Japan Geoscience Union Meeting 2013
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BPO02-P01 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

生鉱物化と古海洋代替指標の地球化学： シンポジウムの趣旨
Biocalcification and teh geochemistry of proxies

北里 洋 [1*]
Hiroshi Kitazato[1*]

[1] 独立行政法人海洋研究開発機構、海洋・極限環境生物圏領域
[1]Institute of Biogeosciences, JAMSTEC

JpGU と EGU Biogeosciences Devision が共同で行っている「生鉱物化と古海洋プロキシーの地球化学」の科学的背景とセッションの趣旨について述べる。

キーワード: 地球生命科学, 生鉱物, 地球化学, プロキシー, EGU-JpGU 共同セッション
Keywords: Biogeosciences, biomineralisation, geochemistry, proxies, EGU-JpGU Joint Session

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BPO02-P02 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Assessing the environmental impact of T?hoku tsunami off Hachinohe (NE Japan): a multidisciplinary approach.
Assessing the environmental impact of T?hoku tsunami off Hachinohe (NE Japan): a multidisciplinary approach

フォンタニエ　クリストフ[2], 豊福 高志[1*]
Christophe Fontanier[2], Takashi Toyofuku[1*]

[1] ボルドー大学, [2] 海洋研究開発機構
[1]Univeristy oif Bordeaux 1, [2]JAMSTEC

On March 11th 2011 the Japanese East coast was hit by a tsunami, which killed more than 18.000 people, caused major devastation in the coastal zone and the meltdown of 3 nuclear reactors. A magnitude 9 on the Richter scale earthquake offshore Sendai resulted in Tsunami waves reaching heights of up to 40.5 meters, which travelled 10 kilometers inland. Whereas the devastation on land is clearly visible, underwater impact is more difficult to assess. Here we present an overview of the multidisciplinary approach used to describe the benthic ecosystems off Hachinohe (NE Japan), 5 months after the T?hoku earthquake. Middle height (˜4m) of Tsunami also came to the coastal area of Shimokita Peninsula. An oceanographic cruise (cruise KT11-20? aboard R/V TANSEI MARU, AORI/JAMSTEC) took place in August 2011. An international group of Japanese, French and Dutch oceanographers, all specialists in marine ecology and marine biogeochemistry, joined this scientific mission in order to describe benthic ecosystems and fossilizing foraminiferal faunas. 4 scientific tasks were defined. The sedimentological investigation has consisted in the identification of all sedimentary evidences (physical structures and radionuclides) that illustrate hydrosedimentary processes at the seafloor (erosion, sediment gravity flow deposition). The geochemical investigation has consisted in the optimal characterization of geochemical conditions prevailing in the benthic ecosystems. A special attention has been addressed to the dissolved species (oxygen, nitrate…) in the bottom and pore water, the organics buried in the sediment and the nature of solid phases. The faunal investigation has consisted in the ecological study of benthic foraminifera (living and dead faunas). This study has given reliable information about the response of benthic life to environmental constraints related to tsunami. The future investigation will consist in the geochemical study of trace elements in the foraminiferal shells (i.e. tests). Those overall observations should enlighten scientific community on the effect of the T?hoku tsunami on marine ecosystems off Hachinohe, and on the potential resilience of benthic communities.

キーワード: 津波, 有孔虫
Keywords: foraminifera

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BPO02-P03 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Using microComputedTomography to study the impact of environmental stressors on benthic foraminifera: initial results

Using microComputedTomography to study the impact of environmental stressors on benthic foraminifera: initial results

Filipsson Helena[1], 豊福 高志 [2*], 佐々木 理 [3]
Helena Filipsson[1], Takashi Toyofuku[2*], Osamu Sasaki[3]

[1] ルンド大学, [2] 海洋研究開発機構, [3] 東北大学総合博物館
[1]Lund University, [2]JAMSTEC, [3]Tohoku University

We performed microComputedTomography (μ CT) scans of benthic foraminifera, in order to better understand how multiple environmental stressors are affecting biomineralization as well as preservation of benthic foraminifera. Both live (Cell Tracker Green labeled) and dead foraminiferal specimens from the Skagerrak and Kattegat, NE Atlantic were scanned. The samples originate from 330m and 130m of water depth, where salinity ranged between 35.2 (Skagerrak) and 34.7 (Kattegat) and dissolved oxygen content varied from full oxygenated in the Skagerrak to hypoxic conditions (<2mlO2/L) at the Kattegat station. Substantial differences were noted in test (shell) preservation and morphology between fossil and modern samples, where pre-industrial samples were less affected by dissolution processes.

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BPO02-P04 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Ecological impact of the T?hoku Tsunami on shallow-water marine biodiversity off Hachinohe (NE JAPAN)
Ecological impact of the T?hoku Tsunami on shallow-water marine biodiversity off Hachinohe (NE JAPAN)

Duros Pauline[1*]
Pauline Duros[1*]

[1] 海洋研究開発機構
[1]JAMSTEC

The 11th of March 2011, Japan was struck by one of the most powerful known earthquakes, the so-called T?hoku earthquake. This earthquake presented a magnitude of 9.0 and an epicenter located 70 kilometers east of the Oshika Peninsula of T?hoku. It triggered extremely destructive tsunami waves of up to 10 meters that struck Japanese coasts. Both earthquake and tsunami caused extensive and severe structural damage in Japan. More than 15.000 people died; 8.000 are still missing. This aim of the present study is to evaluate the post-crisis environmental health of the marine biosphere from the NE Japan. In order to assess the impact of this terrible disaster on marine ecosystems, and more precisely, to assess the impact of tsunami on coastal marine ecosystems, an oceanographic cruise occured in August 2011 and sediments off Iwate prefectures (NE JAPAN) were sampled. Living benthic foraminifera collected in theses sediments were used as bio-indicators of sedimentary disturbance. Indeed, after a sediment gravity event (e.g. turbidite) triggered for instance by an earthquake, high amount of organic and inorganic detritus may be supply by lateral advection to the ocean. There, foraminiferal faunas are characterised either by recolonisation stages occurring after physical disturbance (e.g. turbidite related to tsunami) or by equilibrium phases related to gradual organic matter focussing (e.g. eutrophication). Biotic recovery after benthic crisis consists in the dominance of opportunistic pioneer species. The foraminiferal biodiversity is low. When the resilience of an ecosystem is surpassed (after weeks, months or years), opportunistic taxa are generally replaced by highly specialised communities. Then, the foraminiferal diversity increases. In case of the T?hoku Tsunami, the inherent question is: Do benthic Foraminifera indicate environmental alteration/resilience of marine biodiversity in relation to tsunami?

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BPO02-P05 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

First-order estimate of the planktic foraminifer biomass in the modern global ocean
First-order estimate of the planktic foraminifer biomass in the modern global ocean

Movellan Aurore[1], シーベル ラルフ [1*], Howa Helene[1]
Aurore Movellan[1], Ralf Schiebel[1*], Helene Howa[1]

[1] アンジェ大学
[1]Laboratoire des Bio-Indicateurs Actuels et Fossiles (BIAF), CNRS UMR 6112 LPGN, Universite d'Angers

Planktic foraminifers are heterotrophic mesozooplankton of global marine abundance ubiquitously used in paleoecology, paleoceanography, and paleoclimate reconstruction. However, the biomass and trophic role of planktic foraminifers was largely unknown. To better understand the position of planktic foraminifers within the regional and global plankton, we have developed a new analytical method and quantified the individual and species specific planktic foraminifer biomass. With a new non-destructive protocol developed from the bicinchoninic acid (BCA) method and nano-photospectrometry, we have analysed the foraminifer protein-biomass, along with test morphometry. From additional CHN analysis, it can be assumed that protein biomass equals carbon-biomass. The foraminifer cytoplasm is exposed to the analytical reagents without breaking the test by applying an osmotic shock. The new method is quick and easy to apply, and we have so far produced a data set of the protein-biomass in function of test size of 21 planktic foraminifer species from Atlantic, Pacific, and Southern Ocean waters.

Our data include a wide range of oligotrophic to eutrophic conditions covering six orders of magnitude of assemblage biomass. Samples include symbiont bearing and symbiont-barren species from the sea surface down to 2500 m water depth. Being secondary producers with an omnivorous diet, which ranges from algae to small metazoans, planktic foraminifers are not limited to a single food source, and are assumed to occur at a balanced abundance displaying the overall marine biological productivity at a regional scale. Accordingly, the average individual planktic foraminifer protein- and carbon biomass amounts to 0.845 μg. Conversion factors between individual biomass and assemblage-biomass are calculated for test sizes between 72 and 845 μm (minimum test diameter). Assemblage-biomass data presented here include 1128 sites and water depth intervals. The regional coverage of data includes the North Atlantic, Arabian Sea, Red Sea, Caribbean, as well as literature data from the eastern and western North Pacific off Japan, and covers a wide range of oligotrophic to eutrophic waters over six orders of magnitude of planktic foraminifer assemblage-biomass (PFAB). A first order estimate of the average global planktic foraminifer biomass production (>125 μm) ranges from 8.2?32.7 Tg C yr?1 (i.e. 0.008?0.033 Gt C yr?1), and might be more than three times as high including neanic and juvenile individuals adding up to 25?100 Tg C yr?1. However, this is a first estimate of regional PFAB extrapolated to the global scale, and future estimates based on larger data sets might considerably deviate from the one presented here. This paper is supported by, and a contribution to the Marine Ecosystem Data project (MAREDAT). Data are available from http://www.pangaea.de (http://doi.pangaea.de/10.1594/PANGAEA.777386).

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BPO02-P06 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Vertical migration, nitrate uptake and denitrification: survival mechanisms of foraminifers under low DO conditions

Vertical migration, nitrate uptake and denitrification: survival mechanisms of foraminifers under low DO conditions

Koho Karolina[1*], Pina-Ochoa E[2], Geslin Emmanuelle[3], Risgaard-Petersen N[2]
Karolina Koho[1*], E Pina-Ochoa[2], Emmanuelle Geslin[3], N. Risgaard-Petersen[2]

[1]Faculty of Geosciences, Utrecht University, [2]Center for Geomicrobiology, Institute of Biological Sciences, Aarhus University, [3]Recent and Fossil Bio-Indicators, Angers University
[1]Faculty of Geosciences, Utrecht University, [2]Center for Geomicrobiology, Institute of Biological Sciences, Aarhus University, [3]Recent and Fossil Bio-Indicators, Angers University

15NO3 - isotope labelling experiments were carried out to study foraminiferal nitrate uptake strategies and the role of pseudopodial networks in nitrate uptake. Globobulimina turgida were placed below the nitrate penetration depth in homogenised sediment cores, which were subsequently incubated in artificial seawater containing the label. The physical migration of foraminifera to strata containing nitrate and oxygen was prevented by a nylon net, however, potential access to such strata by extension of pseudopods was still possible. As no 15NO3 - was found in G. turgida in the experimental cores, we concluded that foraminifera cannot extend their pseudopods for nitrate uptake through several millimetres of sediment. In stead they must physically migrate upwards closer to nitratecontaining strata. The foraminiferal migration patterns in the control cores (with no nylon net) were observed to be erratic, suggesting that individuals move in random orientations until they find favourable conditions (i.e. free nitrate or oxygen).

A second experiment showed that foraminifera actively collect nitrate in both the presence and absence of oxygen, although uptake was initiated faster if oxygen was absent from the environment. However, no systematic influence of the size of the intracellular nitrate pool on nitrate uptake was observed, as specimens containing a large range of intracellular nitrate (636-19992 pmol/cell) were measured to take up 15NO3 - at comparable rates.

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BPO02-P07 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Seawater Mg/Ca variability during the Middle Miocene Climate Optimum
Seawater Mg/Ca variability during the Middle Miocene Climate Optimum

ド・ノーイエ レナート [1*], van Dijk IEY[1], 豊福 高志 [3], Sluijs A[2], Reichart GJ[1]
Lennart Jan de Nooijer[1*], IEY van Dijk[1], Takashi Toyofuku[3], A Sluijs[2], GJ Reichart[1]

[1]NIOZ, [2] ユトレヒト大学, [3] 海洋研究開発機構
[1]Royal NIOZ, [2]Utrecht University, [3]JAMSTEC

Variability in seawater [Ca2+] and [Mg2+] over timescales >1 Ma challenges the use of foraminiferal Mg/Ca as a temperature proxy. Since temperature and seawater Mg/Ca both determine foraminiferal Mg/Ca, reconstructed temperatures need to be corrected for past seawater Mg/Ca when applied to long timescales. Currently, such corrections are based on models with a low temporal resolution and relatively large uncertainty in past seawater Mg/Ca. Moreover, when applying correction factors it is assumed that the sensitivity of the Mg/Ca-temperature calibration is not affected by seawater Mg/Ca. To quantify the combined impact of seawater Mg/Ca and temperature on foraminiferal Mg/Ca, we conducted a set of culturing experiments in which these parameters were manipulated independently. The combined effect of seawater Mg/Ca and temperature on calcite Mg/Ca in a hyaline (Elphidium crispum) and a miliolid (Quinqueloculina sp.) species was determined by laser ablation-ICP-MS.

The dependencies of calcite Mg/Ca on these two parameters for both species were used to reconstruct seawater Mg/Ca over the Middle Miocene Climatic Optimum (MMCO) from the Equatorial Pacific using IODP core 1338. Using the different Mg-incorporation mechanisms of hyaline and miliollid foraminifera reveals that seawater Mg/Ca for this interval is on average different and more variable than previous studies suggested. The accompanying deep sea temperatures for this interval are on average lower than previously reported. This new reconstruction also shows that variability in seawater Mg/Ca warrants high resolution reconstructions when correcting temperatures based on foraminiferal Mg/Ca.

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BPO02-P08 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

Seasonality in the Arabian Sea over glacial-interglacial cycles
Seasonality in the Arabian Sea over glacial-interglacial cycles

ド・ノーイエ レナート [1*], Tjallingii R[1], Brummer GJ[1], Reichart GJ[1]
Lennart Jan de Nooijer[1*], R Tjallingii[1], GJ Brummer[1], GJ Reichart[1]

[1]Royal Netherlands Institute for Sea Research
[1]Royal Netherlands Institute for Sea Research

The Indian monsoon system controls seasonal precipitation alterations over the Indian continent and upwelling of nutrient-rich waters to the surface in the northern Arabian Sea. Functioning and strength of this weather system due to climate change is one of the important issues in predicting the effects of global warming on the region ’s economy, agriculture and social welfare. The strength of the Indian monsoon system through time can be studied by changes in seawater temperature and chemistry from single-specimen analysis of planktic foraminiferal calcite. Temperature reconstructions based on many single specimens allow reconstruction of past seasonal sea water temperatures ranges and thus seasonal temperature variability. .

Here we present seawater reconstructions based on single-specimen Mg/Ca of the surface dweller Globigerinoides ruber and the deeper-living G. dutertrei of two sediment cores of the western equatorial Indian Ocean off Tanzania and the northern Arabian Sea. From both cores, specimens are analyzed for calcitic Mg/Ca using laser ablation-ICP-MS of time-intervals representing the Holocene optimum, Last Glacial Maximum, Marine Isotope Stage 4, MIS 5 and MIS6. The resulting temperature ranges allow reconstruction of variability in the strength of the Indian Monsoon as well as cross-equatorial heat transport during glacials and interglacials.

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BPO02-P09 会場:コンベンションホール 時間:5 月 21 日 18:15-19:30

アカガイの微細構造形成の水温飼育実験
Temperature-controlled experiments for the shell microstructural formation of S. broughtonii (Mollusca: Bivalvia)

西田 梢 [1*], 鈴木 淳 [2], 磯野良介 [3], 渡邉裕介 [3], 野尻 幸宏 [4], 森千晴 [1], 佐藤瑞穂 [2], 佐藤圭 [1], 佐々木猛智 [1]
Kozue Nishida[1*], Atsushi Suzuki[2], Ryosuke Isono[3], Yusuke Watanabe[3], Yukihiro Nojiri[4], Chiharu Mori[1], Mizuho Sato[2], Kei Sato[1], Takenori Sasaki[1]

[1] 東京大学大学院理学系研究科, [2] 産総研, [3] 海洋生物研究所, [4] 国立環境研
[1]The University of Tokyo, [2]AIST, [3]MERI, [4]National Institute for Environmental Studies

A temperature experiment was performed to corroborate the thermal control of microstructural formation, and the cultured specimens were found to exhibit differences in shell formation by temperature. It has been suggested that the cyclical changes in the shell microstructures of *S. broughtonii* might be affected by temperature seasonality based on a study of field specimens (Nishida et al., 2012). This is the first report of temperature experiments in relation to the microstructural formation of shells. Additionally, this experiment contributes to the reconstruction of the paleoenvironments using shell microstructures and to our understanding of the mechanisms of shell microstructural formation.

We cultured specimens of *S. broughtonii* under five different temperature conditions at the Demonstration Laboratory, Marine Ecology Research Institute (MERI) in Kashiwazaki City, Niigata Prefecture, Japan. The investigated temperatures were 13 C, 17 C, 21 C, 25 C, and 29 C, and the specimens were cultured for approximately 58 days. We placed 5 aquariums (12 liters) in the laboratory with 5-7 specimens placed in each aquarium. We removed part of the marginal periostracum to determine shell growth during the experiment.

The shell sizes and increment of the shell deposition during the experiment show that the most rapid growth occurs at 17 C. Based on the d18O data, the specimens at 17 C, 21 C, 25 C, and 29 C formed shell material at each temperature condition. The thickness of the composite prismatic structure increases at higher water temperatures, and this trend is same as that of the field specimens. The specimen at 17 C showed the sharpest edge in the marginal part of the outer layer in comparison to the specimens cultivated at 21 C, 25 C, and 29 C. Accounting for the outer layer, the area of the composite prismatic structure increases as the water temperature is reduced. The growth increment of the crossed lamellar structure was relatively constant, whereas that of the composite prismatic structure increased rapidly as the thickness of the composite prismatic structure increased at cooler temperatures. This finding suggests that the optimum temperature for *S. broughtonii* growth as determined experimentally is consistent with the shell growth in the temperate area and that the formation of the composite prismatic structure increases the shell growth, especially the expansion of the growth increments in the outermost part of the outer layer.

Keywords: Bivalve, shell microstructure, Stable oxygen isotopes, temperature experiment, shell growth

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東地中海クレタ島沖の海底塩湖堆積物の地球化学（KH06-04 航海）：リンの形態別存在量から探る過去 5〜21 万年前の酸化還元状態
Phosphorus speciation analysis of sediments in the hypersaline Meedee Lake, off Crete Island, Eastern Mediterranean Sea

山口 友理恵 [1*], 山口 耕生 [2], 村山 雅史 [3], 池原 実 [3]
Yurie Yamaguchi[1*], Kosei E. Yamaguchi[2], Masafumi MURAYAMA[3], Minoru Ikehara[3]

[1] 東邦大学理学研究科化学専攻, [2] 東邦大学理学研究科化学専攻、Nasa Astrobiology Institute, [3] 高知大学海洋コア総合研究センター
[1]Department of Chemistry, Graduate School of Science,Toho University, [2]Department of Chemistry, Graduate School of Science,Toho University , Nasa Astrobiology Institute, [3]Center for Advanced Marine Core Research , Kochi University

現代の地中海には、約 5.6-5.3Ma の Messinian Salinity Crisis 時に堆積した海底下の岩塩層からしみ出した高塩分濃度の流体が起源となる、海底塩水湖が複数存在する。学術研究船白鳳丸の KH06-04 航海で採取された東地中海クレタ島沖の海底塩水湖（Meedee Lake; 塩分濃度は海水の 10 倍）堆積物は、明・暗色層が数 cm〜数 10cm 間隔で互層する。この色調変化は、有孔虫種の解析等により、当時の堆積環境の酸化還元の変遷に起因するとされる（泉谷, 2010）。本研究では、この酸化還元状態の変化の定量化を行うため、リンの存在形態別の定量分析を行った。海洋中では主にリン酸として存在するリンは、（微）生物活動・酸化還元状態・続性作用の影響を受けて、堆積物中ではアパタイトを形成したり、鉄酸化物に吸着したり、有機態として保存される。逆に、堆積物中のリンの存在形態別の良は、堆積環境の推定を行う手がかりとなる。Ruttenberg (1992) と Schenau and de Lange (2000) を改良した橋本 (2010) の方法に従って、KH06-04 堆積物の粉末試料中のリンの 5 種の存在形態別（［1］吸着性リン＋生体由来アパタイト＋炭酸塩結合態リン、［2］鉄結合態リン、［3］炭酸フッ素アパタイト (CFAP)、［4］砕屑性リン (FAP)、［5］有機態リンの連続抽出分析を行った。リン濃度の測定はモリブデン青法により吸光光度計で行った。

形態別では、CFAP 相に含まれるリン濃度が他の形態と比較し大きく、明色層中では全体の約 76%、暗色層中では全体の約 67%であった。有機態リン・砕屑性リンの濃度は予想値よりも遥かに小さかった。

明/暗色層でのリン濃度差が最も大きい形態は、鉄結合態リンであり、明色を示すほど、鉄結合態リン濃度は低くなる傾向にあった。これは、リン酸は酸化的環境では鉄酸化物の表面に吸着するが、還元的環境では鉄酸化物の還元的溶解により表面吸着していたリン酸が海水中に放出されたためと考えられる。明色層は還元的・暗色層は酸化的な堆積環境であったことが示唆されるが、これは、泉谷 (2010) の結果と整合的である。

有機物は、酸化的環境下で好気的分解反応が進むために存在量は減少し、有機態リンも存在量が減少すると考えられるが、今回得られた結果はその逆で、酸化的環境を示唆する暗色層の有機態リンより多かった。これは、高塩分濃度水からなる Meedee Lake の湖面付近では密度差があるために、有機物等の沈降粒子が塩水湖中に沈殿しにくく、かつ暗色層に底生有孔虫が多く生息していた（泉谷、2010）ことから、暗色層の有機態リンの起源は底生有孔虫であることが示唆される。あるいは、堆積環境の影響ではなく、気候変動による影響を受けたとも考えられる。有孔虫殻に含まれる酸素同位体の解析より明色層・暗色層はそれぞれ温暖期・寒冷期に属していたことが明らかにされている（泉谷, 2010）。寒冷期には、海水準が低下し露出した陸棚の堆積物からリンが供給され富栄養価して生物生産が高くなったので、その影響により生産された有機物が多く堆積した可能性も考えられる。

CaCO3 量の多い有孔虫殻が起源となり、炭酸塩結合態のリン濃度が最も高いと予想されたが、実際は CFAP 相のリン濃度が一番高かった。その要因として 2 つ考えられる。まず、地中海塩水湖におけるリンは分解速度が大きく、分解後には海水にリン酸として回帰したのち再び塩水湖中の堆積物中に戻り、続成作用によって CFAP 相へと変化した可能性が挙げられる。通常、鉄結合態リン、有機態リンが初期続成作用を受け CFAP 相へと変化するため、それらの濃度が小さかったことからも調和する。もしくは、本試料の CaCO3 量（%）と CFAP 相のリン濃度が類似した深度分布を示すことから、続成作用ではなく、蒸発岩由来の鉱物等を起源とする非生物性 CaCO3 の濃度を反映していることも考えられる。

以上より、KH06-04 航海で採取された堆積物は、酸化還元状態の変遷に加え、塩水湖自体の影響も大きく受けていることが予想される。