

# **International Training Programs for Human Resource Development in Geothermal Energy by Japanese Government**

**Ryuichi Itoi<sup>1</sup>, Hiroto Kamiishi<sup>2</sup>, Eiji Wakamatsu<sup>2</sup>, Haruka Nakagawa<sup>2</sup>**

<sup>1</sup> **Kyushu University, Fukuoka, Japan**

<sup>2</sup>**Japan International Cooperation Agency (JICA), Tokyo, Japan**

[itoi@mine.kyushu-u.ac.jp](mailto:itoi@mine.kyushu-u.ac.jp)

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## **ABSTRACT**

The Japanese government has been actively supporting geothermal development in developing countries in various fields from technical support and financial support to human resource development of geothermal related engineers. Japan International Cooperation Agency (JICA), subsidiary of Ministry of Foreign Affairs, is in charge of planning and organizing these activities. One of the pillars of JICA's assistance in geothermal development is human resource development. JICA's technical cooperation projects send experts to client countries to work hand in hand in order to find solutions and to improve the public institutions' capacity. What makes JICA's assistance in geothermal development unique is a range of training programs offered in Japan. The training programs range from a short one week course for executives to 6 week course for drilling managers, a half year course for geothermal resource engineers. These courses are carried out with cooperation of 36 organizations including universities, private companies and national institutions. Other than these short term programs, master and doctoral programs are also prepared in collaboration with universities in Japan.

## **1. Introduction**

Since 1970, the Japanese government has been supporting geothermal development in developing countries that have geothermal potentials through various activities; technical support, financial loans and capacity development. Regarding capacity building in geothermal sector, Japan has a long history from as early as 1970 when the geothermal training program started at Kyushu University in collaboration with UNESCO and the Japanese government. Around the same time, several programs were started by Iceland, New Zealand, and Italy. Kyushu University's course lasted for 32 years until 2001. New Zealand also stopped Geothermal Diploma Course in 2002, but restarted it as a six month program in

2007. The United Nations University Geothermal Training Program (UNU-GP) is the only one running continuously until now from its start in 1978.

As geothermal development in developing countries has become more and more active in recent years, a lack of manpower of geothermal expert has increasingly become a serious problem for a steady progress of development as widely recognized in the global geothermal community. In order to solve this problem and to contribute to geothermal development in developing countries, JICA has recently started new capacity building programs of short and long terms. The short term program consists of three courses started in 2016 and long term program for master and doctoral courses started in 2014. This paper introduces these geothermal capacity development programs.

## **2. History of geothermal training course in Japan**

In 1970, the Geothermal Training Course was started by the Japanese government upon the request by UNESCO (Fukuda et al., 2000). The course aimed at enhancing development and utilizing geothermal energy by providing improved technical knowledge and skills related to geothermal energy to engineers and scientists from developing countries. The course had been arranged by the Oversea Technical Cooperation Agency (OTCA) from 1970 to 1973, then by the Japan International Cooperation Agency (JICA) from 1974. Since the inception of the course in 1970, Kyushu University was responsible for the technical aspect of the program such as organizing lectures and field trips under administration of JICA. The course duration was for three months. It consisted of lectures on geothermal engineering as well as on geoscience, fieldwork for one week at the Hatchobaru and Otake geothermal fields, and field trip to Tohoku of northern Japan. Participants were mostly from governmental organization and a very few from academic organizations such as universities. The course lasted for twenty years and closed in 1989. A total of 272 participants from 32 countries had finished the course.

From 1990, the course was upgraded to a new four months course, Geothermal Training Course (Advance), also conducted by Kyushu University commissioned by JICA. The course aimed to enable the participants to play a leading role in geothermal development projects in their countries by emphasizing practical works. The course consisted of lectures, field trips and a short term project study for one and half months. Project studies provided practical exercises for participants. This course lasted for 10 years until 1999. A total of 108 participants from 16 countries was accepted.

Geothermal energy development steadily continued worldwide during the period of 1980's and 1990's when we ran these courses. Thus, even when the advanced course ended in 1999, there were still high demand for capacity building in geothermal development in developing countries. At the same time, more and more attention for environmental considerations were required for development of geothermal fields and operation of power plants. This led to a start of a new course, Geothermal Energy and Environmental Sciences, at Kyushu University commissioned by JICA. The course emphasized environmental aspects by adding lectures on environment related to geothermal development. The course, however, lasted only two years from 2000 to 2001 and ended with the total number of participants 23 from 16 countries.

Kyushu University did not have any specific organization for running the courses, but one professor was assigned as a course leader and his department or research center played as an accepting organization. These organizations are the Mining Department, the Geothermal Research Center, and the Department of Earth Resources Engineering (ERE) in Faculty of Engineering. The Geothermal Research Center played an accepting organization from 1985

to 1998 when Prof.Koga was a course leader followed by Prof.Fukuda. The center had three permanent academic staff and one officer. After 1998, the center was merged into the department of ERE as one of the laboratories and shifted to more on education and research for undergraduate and graduate programs.

### **3. Geothermal training programs in Japan**

Since 2014, Japan International Cooperation Agency (JICA) has started a range of short term and long term programs for capacity building in the field of geothermal energy development. On the basis of analysis of geothermal development scheme in developing countries, there are some key issues which hinder a smooth and steady progress of geothermal development such as hesitation of investment, inappropriate judgement in drilling process, and a lack of manpower in geothermal engineering field. In order to solve these problems to promote geothermal development in developing countries, JICA has designed and organized short term programs on geothermal which consists of three courses started in 2016. They are

- 1) Geothermal Resource Engineers (GRE)
- 2) Geothermal Drilling Management (GDM)
- 3) Geothermal Policy and Strategy Program for Executives (Executives).

These courses are prepared for assigned countries in Asia, Central and South America, and Africa where geothermal resources are present. As JICA's program is on the basis of government cooperation, application and nomination of candidate of respective countries can only be made by relevant governmental organization of the country. Candidates for the course should be currently engaged in geothermal development and have more than 3 years of work experience, should have a university degree of engineering or science, and fluent in English. Information on these courses can be obtained at JICA office or Japanese Embassy of respective country. Details of the courses are described below.

#### ***3.1 Geothermal Resource Engineers (GRE)***

This course is prepared for university graduate level engineers with a few years of practical experiences in geothermal industry to learn a wide range of subjects related to geothermal development from geology, geochemistry, exploration geophysics, reservoir engineering, environmental chemistry and sustainable development. Duration of the course is six months and the course generally starts in early June and finishes in the middle of December. First three months are mainly classroom lectures and exercises followed by three months individual project study. Lectures and project studies are carried out at Kyushu University in Fukuoka prefecture. Lecturers are from 17 organizations in 2018 which are universities including Kyushu University, private companies and national institutes. During the course, field trips are carried out three times: twice in Kyushu and once in Tokyo and Tohoku, northern part of Japan. The first field trip is carried out after two weeks of general lectures on geothermal energy. This is because some participants do not have geothermal power plants in their country and need to understand its system. During the trip, they will visit Beppu thermal area, the Hatchobaru geothermal power plant and small scale binary plant.

Three months of the latter part of the course is assigned for project study. Participants are requested beforehand to select one out of seven specific research categories; geology, exploration geophysics, geothermics, geochemistry, reservoir engineering and exergy analysis for their project study. At the same time, they are recommended to bring their own data from their country for their research work. If the data are not available, they can use

existing field data in Japan or carry out field work in Kyushu and collect samples for their study. These research categories are on the basis of research laboratories of the department of Earth Resources Engineering, a main organization in charge of running the course. Each participant is assigned to a laboratory of the department. Graduate students of master and doctor courses of the laboratory guide and support the participant's project study, and professors of the department also supervise them. At the end of the course, participants need to write a report on their study results. At the same time, they present their output for 15 minutes followed by Q&A.

Maximum number of participants for the course is 18 per year. Number of participant is 16, 15, and 9 for 2016, 2017 and 2018, respectively. One participant in 2016 and one in 2017 left the program before completion of the course.

During the course, participants need to make presentations on the situation of geothermal energy resource and its development in their countries, on the results of the project study in a seminar, and on an action plan at the end of the course. Action plan is a future plan of each participant's activity after going back to their country and organization.

Expenses for the course includes international travel fee, daily allowance, accommodation fee, field trip fee covered by JICA. Upon completion of the course, certificate both from Kyushu University and JICA will be handed to each participant at the closing ceremony.



**Figure 1: Group photo of participants for Geothermal Resource Engineers course and staff of Kyushu University at the closing ceremony in December, 2017.**

### ***3.2 Geothermal Drilling Management (GDM)***

This program is designed to train drilling managers for planning, managing, and supervising drilling activities. Six (6) week program comprises of lectures and site visits to drilling sites, warehouses for drilling rigs, and manufacturing factories for obtaining knowledge for drilling

management, drilling technology, logistics, and contract management. Participants can discuss with lecturers on specific cases on the basis of analysis of actual drilling accidents that occurred in Japan. The program is implemented by Kitakyushu International Techno-cooperative Association (KITA) under administration of JICA Kyushu.

Maximum number of participant acceptable is eight (8) per year. Number of participant is 7, 7 and 4 for 2016, 2017 and 2018, respectively. Candidate for the course is required to formulate a drilling plan before completion of the course for presentation.

Expenses for the participant of the course is borne by JICA as explained in the course of GRE.

### ***3.3 Geothermal Policy and Strategy Program for Executives (Executives)***

To promoting geothermal energy development, management level persons need to understand the basics of the technology and its development risks as energy resources. This one-week course provides an opportunity for participants to learn geothermal law, economic evaluation model of geothermal development on the basis of engineering economy, and country case studies of comparative analysis of public and private investments. Participants will discuss issues such as the role of public and private sectors for geothermal development, and how to attract private sector for investment. Japanese executives of the private sector, government and academic organizations will join the discussion. A network among participants and Japanese executives can also be developed during the course. The program is implemented by JICA Kyushu with support of West Japan Engineering Consultants Inc. (WEST JEC).

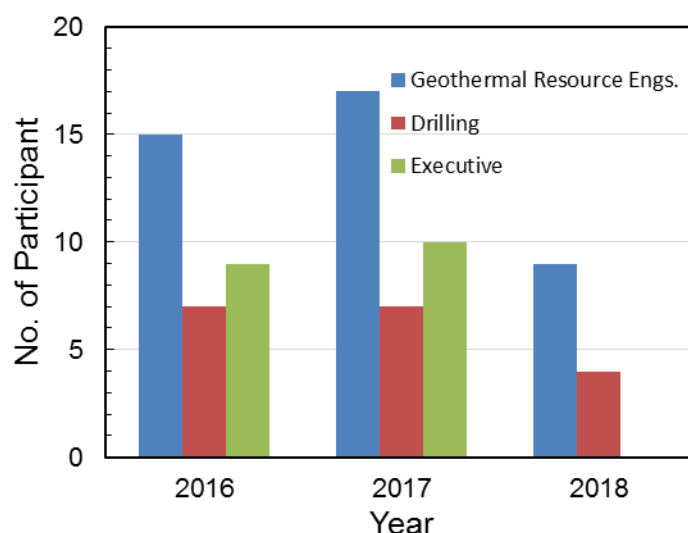
Maximum number of participant is twelve (12) per year. Number of participant is 10 and 9 in 2016 and 2017, respectively.

Participants are requested to make an action plan to be implemented in their mother institutions on the basis of what they learned during the course.

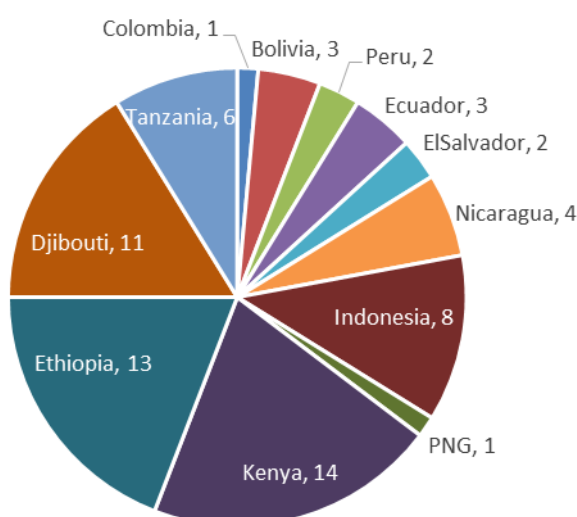
Expenses for the participant of the course is borne by JICA as explained in the GRE course.

Figure 2 presents the number of participants that attended the three courses. A total number of participants for three courses by 2018 is 78. This excludes that for Executive course for 2018, as the selection of participants has not yet started.

Figure 3 shows the number of participant by 2018 by country. The largest number is Kenya (14) followed by Ethiopia (13) and Djibouti (11).



**Figure 2: Number of participant for the courses of Geothermal Resource Engineers, Geothermal Drilling Management and Geothermal Policy and Strategy Program for Executives from the year 2016 to 2018.**



**Figure 3: Number of participants for three courses by country. The largest number is Kenya followed by Ethiopia and Djibouti.**

### ***3.4 Long term programs for master and doctor***

Other than short term programs, JICA started a long term program for capacity building in the field of mining and earth resources called the Kizuna Program. *Kizuna* means “bond” in Japanese. Many developing countries are rich in mineral, oil and gas, coal and geothermal energy resources. In order to develop these resources in a sustainable manner, engineers and governmental officials need to have the necessary knowledge and experiences on their development. The aim of the program is to 1) develop human resources for earth resources, and 2) develop human resources network, or *kizuna*, among developing countries and Japan.

The program started in 2014 with collaboration of Japanese universities that have departments specialized in education and research in earth resources and mining. They are Kyushu University, Hokkaido University, Akita University, Tohoku University, Tokyo University and Waseda University. This program covers not only geothermal but also oil and gas, coal and metal mining. A total number of students allocated for geothermal sector in the program is expected to be 50 for 10 years from 17 countries. In 2018, there are five master course students and four doctoral students: one in Tohoku University and seven in Kyushu University as of May 1<sup>st</sup>. Five students, four for master and one for doctor, will be enrolled next April 2019 in Kyushu University. Six master course students have already completed their program after finishing their defense in 2016 and 2018: three from Rwanda, two from Ethiopia and one from Kenya. They have already gone back to their home country after their completion. One student from 2016 has finished the GRE course, gone back to their home institutions, and returned to Japan after being admitted to the Kizuna Program, and two students from 2017 will start the program from the fall semester in 2018.

Students will be enrolled in the graduate school at respective universities and supervised by professors of related field for their research project. JICA also prepares site visits in Japan during the program to geothermal power plants and manufacturing company of geothermal turbines, and assists participants to participate in short term internships at relevant private companies. These programs provide opportunities to students to enhance their knowledge obtained during the program in actual application. Another program by JICA is financial support for field work in their country which is a part of their research project for master or doctor thesis. Figure 4 shows geochemical work at the Gisenyi geothermal area in Rwanda where two students carried out hot water sampling as well as field measurement for chemistry. Her/his supervisor will accompany for the field work supported by JICA. This includes travel expense of student and supervisor.

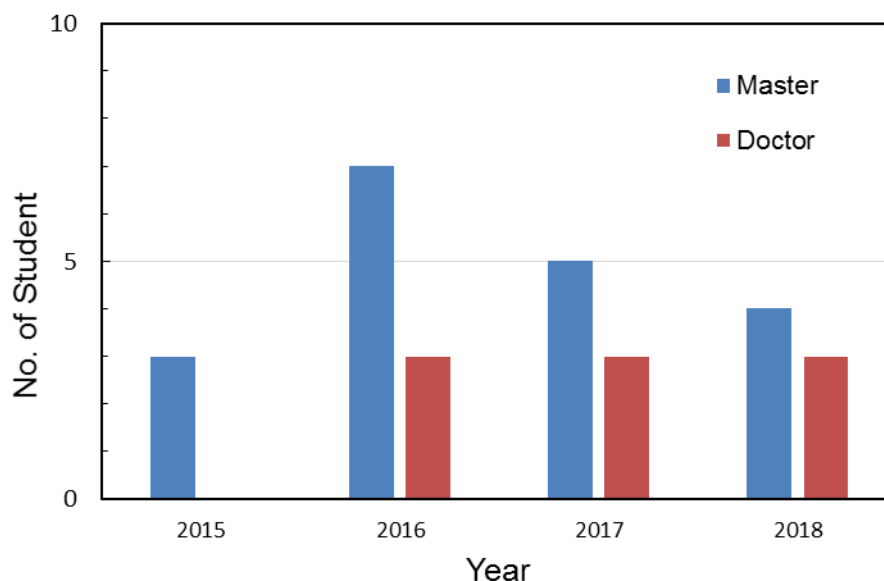


**Figure 4: Picture of master course student in the field work at Gisenyi, Rwanda.**

Target countries for the Kizuna Program's geothermal sector are ones with geothermal potential. So far, the program has accepted students from Rwanda, Kenya, Ethiopia, Tanzania, Djibouti, El Salvador, and Indonesia. Eligible applicants of these countries are employees of governmental organization such as geological survey, public corporation and academic staffs of university. Brochure of the Kizuna Program can be found at

[https://www.jica.go.jp/english/publications/brochures/c8h0vm0000avs7w2-att/japan\\_brand\\_09.pdf](https://www.jica.go.jp/english/publications/brochures/c8h0vm0000avs7w2-att/japan_brand_09.pdf)





**Figure 5: Number of students for master and doctor programs.**

#### 4. Summary

JICA started several capacity development programs in geothermal energy sector in 2014 for long term courses and in 2016 for short term courses. Short term courses are based on the previous training courses conducted at Kyushu University for more than 30 years and on the analysis of geothermal development in developing countries by JICA. JICA will actively support geothermal development by conducting capacity development program in geothermal energy sector.

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