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岡山大学 OKAYAMA UNIVERSITY | SUSTAINABLE DEVELOPMENT GOALS

"Okayama University supports the Sustainable Development Goals"

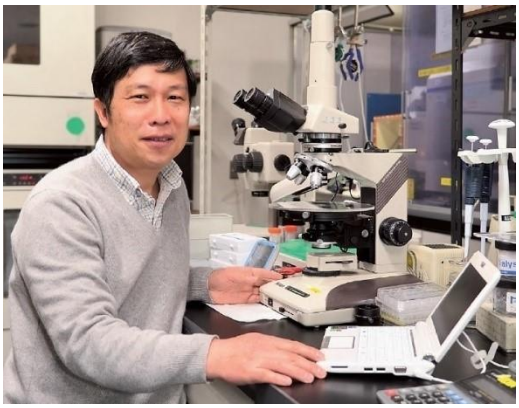
1-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530 Japan

Contents

■ Feature

Okayama University excels in research on photosynthesis
Jian-Rena Shen and colleagues open up a bright future on artificial photosynthesis

Plants and various algae use sunlight to convert carbon dioxide and water into carbohydrates and oxygen, thus providing the source of foods and oxygen for sustaining almost all life forms on the earth. Needless to say, school children learn about this process of "photosynthesis", but intriguingly, some of the detailed mechanisms of photosynthesis are still not well understood. Revealing the mechanisms of photosynthesis will not only have a huge scientific impact, but may also provide insights for the development of artificial photosynthetic systems which may contribute to mitigating the world's energy and environmental problems. Ultimately, such developments may change the daily lives of all the people in the world. With this background, there is increasing worldwide interests in demystifying the mechanisms underlying photosynthesis.



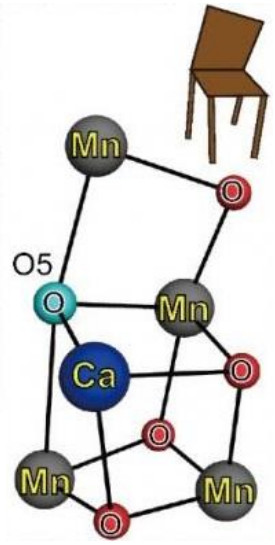
Professor Jian-Ren Shen

At Okayama University, a wide variety of cutting-edge research projects are underway, and one of the university's strengths is research on plants. Notably, Professor Jian-Ren Shen, Vice Dean of the Research Institute for Interdisciplinary Science, Okayama University, is one of the world's pioneers in the field of photosynthesis research. He and his group has solved the atomic structure of photosystem II, a huge membrane-protein complex catalyzing the light-induced water-splitting reaction, based on which, the mechanism of water-splitting and oxygen-evolving reaction was revealed. To recognize his achievements, Professor Shen was awarded the Gregori Aminoff Prize for 2020 by the Royal Swedish Academy of Sciences.

The Gregori Aminoff Prize is awarded annually to recognize researchers who have accomplished notable achievements in crystallography. Professor Shen was awarded the Prize jointly with Professor Douglas Rees of the California Institute of Technology for "their fundamental contributions to the understanding of biological redox metal clusters".

In 2009, Professor Shen's team succeeded for the first time in obtaining a well-ordered, high quality crystal of photosystem II. This enabled analysis of the long-unknown atomic structure of photosystem II. His

achievement was published in the journal Nature in 2011, and was also selected as one of the Top 10 Scientific Achievements of 2011 by the Science magazine. Since then, Professor Shen's group continued to study the mechanism of photosynthetic water-splitting by solving the intermediate state structures of photosystem II using femtosecond X-ray free electron lasers, and demonstrated the incorporation of water molecules into the Mn4CaO5-cluster, the catalyst for water-splitting in photosystem II, as well as the formation of oxygen molecules within the catalyst.



Structure of a catalyst contained in photosystem II for splitting water molecules revealed by Professor Jian-Rena Shen and his colleague. The structure looks like a distorted chair.

The structure and mechanism of the natural catalyst for water-splitting provide important clues for the development of artificial catalysts for obtaining hydrogen from water. If artificial photosynthesis were to become a reality, it would be possible to generate hydrogen energy from water and sunlight, and produce ethanol and other organic substances to be used as fuels from carbon dioxide that is the source of global warming. Thus, artificial photosynthesis is drawing much attention from around the world as an extremely important technology towards achieving the U.N. Sustainable Development Goals (SDGs), to which Okayama University is extensively committed,

The awards ceremony and commemorative lecture will take place in the academy's annual meeting on March 30 and 31, 2020 in Stockholm. Professor SHEN commented on receiving the Prize: "It is a great honor to be awarded the Gregori Aminoff Prize. My achievements so far are the results of joint researches with many co-researchers. I would like to express my sincere gratitude to my co-researchers and continue my efforts to obtain even greater research results."

In 2013, Okayama University was selected by the Program for Promoting the Enhancement of Research Universities, designed to support world-leading, excellent research projects, by the Ministry of Education, Culture, Sports, Science and Technology. A wide variety of innovative research projects are underway at the University. As a research university, Okayama will continue to promote innovative research projects and transfer the results of such projects into the society.

Further information

Professor Shen was awarded Gregori Aminoff Prize
from Royal Swedish Academy of Sciences
http://www.okayama-u.ac.jp/eng/news/index_id8822.html

The Royal Swedish Academy of Sciences website
https://www.kva.se/en/startsida

1-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530 Japan

■ News

Okayama University Integrated Reporting Forum 2019
- Release Okayama University's First Integrated Report "Pay it Forward" -

On October 26, Okayama University, celebrating the 70th anniversary of its foundation this year, released Okayama University Integrated Report 2019 - Pay it Forward. This was the first time that we issued an integrated report, which was intended to explain how "an organization creates value over time" (quoted from the International Integrated Reporting Framework; International Integrated Reporting Council [IIRC]). Featuring an organic integration of our vision and the combination of financial information and other information, our integrated report presented a review of our past achievements and results, and explained our future vision in an easy-to-understand manner.

On the same day when the report was released, we held the Okayama University Integrated Reporting Forum 2019 at the 50th Anniversary T. Kanemitsu Hall. The event attracted approximately 200 participants, including alumni and students of the university, high school students in Okayama Prefecture, those from other universities and companies, and local residents.

President MAKINO Hirofumi delivered an opening address, explaining the university's firm determination to "Pay it Forward." He declared that the university will ensure that the integrated report leads to the sharing, empathy, and cooperation with people both inside and outside the university. Moreover, while looking back on the steps taken so far by the university, he described the efforts made as of AY 2019, the first year for the university's management with emphasis on the SDGs, and released the Okayama University Vision 2.0 as a new scheme for the future.

President MAKINO explained about the integrated report

This was followed by a panel discussion with the theme "What Is Value Created by a University Managed with Emphasis on the SDGs?" Invited as panelists for the discussion were alumni of the university who are presently demonstrating the leadership at a company and a government. Together with them, a faculty member, a staff member, and a student of the university also engaged in

Managing Officer KAWATA (center)

the discussion. Managing Officer KAWATA Takashi of Shimizu Corporation referred to the university's Faculty of Engineering, which will be reformed drastically in academic year 2021, stating that the reformation would fit with the times very much. He also commented "It is sometimes hard to study at university, but I hope that the university will provide education in which students can find pleasure comfortably." Meanwhile, Vice Governor SATO Kenro of Okayama Prefecture praised the spirit of Okayama University as one of only a dozen of universities in the world to prepare an integrated report. He said that the report was considerably significant not only in terms of disclosure to the outside, but also in terms of the sharing of the awareness inside the university. In addition, Ms. ONO Sakura, a sophomore of the Faculty of Science and representative of the members of Okayama University Future Session, Ms. HAMADA Maho, a clerical staff member of the Academic Planning Section of the Academic Affairs Department, and Assistant Prof. KOYAMA Toshihiro of the Graduate School of Medicine, Dentistry and Pharmaceutical Sciences presented specific proposals regarding the management of the university, respectively from the perspective of students, university staff, and faculty members. Such proposals included providing a practice-based class in which students think of the SDGs from the point of view that they are the key player. Thus, a wide variety of opinions were exchanged in the panel discussion.

Vice Governor SATO

In the Q&A session, high school students and other audience members from other universities also advanced their opinions actively. For example, Ms. AOKI Shiho, Manager of Institutional Reseach Group of Management Planning Department, The University of Tokyo, which prepared an integrated report in 2018 for the first time in the history of the universities in Japan, stated that the concept "Pay it Forward" and Okayama University's four processes for earning trust from society by taking advantage of the university's knowledge resources were simple and persuasive. She also gave advice that if specific stakeholders were involved in the integrated report from the perspective of the cooperation with stakeholders, the report would further deepen readers' empathy.


Ms. AOKI

In conclusion, Managing Officer KAWATA Takashi and Vice Governor SATO Kenro commented from the standpoint of alumni of the university. They respectively stated with expectation "I hope Okayama University will serve as the core for the industry-government-academia cooperation" and "I hope that the university will have an impact on the world with its eyes set on Japanese aging population with a falling

birthrate." The panel discussion concluded with the review by the forum facilitator TAKAHASHI Kayo, the university's Executive Director for Planning and General Affairs and Director of the IR/IE Office, saying "We would like to carry out activities that will make impact in cooperation with all of you based not on the general catchphrase like "from the region to the world," but on the catchphrase "from Okayama to the world."

A scene of the panel discussion

Further information

Okayama University's integrated report (Japanese page)
https://www.okayama-u.ac.jp/tp/profile/annual.html

1-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530 Japan

■ News

A Side Event for the G20 Health Minister's meeting held on the theme "Life-Cycle/ Course Approaches to Promote Healthy and Active Ageing and Economic Implications"

On October 18, 2019, an international symposium was held at the 50th Anniversary Hall, Okayama University, as a side event for the G20 Okayama Health Minister's Meeting.

Opening session, which was moderated by Okayama University Vice President for Global Engagement Strategy YOKOI Atsufumi, started with a moment of silent prayer for the victims of Typhoon Hagibis, followed by the remarks by Mr. TAGUCHI Kazuho, Director, Office of Global Health Cooperation, International Affairs Division, Minister's Secretariat, Ministry of Health Labour and Welfare. Then, Okayama University President MAKINO Hirofumi introduced the University's efforts towards to SDGs.

In the following sessions, the theory for life-cycle approach and its examples from Japan and the potential positive economic impacts of healthy and active ageing were discussed. In the panel discussion, representatives from the six Asian countries discussed their issues and concerns related to population ageing and called for government's policies and programs based on life-cycle/ course approaches to population ageing while acknowledging the importance of the individual's effort towards healthy and active ageing.

The event was co-hosted by United Nations Population Fund Asia-Pacific Regional Office, Ministry of Foreign Affairs of Japan, World Health Organization, ASEM Global Ageing Center, European Observatory on Health Systems and Policies, Japan Gerontological Evaluation Study, with support from the Promotion Council for Support of the G20 Health Minister's meeting. And the event was held with cooperation of Dr. Rintaro Mori (Regional Adviser, Asia-Pacific Regional Office, UNFPA) who is alumnus of Okayama University.

A scene of the panel discussion

Further information

G20 Okayama Health Ministers' Meeting website
https://g20-meeting2019.mhlw.go.jp/health/

■ News

Student representatives attended the One Young World (OYW) 2019 Japan delegation send-off party held at the JT Art Hall Affinis, Tokyo

Two Okayama University students, MATSUMOTO Sota (Junior of the Faculty of Law) and KISHABA Tomoki (Freshman of the Medical School), have been chosen as student representatives to participate in the One Young World (OYW) 2019, which is to be held in London, the U.K. from October 22 to 25. On September 18, the two students attended a Japan delegation send-off party held at the JT Art Hall Affinis in Tokyo. Vice President for Global Engagement Strategy, Mr. Atsufumi Yokoi, who also participated in the OYW 2019, attended the party as an observer.

(from left) Vice President Yokoi, Mr.Matsumoto, Mr. Kishaba and Director of OYW Japan Committee Mr. Okubo

The party included a speech made by Ms. Lori Henderson, Executive Director at British Chamber of Commerce in Japan and Mr. OKUBO Kimihito, a representative Director of the One Young World Japan Committee, which was followed by a briefing on the OYW 2019 and OYW's history of celebrating its 10th anniversary this year. During the party, the Japan delegation members interacted with one another and boosted morale for the upcoming event.

Ms. Lori Henderson, Executive Director at British Chamber of Commerce in Japan

At the OYW 2019, Mr. Matsumoto and Mr. Kishaba are expected to discuss various topics within the framework of the UN Sustainable Development Goals, including climate change, war and peace, education, human rights, leadership and global business. They are also expected to participate in workshops, networking events and other activities related to SDGs.

Networking event at JT Hall

Commemorative photo

Further information

One Young World website
https://www.oneyoungworld.com/

OYW Okayama University website
http://www.okayama-u.ac.jp/user/ouic/japanese/international/OYW.html

岡山大学 OKAYAMA UNIVERSITY SUSTAINABLE DEVELOPMENT GOALS

"Okayama University supports the Sustainable Development Goals"

■ News

Kickoff meeting held for "Okayama University SDGs Ambassadors" to enhance public awareness of SDGs and promote SDGs

As part of our efforts to enhance public awareness of the United Nations Sustainable Development Goals (SDGs) and promote SDGs, Okayama University has newly established a system to assign individuals and organizations supporting SDGs activities as "Okayama University SDGs Ambassadors." On July 31, a kickoff meeting was held at the University's 50th Anniversary Hall, with the participation of students interested in SDGs.

The event was attended by about 140 students, including Okayama University students who were applying to SDGs Ambassadors and local high school students currently working for SDGs. With Vice Executive Director KANO Mitsunobu as the facilitator, President MAKINO Hirofumi explained the significance of promoting SDGs in today's society, which is filled with unpredictable difficulties, and the University's SDGs-related initiatives and achievements. The President also called on the students wishing to be Okayama University SDGs Ambassadors to share the University's efforts to contribute to SDGs with as many people as possible, and encourage them to work for the SDGs as an issue that directly affects themselves. The President's speech was followed by a question-and-answer session, in which participants—both Okayama University students and high school students—actively posed many questions to the President. This productive and significant meeting was closed with a commemorative photo shooting of all the participants.

The presentation of President MAKINO Hirofumi

Vice Executive Director KANO Mitsunobu

Taking full advantage of the SDGs Ambassadors system, Okayama University will continue to strive to enhance public awareness of SDGs and promote our efforts toward the achievement of the SDGs.

The picture of the ceremony

The picture of Okayama University SDGs ambassadors

Further information

OKAYAMA UNIVERSITY X SDGs website
https://sdgs.okayama-u.ac.jp/en/

岡山大学 OKAYAMA UNIVERSITY | SUSTAINABLE DEVELOPMENT GOALS

"Okayama University supports the Sustainable Development Goals"

■ Research Highlights

Novel production method of the lowest energy nuclear state Thorium-229 nuclear clock isomer

Among thousands of nuclei, thorium-229 (Th-229) has the lowest energy excited state – so called isomer. This state is the unique nuclear state whose energy is low enough to be excited optically with laser light. Laser manipulation of the state could be utilized for an ultra-precise "nuclear clock" as well as to study fundamental physics such as time variation of physical constants.

This unique feature of Th-229 has attracted interest for over 40 years. Despite of many attempts, however, direct laser excitation has not yet achieved and its basic properties still remain elusive. One of the difficulties in the study of Th-229 is that its isomer only exists throughαdecay of uranium-233, which accompanies a complicated nuclear process with large radio activity.

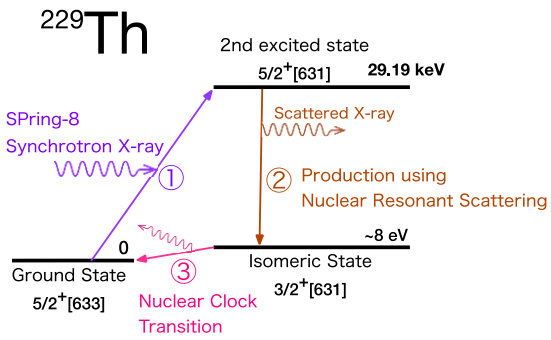


Fig.1 Energy levels of Th-229 (Ground state and excited states).
The Th-229 isomer is produced in the process of order ①-②. Using the resulting isomer, a nuclear clock transition (③) would be observed.

Here, a research team comprising of members from Okayama University, National Institute of Advanced Industrial Science and Technology (AIST), Osaka University, Kyoto university, Tohoku university, TU Wien, RIKEN, and Japan Synchrotron have developed a novel method for producing the Th-229 isomer via the second excited state near 29 keV using X-ray beams (Fig.1). The method is based on a nuclear resonant scattering technique (NRS) using the strong synchrotron X-ray facility, SPring-8.

The research team successfully observed the NRS signal and determined the energy level and the life time of the 2nd excited state of Th-229 with unprecedented accuracy (Fig.2 and Fig.3). A large amount of Th-229 isomer, predominantly decayed from the 2nd excited state, can now be produced in a controllable manner. This new method enables the production of Th-229 isomer under clean conditions without radioactivity and is expected to push forward research on Th-229 towards the realization of a "nuclear clock".

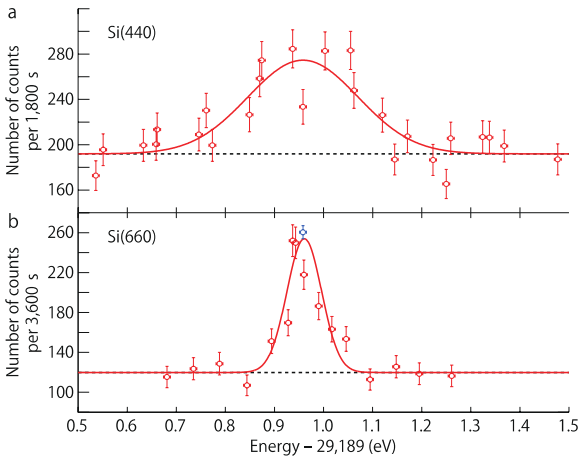


Fig. 2 Resonance curves of Th-229 NRS.
The plots showed number of events scattered by nuclei with various X-ray beam energies. Resonance peaks are clearly observed in both energy scan using different energy resolution monochromators (Si440, Si660).

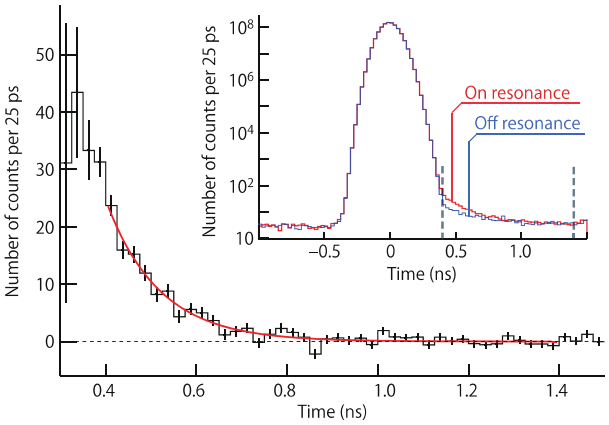


Fig. 3 Half life of 2nd excited state.
Inset shows the temporal profile of on resonance and off resonance data. The difference is plotted in the main plot showing the clear exponential decay with 82.2 ps half life.

Reference:

- Authors: Takahiko Masuda, Akihiro Yoshimi, Akira Fujieda, Hiroyuki Fujimoto, Hiromitsu Haba, Hideaki Hara, Takahiro Hiraki, Hiroyuki Kaino, Yoshitaka Kasamatsu, Shinji Kitao, Kenji Konashi, Yuki Miyamoto, Koichi Okai, Sho Okubo, Noboru Sasao, Makoto Seto, Thorsten Schumm, Yudai Shigekawa, Kenta Suzuki, Simon Stellmer, Kenji Tamasaku, Satoshi Uetake, Makoto Watanabe, Tsukasa Watanabe, Yuki Yasuda, Atsushi Yamaguchi, Yoshitaka Yoda, Takuya Yokokita, Motohiko Yoshimura & Koji Yoshimura
- Title of original paper: X-ray pumping of the 229Th nuclear clock isomer.
- Journal: Nature volume 573, pages238–242(2019)
- Digital Object Identifier (DOI) :https://doi.org/10.1038/s41586-019-1542-3
- Journal website: https://www.nature.com/articles/s41586-019-1542-3
- Affiliations: Research Institute for Interdisciplinary Science, Okayama University
  Research Institute for Interdisciplinary Science, Okayama University
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  Graduate School of Science, Osaka University
  Institute for Integrated Radiation and Nuclear Science, Kyoto University
  Institute for Materials Research, Tohoku University
  Institute for Atomic and Subatomic Physics, TU Wien
  RIKEN SPring-8 Center
  Japan Synchrotron Radiation Research Institute

岡山大学 OKAYAMA UNIVERSITY SUSTAINABLE DEVELOPMENT GOALS

“Okayama University supports the Sustainable Development Goals”

Research Highlights

Non-plume hypothesis for the genesis of passive continental margin ocean island basalts

The genesis of Ocean Island Basalt (OIB) has been debated for more than four decades, and the model that is most accepted is the whole-mantle convection theory.

However, the lack of a clear age progression within volcanic chains for the OIB at the western offshore of West Africa—one of the major OIB regions on Earth—is inconsistent with the formation of hotspot tracks by melting of stationary plumes.

Iyasu G. Belay and colleagues at Okayama University measured isotopic data on Sr, Nd, Hf, and Pb for basaltic samples from the Cameroon Volcanic Line (CVL) volcanoes and found that they were generated by a mixture of the refertilized subcontinental lithospheric mantle and the asthenospheric mantle.

To decipher the common source materials of the OIB in the western offshore of West Africa, the principal component analysis was performed using the analyzed and the compiled data from Canary Islands, Cape Verde Islands, Madeira Islands, Atlas Mountains, and CVL volcanoes.

The researchers found that the parental magmas of most of the OIB studied were generated from the same materials for CVL, and their locations were strongly controlled by the former location of the Mesozoic rift axis when the African and South American continents broke up.

The genesis of OIB at the passive continental margin could be triggered by a small-scale convection beneath the discontinuous lithosphere-asthenosphere boundary, and a plume rising from the lower mantle is not necessary for the generation of these magmas.

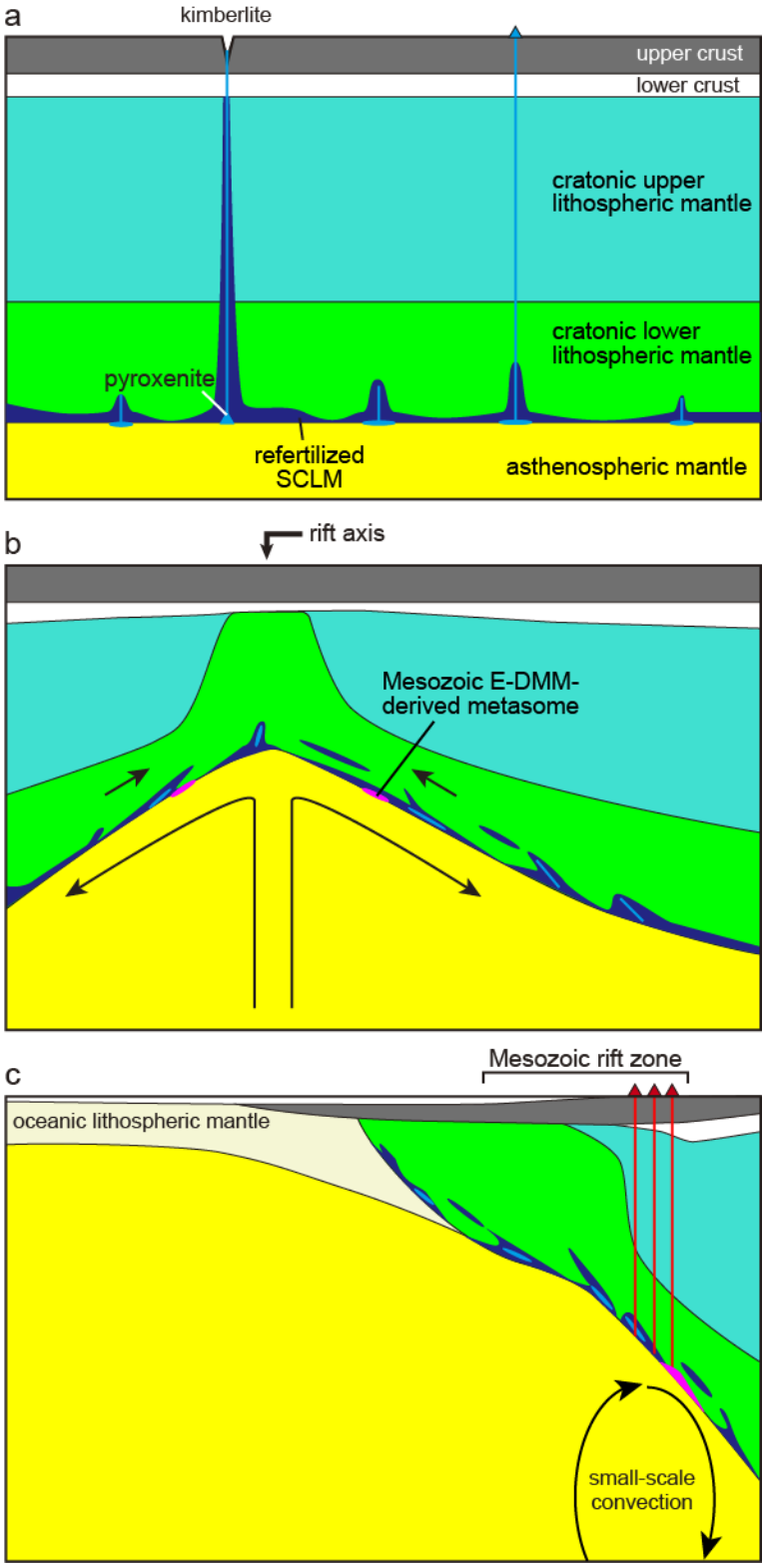

Figure caption: Schematic cross-sections illustrating the source materials and melting process of passive continental margin magmatism.

Reference:

- Authors: Iyasu G. Belay, Ryoji Tanaka, Hiroshi Kitagawa, Katsura Kobayashi & Eizo Nakamura.
- Title of original paper: Origin of ocean island basalts in the West African passive margin without mantle plume involvement.
- Journal, volume, pages and year: Nature Communications 10, 3022 (2019).
- Digital Object Identifier (DOI): 10.1038/s41467-019-10832-7
- Journal website: https://www.nature.com/articles/s41467-019-10832-7
- Affiliations: The Pheasant Memorial Laboratory, Institute for Planetary Materials, Okayama University
- Department website: Department website: http://www.misasa.okayama-u.ac.jp/eng
- Okayama University Scientific Achievement Repository: http://ousar.lib.okayama-u.ac.jp/ja/56914

■ Research Highlights

Death feigning is controlled by dopamine in a beetle

Since Edmunds, much research has focused on the behavior adopted by animals to avoid attack by enemies.

However, there have been no analysis of gene expression associated with death feigning as an animal defense behavior.

Now, Takahisa Miyatake at Okayama University, Ken Sasaki at Tamagawa University, and Yajima Shunsuke at Tokyo University of Agriculture and their colleagues have compared the gene expression profiles of strains exhibiting different behaviors, that is differing durations of death feigning, in the beetle Tribolium castaneum. Beetles artificially selected for short and long durations of death feigning for many generations were compared thoroughly by RNA sequencing.

The researchers identified 518 differentially expressed genes (DEGs) between the strains. The strains also showed divergence in unexpected gene expression regions. As expected from previous physiological studies, genes associated with the metabolic pathways of tyrosine, a precursor of dopamine, were differentially expressed between the S and L strains; these enzyme-encoding genes were expressed at higher levels in the L strain than in the S strain.

Furthermore, it was also found that several genes associated with insulin signaling were expressed at higher levels in the S strain than in the L strain. Quantitative real-time PCR analysis showed that the relative expression levels of Tchpd (encoding 4-hydroxyphenylpyruvate dioxygenase, Hpd) and Tcnat (encoding N-acetyltransferase, Nat) were significantly higher in the L strain than in the S strain.

These results suggest the influence of these enzymes on the supply of dopamine and duration of death feigning.

Figure caption: feigned death (left) and walking (right) beetles

Reference:

- Title of original paper: Transcriptomic comparison between beetle strains selected for short and long durations of death feigning
- Journal, volume, pages and year: Scientific Reports 9, 14001 (2019)
- Digital Object Identifier (DOI): doi:10.1038/s41598-019-50440-5
- Journal website: https://www.nature.com/articles/s41598-019-50440-5#Sec1
- Affiliations: Department of Graduate Sciences of Environmental and Life Sciences, Okayama University
- Okayama University Scientific Achievement Repository: http://ousar.lib.okayama-u.ac.jp/57359

■ Topics

Okayama University Dance Sport Club

Currently, Okayama University Dance Sport Club is brisk club which consists of more than 100 members, as indicated by the fact that the club has long continued to win the overall championship in the division of groups in a competition held in the Chugoku and Shikoku region.

In Dance Sport, competitive ballroom dancing, it is important for dancers to improve high-level techniques and demonstrate their features as a pair. Thus, it is normal for dancers to continue training over a long period of time without changing their partners. Mr. NOMOTO Hikaru and Ms. NAKATA Noa formed a pair when they were freshmen. This year, when they are in junior year, they won the overall victory in a competition held in the Chugoku and Shikoku region.

Asked about what they have obtained through Dance Sport, Mr. NOMOTO said that he had learned communication manners and skills, while Ms. NAKATA stated that she had developed her compassion and sensitivity for others. Dance Sport is attractive, especially in that it enables dancers to learn about the importance of establishing a relationship of trust and to grow themselves both physically and mentally. There is a growing expectation that Okayama University Dance Sport Club will continue to make a spectacular showing.

Mr. NOMOTO (left) and Ms. NAKATA

Further information

Okayama University Dance Sport Club (Japanese page)
https://www.vocavation.com/okadance/

◆Further information

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Website: https://www.okayama-u.ac.jp/index_e.html

Okayama University e-Bulletin
https://www.okayama-u.ac.jp/user/kouhou/ebulletin/

Okayama University Medical Research Updates (OU-MRU)
https://www.okayama-u.ac.jp/eng/research/ou-mru.html

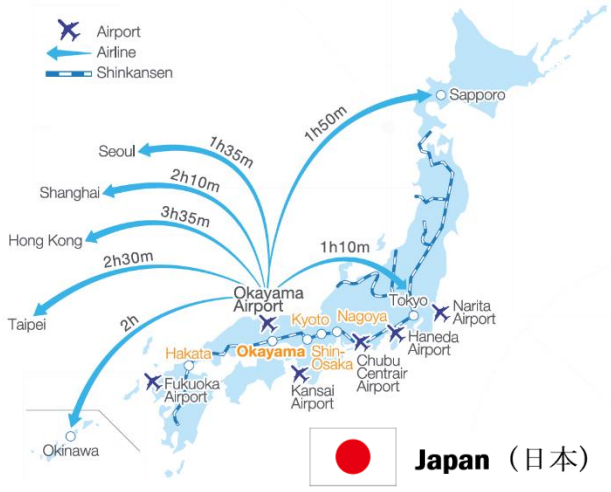
About Okayama University (YouTube 1)
https://www.youtube.com/watch?v=iDL1coqPRYI

Okayama University Image Movie (YouTube 2)
https://www.youtube.com/watch?v=KU3hOIXS5kk

◆About Okayama University

Okayama University is one of the largest comprehensive universities in Japan with roots going back to the Medical Training Place sponsored by the Lord of Okayama and established in 1870. Now with 1,300 faculty and 13,000 students, the University offers courses in specialties ranging from medicine and pharmacy to humanities and physical sciences.
Okayama University is located in the heart of Japan approximately 3 hours west of Tokyo by Shinkansen.

Hirofumi Makino, M.D., Ph.D.
President, Okayama University



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