2nd International Workshop on Ancient Hydrocarbon Seep and Cognate Communities

13th-15th June 2019, Sapporo, Hokkaido, Japan

Field Trip: 10th-12th June, 2019, Hokkaido

June 13-15, 2019

Sapporo, Japan

Hokkaido University Museum

Abstract volume

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Organized by Organizing committee of the 2nd International Workshop on Ancient Hydrocarbon Seep and Cognate Communities, Hokkaido University Museum.

The Hokkaido University Museum

2nd International Workshop on Ancient Hydrocarbon Seep and Cognate Communities

2nd International Workshop on Ancient Hydrocarbon Seep and Cognate Communities will be held during June 13-15, 2019 at the Hokkaido University Museum in Sapporo City, Hokkaido, Japan.
This symposium will be co-organized with the Hokkaido University Museum. The workshop is sponsored by the Paleontological Society of Japan and Nakagawa Town (Hokkaido).

Meetings: June 13th -15th, 2019
Sapporo, Japan
Hokkaido University Museum

Pre-meeting field trip: June 10th – 12th, 2019
Cretaceous and Miocene seep localities in Nakagawa Town, Obira Town and Ishikari City, Hokkaido

Scope of the workshop

The discovery of hydrothermal vent ecosystem along the Galápagos Rift in 1977 has changed our perception of deep water marine life. The vent ecosystem consists of large and numerous polychaetes, mollusks, arthropods and other animals. Subsequently, similar communities have been found around hydrocarbon seeps, sunken whale carcasses and sunken driftwood on sea floor. It turned out that these communities depend largely upon chemosynthetic bacteria, especially sulfur-oxidizing bacteria, for their food/energy source, and thus the communities have been called "chemosynthetic communities".

Since the discovery of chemosynthetic communities in modern oceans, numerous ancient chemosynthetic communities have been discovered/re-interpreted worldwide from rock formations of various ages. Majority of ancient chemosynthetic communities was found associated with hydrocarbon seep deposits because of their high fossilization potential related to anaerobic oxidation of methane, which increases alkalinity and triggers precipitation of carbonate minerals.

The great advantages to study on the ancient chemosynthetic communities and their associated seep deposits is that the fossil record allows us to understand the evolution of chemosynthetic communities and the spatial/temporal trajectories of seep systems are much easier to observe than in their modern counterparts. To improve and exchange our knowledge on ancient chemosynthetic communities, the 1st International Workshop on the hydrocarbon seep and cognate communities was held in Warsaw, Poland in 2016. The successful meeting encouraged us to have regular meetings on the ancient seeps.

This time we meet for the 2nd International Workshop on the hydrocarbon seep and cognate communities in Sapporo, Hokkaido, Japan. The Japanese archipelago and surrounding waters yield numerous examples of ancient and modern seeps ranging from the Cretaceous to the Recent times. Following the last workshop, the aims of the 2nd workshop are to exchange ideas, data and contacts among the researchers studying chemosynthetic communities around the world. Paleontological, geochemical and modern biological perspectives are all most welcomed.

We also prepared a 3 days pre-meeting field trip in Hokkaido Island. We will visit Morai (Miocene), Kanajirisawa in Obira Town (Cenomanian, Late Cretaceous) and Nakagawa Town (Santonian-Campanian, Late Cretaceous). You can enjoy taking samples from those classic outcrops.

It is noteworthy that the final stage of the upcoming book on Fossil Hydrocarbon Seeps to be published in the Topics of Paleobiology series of Springer Verlag (editors Andrzej Kaim, Neil H. Landman, J. Kirk Cochran) will be discussed among participating authors.

We heartily invite all paleontologists, geologists, geochemists and biologists involved in seep, vent and fall research to participate in our workshop!

Hosting organization

Organizing committee of the 2nd International Workshop on Ancient Hydrocarbon Seep and Cognate Communities

Hokkaido University Museum

The Nakagawa Town and the Nakagawa Museum of Natural History

Organizing Committee

Robert G. Jenkins (Kanazawa, Japan), Andrzej Kaim (Warsaw, Poland), Yoshitsugu Kobayashi (Sapporo,Japan), Yasuhiro Iba (Sapporo, Japan), Yoshinori Hikida (Nakagawa, Japan)

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Sponsors

The Palaenontological Society of Japan
Nakagawa Town, Hokkaido

Time Table

June 13, 2019

10:00 Open for Registration at the Hokkaido University Museum

10:30 Opening address

Seep system

Keynote

10:40-11:30 O-01 Ijiri, A.

Significance of biogeochemical processe in submarine mud volcanoes

11:30 Break

11:50 O-02 Jakubowicz, M., Kiel, S., Goedert, J., Dopieralska, J. and Belka, Z.

Reconstructing a fluid expulsion system during early evolution of the Cascadia margin: a message from isotopic composition of mid-Eocene methane seep carbonates (humptulips formation, Washington, USA)

12:20 O-03 Miyajima, Y., Jakubowicz, M. and Hirata, T.

In situ Sr isotope analysis and U-Pb dating of methane-seep carbonates: Insight into origin of seeping fluids at Cretaceous seeps in Hokkaido, Japan

12:50 Lunch Break

Seep fauna

14:20 O-04 Kiel, S.

An update on Cenozoic seep faunas

14:50 O-05 Pisera, A., Hryniewicz, K., Bitner, M. A. and Kaim, A.

Extant and fossil sponges associated with hydrothermal vent and cold seep communities

15:20 O-06 Kato, M.

Echinoderms in chemosynthetic communities: their foods, habitats, evolution and roles in the ecosystem

15:50 Break

16:10 O-07 Klompmaker, A. A., Nyborg, T., Brezina, J. and Ando, Y.

Crustaceans from fossil cold seep environments

16:40 Poster session

P-01 Hryniewicz, K., Amano, K., Bitner, M.A., Hagström, J., Kiel, S., Klompmaker, A.A., Mörs, A., Robins, C.M. And Kaim, A.

A late Paleocene fauna from seep and associated sunken driftwood from Spitsbergen, Svalbard, and its evolutionary significance

P-02 Bitner, M. A., Hryniewicz, K., Amano, K., Jenkins, R.G. And Kaim, A.

New data on non-dimerelloid brachiopods from chemosynthesis-based communities

P-03 Seki, A. and Jenkins, R.G.

Pleistocene shallow-water whale-fall community from the Omma Formation in central Japan

P-04 Suzuki, M., Jenkins, R.G., Ogiso, S. and Suzuki, N.

Taxonomy and diet of the Ophryotrocha (Annelida: Dorvilleidae) from whale- falls in the Tsukumo Bay, Japan

P-05 Hikosaka, M., Kimura, K., Watanabe, K. H., Chen, C., Takahashi, Y. and Jenkins, R.G.

Minerals in the gill chamber and the digestive tract of hydrothermal vent shrimp

17:20 Welcome party

June 14, 2019

Biotic response to environment

10:30 **O-08** **Jenkins, R.G.**
Epifaunal bivalves in seeps: rethinking its meaning and reasons

11:00 **O-09** **Sato, K., Chen, C., Jenkins, R.G. and Watanabe, H. K.**
Shell microstructures of vent and seep pectinodontid limpets: Implications on phenotypic changes and systematics

11:30 **Lunch Break**

13:00 **Businness Meeting (publishing 'seep book' from Springer and other things)**

Wood- and Whale-fall communities, and non-seep community

13:40 **O-10** **Brezina, J. A., Larson, N. L. and Landman, N. H.**
Fossil wood fall and associated fauna from the Late Cretaceous Western Interior Seaway in South Dakota

14:00 **O-11** **Watanabe, S.**
Transportation processes of organic matter from whale bones during formation of whale-fall communities

14:20 **O-12** **Hryniewicz, K. Bakayeva, S., Heneralova, L. and Kaim, A.**
Chemosymbiotic bivalves from Eocene deep-water deposits of Eastern Carpathians (Ukraine) and their taphonomy

14:50 **Coffee Break**

Local to Global

15:10 **O-13** **Shimazu, N. and Jenkins, R.G.**
Early Cretaceous Utagoesawa seep community from Yubari City, Hokkaido, Japan

15:30 **O-14** **Kaim, A., Little, C.T.S., Mears, E., Kennedy, W. J. and Anderson, L.**
Fossil associations from Turonian, Upper Cretaceous hydrothermal vent deposits from Cyprus, A glimpse into Mesozoic hydrothermal vent ecosystems

16:00 **O-15** **Amano, K., Jenkins, R.G., Miyajima, Y. and Kiel, S.**
Evolution and geographic distribution of chemosynthetic bivalves in Japan

16:30 **Closing talk**

18:30 **Meet at the Gate of Hokkaido University for Banquet**

19:00 **Banquet**

June 15, 2019

One-day field and museum tour (Misaka City Museum and Eocene seep locality in Mikasa City)

ABSTRACT

Oral 01 Keynote

SIGNIFICANCE OF BIOGEOCHEMICAL PROCESSES IN SUBMARINE MUD VOLCANOES

Akira Ijiri[1]

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Abstract

Submarine mud volcanoes are formed by the upward intrusion of deformable lower-density materials from several kilometers below the seabed. This process transports deep-sourced fluids, elements, and hydrocarbons to the seafloor, supporting chemosynthetic benthic life including microbial communities that mediate the anaerobic oxidation of methane with sulfate reduction. However, the biogeochemical and microbiological characteristics of deep submarine mud volcanoes have remained largely unknown. During research cruises by the deep-sea drilling vessel D/V Chikyu in 2009 and 2012, scientists drilled 200 m into the summit of a highly active submarine mud volcano in the Kumano forearc basin and obtained core samples. Our analyses of deep biosphere and carbon cycling in this setting, using geochemical and geophysical data with microbiological methods, estimated that methane hydrate could exist as deep as 590 m below the summit (112–160 m above the seafloor). The amount of methane was estimated as 3.2 billion m^3, ten times larger than expected in a single mud volcano. In addition, more than 90% of the methane appears to be microbial in origin and was produced in sediments 400–700 m below the seafloor, the mud volcano's source layer. In this environment, low-salinity water derived from clay mineral dehydration is supplied from an old accretionary prism through a mega-splay fault; this fluid seems to promote microbial activities such as hydrogenotrophic methanogenesis. These results indicate that the production and migration of fluid in an oceanic plate subduction zone is strongly related to the production of natural gas by microorganisms living in the deep subseafloor. These findings are highly important for a better understanding of biogenic gas generation under the seafloor as well as the relationship between earth dynamics and the deep biosphere. On the other hand, the activity of submarine mud volcanoes may also affect the water column ecology. In the submarine mud volcanoes off Tanegashima island southern part of Japan, sedimentary Atribacteria was found in methane plumes in the overlying water column. This observation suggests microbial dispersal from the deep sedimentary biosphere to the overlying hydrosphere through submarine mud-volcano activity.

Keywords: Mud volcano, methanogenesis, deep biosphere

Oral 02

RECONSTRUCTING A FLUID EXPULSION SYSTEM DURING EARLY EVOLUTION OF THE CASCADIA MARGIN: A MESSAGE FROM ISOTOPIC COMPOSITION OF MID-EOCENE METHANE SEEP CARBONATES (HUMPTULIPS FORMATION, WASHINGTON, USA)

MICHAŁ JAKUBOWICZ[1], STEFFEN KIEL[2], JAMES GOEDERT[3], JOLANTA DOPIERALSKA[4], ZDZISLAW BELKA[1]

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Abstract

Recent studies have addressed the potential applicability of the Nd isotope system to investigations of subseafloor circulation of fluids feeding deep marine methane seeps (Jakubowicz et al., 2015, 2019). The method has been shown to provide a sensitive tool of detecting former interactions between the seeping fluids and volcanogenic, mafic crustal materials. Nevertheless, the prospects of the system to address broader geological questions, such as those regarding structural architecture and tectonic evolution of seep-hosting sedimentary basins, remained largely unexplored. In this study, we have combined Nd, Sr, C and O isotope analyses of mid-Eocene (42.5-40.5 Ma) methane seep carbonates of the Humptulips Formation (Washington, USA) to investigate an early hydrogeological regime of the Cascadia subduction zone in the north-eastern Pacific. The oldest among a suite of fossil seep deposits of the Pacific Northwest, these seeps provide a record of fluid expulsion during a period of dramatic margin reconfiguration, following docking of a large igneous terrane of Siletzia at 50-45 Ma. Both the high $\varepsilon_{Nd}(t)$ values and low $^{87}Sr/^{86}Sr$ isotope signatures of the studied seep deposits consistently point to former interactions between the seeping fluids and mafic, volcanic-derived basement components present in the plumbing system. The observed $\delta^{13}C$ values suggest thermogenic origin of methane at three out of four studies seeps, with biotic hydrocarbons likely involved at a single, landward-most site. When combined with structural data, the geochemical signals point to expulsions of fluids originating mostly from deep portions of the young subduction wedge, and their ascent through the Siletzia terrane before emerging on the forearc seafloor. The study attests the presence of a fluid expulsion system typical of convergent accretionary margins prior to maturation of arc magmatism in the Cascades, lending support to the models placing the onset of the Cascadian subduction before development of the typical Cascade volcanic arc.

Keywords: cold seeps, seep and vent carbonates, isotope tracers, fluid-rock interactions

References:

Jakubowicz, M, Dopieralska, J, Belka, Z (2015) Tracing the composition and origin of fluids at an ancient hydrocarbon seep (Hollard Mound, Middle Devonian, Morocco): A Nd, REE and stable isotope study. Geochimica et Cosmochimica Acta 156: 50-74.

Jakubowicz, M, Dopieralska, J, Kaim, A, Skupien, P, Kiel, S, Belka, Z (2019) Nd isotope composition of seep carbonates: Towards a new approach for constraining subseafloor fluid circulation at hydrocarbon seeps. Chemical Geology 503: 40-51.

Oral 03

IN SITU SR ISOTOPE ANALYSIS AND U–PB DATING OF METHANE-SEEP CARBONATES: INSIGHT INTO ORIGIN OF SEEPING FLUIDS AT CRETACEOUS SEEPS IN HOKKAIDO, JAPAN

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Abstract

Understanding the origin of fluids discharged at ancient methane seeps provides insights into subseafloor fluid–rock interactions and fluid-flow pathways in ancient sedimentary basins. Carbonate rocks formed at methane seeps are valuable archives of elemental and isotopic signals of seeping fluids that are the key to decode the fluid origin. We have attempted to reveal the origin of fluids at Cretaceous seeps in Hokkaido, northern Japan, by *in situ* strontium (Sr) isotope analysis of seep carbonates. Strontium isotope ratio ($^{87}Sr/^{86}Sr$) of seep carbonates is a useful recorder of the fluid origin, but interpretational value of bulk analytical data may be compromised by mixing with signals of the coeval seawater and detrital sediments, and by effects of diagenetic alteration. Here, we have applied a high spatial-resolution laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) to measure the $^{87}Sr/^{86}Sr$ ratios in cement phases of seep carbonates that are devoid of detrital materials. We measured the $^{87}Sr/^{86}Sr$ ratios in radial calcite cements of two Campanian seep carbonates collected at Gakkonosawa and Omagari in the Nakagawa area, hosted by sediments of the Yezo forearc. The $^{87}Sr/^{86}Sr$ ratio in the Gakkonosawa cement was lower than the seawater signal through the Campanian, indicating input from a less radiogenic, deep-sourced fluid. The deep-sourced fluid presumably originated from the Jurassic to Lower Cretaceous mafic basement rocks underlying the forearc sediments, which we could verify through further isotope analysis of the basement rocks. Our result also implies the presence of deep-rooted fluid conduits and compaction-induced dewatering from the deep subsurface at the Cretaceous subduction zone.

Although the Sr isotope ratio can be used to date fossil seep carbonates, this is not feasible when the isotope signal in a seep carbonate is originally distinct from that of the coeval seawater. As the Gakkonosawa carbonate is a boulder rock and its age is uncertain, we tested direct uranium–lead (U–Pb) dating technique by LA-ICP-MS to determine the age of the carbonate and to constrain the seawater Sr isotopic compositions. Using the international calcite reference material and applying a common-Pb correction, we obtained a lower to middle Campanian age for the Gakkonosawa cement.

In situ Sr isotope analysis and U–Pb dating of seep carbonates is useful not only to determine the age of the fluid discharge and chemosynthetic animal fossils, but also to reveal triggers of the fluid discharge such as tectonic activity. Revealing factors controlling the discharge of fluids that contain the nutritional source for the chemosynthesis-based communities, i.e., methane and sulfide, can then provide insights into drivers of the evolution of these unique ecosystems.

Keywords: carbonate, Cretaceous, Hokkaido, hydrocarbon seep, strontium isotope, uranium–lead dating

Oral 04

AN UPDATE ON CENOZOIC SEEP FAUNAS

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Abstract

I will provide an overview of, and an update on, Cenozoic seep faunas around the world. The update is based on several field trips to new and previously underexplored seep deposits in northern Peru, northern Italy, Cuba, Taiwan, and the Philippines. It will include mainly new data on taxonomy and stratigraphy. The overall aim of my current research on Cenozoic seeps is biogeography and I'll present some preliminary results.

Oral 05

EXTANT AND FOSSIL SPONGES ASSOCIATED WITH HYDROTHERMAL VENT AND COLD SEEP COMMUNITIES

Andrzej Pisera, Krzysztof Hryniewicz, Maria Aleksandra Bitner, Andrzej Kaim

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Abstract

In the present-day chemosynthesis–based communities Demospongiae dominate, Hexactinellida are rare, while Calcarea are only exceptionally reported. All extant sponges known from such environments belong to groups with loose (not fused or articulated) spicules that fall apart after sponge death, thus their fossilization potential is low.

Most of these sponges are considered as 'background' fauna because they do not depend directly on chemosynthesis and can occur in other environments as well. Notable exception is *Cladorhiza methanophila* from Barbados and probably *Pseudosuberites thurberi* from New Zealand (both belonging to Demospongiae).

The oldest fossil record of sponges associated with hydrothermally influenced deposits comes from the Lower Cambrian of China that are identified as putative hexactinellids and ?astrophorid demosponges. The first Mesozoic seep associated sponges (both hexactinellids and demosponges) are reported from the Late Jurassic of France and Jurassic/Cretaceous boundary beds in Svalbard (hexactinellids and probably demosponges). The most known Oligocene fauna of sponges, composed exclusively of hexactinellids with fused skeleton (Hexactinosa), was described from the Lincoln Creek Fm of north-western United States.

The presence of sponges in the seep deposits of Cretaceous age (Campanian) of Japanese localities Gakkonosawa and Yasukawa is reported here for the first time. This fauna consists of hexactinelids with fused skeleton (Hexactinosa), but loose spicules of astrophorid demosponges have been also found. New fauna of hexactinellids with fused skeleton, that are accompanied by astrophorid demosponge spicules, is reported here also from the Eocene Crescent Fm of Washington State, USA. No calcareous sponges have been reported so far from the ancient vent and seep communities.

Hexactinosa are the most common sponges occurring at ancient seeps and vents, but they are yet not recorded from their modern counterparts. Those in turn are inhabited by Demosponges with skeleton composed of loose spicules. Such sponges are very rarely reported from the ancient communities what we interpret as taphonomic effect: lack of preservation of complete sponges. The dominance of hexactinellids with fused skeleton in the fossil communities over demosponges cannot be, however, exclusively an artefact (taphonomic effect due to their higher preservation potential) because they were not noted so far from the present day communities.

Keywords: hydrocarbon seep, Japan, USA, Cretaceous, Eocene, Porifera.

Oral 06

ECHINODERMS IN CHEMOSYNTHETIC COMMUNITIES: THEIR FOODS, HABITATS, EVOLUTION AND ROLES IN THE ECOSYSTEM

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Abstract

Echinoderms are among the major components of marine invertebrates from the Cambrian to the present. Although they inhabit at all depths and latitudes of the world oceans at the present, the records of them are rare in chemosynthetic communities. However, in the last few decade years, modern echinoderms were discovered from hydrothermal vents (Stöhr and Segonzac. 2005) and methane seeps (Pawson and Vance. 2004), and some fossil echinoderms were found around methane seep deposits (Gaillard et al. 2011; Hunter et al. 2016). The fossil echinoderms (crinoid) from the Upper Cretaceous methane seep deposits (the Western Interior Seaway of the U.S. and Hokkaido in Japan) are characterized by their skeleton with low $\delta^{13}C$ value (lower than 20‰). It is thought that the fossil crinoids occurred from methane seep deposits ate organic matter related with methane having low $\delta^{13}C$ value because they build their high-magnesian calcite skeleton by using both dissolved inorganic carbon in ambient water and carbon derived from their foods. Thus, there were echinoderms depending on chemosynthetic ecosystems in the Upper Cretaceous. Some modern echinoderms species occur both in hydrothermal vents or methane seeps and normal deep-sea bottom. Therefore, some echinoderms might transport rich organic matter produced by chemosynthetic communities from a chemosynthetic ecosystem to surrounding deep-sea ecosystems by their feeding and moving.

Keywords: cold seep, hydrothermal vent, deep-sea ecosystem, Echinoderm

References:

Gaillard, C., Didier, N. and Jacques, T. (2011) *Tithonia oxfordiana*, a new irregular echinoid associated with Jurassic seep deposits in south-east France. Palaeontology 54: 735–752.

Hunter, A.W., Larson, N.L., Landman, N.H. and Oji, T. (2016) *Lakotacrinus brezinai* n. gen. n. sp., a new stalked crinoid from cold methane seeps in the Upper Cretaceous (Campanian) Pierre Shale, South Dakota, United States. Journal of Paleontology 90: 506–524.

Pawson, S.D.L. and Vance, D.J. (2004) *Chiridota heheva*, new species, from Western Atlantic deep-sea cold seeps and anthropogenic habitats (Echionodermata, Holothuroidea, Apodida). Zootaxa 535: 1–13.

Stöhr, S. and Segonzac, M. (2005) Deep-sea ophiuroids (Echinodermata) from reducing and non-reducing environments in the North Atlantic Ocean. Journal of the Marine Biology Association UK 85: 383–402.

Oral 07

CRUSTACEANS FROM FOSSIL COLD SEEP ENVIRONMENTS

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Abstract

Crustaceans including decapods, copepods, amphipods, cumaceans, tanaidaceans, ostracods, and isopods are major components of modern marine methane seeps, where they play a key role in these hotspots of diversity. It is likely that they were common too in ancient seeps, but relatively few studies have focused on crustaceans from ancient seeps thus far. We hypothesized that crustaceans can be commonly found in Meso-Cenozoic seeps when many of the aforementioned groups were present and/or radiated. To this end, we reviewed the global fossil record of crustaceans in seeps for the first time using the primary literature and newly collected specimens from the Late Cretaceous of South Dakota, USA. We find that seep crustaceans are much more common than previously known, are found on each continent, and occur more frequently starting in the Jurassic. Decapod crustaceans are represented by body fossils and traces (coprolites, repair scars in mollusks, and burrows), whereas only body fossils of ostracods and barnacles are known. Other groups are lacking. While modern seep decapods are dominated by galatheoid squat lobsters, alvinocaridid shrimps, king crabs, and true crabs, the fossil record is consisting primarily of callianassid ghost shrimps and true crabs thus far. Preservation and recognition are likely to have influenced this discrepancy. The relatively unexplored fossil record of seep crustaceans provides many opportunities for systematic and paleoecological research.

Oral 08

EPIFAUNAL BIVALVES IN SEEPS: RETHINKING ITS MEANING AND REASONS

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Abstract

One of very interesting phenomena in the fossil record of seep fauna is repeating appearance and demise of seep-restricted epifaunal/semi-infaunal bivalves since their first appearance at ca. 390 Ma (Kiel 2015; Hryniewicz et al. 2017; Jenkins et al. 2018). Its Paleozoic record is still scares, however, much more common Mesozoic to Cenozoic record of those bivalve shows decreasing of semi-infaunal bivalve, *Caspiconcha* (Kalenteridae), in the Late Cretaceous until appearance of bathymodiolin and vesicomyid bivalves in Eocene. There are several hypotheses, e.g. "sulfate hypothesis" (Kiel, 2015) and agronomic revolution by infaunal bivalve (Hryniewicz et al. 2017), proposed to explain the pattern of epifaunal/semi-infaunal bivalve occurrence in Mesozoic and Cenozoic seep environment. In addition to those hypothesis, fluctuation of organic flux (marine snow), produced by photosynthetic primary producers from sea surface to sea floor through age, could control the pattern of epifaunal/semi-infaunal bivalve occurrence. This scenario is evidenced by oil resources in sedimentary rocks through ages. The oil production is largely related to input of organic matter into sediments, and the methane production rate is ultimately related to the amount of organic matter in sediment. The organic matter on the seafloor also control sulfate/methane interface. Thus, increasing organic matter on the seafloor evoke increasing methane production and rising up of sulfate/methane interface. Both higher methane production and raised sulfate/methane interface provide favorable condition for epifaunal/semi-infaunal bivalves.

References

Hryniewicz, K., Jakubowicz, M., Belka, Z., Dopieralska, J. and Kaim, A. (2017) New bivalves from a Middle Devonian methane seep in Morocco: the oldest record of repetitive shell morphologies among some seep bivalve molluscs. Journal of Systematic Palaeontology 15: 19–41.

Jenkins, R.G., Kaim, A., Hikida, Y. and Kiel, S. (2018) Four new species of the Jurassic to Cretaceous seep-restricted bivalve *Caspiconcha* and implications for the history of chemosynthetic communities. Journal of Paleontology 92: 596-610.

Kiel, S. (2015) Did shifting seawater sulfate concentrations drive the evolution of deep-sea methane-seep ecosystems? Proceedings of the Royal Society B: Biological Sciences 282: 1804.

Oral 09

SHELL MICROSTRUCTURES OF VENT AND SEEP PECTINODONTID LIMPETS: IMPLICATIONS ON PHENOTYPIC CHANGES AND SYSTEMATICSES AND SYSTEMATICS

Kei Sato[1], Chong Chen[2], Robert G. Jenkins[3] and Hiromi K. Watanabe[2]

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Abstract

Gastropods often show intraspecific variation in phenotypes among different habitats. Recently, the authors carried out molecular phylogenetic analyses of pectinodontid limpets in two genera, *Bathyacmaea* and *Serradonta*, commonly associated with vent and seep environments in the west Pacific (Nakano & Sasaki, 2011). Instead of revealing distinct lineages corresponding to morphological identification, the analyses showed that all individuals from both genera were mixed in a single nested monophyletic clade, except for one undescribed species from the South Chamorro Seamount. This result strongly implies that most previously recognized 'species' in fact belong to one species that is highly morphologically plastic in shell form. We therefore investigated their shell microstructures, which can be a strong tool to estimate phyletic relationships and physiology, including extinct taxa. We were able to estimate specimens to genus level classification based on their shell microstructural compositions. Furthermore, the proportion of shell microstructures with two different mineral compositions (aragonite or calcite) clearly corresponds to differences in chemosynthetic habitat. We also revealed that systematics and estimations of habitat based on shell microstructures are useful even for extinct taxa according to our observations on the shell microstructures from Cretaceous seep pectinodontids.

Keywords: shell microstructure, Pectinodontidae, limpet, seep, vent, aragonite, calcite.

References:

Nakano, T. & Sasaki, T. (2011) Recent advances in molecular phylogeny, systematics and evolution of Patellogastropod limpets. Journal of Molluscan Studies 77: 203–217

Oral 10

FOSSIL WOOD FALL AND ASSOCIATED FAUNA FROM THE LATE CRETACEOUS WESTERN INTERIOR SEAWAY IN SOUTH DAKOTA

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Abstract

Ancient and modern wood falls can create diverse biotic communities on the ocean floor generating a food source for bivalves and bacteria alike. In July 2018 a wood fall was discovered in Custer County, South Dakota, during a research expedition of the American Museum of Natural History, University of New Mexico, Brooklyn College, and Stony Brook University. The wood fall was deposited in the Upper Cretaceous (upper Campanian) Pierre Shale near the base of the *Baculites compressus* Zone and the top of the *Didymoceras cheyennense* Zone. The fossil log is preserved in a concretion imbedded in dark grey shale (Pierre Shale). The log measures 2.8 m long while the concretion is 3.4 m long. Fauna in and around the log include boring and non-boring bivalves, baculitid, and scaphitid ammonoids along with heavy concentrations of bivalves in specific regions of the log.

The shoreline during the *Baculites compressus* Zone appears to have been from central Colorado through Wyoming and into west, central Montana (Cobban et al., 1994). The water depth during the Late Cretaceous Seaway in South Dakota is reported to have been 100 m or less (Landman et al., 2010). The log is oriented east/west, which may indicate sea floor bottom currents; alternatively, the log could have come to rest in a depression on the sea floor. The log is located in a hydrocarbon seep field where several seeps have been mapped and documented, but it is not directly associated with a seep. The surface of the log is covered with teredinid boring and lucinid bivalves. Although fossil wood is common in certain regions of the Western Interior Seaway, much of it consists of small fragments and not associated with a wood fall fauna. This unusually large log sunk to the bottom of the Seaway, attracting fauna that were able to take advantage of this energy source to generate a community until the fine muddy sediments slowly buried the log. Subsequently, a concretion grew around the log, with the log acting as a nucleus for concretion formation.

Keywords: wood fall, seep, cognate, bivalve, Pierre Shale, South Dakota, concretion, ammonoids.

References:

COBBAN, W.A., E.A. MEREWETHER, T.D. FOUCH and J.D. OBRADOVICH, 1994, Some Cretaceous shorelines in the Western Interior of the United States, In M.V. CAPUTO, J.A. PETERSON, J. A., and K.J. FRANCZYK, eds., Mesozoic systems of the Rocky Mountain Region, U.S.A.: Rocky Mountain Section of Society for Sedimentary Geology, p. 393-413.

Oral 11

TRANSPORTATION PROCESSES OF ORGANIC MATTER FROM WHALE BONES DURING FORMATION OF WHALE-FALL COMMUNITIES

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Abstract

The whale-fall community is one of the chemosynthetic community like seep or vent, formed on decaying whale carcass on the sea floor. Several studies on whale-fall communities have revealed the communities were sustained more than several years even after removal of soft tissue from the bones. After removal of the soft tissues, organic matter within the bones are main energy source for the communities. It is well known that the hydrogen sulfide, released from decaying organic matter within the bones, is the energy source for chemosynthetic microbes and animals harboring the microbes. Recently, it has been revealed that many polychaetes, but restricted species, lives abundantly inside the whale bone (ref). Excrements of them from whale bones would be useful for other animals which lives around the carcass. However, detailed observation of those feces and excretion processes haven't been done yet. Thus, we examined the transportation processes of organic matter from whale bones by observing the whale-fall communities in the aquarium. We deployed two sets of whale bone in shallow sea floor (11 m in depth) in Tsukumo Bay, Noto Peninsula, Japan. After 2 and 3 months, each set of the whale bone was recovered by scuba; one bone was analyzed for species composition at time of recovered and the other bone was put into aquarium (40L) with sea water and sediments from the Tsukumo Bay.

Characteristic species for the shallow water whale-fall communities such as *Xenoskenea* sp., dorvilleid polychaeates, white microbial mat (*Beggiatoa* spp., indicator of sulphophilic stage) and ciliate *Zoothamnium* sp. (indicator of sulphophilic stage) can be observed at time of recovery and during aquarium experiments (most time). As a result of observations of aquariums, accumulations of several types of fecal excretions around the whale bones were observed. Four types of the excretion style of feces were observed, and transport distance of feces from the bones are depending on the styles. Total organic carbon content (TOC) analysis showed higher contents at shorter distances from the bones.

Occurrences of *Zoothamnium* sp. (host of eposymbiotic chemosynthethic bacteria), giant sulphur-oxidizing bacteria and *Xenoskenea* sp., dorvilleid polychaeates in/on the bones suggest that our aquarium experiments could form shallow water whale-fall communities. From the results of TOC analysis, it was suggested that organic matter inside the whale bone is transported to the outside of the bone due to excretion of feces. In this study, we observed not only the transportation process that organic matter is eaten and excreted as feces, but also processes related to giant Sulphur-oxidizing bacteria. Detailed observation by further aquarium experiments will make it possible to clarify the whole movement of organic matter around the whale bones.

Oral 12

CHEMOSYMBIOTIC BIVALVES FROM EOCENE DEEP-WATER DEPOSITS OF EASTERN CARPATHIANS (UKRAINE) AND THEIR TAPHONOMY

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Abstract

Chemosymbiotic solemyid and lucinid bivalves discussed here come from the lower to middle Eocene calcareous deposits outcropping near Nadvirna, Ivano-Frankivsk Region, Ukraine. The bivalves occur in laminated pelagic marls intercalated with calcareous turbidite deposits, indicative of deep-water environment. No could not find any evidence for hydrocarbon seepage, for example there are no textures typical for methane-derived authigenic carbonates. This suggests that the fauna in question comes from 'background' environment with high redox potential but not from the seep deposit.

Both solemyid and lucinid bivalves are too poorly preserved to allow their taxonomic identification. The solemyid bivalves have been previously initially classified as *Solemya vialovi* which apparently has not been known from elsewhere in the Carpathians.. Large size (shell length up to 77 mm) and relatively thick shell suggest the species might actually belong to *Acharax*, often associated with deep-water environments. The identity of the lucinid is equally difficult to resolve, although some morphological details preserved make it dissimilar to Eocene shallow-water lucinids known from that time, and suggest affinities to deep-water lucinid taxa.

Solemyid bivalves show the 'butterflied' preservation with the dorsal margin upward and characteristic breakage pattern, allowing to reconstruct the events around the time of their death, and shortly thereafter. The arrangement of the shells is indicative for *in situ* preservation, and not for redeposition, which is in agreement with the deep-water character of this fauna. The breakage pattern is suggestive of a collapse of largely articulated shell which was unsupported by the sediment filling and squeezed in a semi-confined space. The shells collapsed in two stages, with thinner posterior and central part collapsing prior the thicker anterior part of the shell. We argue that the collapse occurred within the solemyid burrow system either *syn-vivo* or early post-mortem, as would be the case if the solemyid-bearing pelagic carbonate ooze would be rapidly covered with thick blanket of calcareous turbidite deposit.

Keywords: Carpathians, chemosymbiosis, deep-water, lucinids, solemyids, taphonomy.

Oral 13

CHEMOSYNTHETIC FOSSIL COMMUNITY IN EARLY CRETACEOUS METHANE SEEP FROM YUBARI CITY, HOKKAIDO

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Abstract

The Japanese archipelago has many fossil records of Cretaceous to Quaternary methane-seep communities, and many researches on it have been performed. However, the Early Cretaceous seep communities in Japan has hardly been studied so far. We studied the Early Cretaceous seep material found along the Utagoesawa Creek, Yubari City, Hokkaido, using comprehensive approaches including sedimentary petrological, isotope geochemical and paleontological analyses.

Many carbonate rocks were found along the creek as floats, and its size was small in downstream and becomes bigger, sometime more than 1 m in diameter, toward upstream. The carbonate rocks have mosaic textures mainly composed of micritic grayish patchy brocks. Bladed calcite and sparry calcite are also found in voids and cracks in the rocks. Detailed observation revealed the paragenetic sequence, i.e. micrites and the bladed calcites were precipitated in early diagenetic stages, whereas the sparry calcite were precipitated in later diagenetic stage. Isotopic compositions of the micrite and bladed calcite facies are -45.8 to -38.5 ‰ VPDB for carbon and -4.9 to 2.4 ‰ VPDB for oxygen. Those lithology and isotopic features suggests that carbonate formation was associated with anaerobic oxidation of methane (AOM) caused by microbial activity in methane seep.

The carbonate rocks yield many bivalves such as *Caspiconcha*, lucinids, *Nucinella*, solemyids, thyasirids, and some gastropods such as hokkaidoconchids. These molluscan fossils are typical for other Cretaceous seeps. Interestingly, there is no brachiopods, which were thought to be main biotic component in Paleozoic to mid-Cretaceous seeps. Actually, many brachiopods were found in late Jurassic to Early Cretaceous seeps in California. Current study and other recently published studies, however, have shown molluscs were main component in other area of the world. Thus, Early Cretaceous seeps characterized by the brachiopods were distributed in California region only, and the other Cretaceous seeps in the world were characterized by mollusks.

Oral 14

FOSSIL ASSOCIATIONS FROM TURONIAN, UPPER CRETACEOUS HYDROTHERMAL VENT DEPOSITS FROM CYPRUS, A GLIMPSE INTO MESOZOIC HYDROTHERMAL VENT ECOSYSTEMS

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Abstract

The Troodos Ophiolite from Cyprus is a 91 million-year-old (Upper Cretaceous; Turonian) piece of Tethyan ocean seafloor that contains numerous ancient hydrothermal vent deposits. Six of these (Kambia, Kinousa, Memi, Peristerka, Kapedhes and Sha) contain relatively well-preserved pyritized fossils: worm tubes (in all six sites), gastropods (in three sites: Kambia, Kinousa, Memi), and single gaudryceratid ammonite (Kambia only). There is a surprising absence of bivalve taxa from the Cypriot vent deposits. The gastropod and worm tube fossils were preliminarily discussed in Little et al. (1999) and the worm tubes were subsequently described by Georgieva et al. (2019). The gastropods are in a final stage of detailed taxonomic description. The gastropod fauna is dominated by small specimens with a gross cerithioid morphology and identified as such in Little et al. (1999). However, a provannid-like protoconch specimen found subsequently to this publication strongly supports these cerithioid-like gastropods being provannids, belonging to *Desbruyeresia*. In total three species in this genus have been identified, with the Kambia, Kinousa and Memi sites each yielding its own species. In addition, two species of *Paskentana*, one species of *Ascheria* and one species of *Hokkaidoconcha* have been found. A new genus and species of a previously unknown hokkaidoconchid will be described. The most intriguing feature of the Cypriot vent gastropod fauna is a total lack of any vetigastropods and neomphalids—either limpet-shaped or spiral shaped—and any other gastropod groups, which are common in modern hydrothermal vents. This suggests either preferential preservation of abyssochrysoids (provannids, paskentanids, hokkaidoconchids) in the Cypriot vent deposits, or, more likely, a lack of other gastropod groups associated with worm tube clusters in Upper Cretaceous Neotethyan hydrothermal vents.

Keywords: hydrothermal vent, Cyprus, Cretaceous, Gastropoda, Ammonoidea, worm tubes.

References:

Georgieva, M.N, Little, C.T.S., Watson J.S., Sephton M.A., Ball A.D. and Glover A.G. (2019) Identification of fossil worm tubes from Phanerozoic hydrothermal vents and cold seeps. Journal of Systematic Palaeontology 17: 287-329.

Little, C.T.S., Cann, J.R., Herrington, R.J. and Morisseau, M. (1999) Late Cretaceous hydrothermal vent communities from the Trodos ophiolite, Cyprus. Geology 27: 1027-1030.

Oral 15

EVOLUTION AND GEOGRAPHIC DISTRIBUTION OF CHEMOSYNTHETIC BIVALVES IN JAPAN

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Abstract

Numerous Cretaceous and Cenozoic chemosynthetic communities have been found in Japan (Majima et al., 2005; Amano, 2014; Amano et al., 2018; Jenkins et al., 2018). These communities include members of characteristic families or subfamilies of chemosynthetic bivalves such as solemyids, lucinids, nucinellids, thyasirids, vesicomyids, and bathymodiolins. The first four families are found from the mid-Cretaceous onward, the latter two appeared in the late Eocene and the late Eocene to early Oligocene, respectively (Amano, 2014). The families Thyasiridae, Lucinidae, and Vesicomyidae show remarkable changes in their generic composition through time, while solemyids, nucinellids, and bathymodiolins do not. Lucinidae were diverse during the Cretaceous, are absent during the Eocene, and *Lucinoma* is the dominant genus from the early Miocene onward. Within the Thyasiridae, *Conchocele* replaced Thyasira as the dominant genus in the late Eocene. The vesicomyids show two occasions of turnovers of the dominant genera: during the Oligocene and at the end of the middle Miocene. *Hubertschenckia* is as-yet the only known vesicomyid genus in Japan in late Eocene to early Oligocene time. It was replaced by *Pleurophopsis* in the late Oligocene, which lasted as dominant genus until the middle Miocene. From the late Miocene onward Archivesica and Calyptogena are the most diverse and widespread genera. An interesting paleobiogeographic pattern can be observed among the Neogene vesicomyids, when they show marked differences in diversity and species composition between the Japan Sea side and the Pacific side of Japan. The Japan Sea hosts mainly species of *Calyptogena*, with an increase in species diversity since the early Miocene, attributed to the semi-enclosed geographic situation with an open strait to the north, likely allowing the influx of cold northern waters. In contrast, only *Archivesica* has been recorded from the Pacific side with its presumably warmer waters since the Pliocene. No such paleobiogeographic trends have been observed in other families of chemosymbiotic bivalves.

Keywords: evolution, paleogeography, chemosynthesis, Bivalvia.

References:

AMANO, K (2014) Fossil records and evolution of chemosynthetic bivalves. Fossils (Palaeont. Soc. Japan) 96: 5-14. (in Japanese with English abstract)

AMANO, K, RG JENKINS & H KURITA (2018) New and Mesozoic-relict mollusks from Paleocene wood-fall communities in Urahoro Town, eastern Hokkaido, northern Japan. Journal of Paleontology 92: 634-647.

JENKINS, RG, A KAIM, K AMANO, K SAKURAI & K MATSUBARA (2018) A new Miocene whale-fall community dominated by the bathymodiolin mussel *Adipicola* from the Hobetsu Area, Hokkaido, Japan. Paleontological Research 22:105-111.

MAJIMA, R, T NOBUHARA & T KITAZAKI (2005) Review of fossil chemosynthetic assemblages in Japan. Palaeogeography, Palaeoclimatology, Palaeoecology 227:86–123.

Poster 01

A LATE PALEOCENE FAUNA FROM SEEP AND ASSOCIATED SUNKEN DRIFTWOOD FROM SPITSBERGEN, SVALBARD, AND ITS EVOLUTIONARY SIGNIFICANCE

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Abstract

A late Paleocene macrofauna from methane seep carbonates and sunken driftwood of the shallow marine Basilika Formation, Spitsbergen, Svalbard, is discussed. The macrofauna comprises 22 taxa, chiefly bivalves (14 species), with subordinate crustaceans (3 species), gastropods (3 species), brachiopod (1 species) and a bony fish (1 species). One genus, a munidid decapod crustacean Valamunida Klompmaker and Robins gen. nov., is new to science. Four new species have been discovered: the terebratulide brachiopod *Neoliothyrina nakremi* Bitner sp. nov., the protobranch bivalve *Yoldiella spitsbergensis* Amano sp. nov., the xylophagain bivalve *Xylophagella littlei* Hryniewicz sp. nov., and the munidid decapod *Valamunida haeggi* Klompmaker and Robins gen. et sp. nov. New combinations are provided for four taxa: mytilid bivalve *Inoperna plenicostata*, thyasirid bivalve *Rhacothyas spitzbergensis*, ampullinid gastropod *Globularia isfjordensis*, and munidid decapod *Protomunida spitzbergica*. Thirteen taxa are left in open nomenclature.

The fauna discussed herein lived in a shallow marine embayment, where gas seepage and accumulation of plant material from adjacent land mass allowed seep and sunken driftwood fauna to co-exist in mutual proximity. With respect of their evolutionary histories, the studied taxa can be subdivided into three main groups: long-lasting genera with pre-Paleocene origins which survive to the post-Paleocene times (5 genera), Cretaceous relics which go extinct during the Paleocene or shortly thereafter (4 genera) and Cenozoic novelties which have Paleocene origins (4 taxa). It is notable that chemosymbiotic bivalves belong either to the long-lasting genus *Solemya*, or to the two species of thyasirid bivalve family which has originated during the Cretaceous. The wood-boring xylophagain *Xylophagella* also has Cretaceous affinity, and is in fact a relict going extinct after the Paleocene. No novelties are discovered among the chemosymbiotic taxa or taxa normally associated with sunken driftwood environments. We therefore argue that Paleocene chemosynthesis-based faunas where largely a continuation of their Cretaceous predecessors.

Poster 02

NEW DATA ON NON-DIMERELLOID BRACHIOPODS FROM CHEMOSYNTHESIS-BASED COMMUNITIES

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Abstract

Dimerelloid brachiopods are most characteristic for ancient hydrocarbon seeps and hydrothermal vents. They commonly occur in mass accumulations and thus could have lived some form of relationship with chemosynthesizing bacteria. The other brachiopod groups are much less common and in several instances they occur seemingly fortuitously at hydrocarbon seeps. So far the best known association is that reported from the Upper Cretaceous (Campanian) Omagari site in Japan with terebratulide *Eucalathis* occurring in significant quantities (Kaim et al. 2010). Brachiopods were also found in the Oligocene seeps in Japan, being represented by a rhynchonellide *Frieleia* sp. and cancellothyrid ?*Terebratulina* sp.

Recently a new species *Neoliothyrina nakremi* Bitner, 2019 has been described from the Paleocene hydrocarbon seeps in Spitsbergen (Hryniewicz et al. 2019). This species was initially tentatively assigned to *Pliothyrina* (see Hryniewicz et al. 2016), however, the investigations of internal structures proved that it represents the genus *Neoliothyrina*. *Neoliothyrina* is a short-looped terebratulide, characterized by the presence of inner hinge plates, a feature rarely present in terebratuloids. It was known so far from the Upper Cretaceous of Europe, thus it is another example of Cretaceous survivor at generic level.

Brachiopods were also found in the wood-fall communities in the Paleocene deep-water deposits of the Katsuhira Formation in Hokkaido, Japan. They are represented by a rhynchonellide ?*Hemithiris* sp. and short-looped terebratulide *Abyssothyris* sp.

References:

Hryniewicz, K., Bitner, M.A., Durska, E., Hagström, J., Hjálmársdottir H.R., Jenkins, R.G., Little, C.T.S., Miyajima, Y., Nakrem, H.A., and Kaim, A. 2016. Paleocene methane seep and wood-fall marine environments from Spitsbergen, Svalbard. Palaeogeography, Palaeoclimatology,Palaeoecology 462: 41–56.

Hryniewicz, K., Amano, A., Bitner, M.A., Hagström, J., Kiel, S., Klompmaker, A.A., Mörs, T., Robins, C.M., and Kaim, A. 2019. A late Paleocene fauna from shallow-water chemosynthesis-based ecosystems, Spitsbergen, Svalbard. Acta Palaeontologica Polonica 64 (1): 101–141.

Kaim, A., Bitner, M.A., Jenkins, R.G., and Hikida, Y. 2010. A monospecific assemblage of terebratulide brachiopods in the Upper Cretaceous seep deposits of Omagari, Hokkaido, Japan. Acta Palaeontologica Polonica 55: 73–84.

Poster 03

PLEISTOCENE SHALLOW WATER WHALE-FALL COMMUNITY FROM THE OMMA FORMATION IN CENTRAL JAPAN

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Abstract

We report a single whale bone associated mainly with lucinid bivalves, *Lucinoma* sp., found in the lower Pleistocene shallow-water Omma Formation distributed along the Sai-gawa River, Kanazawa City. Recent lucinid bivalves harbour chemosymbiotic bacteria in their gills and are well known as a member of chemosynthetic community (Taylor and Glover, 2000). Most of the lucinid bivalves from the Omma Formation show articulated valves and umbo-upward position indicating *in situ* occurrence. Thus, the fossil assemblage associated with the whale bone is interpreted as a fossil whale-fall community established in shallow water environment. The shallow-water whale-fall community may differ from the deep-water ones by dominance of infaunal bivalve (lucinid) and lack of epifaunal and semi-infaunal chemosynthetic bivalves, such as bathymodiolins and vesicomyids. This lack (rare) of epifauna and semi-infaunal species would be influenced by various factors such as high predation pressure and high rate of deposition in shallow water (Sahling et al., 2003).

Keywords: Pleistocene, Baleen Whale, *Lucinoma*, chemosymbiotec bivalve, Whale-fall community, Shallow-water, Omma Formation

References:

Sahling, H., Galkin, S. V., Salyuk, A., Greinert, J., Foerstel, H., Piepenburg, D. and Suess, E. (2003) Depth-related structure and ecological significance of cold-seep communities –a case study from the Sea of Okhotsk. Deep-Sea Research Part I: Oceanographic Research Papers 50:1391–1409.

Taylor, J. D. and Glover, E. A. (2000) Functional anatomy, chemosymbiosis and evolution of the Lucinidae. In, Harper, E. N., Taylor, J. D. and Crame, J. A. eds., The Evolutionary Biology of the Bivalvia, 177:207–225. Geological Society of London Special Publications, London.

Poster 04

DIET OF THE *OPHRYOTROCHA* (ANNELIDA: DORVILLEIDAE) FROM WHALE- FALLS IN THE TSUKUMO BAY, JAPAN

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Abstract

Decomposition of large organic-falls, *e. g.* sunken whale carcasses is a part of nutrient cycle (Smith et al., 2015). The decomposition is performed by not only microbes but also some animals, *e. g.* the polychaetes. Some polychaetes can be found from inside of decaying bone, however, roles of the polychaetes animals are poorly understood. We examined the organic carbon isotope ratio and DNA(COI) of polychaete *Ophryotrocha* (Annelida: Dorvilleidae), a species lived in the whale bone deployed in the Tsukumo Bay. They are exposed to stress in the form of high levels of hydrogen sulfide but have successfully invaded into the bone. Morphological observation revealed the species is mainly characterized by shape of jaw and we considered as new species. Phylogenetic analyses based on COI suggest that they have independently invaded into whale falls, hydrothermal vent and methane seep from normal environment for each taxon group. The examined *Ophryotrocha* sp. had the broadest $\delta^{13}C$ range (-33.8‰~-19.0‰) among other species lived on/in the bones. It indicates that some of them fed on bacterial mat such as *Beggiatoa* sp. (-37.2‰~-28.5‰) but some of them don't. These results highlight the role of *Ophryotrocha* has diverse food source, and it would be an advantage to adapt various "extreme environment" such as vent, seep, and whale falls.

References:

Smith, C.R., Glover, A.G., Treude, T., Higgs, N.D. and Amon, D.J. (2015) Whale-fall ecosystems: recent insights into ecology, paleoecology, and evolution. Marine Science 7: 571–596.

Poster 05

MINERALS IN THE GILL CHAMBER AND THE DIGESTIVE TRACT OF HYDROTHERMAL VENT SHRIMP RIMICARIS KAIREI

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Abstract

The hydrothermal vent shrimp *Rimicaris* dominates the macrofauna community in the Mid Atlantic Ridge, the Central Indian Ridge (CIR), and the Caribbean Mid-Cayman Rise. This shrimp harbors numerous strains of episymbiotic bacterial community in its gill chamber, and depends on them for most of the nutrition. It is known that the tissues in the gill chamber were encrusted with brown or black iron precipitates probably due to the metabolism of the symbiotic bacterial community. Moreover, various minerals probably originated from hydrothermal vent fluid accumulated in the digestive tract. Considering that these minerals will deposit on the sea floor with molting or excretion, it is expected that *Rimicaris* play a role in metal accumulation and precipitating in the hydrothermal vent system. However, Detailes of the bioaccumulated minerals, e.g. mineral phase, quantities, and distribution, in the gill chamber and digestive tract haven't been studied deeply. In this study, we investigated the mineral species and mineral distribution in gill chamber and digestive tract of *Rimicaris kairei* from Edmond and Kairei vent fields in the CIR.

Observations on freeze-dried and thin-section samples using SEM and polarized microscopy respectively, it was observed that the brown precipitates form crusts of about 50 μm in thickness and cover entirely the inside of branchiostegite, where black precipitates occur as submicron size microparticles in organic filmy tissues around filamentous bacteria. Using SEM-EDX and μXRF-XAFS, it was suggested that the brown precipitates contain ferrihydrite, goethite, $FePO_4$, while the black precipitates contain ferrihydrite, goethite, $FePO_4$, and pyrrhotite. In the digestive tract, iron oxides, narive sulfur [S], pyrite [FeS_2], marcasite [FeS_2], chalcopyrite [$CuFeS_2$], sphalerite [(Zn,Fe) S], and barite [$BaSO_4$] were detected by XRD and Raman spectroscopy in specimens from the Edmond Field; while anhydrite was additionally detected in specimens from the Kairei Field. The metal sulfides decreased in density through the digestive tract from the mouth towards the anus in specimens from Edmond.

These results suggested that *Rimicaris* eat metal sulfides, sulfates, and iron oxides, and crush and consume these minerals through mouth to digeseive tract. On the other hand, in the gill chamber, it was suggested that iron hydroxide and pyrrhotite could be precipitated by microbial metabolism. In this study, we show different metal accumulation process in in the gill chamber and digestive tract of *Rimicaris*, respectively.

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