

FINAL REPORT
For Japan-Korea Joint Research Project

AREA	1. Mathematics & Physics 2. Chemistry & Material Science 3. Biology 4. Informatics & Mechatronics 5. Geo-Science & Space Science 6. Medical Science 7. Humanities & Social Sciences
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1. Research Title:

Analysis of environmental changes with mid-latitude massive coral skeletons in the Korea and Tsushima Straight region

2. Term of Research: From 1 July 2009 To 30 June 2011

3. Total Budget

a. Financial Support by JSPS: Total amount: 2,400 thousand yen

1st Year 900 thousand yen 2nd Year 1,200 thousand yen

3rd Year 300 thousand yen

b. Other Financial Support : Total amount: _____ thousand yen

4. Project Organization

a. Japanese Principal Researcher	
Name	Hiroya Yamano
Institution / Department	National Institute for Environmental Studies / Center for Global Environmental Research
Position	Senior Researcher
b. Korean Principal Researcher	
Name	Kiseong Hyeong
Institution / Department	Korea Ocean Research & Development Institute
Position	Senior Research Scientist

c. List of Japanese-side Participants (Except for Principal Researcher)

Name	Institution/Department	Position
Kaoru Sugihara	National Institute for Environmental Studies / Center for Global Environmental Research	Research Associate
Tsuyoshi Watanabe	Hokkaido University / Faculty of Science	Lecturer
Michiyo Shimamura	Hokkaido University / Faculty of Science	PostDoc Fellow
Masataka Ikeda	Hokkaido University / Faculty of Science	Technician
Masataka Ikeda	Hokkaido University / Faculty of Science	Doctorcourse student
Koki Sowa	Hokkaido University / Faculty of Science	Doctor course student
Atsuko Yamazaki	Hokkaido University / Faculty of Science	Master course student
Suguru Kawamura	Hokkaido University / Faculty of Science	Assistant
Tomohisa Irino	Hokkaido University / Graduate School of Environmental Science	Professor

d. List of Korean-side Participants (Except for Principal Researcher)

Name	Institution/Department	Position
Jong-Uk Kim	Korea Ocean Research & Development Institute	Senior Research Scientist
Chanmin Yoo	Korea Ocean Research & Development Institute	Senior Research Scientist

5. Number of Exchanges during the Final Fiscal Year

a. from Japan to Korea

Name	Home Institution	Duration	Host Institution
Hiroya Yamano	National Institute for Environmental Studies	13-16 June 2011	Korea Ocean Research & Development Institute
Kaoru Sugihara	National Institute for Environmental Studies	13-16 June 2011	Korea Ocean Research & Development Institute
For Final Fiscal Year(FY2011) Total: <u> 2 </u> persons		For Final Fiscal Year(FY2011) Total: <u> 8 </u> man-days	
Numbers of Exchanges during the past fiscal years			
FY2009: Total <u> 1 </u> persons			
FY2010: Total <u> 4 </u> persons			

b. from Korea to Japan

Name	Home Institution	Duration	Host Institution
For Final Fiscal Year(FY2011) Total: <u> 0 </u> persons		For Final Fiscal Year(FY2011) Total: <u> 0 </u> persons	
Numbers of Exchanges during the past fiscal years			
FY2009: Total <u> 1 </u> persons			
FY2010: Total <u> 0 </u> persons			

6. Objective of Research

The Korea/Tsushima Strait is the major passage of the Tsushima and Korea warm currents and is the best place to monitor the effect of global climate change on Korean and Japanese marine environments. The region is situated close to the northern limit of coral distribution. The study of coral skeletons is an effective and unique tool to reconstruct high resolution (seasonal to annual) marine environmental changes. So, a collaborative research on corals across the national border of the strait is essential for the successful reconstruction of environmental changes in Korea and Japan seas.

In the previous KOSEF-JSPS collaborative project (FY2007-2009), we have made the first systematic survey for coral communities in the Korea/Tsushima Strait region, and showed abundant existence of living massive faviid corals there. An X-ray photo of one sample showed the age of ~100 years. Further, we succeeded in coring of faviid coral mounds whose radiocarbon-based ages ranged from ~4,000 to several hundred years. Preliminary analyses in this collaborative project showed the possibility of faviid corals as recorders of paleoenvironment using Sr/Ca and stable isotopes.

Here, we extend the collaborative project to analyze the collected modern and fossil corals for the reconstruction of paleo-environment at centennial and millennium time scales, respectively. To achieve this, we invite new members (Drs Irino, Kim and Yoo) to enhance paleoenvironmental point of view. For the centennial time scale, the modern faviid coral sample that lived ~100 years could show the trend for global warming and ocean acidification after the industrial revolution. For the millennium time scale, our fossil faviid coral samples could show the evolutionary trend of the Tsushima/Korea warm current and coastal waters which might have affected human settlement in the region.

Collectively, the outcomes of the collaborative project would contribute to significant advance in understanding environmental changes in the Korea/Tsushima Strait region across the national border.

7. Methodology

Three sites in Japan (Tsushima/Iki, Goto, and Koshiki-jima) were successfully co-surveyed for coral distribution in 2007 and 2008 under the collaborative project. Sample collection for paleo-environmental study was also completed in these sites. One site in Korea (Jeju) was surveyed for coral distribution to try to extend our work across

the national border of the Korea/Tsushima Strait.

This collaborative study focused mainly on geochemical analyses of faviid coral skeletons that we have collected in Tsushima and Iki. Elemental (Sr/Ca) and isotopic compositions (carbon and oxygen) were determined to reconstruct the sea surface temperature of the Korea/Tsushima Strait region using a faviid coral dated as ~2600 cal BP. These analytical results obtained from the modern corals were validated by logger and water sampling data obtained in situ, enabling their application to fossil samples. We also discussed about future collaboration to set up monitoring for future.

FY2009: We analyzed modern and fossil faviid corals collected from Iki Island. The procedure was as follows.

The modern and fossil coral cores were sliced into a 10-mm-thick slab. The slab was rinsed with Milli-Q water in an ultrasonic bath to remove remaining surface contaminants and salt and then dried in an oven at 50°C. X-ray radiographs were obtained for modern coral slab and fossil coral specimen using a SOFTEX radiographer M-60. With an aid of the acquired X-ray image, a single continuous corallite grown 146 along the major growth axis was selected from both modern and fossil coral slabs and were isolated from the slab for micro-sampling. The isolated corallites were cut perpendicular to the growth axis to 5-cm-long sticks or less to fit into a microtome. *Favia* has a large polyp size of ~ 1 cm and shows calcification progressing at slightly different rates at varying directions. To minimize the averaging effect due to mingling of adjacent structures, the corallite was then cut into quarter rounds parallel to the growth axis. The internal skeletal structures except the wall were removed with a dental drill. Each corallite stick was then buried into a Milli-Q water ice block after washing. The stick was sliced by a Bright Instrument OTF 5000 Cryostat microtome. The micro-sampling was done in a thermal constant condition maintained at -30° C. The average sampling interval was estimated to be about 140 μ m. The subsamples were freeze-dried to remove water.

Freeze-dried sub-samples were treated with 4 mM HNO₃ and rinsed 3 times with Milli-Q water, as described in Watanabe et al. (2001a), to remove potential contaminants and inorganically precipitated aragonite. Subsamples of ~1 mg were then dissolved into 20 mL of 0.5 N HNO₃ and then sample solutions were further diluted to have final calcium concentration of 5 to 10 ppm with known average concentrations of Ca and Sr in coral aragonite and approximate sample weight, to minimize a matrix effect. Concentrations of Ca and Sr were measured from the spectral lines of 407.776 and 317.933 nm, respectively, using an inductively coupled plasma optical emission spectrophotometer Perkin-Elmer Optima 3300 DV at Korea Ocean Research and Development Institute.

An internal standard with concentration of 10 ppm for Ca were prepared from JCp-1, a coral standard material provided by Geological Survey 171 of Japan, and measured after every third sample measurement. After the analyses, the results of internal standards were examined for instrumental drifting and weighing error of calibration standard.

FY2010: We continued the skeletal analysis as described above, and completed it. We held a workshop at KORDI to discuss about the results and submitted a paper.

FY2011: We co-surveyed Jeju Island and discuss about future collaboration about coral monitoring.