

## **Earth Science Disciplines in the Global Resource Management Program from 2013 to 2022 and Beyond**

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### **Abstract**

The Global Resource Management program of Doshisha University has provided opportunities for students to explore problems and issues addressed by earth sciences. Mainly through site visits in the practice courses, students have developed a better understanding of natural resources, environmental issues, and natural hazards, which are key aspects in the relationship between people and nature. Basic knowledge about the earth's environment is essential for global leaders engaged in various sectors, particularly for the provision against environmental changes and catastrophic disasters. Earth science disciplines are expected to be continuously offered as liberal arts courses in the higher education sector.

Keywords: *resource management, earth science, natural environment, hazards, liberal arts*

### **I. Introduction**

The Global Resource Management (GRM) program of Doshisha University started in 2013 as a sub-major course for doctoral students to provide education in the interdisciplinary field centralized in global resource management. While this program aims for the integration of global studies and infrastructure, resource and energy science, earth science has not been considered as a principal component of the GRM program. However, the students have had opportunities to become familiar with several earth science topics by attending the elective lecture course “Introductory Earth and Environment Science” and through the requisite activities of the “GRM Joint Seminar” and “GRM On-Site Practice”, or the “GRM Group Work Practice” in the recent curriculum.

This article describes several examples of the practice courses that cover earth science topics. The GRM students gained basic knowledge about natural resources and the earth's surface environment relevant to natural hazards and human impacts. The examples shown here suggest the importance of earth science when considering the relationships between people and the natural environment in interdisciplinary education programs.

### **II. Earth Science Topics in the On-Site Practice**

To provide the GRM students with opportunities to experience the actual situation of resource management and related topics, several places were selected both in Japan and in foreign countries as targets of the On-Site Practice or the Joint Seminar. Among the targets selected in the Japanese Islands (Figure 1), examples of the site visit and their main scopes are outlined here.



**Figure 1. Locations of the GRM On-site Practice and Joint Seminar in Japan.**

**Base map is from Bathymetric Data Viewer of the National Centers for Environmental Information, NOAA (<https://www.ncei.noaa.gov/maps/bathymetry/>).**

The first on-site practice of the GRM program was conducted in March 2013 through a visit to Miyako Island (Miyakojima) of the Ryukyu Islands. This field trip was designed to facilitate students' understanding of the efforts made for energy and water resource management on an isolated island which is not connected to a power grid of the mainland. We therefore visited infrastructure facilities including a mega-solar demonstration facility, a wind-power generation system, a small hydroelectric power plant, and the Underground Dam Museum, as reported by Abdrahamanov et al. (2014). The underground dam in Miyako Island was constructed for storing groundwater in the porous limestone strata and the sustainable use of groundwater mainly for irrigation. At this site, students learned that for efficient and sustainable management of groundwater resources, it is necessary to understand the geological structure and topography of the drainage basin in addition to weather conditions. In addition to the issues on resource management, Miyako Island provided an opportunity to learn about earthquake and tsunami hazards. Huge erratic boulders (tsunami-ishi) on the Agari-hennazaki Peninsula (Figure 2), which were emplaced by prehistoric tsunami waves including the 1771 Meiwa Earthquake Tsunami (Goto et al. 2010), were particularly impressive, suggesting the severe impact of tsunami waves like those caused by the 2011 off the Pacific Coast of Tohoku Earthquake.



**Figure 2. Erratic boulders (tsunami-ishi) on the Agari-hennazaki Peninsula, Miyako Island.**

Rishiri Island, located about 20 km northwest off Hokkaido, was the destination of the on-site practice in 2013 (Lamos 2014). Like Miyako Island, it is desired to secure energy sources within Rishiri Island, and therefore, the main objective of the practice was to examine the possibility of implementing renewable energy systems on the island. Rishiri Island was formed by the volcanic activity of Rishiri-zan, classified as an active volcano, although there is no record of activity in historical documents. This fact reminded the students of the importance of security measures against the risk of volcanic eruption as well as tsunami and earthquake hazards for implementation of the energy infrastructure.

The on-site practice was first conducted in the Beppu and Kuju areas in central Kyushu in 2014 (Carada 2016) to learn about the utilization of geothermal energy in Japan and in other countries, such as the Philippines, Kenya, and Indonesia. As there are several geothermal power plants of various sizes in central Kyushu, including the Hatchobaru Geothermal Power Plant of Kyushu Electric Power Co. and small-scale plants using hot spring water in Beppu City, we repeatedly visited central Kyushu to investigate the social impacts of geothermal energy development such as those on nature conservation and hot-spring tourism.

As strong earthquakes struck central Kyushu and caused severe damage mainly in the Kumamoto area in 2016, the fieldwork of the groupwork practice in 2022 was conducted in the Kumamoto area to learn about the occurrence of active faults, people's response to the earthquakes, and recovery from the disaster. Through these experiences, we recognized that central Kyushu represents a typical example of the Circum-Pacific orogenic belt characterized by earthquakes and volcanic activities and that such natural processes provide us with both benefits and disadvantages in the form of natural resources and disasters.

### III. Importance of Earth Science Disciplines

The GRM students gained a better understanding of the natural environment related to resource management mainly from the viewpoints of geology and geomorphology during the on-site practices. They obtained not only knowledge about the origin of natural resources, but also the environmental impact of extraction and use of the resources. Natural hazards and disasters were also important issues addressed by earth science when we consider the relationship between people and the natural environment in the practice courses. The GRM program has aimed at fostering global leaders who can challenge difficult issues in the troubled areas and developing countries. Such ability would also be anticipated in advanced countries, particularly those which are situated in active mobile belts like Japan, for constructing a resilient society with provisions against environmental changes and catastrophic disasters.

Systematic knowledge and research ability in earth science disciplines are inevitably important for global leaders engaged in various sectors of the present and future society. For the students taking the GRM course as a sub-major, however, the study of practical problems such as natural hazards, natural resources, and various environmental issues would be preferred rather than fundamental studies of earth science. It is expected that the basic and wide-ranging disciplines of earth science will be fully implemented as liberal arts subjects in both undergraduate and graduate education.

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