

The 27th Formation Evaluation Symposium of Japan

Special Session
“Geothermal”

PROGRAM

Virtual Symposium
September 14 & 15, 2022



Sponsorship	Japan Formation Evaluation Society - Japan Chapter of SPWLA
Co-sponsorship	Society of Petrophysicists and Well Log Analysts Technology & Research Center, Japan Oil, Gas and Metals National Corporation
Support	Geothermal Research Society of Japan Japanese Association for Petroleum Technology Society of Exploration Geophysicists of Japan Society of Petroleum Engineers, Japan Section

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Program

Wednesday, September 14

Start time (JST)	Session	Chair
9:00	Opening	Yuki Maehara/Masatoshi Nishi
9:45	Invited Talk 1: Geothermal	Tatsuya Sato/Takeaki Otani
11:00	Invited Talk 2: Geothermal	Yoshinori Sanada/Tatsuya Sato
12:00	<i>Lunch Break</i>	
13:15	Special Session: Geothermal	Kentaro Hasebe/Chisato Konishi
14:20	Formation Evaluation	Chisato Konishi/Takayuki Wada
15:40	Borehole Geology and Geomechanics	Takeaki Otani/Yoshinori Sanada
16:30	General Meeting	Yoshinori Sanada/Aiko Takada

Thursday, September 15

Start time (JST)	Session	Chair
9:00	Keynote	Tetsuya Yamamoto/Yuki Maehara
9:45	Invited Talk 3: Geothermal	Takayuki Wada/Tsuyoki Fujii
11:00	Invited Talk 4: Geothermal	Yasuhiro Yamada/Shota Yamashita
12:15	<i>Lunch Break</i>	
13:15	Simulation and Seismic	Shota Yamashita/Aiko Takada
14:45	Machine Learning	Tsuyoki Fujii/Chisato Konishi
15:55	Closing	Tetsuya Yamamoto/Yuki Maehara

Technical Session: Wednesday, September 14 (JST)

Opening

Chairpersons: Yuki Maehara (SLB) and Masatoshi Nishi (INPEX)

09:00 **Opening**

09:15 **Opening Address**

Masatoshi Nishi (President of JFES; INPEX CORPORATION)

Invited Talk 1: Geothermal

Chairpersons: Tatsuya Sato (GERD) and Takeaki Otani (JAPEX)

09:45 **PATHWAYS FOR ADVANCING GEOTHERMAL DEPLOYMENT**
Dr. Carolyn Seto (S&P Global Commodity Insights)

10:15 **GEOTHERMAL ELECTRICITY IN A HIGH RENEWABLE GRID**
Prof. Roland N. Horne (Stanford University)

10:45 **Break**

Invited Talk 2: Geothermal

Chairpersons: Yoshinori Sanada (JAMSTEC) and Tatsuya Sato (GERD)

11:00 **THE GEOTHERMAL FUTURE**
Pres. Andrea Blair (International Geothermal Association)

11:30 **GEOTHERMAL DEVELOPMENT BETWEEN JAPAN AND INDONESIA**
Ms. Finna Christi Lingkan (INPEX Corporation)

12:00 **Lunch Break**

Special Session: Geothermal

Chairpersons: Kentaro Hasebe (INPEX) and Shinichi Takaoka (MOECO)

13:15 **-B- INTEGRATED FRACTURE ANALYSIS WITH BOREHOLE GEOLOGY, ACOUSTIC AND GEOMECHANICS FOR FLOW ZONE IDENTIFICATION: CASE STUDY FROM VOLCANIC GEOTHERMAL WELL IN JAPAN**
Chiaki Morelli, Yuki Maehara, Hong Tian, Chang Wei Qu, Somenath Kar (Schlumberger), Masami Ikeya and Masanori Okamoto (Idemitsu Kosan)

13:40 **-C- A HIGH-ROBUSTNESS TIDAL SIGNAL ANALYSIS FOR ONSHORE RESERVOIRS**
Tianci Zhang, Kozo Sato, Shunsuke Kobayashi, Kazumi Osato and Roland Horne (the University of Tokyo)

14:05 **Break**

Formation Evaluation

Chairpersons: Chisato Konishi (OYO) and Takayuki Wada (WJEC)

- 14:20 -D- EFFECT OF CRUDE VISCOSITY TO NUCLEAR MAGNETIC RESONANCE (NMR) RESPONSES IN DIFFERENT TYPES OF RESERVOIRS: AN EXPERIMENTAL STUDY**
Wei Zhang, Ping Zhang, Yi Li (COSL) and Liang Xiao (China University of Geosciences)
- 14:45 -E- A NOVEL METHOD TO IDENTIFY SURFACE WATER INVASION HYDROCARBON-BEARING POTENTIAL RESERVOIRS USING GEOPHYSICAL WELL LOGGING DATA**
Jinyu Zhou, Yanmei Wang, Bowen Sun, Yitong Yao, Gaoren Li, Die Liu (PetroChina) and Liang Xiao (China University of Geosciences)
- 15:10 Technical Session by Sponsor 1**
- 15:25 Break**

Borehole Geology and Geomechanics

Chairpersons: Takeaki Otani (JAPEx) and Yoshinori Sanada (JAMSTEC)

- 15:40 -F- RESERVOIR CHARACTERIZATION AND FLUID TYPING OF TIGHT CARBONATE RESERVOIR ASSISTED BY HIGH-RESOLUTION ELECTRICAL IMAGE LOGS: A CASE STUDY OF CENTRAL SICHUAN BASIN, CHINA**
Yuyu Wu, Qiang Lai (PetroChina), Kaixuan Li (Schlumberger), Zeyu Wang (PetroChina), Jing Mo, Yue Wang, Feng Pan (Schlumberger) and Huan Su (China National Logging Corporation)
- 16:05 -G- DETERMINING MAGNITUDE AND ORIENTATION OF PRINCIPAL IN-SITU STRESS USING CONVENTIONAL LOGS AND BOREHOLE IMAGE LOGS: A CASE STUDY OF AN IRANIAN CARBONATE RESERVOIR**
Nazir Mafakheri Bashmogh, Weiren Lin (Kyoto University) and Abbas Khaksar Manshad (Petroleum University of Technology and Soran University)
- 16:30 General Meeting**
- 17:00 Closing remarks for 1st day**

Technical Session: Thursday, September 15 (JST)

Keynote

Chairpersons: *Shinichi Takaoka (MOECO) and Tetsuya Yamamoto (JAPEX)*

09:00 **Opening**

09:15 **THE ROLE OF THE PETROPHYSICIST WITHIN THE ALTERNATIVE SUBSURFACE INDUSTRY**

Dr. Tegwyn J.P. Perkins (President of SPWLA; Geoactive)

Invited Talk 3: Geothermal

Chairpersons: *Takayuki Wada (WJEC) and Tsuyoki Fujii (GSC)*

09:45 **FORMATION EVALUATION OF DEEP RESERVOIRS FOR CLOSED-LOOP GEOTHERMAL DEVELOPMENT**

Mr. Peter Bauman (Eavor Technologies Inc.)

10:15 **DEVELOPMENT OF THE FIRST COMMERCIAL 400°C TPS LOGGING TOOL AND DOWNHOLE PH SENSOR**

Pres. Paul von Hirtz (Thermochem, Inc.)

10:45 **Break**

Invited Talk 4: Geothermal

Chairpersons: *Yasuhiro Yamada (Kyushu University) and Shota Yamashita (JX Nippon)*

11:00 **GEOTHERMAL DEVELOPMENT AND ENVIRONMENT - STUDIES IN JAPAN AND AROUND -**

Dr. Kasumi Yasukawa (Geothermal Unit, JOGMEC & IEA)

11:30 **CURRENT STATUS OF RESEARCH ON SUPERCRITICAL GEOTHERMAL POWER GENERATION IN JAPAN**

Dr. Hiroshi Asanuma (Fukushima Renewable Energy Institute, AIST)

12:00 **Technical Session by Sponsor 2**

12:15 **Lunch Break**

Simulation and Seismic

Chairpersons: *Shota Yamashita (JX Nippon) and Aiko Takada (JAPEX)*

13:15 **-H- DEVELOPMENT OF NUMERICAL SIMULATOR PREDICTING METHANE HYDRATE DISSOCIATION AND PRODUCTION BEHAVIOR IN USING GROUT MATERIAL**

Kyohei Matsuka, Yuchen Liu and Masanori Kurihara (Waseda University)

13:40 **-I- DEVELOPMENT OF MULTI-PERMEABILITY, WHITE OIL TYPE NUMERICAL SIMULATOR CAPABLE OF PREDICTING SHALE OIL/GAS PRODUCTION INCREASED BY NANO-EOR**

Toshiaki Nakamoto, Yasuhiro Kaneshima and Masanori Kurihara (Waseda University)

14:05 **-J- SEISMIC P WAVE REFLECTIVITY IMAGING OF THE 3D SHALLOW LITHOLOGICAL BOUNDARIES BY ACTIVE MINE BLAST SIGNAL AUTOCORRELATION ANALYSIS BASED ON SEISMIC INTERFEROMETRY**
Tarek Imam, Tatsunori Ikeda (Kyushu University), Takeshi Tsuji (Tokyo University), Jiro Uesugi, Takeshi Nakamura and Yoshinori Okaue (Sumitomo Metal Mining)

14:30 **Break**

Machine Learning

Chairpersons: Tsuyoki Fujii (GSC) and Chisato Konishi (OYO)

14:45 **-K- QUANTIFYING THE SURFACE RUGGEDNESS OF THE ROCK OUTCROPS BY USING 3D DIGITAL OUTCROP MODELS**
Takumu Nakamura, Arata Kioka and Yasuhiro Yamada (Kyushu University)

15:05 **-L- GAS CHANNELS AND CHIMNEYS DETECTION USING 3D SEISMIC DATA AND CONVOLUTIONAL NEURAL NETWORKS (CNNS)**
Ahmad Bahaa Ahmad (Kyushu University), Amir Ismail (Helwan University), Tarek Samir Imam (Kyushu University) and Takeshi Tsuji (Tokyo University)

15:30 **-M- TIGHT SANDSTONE RESERVOIR PORE STRUCTURE CHARACTERIZATION FROM CONVENTIONAL WELL LOGGING DATA BASED ON MACHINE LEARNING METHOD**
Fei Li, Wenjing Zhang, Weibing Li, Zhen Chen, Bowen Sun, Ruiqiang Chi (PetroChina) and Liang Xiao (China University of Geosciences)

Closing

Chairpersons: Yuki Maehara (SLB) and Tetsuya Yamamoto (JAPEx)

15:55 **Closing Remarks**
Tetsuya Yamamoto (First VP of JFES; JAPEx)

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Review	Takayuki Wada, WJEC
Review	Yasuhiro Yamada, Kyushu University
Review	Yoshinori Sanada, JAMSTEC

Keynote Address

The role of the petrophysicist within the alternative subsurface industry

Dr. Tegwyn J.P. Perkins (President at SPWLA; Geoactive)

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ABSTRACT

Dr Perkins will begin his presentation by introducing himself and the services SPWLA provides before sharing his thoughts on what the role of the petrophysicist will be in the ongoing energy transition.

The technical component of his presentation will provide an overview of several alternative subsurface disciplines and will highlight the similarities - and the differences - between these new petrophysical roles and hydrocarbon petrophysics.

Biography

Dr. TEGWYN J.P. PERKINS has been employed by Geoactive (previously part of Lloyd's Register) for over ten years where he serves as Principal Technical Advisor with overall responsibility for all technical activities in The Americas, and for the development of the Geo-Engineering modules in Interactive Petrophysics. Tegwyn has 30+ years in the oil and gas industry. Before Geoactive he spent 14 years with Halliburton where he served in various formation evaluation and managerial software development positions. Prior to that he worked for both Z&S Consultants and Intera/Exploration Consultants Ltd.



Dr. Perkins earned his bachelor's degree in Applied Mathematics and his doctorate degree in Rheology and Computational Fluid Dynamics from University of Wales, Aberystwyth, UK. He completed his studies by undertaking a BP-sponsored Post-Doctorate on the "Carry Capacity of Drilling Fluids" at University of Plymouth, UK.

He has authored/co-authored more than a dozen papers on various aspects of petrophysics and formation evaluation and his current career interests include borehole imaging and machine learning.

Tegwyn has been a long-time active and supportive member of SPWLA. He has served as the 2009-11 and 2013-15 VP Information Technology, the 2020-21 VP Technology and on various Awards, Symposia, Education and IT committees over the years. He has also served on the Technology Committee twice previously [in 2009 and 2020]. In 2019, he was honored with SPWLA's Distinguished Service Award. He is currently serving as SPWLA President for 2022-23.

On a personal note, Tegwyn is an avid sports enthusiast who owns and manages his own amateur football club. He also enjoys rugby, cricket and golf.

Invited Talk 1-1

Pathways for geothermal development

Dr. Carolyn Seto (S&P Global Commodity Insights)

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ABSTRACT

With the expanding electrification of the energy sector as well as increasing pressure to decarbonize power industry, geothermal energy is experiencing a renewed interest. While this technology has a long history of deployment, it remains limited in application, with only a fraction of the global geothermal resource being developed. Advancements in new technology are leading to a renewed interest in geothermal energy. What are the barriers to widespread deployment? How can technology and innovation support increased adoption? What new commercial models will arise, and who is best positioned to capture them?

Biography

Carolyn is an Executive Director with S&P Global Commodity Insights's Upstream Transformation Service where she investigates the strategic role of emerging technologies in enabling a firm's broader business goals in the energy transition.

Prior to joining S&P Global Commodity Insights, Carolyn has worked across the energy value chain, in technical and commercial capacities in the upstream oil and gas—working as a reservoir engineer for Shell, BP and Chevron; and utility sectors—managing the quantitative fuels analytics group at Edison Mission Marketing and Trading, where she advised the firm's strategies for environmental policy and natural gas trading.

Carolyn was the Clare Boothe Luce Postdoctoral Fellow at the Massachusetts Institute of Technology, where she researched risk management of large-scale carbon sequestration and was a contributor to the MIT Future of Natural Gas Study. She holds PhD and MSc degrees in Petroleum Engineering from Stanford University and a BSc in Engineering Chemistry from Queen's University.



Invited Talk 1-2

Geothermal Electricity in a High Renewable Grid

Prof. Roland N. Horne (Stanford University)

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ABSTRACT

Geothermal energy has undergone a renaissance over the past 15 years, as many new technologies and new countries have joined the industry. Climate change concerns have focused attention on renewable energy, supported by a global ambition to address greenhouse gas reduction. Geothermal developments have accelerated in many parts of the world, both in countries (such as Turkey, Indonesia, Kenya, New Zealand, and the US) that have a traditional interest in "conventional" geothermal resources, as well as countries without a historical community in geothermal energy (such as France and Germany). Some new developments have followed well-worn paths using conventional hydrothermal resources in volcanic regions, while others have struck out in new directions such as in Enhanced Geothermal System (EGS) projects in nonvolcanic regions.

As an example of the development of traditional, volcanic geothermal resources, the United States is the world's largest producer of geothermal electricity, with an installed capacity of 3700 MW (in 2020). In 2020, the state of California generated about 6% of its electricity from geothermal sources, while the state of Nevada generated 9%. As another example, Turkey increased capacity from 397 MW in 2015 to 1549 MW in 2020.

In the context of similar (or greater) expansion of other renewables, notably solar and wind energy, geothermal electricity must now contribute to a grid that includes large fractions of variable sources. This changing picture means that nonintermittent generators, geothermal and others, are faced with a new requirement to improve their flexible dispatchability.

Biography

Roland N. Horne is the Thomas Davies Barrow Professor of Earth Sciences and Professor of Energy Science and Engineering at Stanford University, and Director of the Stanford Geothermal Program. He was formerly the Chairman of the Department of Petroleum Engineering at Stanford from 1995 to 2006. He is best known for his work in well test interpretation, production optimization, and tracer analysis of fractured geothermal reservoirs. So far in his academic career he has supervised the graduate research of 60 PhD and 130 MS students, including about 55 in geothermal topics. Roland is an

Honorary Member of the Society of Petroleum Engineers, and a member of the US National Academy of Engineering. He served on the International Geothermal Association (IGA) Board 1998-2004, 2007-2016, and was the 2010-2013 President of IGA. He was Technical Program Chairman of the World Geothermal Congress 2005 in Turkey, 2010 in Bali, in Melbourne in 2015, and again in Reykjavik in 2020+1. Roland is one of the founders of the IGA online database of geothermal conference papers. He is a Fellow of the School of Engineering, University of Tokyo, and Honorary Professor of China University of Petroleum (Huadong).



Invited Talk 2-1

The Geothermal Future

Pres. Andrea Blair (International Geothermal Association)

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ABSTRACT

There is potentially 1TW worth of geothermal still to be realised; that's significantly greater than the approximately 1.6 GW installed. Utilising geothermal resources means more than electricity, it more than a simple substitute for other generation types. It's an electricity plus business case. Not only is it the only generation type that can provide baseload power, independent of atmospheric conditions, but post electricity generation, there is still significant value in the remaining heat and constituents of geothermal fluid. Geothermal developments provide returns from the electricity market and at the same time offer additional diverse sources of revenue. We call this cascade use, and it can pose solutions for some of the worlds most pressing problems.

Biography

Andy is the President of the International Geothermal Association and co-founder of Upflow, a geothermal science, research and innovation company that builds expert teams to provide intelligent solutions to global industry. The nexus between science, business and community is where her expertise sits. She has a deep understanding of the drivers relating to the business of science, and a proven ability to turn scientific ideas into economic gains. In her previous role as Business Development Manager at GNS Science (NZ) Andy was responsible for leading and coordinating sub-surface geothermal geoscience contracts worldwide for over 10 years. Awarded the role of Geothermal Business Development Lead for New Zealand (2017-2020), Andy was tasked with driving commercial investment in geothermal industrial direct use projects. The desired outcome was the development of large projects with significant positive impacts on local economies, communities, and the environment.



Andy has experience in leading strategic planning and tactical thinking across several industries including governance roles that required strategic investment decision making. This includes chairing the commercial arm of a Māori organization with a significant geothermal asset base (~\$500m).

Co-founder (2013), previous Global Chair (2013-2020) and current Global Board member for of Women in Geothermal (WING). Andy led the team that grew the organization from 83 members to over 2000 members in 48 countries worldwide, making it the single largest geothermal association in the world. A not-for-profit organization, WING has grown into a global movement of people, both men and woman, supporting the empowerment and advancement of women within the industry.

Andy has held a number of governance roles including Director, Geothermal Resources Association (US); Co-Chair Regional Skills Leadership Group – Bay of Plenty; Chair, Bay of Connections (Regional Economic Development Agency) and is the current Chair for online

accountancy innovation company Beany (NZ).

Andy was a finalist in the 2017 and 2019 NZ Women of Influence Awards for both the Diversity and International Categories.

“Ehara taku toa i te toa takitahi, engari he toa takitini taku hoa’ - My strength is not mine alone, rather my strength comes from many.

Invited Talk 2-2

Geothermal Development between Japan and Indonesia

Ms. Lingkan Finna Christi (INPEX Corporation)

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ABSTRACT

Located within the Pacific Ring of Fire, Japan and Indonesia have one thing in common with regard to the abundance of volcanic coming concurrently with its potencies and hazard risks. This -by the nature- geographic position has brought both countries to the top three of geothermal resource richest country in the world. Moving forward with energy transition trend aiming for carbon neutral in 2050 for Japan followed by Indonesia in 2060, geothermal energy is playing a significant role as an alternative energy to secure the demand of power generation from renewable sector. Carrying out this big vision, as energy developer company, reinforcing strategy to achieve this goal is a must and INPEX is the one that has been reflecting this goal to the company's 2022 vision. Accordingly, other than Japan, Indonesia is the only country where geothermal has become one of the core businesses area along side with its oil and gas sector. Challenges in maturing geothermal business from exploration all the way to production from various project stages are the key points of establishing synergy of geothermal development in both countries. In this presentation, we discuss about how we create synergy of developing geothermal, filling the cultural gap, overcoming the challenges as well as gaining lesson learned to excel in each stage of project development.

BIOGRAPHY

Born in Jakarta, 25 December 1989

Education Background

Bachelor of Geological Engineering, Trisakti University (2012)

Master of Engineering, Earth Resource Engineering, Kyushu University (2015)

Career

Geothermal Engineer, Renewable Energy and Power Business Division, INPEX Corporation (2016 – 2019)

Reservoir Engineer, Sarulla Operation Ltd (2019 – 2020)

Geothermal Resource Engineer, Renewable Energy and New Business Division, INPEX Corporation (2020 – present)



Invited Talk 3-2

Formation Evaluation of Deep Reservoirs for Closed-loop Geothermal Development, examples from North America

Mr. Peter Bauman (Eavor Technologies Inc.)

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ABSTRACT

Heat and electricity production from conventional geothermal energy has been exploited for over 1200 years, however, many geothermal projects are plagued by high up-front exploration (finding and developing) costs and have may have difficulty financing these projects due to subsurface geological environments, specifically low permeability, therefore many projects do not make progress beyond the feasibility or exploration phase.

True closed loop systems seek to overcome these challenges by extracting heat through conductive heat transfer processes by drilling numerous multilateral wells in low permeability rock. Eavor Technologies Inc. has designed and successfully executed a system to address these issues through the drilling of long, closed loop multilateral wells in sedimentary basins and basement terranes. This system can produce predictive output of baseload heat and power.

This presentation illustrates standard and unique petrophysical workflows in the evaluation of closed loop geothermal projects. Through these workflows the determination of geothermal gradient and static rock thermal conductivity are estimated. 2 examples from North America (Canada and Southern USA) are presented.

Biography

Peter Bauman is a Professional Geologist registered with the Association of Professional Engineers and Geoscientists of Alberta (APEGA). For more than 20 years, he has held various technical and managerial roles at major, intermediate and junior energy companies with a successful track record of growth and value addition. His passion and strengths lie in new country entry, exploration, and development. His geographic experience includes North America, South America, Europe, Australia, Western Asia, North Africa, and Middle East. Peter holds a B.Sc and M.Sc from the University of Calgary in Geology and Geophysics.



Peter is a Director of the Canadian Global Energy Forum, the Past-President of the AAPG Canada Region and is an active member of the CSPG. He has authored numerous presentations at domestic and international energy conferences.

Invited Talk 3-2

Development of the first Commercial 400°C TPS Logging Tool and Downhole pH Sensor

Pres. Paul von Hirtz (Thermochem, Inc.)

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ABSTRACT

Thermochem has developed a memory TPS (Temperature, Pressure, Spinner) logging tool to that can be deployed under extreme well conditions, far exceeding conventional logging tool capabilities. The tool has been tested under simulated wellbore conditions up to 400°C. A complete range of simulated well temperature tests have been performed to enable the maximum safe time-in-well to be calculated based on the temperature profile of the well to be logged. An integrated approach, utilizing a high-performance heat shield, combined with internal heat-sinking, high-temperature electronics and battery has allowed us to meet the aggressive goal of a 400°C logging tool.

In a parallel research effort, Thermochem, in partnership with Sandia National Laboratories, is developing High-temperature high-pressure (HTHP) electrodes selectively sensitive to hydrogen (H⁺) ions. This technology has already demonstrated in representative geothermal environments up to 225°C and 100 bar. The goal is to develop the prototype pH and reference electrode sensors into a commercial product incorporated into an existing two-phase downhole sampling tool operable up to 300°C and 350 bar.

Biography

Paul von Hirtz is the President of Thermochem, Inc. Paul has a degree in chemistry and has trained and worked as a chemical engineer with 30 years' experience in the geothermal energy industry. He specializes in chemical process design for steam and binary power plants, chemical modeling and geochemistry. Paul has performed research for the US Department of Energy (DOE) and the California Energy Commission (CEC), with a primary focus on steam purification, advanced wellbore logging tools and pH-modification for silica scale control. Paul is the inventor of the TFT[®] technology for two-phase flow measurement used worldwide, downhole sampling tools and instrumentation for on-line steam purity and quality measurement. Paul chairs the ASTM committee on Materials and Geothermal Fluid Sampling and Analysis and is an associate editor for the international journal Geothermics. Paul founded PT. Thermochem Indonesia in 1998. Both companies were acquired by Kyuden International Corporation and WestJEC in 2000, and Paul continues to lead Thermochem, Inc.



Invited Talk 4-1

Geothermal Development And Environment -Studies In Japan And Around

Dr. Kasumi Yasukawa (Geothermal Unit, JOGMEC & IEA)

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ABSTRACT

Any development, including geothermal development, may give impact to the local environment. However, it may be minimized by technology and innovative ideas. Even with a risk of impact, it worth developing the resources if there exists larger merit, such as local welfare and protection of global environment.

Geothermal development has lots of merit, such as electricity and hot water supply, possibility of new business, contribution to energy security, and reduction of CO₂ emission. Studies to minimize environmental impact by geothermal energy development has been done from many different aspects, from toxic gas emission, induced seismicity, and hydraulic impact to adjacent aquifers. Possible impact to surrounding hot spring aquifer by geothermal development, which is a big issue in Japan, is focused and geochemical method to avoid such impact will be introduced in this paper.

Hydraulic relationship between geothermal reservoir and hot spring aquifer is categorized into five types by shielding ability of caprock between geothermal reservoir and hot spring aquifer. Type 1 is an identical reservoir. Type 2 is Water supply, Type 3 is steam supply and Type 4 is heat conduction from a deep reservoir to hot spring aquifer. Type 5 is independent systems. Possible impact by geothermal fluid extraction differs according to such types: flow rate decline for Types 1 and 2, chemical component change for Type 3 and temperature decline for Type 4. Types 1-5 can be roughly identified by geochemical survey of the hot spring fluid. Thus, possible impact should be investigated in advance of development and adequate monitoring should be conducted.

Biography

Currently a senior councilor of Geothermal Unit, Japan Oil, Gas and Metals Corporation (JOGMEC). Having been a research scientist in National Agency of Industrial Science and Technology (AIST) from 1987 to 2019, she has studied geophysics and geothermal reservoir engineering and involved in many international geothermal research projects. As an officer in the Ministry of Economy, Trade and Industry (2009-2011), she was in charge of international environmental policy such as Inter-governmental Panel for Climate Change (IPCC) and London Convention for marine environment. She is a Board of Directors in International Geothermal Association (IGA) from (2020-2023), leading its bylaws committee. In 2022, she was appointed to be the Chair of the International Energy Agency - Geothermal Implementation Agreement (IEA-GIA).



Invited Talk 4-2

Current status of research on supercritical geothermal power generation in Japan

Dr. Hiroshi Asanuma (Fukushima Renewable Energy Institute, AIST)

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ABSTRACT

Nature of geothermal resources that rate of emission of CO₂ is one of the lowest among all the energy sources is significantly attractive for the counties with geothermal manifestation such as volcanic activities Japanese scientists have estimated that the Japanese nationwide potential of “Supercritical Geothermal Resources”, which has an origin in the subduction of oceanic plates, reaches hundreds GWs from distribution of old volcanos and calderas. Power generation using supercritical geothermal resources, which temperature range is 400 to 500 deg-C and the depth is expected to be less than several kilometers in Japan, (supercritical geothermal power generation) in Japan can significantly contribute to energy security and reduction of emission of CO₂. However, there are a lot of scientific unknowns about nature, especially in rock-mechanical and geochemical behavior under supercritical conditions. We also need technological breakthroughs, because temperature and pressure conditions in the supercritical geothermal systems are far beyond the current technological limitations, and experiences in the foregoing ultra-high temperature geothermal drillings suggest that the presence of acidic geothermal fluid should be expected. The Japanese government has identified supercritical geothermal power generation as one of the key technologies to establish a “Carbon-Free Society in 2050”, and is funding projects for detailed site surveys and well design in the most promising area in northeast Japan and Kyushu as shown in this presentation.

Biography

1992 Dr. Eng. Tohoku University
1992 Research Associate, Tohoku University
1996 Associate Professor, Tohoku University
2013 Senior Principal Researcher, AIST
2013 Team Leader, Geothermal Team, AIST
2019 Principal Research Manager, AIST
2022 Deputy Director, Renewable Energy Research Center, AIST

