

Celebrating First Decade of IODP Core Curation Services at Kochi Core Center, Japan

*Lallan Prasad Gupta¹, Toshio Hisamitsu¹, Toshikuni Yabuki¹, Ryo Yamaoka¹, Nan Xiao¹, Naokazu Ahagon¹, Tsuyoshi Ishikawa¹

1. Kochi Institute for Core Sample Research, Japan Agency for Marine-Earth Science and Technology

Under the auspices of the Integrated Ocean Drilling Program (IODP), Kochi Core Center (KCC) was designated as one of the 3 IODP core repositories in the world. The KCC is in-charge of curating core materials collected/to be collected from most of the Indian Ocean, west Pacific Ocean and Bering Sea. Curation of the IODP core material in the KCC began in 2007 as it started receiving core material from other two IODP core repositories. This core material was collected under the DSDP (Deep Sea Drilling Program) and ODP (Ocean Drilling Program) that preceded the IODP. With the development of various new analytical techniques and geochemical tracers, and ever-going refinement of environmental record based on traditional indices, the core material collected under the DSDP and ODP (also known as 'Legacy core') continuously attract science community. The KCC has not only maintained high curatorial standards of the IODP for providing core samples free of cost, but also added many unique services like curation of cuttings and deep frozen aliquots of cores, open access to logging equipment for core measurements, virtual core library to provide quick online access to 3-D XCT images of the cores collected by the D/V Chikyu, online summary of the cores being curated in the KCC, and up-to-date online images of working half of recently sampled cores to show status of samples available for research. A huge new reefer building was added to the KCC in August 2014 that raised the capacity of the KCC to store 250 km of core. With its current stock of 121 km of the IODP cores, that has built up over last decade, and the cores to be collected under new IODP (International Ocean Discovery Program), the KCC continues to play a significant role in promoting earth and biogeosciences throughout the world.

Keywords: Marine core, Drilling Science, DSDP, ODP, IODP, KCC

沖縄伊是名海穴の海底熱水鉱床における自然ガンマ線と温度と圧力検層データの考察

Discussion on gamma ray, temperature, and pressure downhole logging data at sea-floor hydrothermal deposit in Izena Hole off-shore Okinawa

*真田 佳典¹、山田 泰広¹、北田 数也¹、野崎 達生¹、熊谷 英憲¹、石橋 純一郎²、前田 玲奈¹
、CK16-05 乗船者一同

*Yoshinori Sanada¹, Yasuhiro Yamada¹, Kazuya Kitada¹, Tatsuo Nozaki¹, Hidenori Kumagai¹, Jun-ichiro Ishibashi², Rena Maeda¹, CK16-05 on-board member

1. (国研) 海洋研究開発機構、2. 九州大学

1. Japan Agency for Marine-Earth Science and Technology, 2. Kyushu University

CK16-05 cruise was carried out to understand origin and development process of the sea-floor hydrothermal deposit in Izena Hole off-shore Okinawa on November to December in 2016. It is one of the research cruise under an umbrella of Cross-ministerial Strategic Innovation Promotion Program (SIP), "Next-generation technology for ocean resources exploration (Zipangu in the Ocean)". Natural gamma ray and temperature downhole logging data was acquired at the five wells. It is difficult to take high quality and recovery cores in hydrothermal brittle formation. The continuous natural gamma ray logging data allows us to describe continuous vertical formation profile. The temperature logging indicates potential of hydrothermal deposit activity. The pressure data does not show significant features. We compile the gamma ray, temperature, and pressure data, and discuss its geological and geophysical features.

キーワード：海底熱水鉱床、検層

Keywords: Sea-floor hydrothermal deposit, downhole logging

DCDA(Diametrical Core Deformation Analysis)の解析方法の改良とそれを用いた原位置応力の推定

Estimation of in-situ stress by a new analysis method of Diametrical Core Deformation Analysis (DCDA)

*栢本 悠大¹、林 為人^{1,2}、村田 澄彦¹、伊藤 高敏³

*Yudai Kayamoto¹, Weiren Lin^{1,2}, Sumihiko Murata¹, Takatoshi Ito³

1. 京都大学工学部地球工学科、2. 高知コア研究所、3. 東北大学流体科学研究所

1. Global Engineering, Faculty of Engineering, Kyoto University, 2. Kochi Institute for Core Sample Research, Jamstec, 3. Institute of Fluid Science, Tohoku University

原位置応力の方向と大きさを知ることは地球科学や地球工学において非常に重要なものとなっている。従来のDiametrical Core Deformation Analysis (DCDA)は、坑井に垂直な面内の最大応力と最小応力の方向とその差応力を求めることができる方法である。鉛直坑井の場合は、それらは最大水平主応力SHmaxと最小水平主応力Shminとなる。DCDAはコアリングの際の直径方向のコアの変形に基づいており、測定が容易、理論が単純、コアの非破壊試験であるといった利点を持つ方法である。しかしながら、この手法ではSHmaxとShminのそれぞれの大きさを求めることができない。そこで我々は、同じコアの直径データを使いながらも、SHmax、Shminの大きさとそれらの方向を、鉛直坑井と傾斜坑井のどちらでも求めることができる新しい解析方法を提案する。またこの新しい方法を検証するために、IODP Expedition 319で採取されたコアの直径計測データを用いてその解析を行い、原位置応力を推定した。

この新しい解析方法は、主応力が、水平面内と鉛直方向に存在するという仮定に基づいている。その仮定から、原位置応力の解放に伴うコアの直径変化を、SHmax、Shminそして鉛直応力Svの理論式で表すことができ、その式でコアの直径測定結果にフィッティングすることでSHmax、Shminの大きさとその方向を数値解析的に求めることができる。今回の研究では、南海掘削のIODP Expedition 319におけるサイトC0009の海底下深度約1540mでコアリングされた三つのコアに、この新しい解析方法を適応させて、原位置応力の方向と大きさの推定を行った。さらに、同深度においての他の測定法での原位置応力の測定結果との比較を行った。

その結果、SHmaxの方向はN140°、SHmaxとShminの大きさはそれぞれ、約65MPa、42MPa (3コアの平均)となった。得られたSHmaxの方向は、坑井のブレイクアウトから読み取られた結果と概ね一致した。そして推定したSHmaxとShminの大きさは理にかなった結果と考えられており、他の測定方法による結果と同じ応力レジームを示した。このことから、この新しい解析方法は妥当なSHmaxとShminを推定することができ、有用であるといえる。

キーワード : DCDA、掘削コア試料、主応力

Keywords: DCDA, core sample, principal stress

掘削実験

Driling experiment

*山田 泰広¹、斎藤 実篤¹、モ-キョ-¹、濱田 洋平¹、山本 由弦²、氏家 恒太郎¹

*Yasuhiro Yamada¹, Saneatsu Saito¹, Kyaw Moe¹, Yohei Hamada¹, Yuzuru Yamamoto², Kohtaro Ujiie¹

1. 海洋研究開発機構 海洋掘削科学研究開発センター、2. 海洋研究開発機構 数理科学・先端技術研究分野

1. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), R&D Center for Ocean Drilling Science (ODS),

2. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), MAT

掘削からは非常に多種多様なデータを取得することが可能であるが、そのデータを活用することによって地下で起こりつつある現象を高精度に把握することが可能になると考えられる。そこで、掘削の過程で得られる工学的なデータを処理・解析し、そこから原位置の地下情報を高精度・高解像度で抽出することを計画した。まず単純・安定的かつ低コストで試行錯誤が可能な陸上環境でのFS試験を実施し、それによってデータを精密に取得し、それらのデータの解析手法を確立する計画である。本発表では、この陸上掘削実験の現況を紹介する。

キーワード：掘削、実験

Keywords: drilling, experiments

南海トラフC0002G長期孔内観測点における孔内水圧計校正 Calibration of the borehole pressure gauges installed in the C0002G observatory in the Nankai trough

*町田 祐弥¹、荒木 英一郎¹、木村 俊則¹、Saffer Demian²

*Yuya Machida¹, Eiichiro Araki¹, Toshinori Kimura¹, Demian M Saffer²

1. 海洋研究開発機構、2. The Pennsylvania State University

1. Japan Agency for Marine-Earth Science and Technology, 2. The Pennsylvania State University

In the Nankai Trough region, several large interplate earthquakes with magnitudes of 8 have occurred repeatedly due to a subduction of the Philippine Sea Plate beneath the Eurasian Plate at a rate of 4-6 cm/year. In this area, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed a long-term borehole monitoring system (LTBMS) into the C0002G boreholes during the IODP expedition 332 in 2010 to understand a seismogenic process of large interplate earthquakes. The LTBMS incorporates four pressure sensors, a volumetric strainmeter, a tiltmeter, a geophone, a broadband seismometer, accelerometers, and a thermistor string. Among the sensors, the pressure measurements are important for detections of long-term and small crustal deformations associated with the occurrence of large earthquakes. However pressure measurements contain instrumental drifts in the sensors in addition to the pressure changes associated with crustal deformations. Therefore calibrations for the pressure sensors are indispensable.

All pressure sensors are deployed on the ROV platform of the C0002G observatory, but each pressure sensor measure different water pressure depending on its pressure port depth (0 ~ 948 mbsf). One pressure port is located on the ROV platform (seafloor), the others are distributed inside the C0002G borehole and are connected by steel hydraulic lines with valve systems. The valve systems are manually operated by ROV manipulator, and switch target pressures from the pore fluid pressure in the C0002G borehole to the pressure on the seafloor. The valve systems are used for calibrations of the pressure sensors. Changes in relative instrumental drifts are estimated using the data during recording the seafloor pressure, because all the pressure sensors measure a reference seafloor pressure.

We repeatedly calibrated the pressure sensors in the C0002G borehole in the KY14-04, the KY15-05, and the KY15-16 cruise. Because all valve system were not switched during the cruises, instrumental drifts of the two pressure sensors in the borehole were estimated relative to the seafloor pressure sensor. The relative drift rates were estimated to be -3.88 and 2.37 hPa/year, respectively.

Absolute instrumental drifts are necessary to understand long-term and small pressure change. We are developing a mobile pressure gauge to calibrate a pressure sensor on the seafloor. A target accuracy of the gauge is less than 1 hPa. The absolute instrumental drift rates of all pressure sensors in the borehole will be estimated using the data.

キーワード：長期孔内観測システム、C0002、南海トラフ、水圧計、校正
Keywords: LTBMS, C0002, Nankai trough, pressure sensors, calibration

台湾での隆起削剥と堆積場：台湾沖掘削計画の概要

Episodic tectonic uplifting / erosion and sedimentation offshore southern Taiwan, a possible target of scientific ocean drilling

*山田 泰広¹、斎藤 実篤¹、Kan-Hsi Hsiung¹、LIN Andrew Tien-Shun²、LIU Char-Shine³

*Yasuhiro Yamada¹, Saneatsu Saito¹, Hsiung Kan-Hsi¹, Andrew Tien-Shun LIN², Char-Shine LIU³

1. 海洋研究開発機構 海洋掘削科学研究開発センター、2. 国立台湾中央大学地球科学系、3. 国立台湾大学海洋研究所

1. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), R&D Center for Ocean Drilling Science (ODS),

2. Dept of Earth Sciences/Institute of Geophysics, National Central University, Taiwan, 3. Institute of Oceanography, National Taiwan University, Taiwan

Taiwan has been known as of high uplift rate and the uplifted mountain region provides huge amount of sediments that buries carbon in the surrounding oceanic basins. The uplifting process has been episodic, suggested by several evidences, and this may be associated with episodic accretion and collision process at the eastern and western margins offshore Taiwan. If the uplift is produced as a pop-up structure between these two convergent margins, strength of the two detachment zones may play a key role to determine the uplifting amount. In southern Taiwan, part of the sediments from the retro-wedge is ponded in the ~1000-m deep Southern Longitudinal Trough, a part of the deformed Luzon fore-arc basin. Off SW Taiwan, coarser-grained sediments from the pro-wedge are delivered into the South China Sea through a few canyon winding through the accretionary wedge. The study area is ideal for study links and interplay among mountain building, erosion, sedimentation and efficiency of organic carbon burial. We will introduce outline of our potential targets of offshore scientific drilling to examine such hypothesis, based on our interpretation of seismic profiles.

キーワード：台湾、IODP、隆起削剥

Keywords: Taiwan, IODP, episodic uplift

付加体先端部での断層形成過程

Initiation process of frontal thrust at accretionary prism

*山田 泰広¹、山本 由弦²、稲垣 史生¹、Verana Heuer³、諸野 祐樹²、久保 雄介²、IODP370 乗船研究者

*Yasuhiro Yamada¹, Yuzuru Yamamoto², Fumio Inagaki¹, Verana Heuer³, Yuki Morono², Yusuke Kubo², onboard IODP370

1. 海洋研究開発機構 海洋掘削科学研究開発センター、2. 海洋研究開発機構、3. プレーメン大学

1. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), R&D Center for Ocean Drilling Science (ODS),

2. Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 3. MARUM, Germany

モデル実験によって再現された付加体先端部のスラスト形成過程では、主断層形成前に多数の短寿命・小規模フラクチャーが形成されることが明らかになっている。これを実際に付加体先端部で掘削したIODP370航海で取得されたコア試料に観察されたフラクチャーと比較した結果、モデル実験で予想されたものに近いパターンが得られた。

Physical properties of the Nankai accretionary prism, off Cape Muroto: Preliminary results of IODP Expedition 370

*神谷 奈々^{1,2}、奥津 なつみ³、廣瀬 丈洋²、稲垣 史生²、Heuer Verena⁴、諸野 祐樹²、久保 雄介²
*Nana Kamiya^{1,2}, Natsumi Okutsu³, Takehiro Hirose², Fumio Inagaki², Verena Heuer⁴, Yuki Morono², Yusuke Kubo²

1. 日本大学、2. 海洋研究開発機構、3. 東京大学、4. MARUM

1. Nihon University, 2. JAMSTEC, 3. University of Tokyo, 4. MARUM

International Ocean Discovery Program (IODP) Expedition 370 was carried out to explore the limits of life in the deep seafloor biosphere at a location where temperature exceeds the known temperature maximum of microbial life ($\sim 120^{\circ}\text{C}$) at the sediment/basement interface ~ 1.2 km below the seafloor. Drilling Site C0023 is located in the vicinity of Ocean Drilling Program (ODP) Sites 808 and 1174 at the protothrust zone in the Nankai Trough off Cape Muroto at a water depth of 4776 m. Continuous physical property measurements on cores were performed to identify the occurrence of the accretionary prism and plate boundary fault and to characterize the habitat of seafloor microbial communities. In the presentation, we will report our preliminary physical properties of the Nankai accretionary prism at Site C0023.

Physical property measurements on shipboard, including moisture and density (MAD), thermal conductivity, electrical resistivity, *P*-wave velocity, natural gamma radiation, and magnetic susceptibility were carried out on core samples from 204 to 1176 mbsf under room temperature and pressure conditions. Porosities through the wedge facies (Unit II) to the upper Shikoku Basin facies (Unit III) are characterized by high variability and generally decrease from 45% to 37% in average with increasing depth. Within the lower Shikoku Basin facies (Unit IV), porosities continue to decrease with depth to 33% at the top of the décollement zone at ~ 760 mbsf. However, deeper than 760 mbsf, they turn to increase gradually by 5%–7% with depth to ~ 830 mbsf. This porosity increase is accompanied by a decrease in *P*-wave velocity and apparent formation factor (i.e., electrical resistivity). Deeper than ~ 830 mbsf, porosities resume a general compaction trend to the base of Unit IV and then rapidly increase within Unit V, where tuffaceous mud becomes the dominant lithology. Basaltic rocks in the basement exhibit a range of porosity between 5.5% and 25%. Similar porosity depth profiles were reported at Sites 808 and 1174 (Taira et al., 1991; Moore et al., 2001). However, in contrast to these sites, porosities at Site C0023 begin to elevate gradually within the décollement zone.

In situ temperature measurements between 189 and 408 mbsf and laboratory thermal conductivity measurements indicate a heat flow of 140 mW/m^2 . Assuming that the heat flow is purely conductive and steady state, temperatures of 86° and 120°C are projected for the top of the décollement and the bottom of the hole, respectively.

キーワード：南海、デコルマ

Keywords: Nankai, Décollement

応力測定のためのコア定方位化: IODP第370次航海 Reorientation of cored samples for stress-state analyses: IODP Expedition 370

*杉本 達洋¹、山本 裕二²、林 為人¹、山本 由弦³、廣瀬 丈洋³、神谷 奈々⁴、Heuer Verena⁵、稲垣 史生³、諸野 祐樹³、久保 雄介³、前田 玲奈³、Expedition 370 Scientists

*Tatsuhiko Sugimoto¹, Yuhji Yamamoto², Weiren Lin¹, Yuzuru Yamamoto³, Takehiro Hirose³, Nana Kamiya⁴, Verena Heuer⁵, Fumio Inagaki³, Yuki Morono³, Yusuke Kubo³, Lena Maeda³, Expedition 370 Scientists

1. 京都大学大学院工学研究科、2. 高知大学海洋コア総合研究センター、3. 海洋研究開発機構、4. 日本大学大学院総合基礎科学研究科、5. ブレーメン大学

1. Graduate School of Engineering, Kyoto University, 2. Center for Advanced Marine Core Research, Kochi University, 3. JAMSTEC, 4. Graduated School of Integrated Sciences, Nihon University, 5. University of Bremen

南海トラフではMw 8クラス以上の大地震がおおよそ100年~200年周期で繰り返し発生している。本研究では、南海トラフにおけるプレート沈み込み部分での応力状態を決定するために、IODP第370次航海において掘削されたボーリング孔 (Site C0023) から採取されたコア試料に対して非弾性ひずみ回復法 (ASR法) を適用した。ASR法によって原位置応力の方向を決定するためには、コアの定方位化が必須である。しかし第370次航海での掘削は未定方位コアリングにより行われたため、コアを定方位化する必要がある。本研究では古地磁気解析を用いた方法により掘削コアの定方位化を行った。

古地磁気測定は以下のような手順で実施した。1つの円柱状試料から約2cmの厚みを持つ円盤状の試料を切り出し、その円盤状試料を9つのサブサンプルに切り分ける。乾燥を防ぐため、サブサンプルはパラフィルムで包む。それぞれの岩石試料中の自然残留磁化 (NRM) の初生成分を抽出するため、それらに対しパススルー型超電導磁力計を用いて80mTまで段階的に消磁を行った。消磁には交流消磁を用いた。得られた消磁結果に対して、主成分解析 (Kirschvink, 1980) および大円法による解析 (McFadden and McElhinny, 1988) を行うことで古地磁気方位を決定した。NRMの初生成分は岩石形成時に獲得され、その当時の磁北方向を記録している。そのため、得られた古地磁気方位を磁北方向と一致させることで定方位化することが出来る。

15試料のうち方位決定出来たものは9試料であった。決定できなかった6サンプルに関しては、掘削の際に試料中の残留磁化が乱されたことにより、初生成分が抽出できなかったからであると考えられる。

キーワード：古地磁気、コア定方位、非弾性ひずみ回復

Keywords: Paleomagnetism, Core reorientation, Anelastic Strain Recovery

A new method for measurement of core quality using X-ray CT data of IODP Expedition 370

*藤内 智士¹、Tsang Man-Yin²、Bowden Stephen³、稲垣 史生⁴、Heuer Verena⁵、諸野 祐樹⁴、久保 雄介⁴、Expedition 370 Scientists

*Satoshi Tonai¹, Man-Yin Tsang², Stephen Bowden³, Fumio Inagaki⁴, Verena B. Heuer⁵, Yuki Morono⁴, Yusuke Kubo⁴, Expedition 370 Scientists

1. 高知大学理学部応用理学科、2. University of Toronto、3. University of Aberdeen、4. 海洋研究開発機構、5. MARUM-Center for Marine Environmental Sciences University of Bremen

1. Kochi University, 2. University of Toronto, 3. University of Aberdeen, 4. Japan Agency for Marine-Earth Science and Technology, 5. MARUM-Center for Marine Environmental Sciences University of Bremen

Geological drilling aims to obtain high-quality cores for various purposes, such as the studies of mineralogy, physical properties and subsurface biogeochemistry. It is critical to quickly evaluate the quality of the drilled cores to assess the level of recovery, decide drilling methods, identify intervals for subsampling and estimate the extent of contamination by drilling mud or seawater. X-ray computed tomography (CT) is a powerful tool which shows the distribution of materials, drilling disturbance and geological structures throughout the core in three dimensions. X-ray CT can be carried out without splitting the cores or opening core liners and hence is efficient for core evaluation and desirable for studies sensitive to contamination and disturbance. X-ray CT is generally used as a qualitative method so far. Here we introduce the Core Quality Factor (CQF) as a quantitative method for analyzing and comparing core qualities using X-ray CT data.

Each pixel in X-ray CT images gives a CT number depending on the density of the material, for example, 0 for air (unrecovered area) and 2500 for standard aluminium. The CQF method first examines a cross-sectional slice of the core section at one depth, producing a histogram of numbers of pixels against CT numbers for the slice. The major material in the slice gives a dominant CT number and produces a peak in the histogram. Pixels with CT numbers higher than a threshold (e.g. 70% of the dominant CT number) are considered 'high-quality slice'. We repeat this at intervals of 0.625 mm throughout the entire core section. Then we can calculate the CQF score which is the percentage of 'high-quality slice' among all slices in the section.

We applied the new method to the X-ray CT data at Site C0023 of IODP Expedition 370. The X-ray CT measurements were made on 598 sections from 189 to 1177 mbsf. The X-ray CT instrument on the *Chikyu* is a Discovery CT 750HD (GE Medical Systems) capable of generating thirty-two 0.625 mm thick slice images every 0.4 s, the time for one revolution of the X-ray source around the sample. The CQF scores are lower than 70% at intervals 189–430 mbsf and 1100–1177 mbsf, matching the shipboard geological observation of sandy or soupy sediments and heavy drilling disturbance at these intervals. The CQF scores are above 80% at intervals 540–630 mbsf, 710–790 mbsf, and 860–1080 mbsf. The high CQF scores representing high core quality are in line with geological description of firm sediments and minor drilling disturbance at these intervals.

キーワード : X線CT、南海トラフ

Keywords: X-ray CT, Nankai Trough

広大な海洋地殻中に存在する微生物生態系の解明

Detection of microbial life in the oceanic crust aged 13-100 million years

*鈴木 庸平¹、幸塚 麻里子¹、青 佑太郎¹、山下 誠矢¹、向井 広樹¹、光延 聖²、稲垣 史生³

*Yohey Suzuki¹, Mariko Kouduka¹, Yutaro Ao¹, Seiya Yamashita¹, Hiroki Mukai¹, Satoshi Mitsunobu², Fumio Inagaki³

1. 東京大学大学院理学系研究科 地球惑星科学専攻、2. 静岡県立大学環境科学研究所、3. 国立研究開発法人海洋研究開発機構

1. Department of Earth and Planetary Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, Japan., 2. University of Shizuoka, Institute for Environmental Sciences, 3. Japan Agency for Marine-Earth Science and Technology

Microbial life is widely distributed in extremely oligotrophic habitats. However, the extent and microbiological nature of such oligotrophic habitats are poorly constrained due to the lack of scientific knowledge of the oceanic crust, which has been estimated to be the largest but least accessible microbial habitat. Several lines of evidence previously suggest that seafloor microbial life exists within young ocean crusts on the flanks of mid-ocean ridge systems where fluid circulation is thermally driven. As the oceanic crust is aged, the deposition of sediment cover and the heat loss appear to dramatically alter the physicochemical properties of the oceanic crust after 10–15 Myr. Despite the fact that the oceanic crust older than 10 Ma covers >50% of Earth's lithosphere, microbial life in the vast crustal habitat has been poorly explored mainly due to microbial contamination from drilling fluid made from surface seawater. 13.5–100 Ma basaltic rocks in the oceanic crust distributed with South Pacific Gyre were explored through Integrated Ocean Drilling Project Expedition 329, where primary productivity in the surface seawater is exceedingly low. By undertaking the routine evaluation of microbiological contamination with fluorescent microspheres added to drilling fluid, 11 out of 15 core samples were found to be undetectable for fluorescent microspheres from the core interior. 16S rRNA-based molecular phylogenetic analysis was conducted by pyrosequencing of the 15 core samples, drilling fluid samples and a negative control from the laboratory manipulation was conducted. As a result, pyrosequencing was successful for five core samples undetected for microsphere contamination, one contaminated core sample and one drilling fluid sample and the laboratory control. After carefully excluding contamination sequences, 92–370 sequences and 18–134 operational taxonomic units (OTUs) based on >97% similarity were obtained from the five core samples and subjected to further phylogenetic affiliation. Microbial community structures were shifted in shallow pillow lavas thinly covered with oxygenated sediments from the ϵ -proteobacterial dominance at 13.5 Ma and the β -proteobacterial dominance at 33.5-Ma, which is also represented by the inferred metabolic shift from chemoautotrophy to heterotrophy. In the ~100-Ma lava flows, methanotrophy in basaltic rocks with fractures filled with secondary minerals was indicated by the phylogenetic relationship to known methane-oxidizing bacteria and archaea. Although more research is needed to clarify the biomass, biodiversity and metabolic activities of microbial life in the upper oceanic crust, microbial communities revealed in this study might be widely distributed and playing important roles in the global carbon cycling in previously unrecognized pathways.

IODP Expedition 361 –Southern African Climates and Agulhas LGM Density Profile

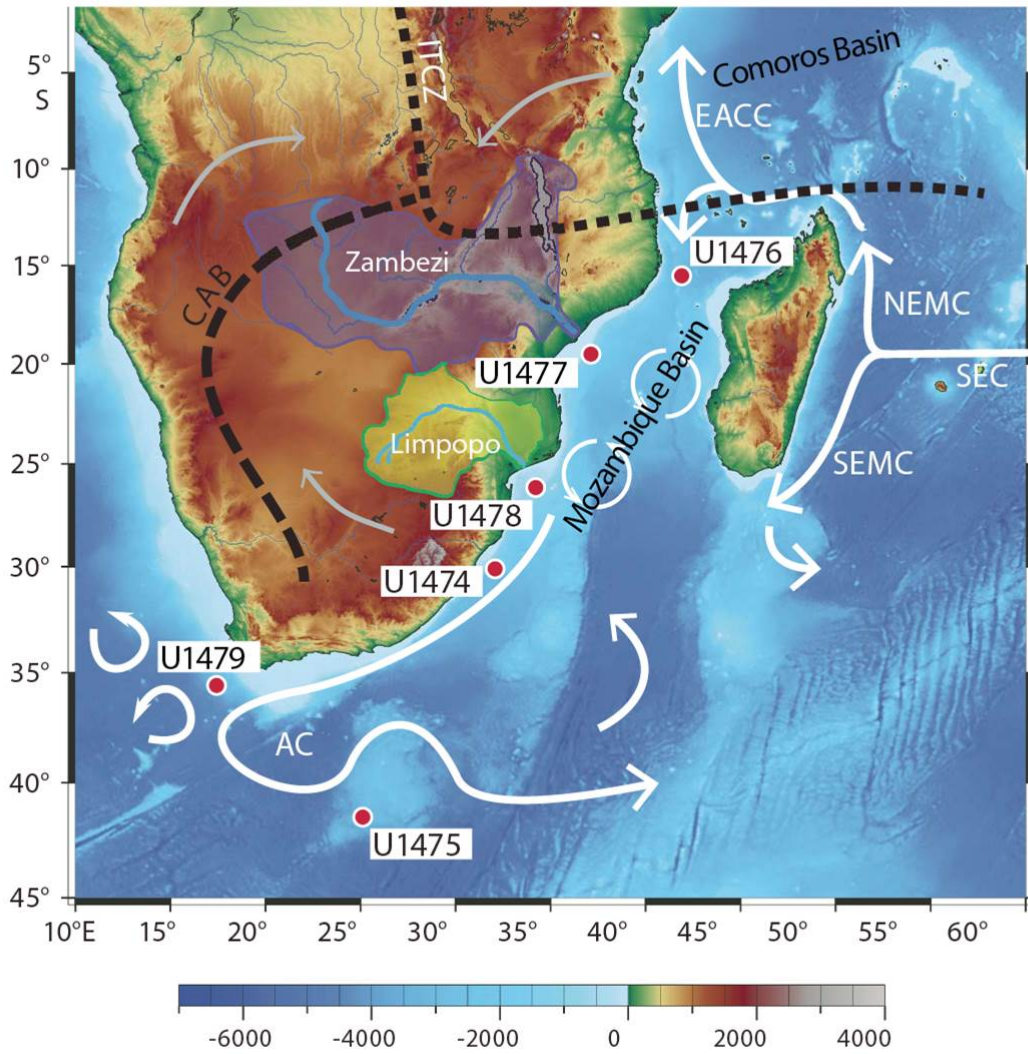
*Francisco J Jimenez-Espejo¹, Masako Yamane², Kaoru Kubota³, Ian R Hall⁴, Sidney R Hemming⁵, Leah J LeVay⁶, IODP Expedition 318 Scientists

1. Depart. Biogeochemistry, JAMSTEC, Japan, 2. Atmosphere and Ocean Research Inst., Univ. of Tokyo, Japan , 3. Kochi Inst. for Core Sample Res., JAMSTEC, Japan, 4. School of Earth and Ocean Sci., Cardiff Univ., UK, 5. Lamont-Doherty Earth Obs., Columbia Univ., USA , 6. International Ocean Discovery Program, Texas A&M, USA

The Agulhas Current constitutes the largest western boundary current system in the Southern Hemisphere and is a key component of the global oceanic thermohaline circulation. IODP Expedition 361 (January-March 2016) was planned to reveal the sensitivity of the Agulhas Current to climate changes over the past ~5 million years, to determine the dynamics of the Indian-Atlantic gateway, and to examine the connection between the Agulhas leakage and the Atlantic Meridional Overturning Circulation. Other scientific objectives included evaluation of the effect of the Agulhas Current on African terrestrial climates (especially rainfall patterns and river runoff) and potential linkages to hominid evolution. Additionally, Ancillary Project Letter aimed at high-resolution sediment-pore fluid sampling in order to constrain deep ocean temperature and salinities during the last glacial maximum was completed.

During the IODP Exp. 361, six sites (Site U1474 –U1479) were drilled and 5,175 m of sediment core was recovered (average recovery 102 %), spanning the time-interval between ~0.13 and 7 million years. Initial results of chronostratigraphic and paleoenvironmental information of both shipboard and post-cruise measurements by IODP Exp. 361 will be presented.

Keywords: IODP Exp. 361, Agulhas Current , Southern Africa Climates



南太平洋環流域の堆積物に含まれる微小金属粒の鉱物学的・地球化学的特徴について (IODP Exp. 329)

Mineralogical and geochemical characteristics of micro-mineral particles in the South Pacific Gyre sediment (IODP Exp. 329)

*浦本 豪一郎^{1,2}、諸野 祐樹¹、富岡 尚敬¹、若木 重行¹、和穎 朗太³、上杉 建太郎⁴、竹内 晃久⁴、星野 真人⁴、鈴木 芳生^{4,5}、光延 聖⁶、菅 大暉⁷、宮本 千尋⁵、高橋 嘉夫⁵、稲垣 史生¹

*Uramoto Go-Ichiro^{1,2}, Yuki Morono¹, Naotaka Tomioka¹, Shigeyuki Wakaki¹, Rota Wagai³, Kentaro Uesugi⁴, Akihisa Takeuchi⁴, Masato Hoshino⁴, Yoshio Suzuki^{4,5}, Satoshi Mitsunobu⁶, Hiroki Suga⁷, Chihiro Miyamoto⁵, Yoshio Takahashi⁵, Fumio Inagaki¹

1. 海洋研究開発機構、2. 高知大学、3. 農業・食品産業技術総合研究機構、4. 高輝度光科学研究センター、5. 東京大学、6. 愛媛大学、7. 広島大学

1. Japan Agency for Marine-Earth Science and Technology, 2. Kochi University, 3. National Agriculture and Food Research Organization, 4. Japan Synchrotron Radiation Research Institute, 5. University of Tokyo, 6. Ehime University, 7. Hiroshima University

Ferromanganese minerals widely occur on the seafloor of abyssal plains as nodules consisting of manganese, iron and various trace metal elements. Accumulation and dissolution of the vast mineral deposits play important roles in the global element cycle. However, no clear picture has yet emerged as to the nature of these mineral deposits in deep seafloor oxic sediments. During the Integrated Ocean Drilling Program (IODP) Expedition 329, we drilled the entire sedimentary sequence at 6 sites in the ultra-oligotrophic region of the South Pacific Gyre (SPG), where dissolved O₂ and aerobic microbial communities are present from the seafloor to the sediment-basement interface [1]. We observed abundant micrometer-scale particles of ferromanganese minerals (Mn-microparticles) in oxic pelagic clay sediments of the SPG over 100 million years. Three-dimensional micro-texture and elemental composition analyses using mass-spectrometric, flow cytometry and synchrotron-based approaches revealed that most Mn-microparticles are poorly crystalline ferromanganese minerals that consist of various trace metals and carbon species, indicating that Mn-microparticles are possibly derived from the past hydrothermal activity and widespread buried in the open-ocean gyre.

[1] D' Hondt et al., Presence of oxygen and aerobic communities from seafloor to basement in deep-sea sediment. *Nature Geosciences*, 8(4), 299-304, 2015.

キーワード：微小鉱物粒、遠洋性粘土、南太平洋環流域

Keywords: micro-mineral particle, pelagic clay, South Pacific Gyre

High-resolution Petrophysical, Geophysical & Chemical Properties Characterization across Crustal-Mantle Transition in Oman

*KYAW MOE¹, Yasuhiro Yamada, Saneatsu Saito, Kazuya Shiraishi

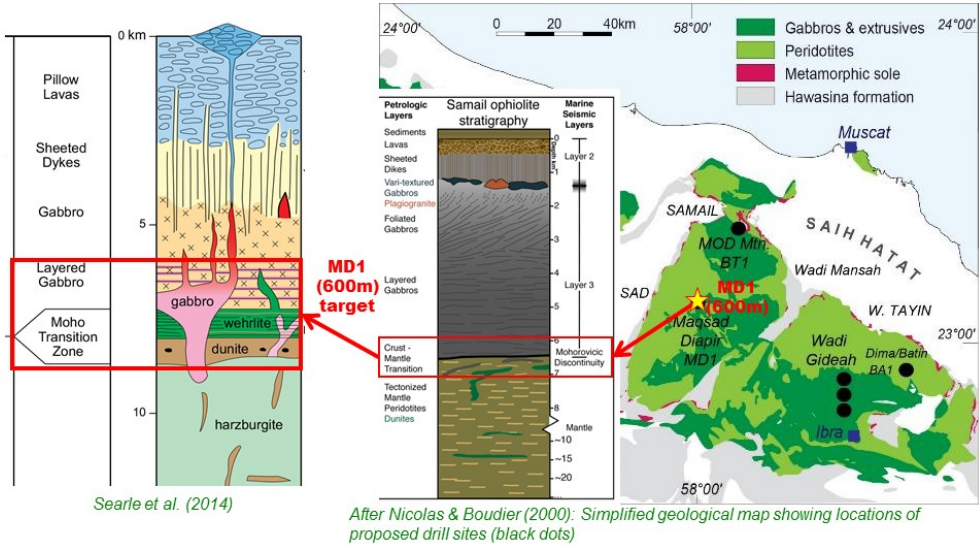
1. Japan Agency for Marine-Earth Science and Technology, Center for Ocean Drilling Science

To clarify the actual condition of the Mohole discontinuity which was first identified in 1909 as step in the velocity of the seismic wave, it is necessary to drill and sample across crustal-mantle transition and that was original idea of the scientific ocean drilling more than four decades ago. This study is aiming to maximize the understanding on the petrophysical, geophysical and chemical nature across crustal-mantle transition, and to support in realistic planning for D/V Chikyu drilling and sampling fresh mantle in the future.

Since the full proposal approved in 2014 and overcoming some delays, Oman drilling operations began in early December, 2016 in the Samail Ophiolite, the largest and best-exposed section of oceanic crust and upper mantle in the World. Among several sites to drill, core, log and experiment, this study targets at the crustal-mantle transition site to collect as much data and sample as possible. Hence, two wells are planned to drill up to 600 m where slim well is for the high quality coring and slim wireline logging, and rotary well is for conventional logging with most advanced tools in the industry. In addition to the scientific core measurements onboard Chikyu, core scratch test will carry out to collect continuous high resolution rock strength (UCS), wireline logging will take various petrophysical measurements from slim logging tools and density-porosity, resistivity image, sonic velocity and various element-mineralogy data from the most advanced logging tool from industry.

As part of the “drilling informatics science” that Center for Ocean Drilling Science is working for three years, all geological samples and petrophysical, chemical and geophysical logging data are planned to process, analyze and integrate to achieve world's first high-resolution petrophysical and chemical properties across the Mohole transition.

Keywords: Oman drilling, Mohole, Drilling Informatics



小笠原前弧で採取された前弧玄武岩・ボニナイトの岩石物性と化学組成 Physical properties and chemical compositions of fore-arc basalt and boninite in Bonin forearc recovered by IODP Expedition 352

*本多 睦美¹、道林 克禎¹、藤井 昌和⁶、針金 由美子²、山本 由弦³、神谷 奈々⁴、柵山 徹也⁵

*Mutsumi Honda¹, Katsuyoshi Michibayashi¹, Masakazu Fujii⁶, Yumiko Harigane², Yuzuru Yamamoto³, Nana Kamiya⁴, Tetsuya Sakuyama⁵

1. 静岡大学大学院総合科学技術研究科、2. 産業技術総合研究所、3. 海洋研究開発機構、4. 日本大学大学院総合基礎科学研究科、5. 大阪市立大学大学院理学研究科、6. 国立極地研究所 / 総合研究大学院大学

1. Shizuoka University, 2. AIST, 3. JAMSTEC, 4. Nihon University, 5. Osaka City University, 6. National Institute of Polar Research and SOKENDAI

日本の南東には、代表的な海洋性島弧である伊豆一小笠原一マリアナ弧 (IBM弧) が形成されている。IBMプロジェクトは、IBM弧における研究を通して島弧進化の総合的理解と大陸地殻成因の解明を目的としたプロジェクトである。その一環として、国際深海科学掘削計画第352次研究航海 (IODP Expedition 352) が行われ、小笠原海溝前弧域で4か所を掘削した (Reagan et al., 2015, IODP)。海溝側のより深い2か所 (U1440, U1441) では前弧玄武岩および関連した岩石が採取され、島弧側のより浅い2か所 (U1439, U1442) ではボニナイトおよび関連した岩石が採取された (Reagan et al., 2015, IODP; Reagan et al., 2017, Int. Geol. Rev.)。

海洋地殻の火山岩は地震波速度構造の第2層に相当する。弾性波速度は、岩石の岩質、空隙率、流体飽和度、温度および圧力に依存する。本研究では、P波速度と岩質および空隙率との関係を検討することとした。そのため、P波速度の測定は強制湿潤させた火山岩試料について常温常圧下で行った。また、浮力法による密度および空隙率の測定、初磁化率の測定、全岩化学組成の測定を行った。

前弧玄武岩グループ (U1440, U1441) の密度は2.13~2.90 g/cm³、空隙率は5.2~35.6%、P波速度は3.0~5.5 km/sであった。ボニナイトグループ (U1439, U1442) の密度は1.98~2.67 g/cm³、空隙率は7.0~37.9%、P波速度は3.1~5.4 km/sであった。採取地点と物性値を比較すると、前弧玄武岩グループの密度はボニナイトグループよりやや高い傾向がみられたが、空隙率やP波速度の範囲に違いはみられなかった。P波速度と空隙率を比べると負の相関がみられた。また、P波速度と密度との間には正の相関があり、空隙を差し引いて求めた粒子密度とP波速度に相関関係はみられなかった。空隙を充填した水や空気を透過する弾性波速度は、構成鉱物を透過する弾性波速度よりも遅いので、空隙の量が速度低下の原因と考えられる。

初磁化率について、前弧玄武岩グループでは $0.4 \sim 2 \times 10^{-2} \text{ m}^3/\text{kg}$ 、ボニナイトグループでは $0.01 \sim 2 \times 10^{-2} \text{ m}^3/\text{kg}$ を示した。ボニナイトは初磁化率が高く前弧玄武岩相当であるグループ ($0.2 \sim 2 \times 10^{-2} \text{ m}^3/\text{kg}$) と低いグループ ($0.01 \sim 0.7 \times 10^{-2} \text{ m}^3/\text{kg}$) に分かれるバイモーダルな分布を示した。さらに、この初磁化率グループをP波速度対密度の関係に当てはめると、それぞれのグループごとにP波速度と密度の正の相関がみられ、その傾きはほぼ等しかった。P波速度の範囲は同じだが、初磁化率の高いグループがより密度が高い傾向を示した。

全岩化学組成分析は変質部を除かずに測定した。その結果、前弧玄武岩グループのSiO₂は53.6~46.7 wt%、FeO*は13.2~8.1 wt%、K₂Oは4.0~0.1 wt%だった。ボニナイトグループのSiO₂は62.4~43.8 wt%、FeO*は9.0~4.6 wt%、K₂Oは3.3~0.1 wt%だった。初磁化率の高いグループと低いグループにおいて、FeO*値の大きな違いはみられなかった。また、比較的高いK₂O値がみられた。変質による沸石や粘土鉱物などの二次鉱物が含まれていることが考えられる。さらに、高いK₂O値をもつ試料はP波速度が遅い傾向がみられた。変質による速度低下があると考えられる。

キーワード：伊豆一小笠原一マリアナ、掘削、ボニナイト、P波速度、帯磁率

Keywords: Izu-Bonin-Mariana, drilling, boninite, velocity, magnetic susceptibility

北部九州ーパラオ海嶺における反射法地震探査の概要： IODPプロポーザルのための事前調査航海KH-16-6

Preliminary results of multichannel seismic reflection survey in the northern Kyushu-Palau Ridge: Site survey cruise (KH-16-6 Leg 2) for IODP proposal

*池原 実¹、山下 幹也²、岡崎 裕典³

*Minoru Ikehara¹, Mikiya Yamashita², Yusuke Okazaki³

1. 高知大学海洋コア総合研究センター、2. 海洋研究開発機構地震津波海域観測研究開発センター、3. 九州大学

1. Center for Advanced Marine Core Research, Kochi University, 2. Research and Development Center for Earthquake and Tsunami, JAMSTEC, 3. Kyushu University

北部九州ーパラオ海嶺において、IODPプロポーザルのための事前調査航海（白鳳丸KH-16-6）を実施し、反射法地震探査を行った。北部九州ーパラオ海嶺では、1971年に実施されたDSDP Leg31によって296地点から約450mのコアが掘削されている。DSDP 296では中新世以降の堆積物が回収されているが、コアの回収率は約60%であった。また、当時の掘削システムではコアとコアの間に必ずギャップができるため、連続的な堆積物が回収されていない。よって、DSDP 296は低時間解像度で長期的な古海洋変動の復元を行う研究には利用可能であるが、キーとなる時代、例えば最終間氷期最盛期、酸素同位体ステージ（MIS）11やMIS 31などの間氷期、鮮新世温暖期、中新世中期高温期（MMCO）などにおける高解像度環境復元は不可能である。そこで、北太平洋における表層および中深層の海洋大循環を高精度かつ高時間解像度で復元し、パナマ地峡などのゲートウェイの開閉イベントや全球気候変動との相互作用の実態を解明することを主目的としたIODPプロポーザルを準備している。その事前調査の一環として実施した新青丸KS-15-4次航海による海底地形探査とピストンコア採取に加え、KH-16-6次航海にて反射法地震探査を行い、DSDP 296地点を起点とする12側線におけるプロファイルを得た。DSDP 296レガシーコアによる堆積速度曲線などとの対比を含め、北部九州ーパラオ海嶺における海底下地質構造について報告する。

キーワード：九州ーパラオ海嶺、反射法地震探査、IODPプロポーザル、古海洋

Keywords: Kyushu-Palau Ridge, Multichannel seismic (MCS) reflection survey, IODP proposal, paleoceanography