

## Geology to understand the megalithic religion in the Shimane Peninsula: A case program of the Kunibiki Geopark Project, Shimane University

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In recent years, it becomes popular to visit a megalith in the Izumo Province. Over 30 people participated in the short tour organized by the Kunibiki Project, Shimane University, to go on an excursion to Tateiwa Shrine, Izumo in October, 2015. There were no more shrine building, but the megalith over 12 meters high existed in the shrine area. People believe the dwelling stone of god for the megalith, which is called Ishigami or Iwakura in the Japanese culture. The stone is no more stone itself, but the symbol of animism. We will introduce herein why such large monument stones were distributed in the Shimane Peninsula.

The Shimane Peninsula is characterized by four major landmasses that display eastward *en echelon* arrangement from the topographical point of view. Such a feature of the Shimane Peninsula is originally related to the early to middle Miocene tectonic event, the opening of the Japan Sea and clock-wise rotation of West Honshu Island that occurred in 20-15 Ma. The geology of the Shimane peninsula is characterized in having severe deformation of sedimentary and volcanoclastic rocks, and thus it has been called as "Sinji Folded Zone" (Otuka, 1939). The tectonic termination with a north-south stress is about 11 Ma. Tectonic duration of the Shinji Folded Zone would be over 4-6 million years, if we regard the opening event of the Japan Sea was stopped at 17 Ma or 15 Ma. We are able to find several large faults such as the Shinji and Taisha Folds that joined in this early to middle Miocene tectonic movement. Therefore, it is clear that the large stone monuments, mostly consisting of rhyolite, are closely related to the formation of the Shimane Peninsula. Shearing in the adjacent rocks and slickenside on the stone surface indicate clear evidence to explain the fault-related block of the stone.

Setting aside the question whether ancient Izumo people, ~1300 years ago, knew the geology or not, they fully understood the topography of the Shimane Peninsula and its neighbors. Moreover they created the "Kunibiki-Shinwa", the story of land-pulling (Izumonokuni-Fudoki; 733). It is surprisingly enough that the story was appeared over 1000 years before the Wegener's Continental Drift Theory (1912).

Keywords: Shimane Peninsula, Kunibiki myths, megalithic religion, Continental Drift theory

## Granite of 18th to 19th century stone works in Itoigawa Geopark

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Determination of production area of stones using as historic stone works is useful for the studies on transportation condition and culture on those days. There are many stone works of 18th to 19th century in some shrines of Itoigawa Geopark. It is considered that they were made by stonemasons of Onomichi facing Seto Inland Sea, because of engraving of their name on the stone. They were brought by cargo vessel named Kitamaebune which is sailed the Japan Sea during the Edo period. These stone works are made of following two type granites.

Rock facies A: Medium grained biotite granites. They are characterized by white-colored K-feldspar and very low magnetic susceptibility showing  $3 \times 10^{-5}$ - $1 \times 10^{-3}$ SI.

Rock facies B: Medium-grained porphyritic hornblende biotite granites. They are characterized by k-feldspar phenocrysts and euhedral hornblende of about 1 cm in long axis. They contain mafic enclaves. Magnetic susceptibilities of this type of granites are  $1 \times 10^{-3}$ SI to  $5 \times 10^{-3}$ SI.

On the other hand, many evidences of quarrying work are remained in Onomichi City. Granites of such quarrying sites have similar rock facies and magnetic susceptibility to stones of Rock Facies B forming stone works in Itoigawa Geopark. Furthermore, stone works in some old temples of Onomichi City are composed of same rocks to Rock Facies B of Itoigawa area. These facts indicate that the granites of this rock facies in Itoigawa Geopark originated from Onomichi area.

However, granites corresponding to Rock Facies A in Itoigawa Geopark are not found in Onomichi area. This suggests a possibility that Onomichi flourished not only as producing center but as agglomeration area of stones.

The 18<sup>th</sup> to 19<sup>th</sup> century stone works produced by stonemasons of Onomichi in Itoigawa Geopark are composed of granites from Onomichi area and them from other area.

Keywords: granite, stone works, magnetic susceptibility

## Roles of the information by geopark in natural disaster -A Case Study of 2015 Hakone eruption

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We'll report about information dissemination by Hakone/Izu-Peninsula Geopark and its questionnaire result of 2015 small eruption in Hakone volcano.

Owakudani in Hakone volcano has been restricting due to volcanic activity since May 6, 2015. We had produced the movie to explain the state of Owakudani and had published at Aug. 6. Aerial video by multirotor was used in this movie, and explanation about volcanic activity was created from the report (July 21) by Hot Springs Research Institute of Kanagawa Prefecture were used in this movie. The movie can be viewed on Youtube and Hakone Visitor Center, is linked from the web site of Hakone and Izu Peninsula Geopark. Views on youtube is about 2700 times.

At the same time as the publication of this movie, we started questionnaire survey at Izu Peninsula Geopark web site and in the Hakone Visitor Center. Number of valid responses was 97 (65 from web site and 32 from visitor center). 99% of answerers agreed to the question "Should such information be published?" From this survey results, it was found that the demand for information about "What has happened at Owakudani?". Geopark is expected to transmit easy-to-understand information. For the information from Geopark is to be trusted, activities in time of a disaster does not occur are also important.

Keywords: Geopark, Disaster Information, Hakone volcano

Lecture of physical geography with topics of geopark for students of University of Nagasaki, southwest Japan

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Lecture of physical geography in the University of Nagasaki was prepared for first- to fourth-years students of all faculties. The lecture focused on regional geography and includes topics of geopark. The tour of Unzen Volcanic Area Global Geopark was impressive activity for student participants. Geology, geomorphology, hazard, history, vegetation, industry were explained comprehensively at five geosites. A questionnaire survey in 2015 indicated that geopark has become familiar with university students for several years and a field tour would be an useful teaching method for facilitating interest and concern on geopark . Geopark is a scheme and an actual example of a concept of regional geography.

Keywords: Unzen Volcanic Area Global Geopark, Nagasaki Prefecture, Physical geography

## Wind ripples with colored sand in a doughnut type circular wind duct

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A doughnut type transparent circular wind duct experimental apparatus (width: 30 cm, inner diameter: 200 cm, depth: 50 cm) was made newly and colored sand according to grain sizes was installed. We performed wind ripple making experiments with 6.0 m/s wind and three issues came up: i) vent shape and position have clue to wind velocity distributions, ii) grain size mixture ratio, and iii) the secondary flow leads to spatial sorting of colored sand.

Keywords: doughnut type circular wind duct, colored sand, wind ripple, secondary flow, spatial sorting, circular wind tunnel

## Important role of resident earth scientists in Geopark-In case of Making Geopark Model Route in San'in Kaigan Global Geopark

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Geoparks is a "bottom-up" or community-led program. Local people approach to recognize geological significance of each Geopark and they conserve and promote geological heritage and regional resources for science, education and tourism etc. One of the important roles of geopark activities is resident understanding of the geopark concept, territory and its features. For this purpose, it is important that local residents participate in geopark activities positively. However, in Japan, where local development has been undertaken by governmental organizations, it is difficult for local residents to take part in geopark activities. This time, we planned "Geopark Model Route" across the San'in Kaigan Geopark in cooperation with local people, to promote better understanding and communication with local people, government and academia involved in geopark activities. In a geopark, creating a tour route and map which allow visitors to explore the geosites easily is required. We have therefore prepared a "Geopark Model Route" for walking tours, sea kayaking, driving in half-day or one day, and for enjoying the feature of each area. Each map includes outlines of about twelve must-see geological spots, allowing visitors to enjoy sightseeing and learn about the San'in Kaigan Geopark.

We were able to make "Geopark Model Route" useful for local residents, by involving experienced local people in the area. By working together by local residents and researchers, scientific information could be shared among local people. However, some problems were found in its operation. The map is not used effectively in the area which has fewer visitors and no local guides. From now on, it is also necessary to accept visitor's opinions and correct continuously so that the map may come to be more effective and useful for both visitors and local residents.

Keywords: Geoparks, Community Development, resident earth scientists

## Recognition of Geoparks Shown in Data Retrievals

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A geopark has a character of "business." In particular, sustainable development and promotion through geotourisms is important. Thus, objective analysis of the business is needed. Full-fledged marketing researches by research companies has been rarely seen in the record and there are only a few studies by researchers with small-scale questionnaire surveys and interviews. Therefore, we are aiming to clarify how geoparks are recognized by using the objective data. In this paper, we try to visualize the degree and the time variation of the spread of geoparks by using the Twitter advanced search and a newspaper article database. In addition, the initial results of the analysis using the traffic big data for the movement of people associated with geoparks will be also reported. We also want to consider what context geoparks are mentioned in, by corpus analysis and morphological analysis of newspaper articles.

Keywords: geopark, geotourism, big data

## Seeking Components of Geotours Attractive to Visitors

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Geological conservation, education, and revitalization of geotourism are important issues for geopark activities. Of these, it is expected that geotourism's revitalization will bring sustainable development to the regions. Itoh et al. (2015) grasped trends and needs of tourists who were potential customers of geotourism via online surveys, and found that tourists would look for "relaxation" and "extraordinariness" in travels. In this study, we quantitatively ascertained directions of attractive geotours for general tourists who are potential customers of geotourism, using an online survey.

We used NTTCom Research Light provided by NTTCom Online Marketing Solutions for the survey, which was conducted on September 27th and 28th, 2015. We set the target respondents as 400 and collected 433 responses.

Among the respondents, 29.8% are in their 50s, and 64.0% are male. Their places of residence are mainly metropolitan areas of Tokyo, Saitama, Chiba, and Kanagawa, and prefectures with big cities such as Aichi, Osaka, and Fukuoka.

In the survey, we asked which tours respondents would like to participate in, from specific geotours at member geoparks of the Japanese Geoparks Network as well as those in general package tours from travel agents' websites, such as "Rurubu" and "Jalan". Respondents could give multiple answers. As a result, the more ordinary the tours are, such as "hot springs" and "to enjoy local cuisines," the more positive the responses. On the other hand, general geotours, such as "to take in the scenery and topography" and "to observe strata and gather fossils," are not so popular. Also, the tours "to visit historic spots" and "to visit shrines, temples, and castles" do not seem to be so popular, either. We did not observe any significant trends by age.

Therefore, we set these tours as variables to conduct principal component analysis using a variance-covariance matrix, and then performed cluster analysis using principal component points as variables (SPSS Statistics ver. 23 produced by IBM). As a result, items representing "to visit shrines, temples, and castles" and "to visit historic spots" were extracted as the first principal components and items representing nature observation such as "bird/animal watching," "botanical observation," and "mountain climbing and trekking" were extracted as the second principal components.

The respondents were sorted into four clusters, of which Cluster 3 especially had a tendency to show strong interests in both items relating to nature and those relating to history and culture. From these results, it could be suggested that expressing seamlessly themes of not only natural phenomenon but also history and culture could attract more visitors to geotours.

Keywords: Geopark, Geotourism, internet questionnaire

## Methodology for seamless geostory

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Geoparks require attractive story based on geoscience. Geostory enhances educational effects for geoconservation and geotourism, whereas the story depends primarily on scientific evidences. Geostory involves many geoscientific disciplines characterized by multi-scale historical, vertical and horizontal phenomena. Field observation in geotour might confuse visitors, because understanding of multi-scale phenomena relies on academic experiences. Geotour for public tourists should produce well-selected and arranged story targeting historical, vertical and/or horizontal phenomena. Educational geotour should produce programs on comprehensive geoscientific system to understand interrelationship among many geoscientific disciplines. Seamless geostory dramatically promotes educational effects in geotour, and improves multidisciplinary and interdisciplinary geoscience. Geoparks should prepare and propose various geostory collaborated with geoscientists.

Keywords: Geoscience, Outreach, Geopark

## ESD for Geoparks in Japan

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Relationships between ESD (Education for Sustainable Development) and Geoparks are examined in this paper. Geoparks have a marked affinity for ESD because education and sustainable development are highlighted in the concepts of geoparks, and both have strong associations with UNESCO. However, small number of papers have been written about the relationships between ESD and geoparks, and few schools in geoparks are the members of the ASPnet (UNESCO Associated Schools Project Network). Therefore, the author tries two methods to examine possibilities of our society led by multiplying ESD and geoparks. Firstly, the description contents of the Global Action Programme (GAP) on ESD were considered about cases of geoparks. GAP is intended to make a substantial contribution to the post-2015 agenda, and the follow up to the United Nations Decade of Education for Sustainable Development (2005-2014). From the "Priority Action Areas" of the GAP, many points related with organizational operations were found as areas which should be improved. Increasing member schools of the ASPnet in geoparks as hubs for practicing ESD, and setting out policies and agendas to integrate ESD into the various processes and structures of stakeholders in geoparks are the examples.

Regarding learning contents, placing great emphasis on efforts to build a sustainable society mentioned in course of study in Japan is important in geoparks, as well as having viewpoints of international cooperation, giving participatory skills to youth, and so on.

Secondly, learning contents for geoparks are examined from the viewpoints of Earth Sciences and community development. From the former, nature of familiar territory as the first stage, and understanding of the mechanism of Earth activity as the second stage have been found. From the latter, relationships between our life and nature as the first stage, and development of social skills for reaching an understanding with other stakeholders as the second stage have been found. Additionally, international understanding and cooperation through geopark would be the third stage. From the above, geoparks could be places for inspiring learners to act for realizing sustainable society if we transform organizational operations and maximize learning contents given by Earth Sciences and community development.

Keywords: Education for Sustainable Development, Geopark, UNESCO Associated Schools