

A Practice Report of Science Classes to Increase the Interest in Regional Geology in Elementary School

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We report two educational practices using the regional geological material in the science class of the sixth grader.

For the first we focused on the learning activity before the observation. We planned students increase their interest themselves with knowledge that already learned and they observe an outcrop near their school. In the prior learning, we distributed the worksheet printing the picture of outcrop. They described their notice on a worksheet. Based their description, they decided observation target at outcrop. Teacher did only help student they can use their knowledge and they can observe with their purpose. As a result, the student observed at outcrop on their own initiative.

Next, we practiced the learning program that student made Rock specimen and they observed geological material around school using it. Probably the learning program to use the rock specimen which student made themselves is rare. In this program, they showed high interest about regional geology.

Keywords: Elementary school science, Regional geology, Active learning

The scientific book and the demonstration experiment in the island library in "Oki" Let's science book! the one which was made with water is enough

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The try to have appeal children put on a scientific book in the island library in Oki and a natural phenomenon with it by the experiment and to have a scientific outfit worn is accomplished every year.

It becomes the 4th last year.

Last year, water on the island in Oki reproduced the natural environment to bring about by the scientific book and the Enji experiment by the theme of "the one which was made with water is enough" with Mr. Doi at the Galileo atelier and deepened the understanding of the natural phenomenon which is related to water in Oki to the children with the protector.

The handled scientific book and the experiment are last year and "Rika doku" theme in Oki which becomes the 4th is Let's Rika doku!

The one which was made with water is so-called adequacy.

- The reading " It doesn't receive Shizuku".
- The dissolving of water, and the difference, the experiment of oil, " various ones dissolve in water "

The case of the tanker accident and the oil leak on the sea

- The evaporation of water and the extraction of the melting one

The experiment, the evaporation and the extraction of seawater in Oki

- The experiment (on) " water in Oki is delicious " (fresh water lens)
- Evaporating water where.

It catches water in the experiment, air.

- The water which becomes rainy

The experiment, the rainfall experiment

The reading " There, it is rain, rain, rain."

- Water density difference (1)

Heavy water - light water (The difference with density by the dissolving)

- Difference (2) with the density of water of 1 of the experiment on the Tsushima Current (the big flow in the sea)

Experiment 2 on heavy water - light water (the difference with density by the temperature difference of water)

It sees an ocean current.

- The aquatic resource with 1 piece of show - the ocean current of the sending it of the sea, too, and rich Oki
- 2 of the sending it of the sea, too

The ocean current and the air mass of show - Oki Geopark

- 3 of the sending it of the sea, too

The alternating current of the show - Oki obsidian - the ironware - the chinaware and so on and the people in the Korea

- The sending it one with thankfulness

The show - drifting-ashore garbage

It did being.

Introduction of “Ocean Education Pioneer Schools” Subsidy Program

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In 2016 we launched the “Ocean Education Pioneer Schools” program to provide financial support to elementary, junior high, and high schools. The aim is enhancing ocean education in Japan as part of school education. 64 schools from 28 prefectures in Japan are participating in this program. They study various ocean themes, from general to regional problems; natural disaster damage prevention, ocean driftage and pollution, marine biology and coastal environment, traditional salt manufacture, coral reef fisheries, and so on. These ocean programs will be brought together into practical ocean education curriculum in the future. We provide information about this Pioneer Schools program to stimulate discussion about ocean education in the natural science and earth planetary science fields.

Keywords: Ocean Education, Ocean Education Pioneer Schools program, Subsidy System

An Exploration of Measures of Citizens' Ocean Literacy in Taiwan

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One important objective of ocean education is the enhancement of learners' ocean literacy, including, but not exclusive to ocean conceptual understanding, problem-solving ability, attitude toward ocean, and care about the ocean public issues. Ocean literacy may be a key to (1) link public with the understanding of ocean and ocean's influence, (2) applying ocean knowledge to solve problems and issues regarding the ocean and its resources, and (3) to inform and taking actions to public issues. However, previous studies have rarely surveyed citizens' ocean literacy, and to confirm the impact of ocean literacy on citizens' willingness to take action. This study attempted to fill this gap by conducting such an inquiry. This study explored public ocean literacy in Taiwan. To measure ocean literacy in terms of ocean concept understanding, attitudes toward the ocean, and interesting in studying ocean issues, Ocean Conception Test (OCT, multiple-choice question), Attitudes toward Ocean Inventory (AOI, 5 point Likert scale), and the Interesting in Studying Ocean Issues Instrument (ISOI) were constructed. Totally 324 subjects participated in this study.

The OCT is a 75questions questionnaire to measure ocean concept understanding. The mean score was 45.02 (SD =11.03). Three major misconceptions were: (1) what is the major mechanism causing sea level rise; (2) what is the major mechanism causing storm surge; (3) The reason why Kuroshio is called 'black current'. The mean score of AOI is 3.48 (SD =0.52), shows subjects have a positive attitude toward marine science. With respect to ISOI, the analysis revealed that the top 3 most interesting topics of marine issues subjects would like to study were: 'coral reef ecosystem', 'dead zones', and 'ocean resource conservation'. Besides, attitudes toward ocean explained significantly more variance in willingness to take ocean action than of ocean concept understanding.

To conclude, this study may be of importance in providing researchers with a better understanding of citizens' ocean literacy. It is our hoped that this analysis and discussion will encourage the inclusion and replication of the public understanding of ocean.

Keywords: Ocean Literacy, Ocean Conception, Attitudes toward Ocean, Interesting issue of Ocean

The making of animations of geological phenomena in JAPAN using global geological data.

*Tadayoshi Kato¹

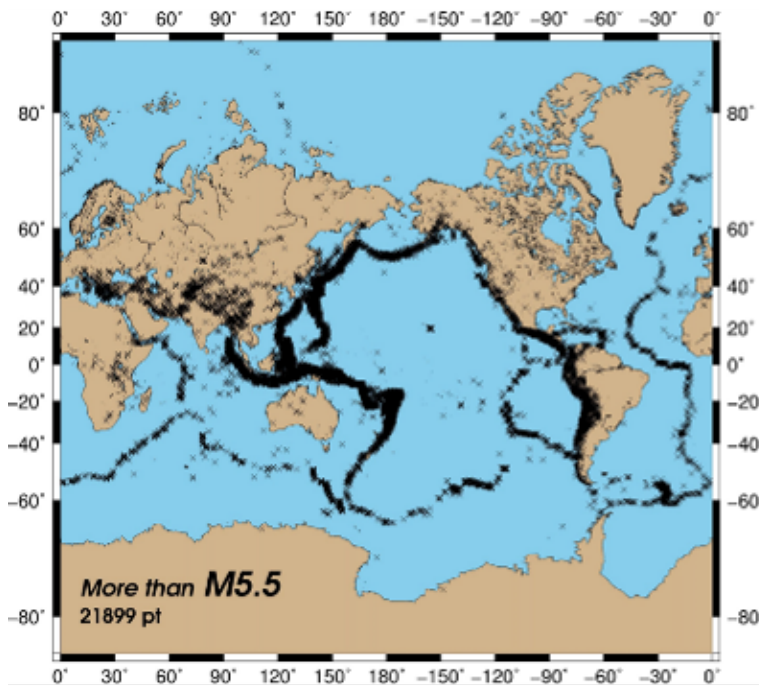
1. Moegino Junior High School

After the 2011.3.11 earthquake in Tohoku, crustal deformation by earthquakes and volcanic activity is being observed every day at Japan. Japanese people realize that they do not know much about how crustal deformation in Japan is continuously occurring, as well as how to prepare for huge earthquakes. One of the reasons for this problem is the fact that crustal deformations in Japan are not taught properly in Junior High Schools. If these things were properly taught, the preparation for huge earthquakes would be much easier to do in the near future.

In this study, we created 3D animations for Japanese crustal deformation using GNSS data obtained by the Geographical Survey Institute of Japan (GSI), and from animations that show the distribution of earthquakes around the world using earthquake catalog data obtained by the United States Geological Survey (USGS). Overall, this would make it easier for school children to understand the Japanese crustal motions and how earthquake work in global distribution. The GSI had already created a 3D animation of Japan, but only for a limited time and area. The utility of that animation was suggested, under KATO (2011), to be applied again to current studies. The newly created animations will help to understand the detailed crustal deformation in Japan and the regularity of earthquakes in the world.

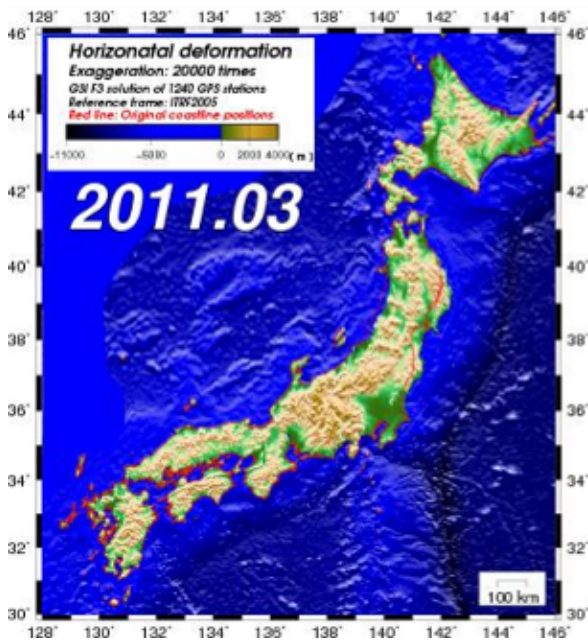
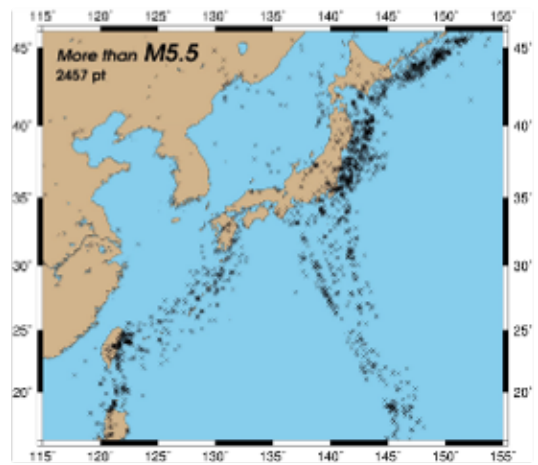
Using these animations in Junior High School education, we hope to change people's attitude toward nature, especially in relation to big earthquakes and the loss of lives, like in the 2011.3.11 Tohoku earthquake and Kumamoto earthquake, etc.

Keywords: GNSS, JAPAN, crustal deformation, GEONET, epicenter



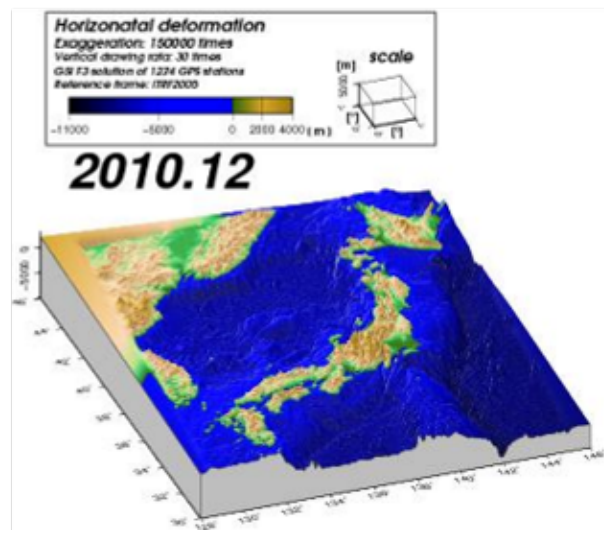
Epicenter map

Earthquake catalog by USGS



Crustal deformation map

GNSS data by GSI



Web service for active learning in Geoscience

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It gets more important to educate about the Earth's environment as the global warming and following unusual meteorological phenomena become serious problems every year. On the other hand, the recent education gives weight "active learning": not only provide new knowledge, but also make students find problems and come up with the conclusion. So, we have been building the new web service, C3 (Cross-Cutting Comparisons/; <http://www.darts.isas.jaxa.jp/C3/>). The feature of the C3 is interactive interface. Even for a beginning student can check various geoscience data because of the leading input form. It also provides free scale adjustment, group working by using URL query and pseud 3D display, which help in understanding various phenomena on Earth. In this presentation, we introduce the practice of the active learning by using C3.

Keywords: Active learning, Web service, Cross-Cutting Comparisons

Preliminary survey about understanding of the volcanic rock texture in students of faculty of education and related discussion in the earth science instruction

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In Japan, every students entered into faculty of education had learned the common curriculum through elementary and middle schools. Preliminary inspection using closed questionnaire was executed to measure the degree of understanding about earth science. 48 students from 4 of 26 student grouping in some lecture were surveyed through 8 questions. About 13 % in those students could correctly designate the groundmass in the porphyritic texture drawing. It is slightly decreased in comparison with the result of Tojo (2006) reported about 20%. This questionnaire shows the drawing of thin section image with the caption of “This is a image of andesite section. Paint all the area of groundmass in this image” . The groundmass looks like hyalopilitic texture, and about 21.7% painted only the fine mineral grains (groundmass minerals), and it seems more analyses must be needed. “Porphyritic texture” is described as “relatively large crystals (phenocrysts) set in a finer-grained or glassy matrix” in Tomkeieff (1983), which refers Rosenbusch (1887), and almost same description was given in every science textbooks of middle school in Japan. At decline of the 19th century, petrologists already utilized polarized microscope and noticed fine grains in the groundmass texture. No data may available that how many middle schools in the present day equip the polarized microscope, or how many science teachers are good at using those microscopes. As a result, we should support increasingly the middle schools for the better practical education in petrological teaching unit.

Keywords: porphyritic texture, groundmass, questionnaire, groundmass texture

An attempt to relate magma's crystal differentiation with formation of basaltic and rhyolitic volcanic island arcs of the Izu Islands as the learning material

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1. Background and purpose

Since the Izu Islands are oceanic volcanic islands, they should originally be all basaltic volcanic island rows. Although it tends to be thought, surprisingly, Niijima, Shikinejima, and Kozushima Islands form rhyolitic volcanic island rows. And, on the east side, basaltic volcanic island rows such as Oshima, Toshima, Miyakejima, Mikurajima, Hachijojima Islands are lying, it is a seemingly strange array of two rows. Why is volcanic island row formed from rhyolite rock magma which can be at the final stage of crystal differentiation exist parallel to basaltic volcanic islands offshore. Consideration about its origin and also about the birth, growth and expansion of the typical basaltic volcanic island such as New Nishinoshima, I think, those are good educational materials to deepen understanding about magmatic "crystal differentiation" and arc formation. Based on the Izu Islands belonging to the Tokyo metropolitan's familiar area as the material, I introduce examples of practical topics on the geological educational theme like this taken up in classes. I will report a part of it.

2. Method ·Description

On the Izu Islands, it seems that it is one of the rare examples in the world as a bimodal event that both basaltic volcanic islands and rhyolitic volcanic islands exist side by side in Pacific Ocean. However, this fact is considered to be an advantageous and valuable teaching material for learning the nature of magma, the eruption style of volcano and the form of volcano.

Regarding the development mechanism of rhyolitic magma, textbooks include a schematic explanation diagram as a model. Based on the model, next two ideas could be arisen. < Draft 1 > By subsiding and sinking of the Pacific plate under the Philippine Sea Plate, magma is supposed to occur. This suggests that as the ascending path becomes longer, the elapsed time since the magma evolves becomes longer, so the crystallization differentiation progresses to the extent that the magmatic nature changes to quality following as the Basaltic material → Andesitic one → Daisitic or Rhyolitic one, as a result. < Draft 2 > By extensional force field (crack etc.) caused by collision, submergence and sinking of the Philippine Sea plate which is carrying the Izu Peninsula and the Izu Islands below the Honshu side plate, "partial melting" in the crust to occur. This another one suggests that in a part of the continental crust (partial deformation) due to some cause (pressure phenomena or temperature rise), partial melting occurs, and staying at that position but with the passage of time, granitic rich in SiO₂ % (or rhyolite quality) magma is formed and eventually appears on the sea bed surface (or on the sea level). Whether it is one of the above two theories, it seems that the elucidation has not been fully understood academically now. However, in any case, it can be said that the core part of the scenario where the magma generated by the partial melting of the plate and the crust eventually reaches the rhyolitic magma due to the crystal differentiation effect, and both can be almost the same conclusion. Therefore, I have taken up to the topic in the class, because these learning materials could make the description items like textbooks more familiar and also could utilize it. Even in the case of geological excursion to the site, it is convenient for traveling to learn by watching while easily compare the relationship between lava nature and volcanic island shape at the same time, because those islands are tied through a same route. So I often solicited applicant students and often carried out excursion in the summer season by myself.

3. Results and discussion

In the lesson based on this materials, I introduce, the main questions and issues issued from the students are as follows. The one for < Draft 1 > is that "why is not the formation of andesitic magmas visible?", next one for < Draft 2 > is that "Niijima, Shikinejima, Kozushima Islands are all on the ocean and why they can be said to be a continental crust? It is strange". The total time required for a series of learning processes is scheduled to be around 30 minutes, including group review and presentation activities. Though I insist repeatedly, correct answers are not provided. However, we learned that by relating the learning matters of "crystal differentiation" which is textual description items to our familiar area's learning-matters of Izu Islands in Tokyo, I felt that the merit of using them is great.

Keywords: magma's crystal differentiation, rhyolitic volcano, plate sinking, Izu Islands,
Niijima/Shikinejima /Kouzujima

Problems concerning the classification of igneous rocks dealt with in earth science education -A practical educational program using cumulate rocks-

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Education of earth sciences deals with the classification of the igneous rocks based on modal and chemical compositions. Plutonic rocks, however, do not necessarily represent magma composition. We propose a practical educational program for verification of classification of the igneous rocks by using ultramafic rocks of drill cores from NE Japan.

Keywords: Igneous rocks, Ultramafic rocks, Cumulate

Digital Classroom, light microscopy, mineralogy

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1. Carl Zeiss Microscopy

Digital Microscopy in a Digital World

The world we are living in is changing rapidly, as digital technology is more and more integrated into our everyday lives. Smart phones are common possessions for most, big data is shared, analysed and interpreted around the world using “Cloud” technology and people are continuously connected via the world wide web. It is therefore safe to say, that in the last 10 years, we have truly undergone a third industrial revolution; the digital revolution.

Digital technology is now revolutionising the way we educate and communicate. These digital capabilities are now being applied to Geoscience education and specifically, in this paper, for the microscopy and mineralogy education.

Optical Mineralogy Education with the ZEISS Digital Classroom

The digital classroom allows the supervisors to connect to all Primotech microscopes in the classroom. Using the Zeiss Matscope iPad application, the supervisor is able to view all the images from the microscopes at any time, giving him a comprehensive overview of the students microscopes. The supervisor has the capability to select and share anyone of the student's microscope images by projecting the image onto the screen.

A simple example of the application of this technology, may be the following scenario. A supervisor is showing his class the features characteristic of an olivine on his light microscope. Now the students will aim to recreate the steps in search for the same features that are used to distinguish an olivine. Whilst overseeing the students microscopes, using the Zeiss Matscope iPad application, the supervisor notes one of the students has an olivine which has been cut perpendicular to the c axis and is showing maximum birefringence. This student's microscopic image can be easily selected and projected on the front screen, to show the rest of the students this example. Another student may have, in plane polarised light, what appears to be an olivine with high relief, fractured texture and colourless pleochroism; the birefringence is black-grey in colour.

Both examples can be projected live from the students' microscopes and be used to provide examples of the difference in birefringence based on the orientation of the crystal relative to the crystallographic axis. This is not just a better way of sharing information but also, by involving the students in such exchanges the supervisor can invoke an element of peer-on-peer teaching and greater student engagement with what is being taught.

In addition, students have the benefits of having iPads, which can wirelessly be connected to the microscope. Typically, students within the lecture make observations with the microscope, taking notes and making sketches based on their observations. This is a time intensive process and can result in students spending more time drawing and making notes than interacting with the microscope and the samples. The Zeiss Matscope iPad application therefore allows students and supervisors to acquire and save images, so they are able to build their own library of images. With the Zeiss Matscope iPad application students have the ability to perform measurements, annotate the images or record short

videos based on their observations. Therefore, supervisors can create practical exercises, where measurements can be taken to ensure students note the relevant features and observe specific details within the sample. The Matscope iPad application thus allows the students to spend more time focused on the sample and its features and acquiring data from the samples.

Summary Remarks

The digital world we now live in provides us with a great opportunity to revolutionise our education provisions. The ZEISS Digital Classroom is one such evolution taking advantage of the digital technology available today. The capabilities of the ZEISS Digital Classroom lead the future of how optical mineralogy and microscopy education are evolving.

Experiments to "feel" Coriolis Force

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See Japanese abstract.

Keywords: Coriolis force, rotating frame of reference, geodynamics, geophysical fluid dynamics

Space Science outreach of National Space Organization Taiwan

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1. National Space Organization

Space science is one of the most popular subjects for the young students and general publics. However, the material of space science is much less than the other subjects in the elementary/junior high school textbook. Students learn the space knowledge from museum, book, movie and educational TV program. National Space Organization (NSPO, Taiwan) hold the space science camp, competition, exhibition and TV program for the young students to further realize the knowledge about space science and satellite technology. More than 3 years of space science outreach experience and results will be seen in this paper.