hiskia Ulinuha A, Siswandi, Dedi Kusnadi**)
6	Mode And Oreintation Comparation Of Magnetutelluric Data Inversion For For Structures Identification Volcanic Area : A Study Case-Mt. Tangkuban Parahu (**Nur Rochman Muhammad,Imam Gazali,Firman Syaifuddin,Sugeng Triyono**)
7	Market Opportunities For Direct Use Of Geothermal Heat In Uganda (**Faith Natukunda, Pall Valdimarsson**)
8	Study Of Geothermal Reservoir Rocks Base On Physical Properties Of Arjuno-Welirang, East Java (**Almira Mahsa**)
9	Integration Of Enhanced Geothermal System And CCS In Sarulla Geothermal Field, North Sumatera, Indonesia: Continuous Loop Of Clean Energy Opportunity (**Rinaldo Siagian, Muhammad Ali Akbar Velayati Salim, Rizke Nadya**)
10	Developing A Framework For Assessing The Impact Of Geothermal Development Phases To The Environment (**Jarot M. Semedi, Louise Willemen, Freek van der Meer, Triarko Nurlambang, Raldi H. Koestoer**)
11	Geothermal Potential Analysis By Integration Geology, Geochemical, And Geophysical Data Of "TG14" Geothermal Field, Sumatera (**Aziz Fajar Setiawan, Evi Muharoroh**)
12	Weak Zones Delineation Using Single Component Electromagnetics And Seismicity Methods In Geothermal Interest Area (**Kevin Gardo Bangkit Ekaristi, Aditya Aries Furkhan, Agra Adipta**)
13	3g Analysis (Geology, Geophysic, Geochemistry) On Ungaran Mountain For Support Improvement And Development Of Geothermal Energy In Indonesia (**Romli Alfian**

	Febrianto, Ahsanitaqwim, Azmi Maulana, Nenden Lestari S, Aulia Umami, Mauludin Kurniawan)
14	Fault Fracture Density Analysis For Non-Volcanic Geothermal Potential To Determine Recharge Area; A Case Study In Lore Lindu Area, Central Sulawesi (**Raden Dikky Surya R, Oki Kurniawan, Gatra Wargaliyasa**)
15	The Aplication Of Second Vertical Derivatives (SVD) To Complete Bougeur Anomaly Data For Interpreting Geology Structures. Case Study: Geothermal Area "X" (**Riki Irfan, Safiul Primasatya, Wonsa Aditya, Sigit Wahono**)
16	Smart Geo-Energy Village Development By Using Cascade Direct Use Of Geothermal Energy In Bonjol, West Sumatera (**Defry Erwinsyah Umra Lubis**)
17	Geology And Geochemistry Of Geothermal Water On The Non-Volcanic Geothermal System In Southern Kuningan, West Java (**Bela Agung Pratama**)
18	Eruptive History Of The Post-Caldera Volcanoes Of Buyan-Bratan Caldera, North Bali, Indonesia (**Mitsuru Okuno, Agung Harijoko, I Wayan Warmada, Koichiro Watanabe, Toshio Nakamura, Sachihiro Taguchi, Tetsuo Kobayashi**)
19	A 63 Mw High Efficiency Steam Turbine Design, Case Study: Kamojang Geothermal Power Plant Unit 4 (**Achmad Nawawi**)
20	Well Calculation For Construction And Steam Field Development Of Geothermal Power Plant (**Endah Kurnia Setia Dewi and Cahaya Ningsih**)
21	Risk Management Options On The Geothermal Exploration Activity (**Yovita Bhritya Adisresti**)
22	Pipeline Modeling With Monazite Mineral To Prevent Heat Loss And Scaling In Geothermal Well Production: A Study Case Field Of Geothermal Dieng (**Nindyan Agna Ramadhan, Izza Hayyu Hanani, Ridwan Chandra, Zainun**)
23	Geothermal System Boundary At The Northern Edge Of Patuha Geothermal Field Based On Integrated Study Of Volcanostratigraphy, Geological Field Mapping And Cold Springs Contamination By Thermal Fluids (**Suryantini, Cindytami Rachmawati, Mirzam Abdurrahman**)
24	Lithology Variation And Hydrothermal Alteration Of Telomoyo Geothermal System (**Yoga Aribowo, Anindia Estiandari, Rinal Khaidar Ali, Muhammad Dani Satria**)
25	Feasible Methods For Assessing Natural Disaster Risk On Geothermal Pipeline Infrastructure, Case Study Of Landslide And Subsidence (**astisiasari**)
26	Identification Of Potential Geothermal With Gravity Methods Using Satellite Data In Blawan, Ijen Volcano, East Java (**Anggi Kristanto, Indri Dwi Yuliandari, Novita Awal Ristanti**)
27	Probabilistic Approach Of Resource Assessment In Kerinci Geothermal Field Using Numerical Simulation Coupling With Monte Carlo Simulation (**Iki Hidayat, Sutopo, Heru Berian Pratama**)
28	The First Conical Diamond Element Bit In Indonesia Geothermal Application (**Bonar Noviasta**)
29	System And Potential Of Geothermal Of Southeast Sulawesi Region For Development Of Future Alternative Energy (**Ariel Afrandi Tatawu, Rydo Faisal Arisandy, Juventus K.S Naibobe, Micnel Ostias Jene**)

30	Reinjection System To Avoid Decreasing Temperature Of Geothermal System Affect Facilities Production Problems, Study Case : Salak Mountain (**Michi Oktaviana, Fandy Fahreza**)
31	3D Vp And Vp/Vs Ratio Seismic Structure Around "ECS" Geothermal Field Derived From Travel Time Tomography (**Eric Candra Simanjuntak, Andri Dian Nugraha, M. Rachmat Sule, Riskiray Ryannugroho, Philippe Jousset, Kemal Erbas, Yosep Kusnadi**)
32	Development Model Of Brine Silica Management At One Of Water Dominated Geothermal Power Plant In Sumatera (**Cukup Mulyana, Moch. Aril Indra Permana, Naufal Nandaliarasyad**)
33	Aerated Drilling Cutting Transport Analysis In Geothermal Well (**Aris Wakhyudin, Deni Setiawan, Oscar Dwi Marjuan**)
34	Study Of Geothermal Utilization For Tea Pasteurization In Ready To Drink Tea Production In Pangalengan, Indonesia (**Mahdi Nurianto Ahmad, Nur Muhamad Isnan Kurnia, Syarifudin**)
35	Fractal Geometry And Gravity Model Of Ungaran Geothermal Area (**Syaiful Alam, Zunarto Saputra**)
36	A Review Of The Geothermal Resources Of Saudi Arabia (**Aref Lashin**)
37	Identification Of Geothermal Potential At Mt. Ciremai Based On Ffd Method (H**asbi Fikru Syabi**)
38	A Critical Review Of Direct Use Of Geothermal Energy For Absorption Refrigeration System (**Revandi Arya Guntara, Jooned Hendrarsakti**)
39	Volcanostratigraphy Approach In Geothermal Exploration On Anjasmoro Volcanic Complex, East Java, Indonesia (**Yuniar Zhafira Abdillah, Immanuel Lumban Gaol, Teguh Rahat Prabowo, Fithriyani Fauziyyah**)
40	Thermo-Hydro-Mechanical Coupling In Fractured Geothermal System (**Thibault Candela and Peter Fokker**)

Closing the technical session, the committee awarded 2 posters as most favorite poster. They are:

Poster Title	Author	Institution
The First Conical Diamond Element Bit in Indonesia Geothermal Application	Bonar Noviasta	Schlumberger
Characteristic Of Non-Volcanic Geothermal System In South Bangka Regency, Bangka Belitung Islands	Riska Nurafifah, Hiskia Ulinuha A, Siswandi, Dedi Kusnadi	Universitas Jendral Soedirman