

Relationship between conch geometry and shell thickness in ammonoids

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Ammonoids had a conch with chambered phragmocone that served as a buoyancy apparatus as in extant nautilus or spirulas. If ammonoids were nektonic or nektobenthic animals, weight saving may have been critical for their locomotion. The relative density of the ammonoid body depends on conch geometry as well as shell thickness. If the conch geometry is such that its surface area to volume ratio is high, a large amount of calcium carbonate is required to form such a conch. An effective way to avoid overweight in ammonoids is to control shell formation such that more inefficient shape with a high surface-area to volume ratio is correlated with thinner shell thickness. In the present study, the relationship between conch geometry and shell thickness was examined in a total of 87 ammonoid species ranging in age from Devonian to Cretaceous. Specific surface was computed for theoretical models of ammonoid shell morphology with various values of Raupian parameter to assess how efficient each shape is to save the body weight. The values of the Raupian parameters were examined for each growth stage of the specimens examined and the specific surface of the model defined by the parameter values was calculated for each whorl. The relative shell thickness was measured for actual specimens as the cross-sectional area of shell material divided by the perimeter of the whorl cross section standardized by the conch diameter. As a result of morphometric analysis, a significant negative correlation was found between the specific surface and relative shell thickness; that is, the species with inefficient shell shapes tend to form whorls that are made of a thin material. The result suggests that density control was critical for ammonoids and conch geometry was important for their hydrostatic properties.

Keywords: ammonoids, specific surface, shell thickness

The significance of the Middle Pleistocene freshwater fishes from the Nogami Formation in Kyushu, Japan based on the study of phylogeny and paleobiogeography of the genus *Nipponocypris*

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Many well preserved freshwater fish fossils have been found from the Middle Pleistocene Nogami Formation, which is a lacustrine diatomaceous bed in Kusu Basin, Oita Prefecture in the northern part of Kyushu, Japan. Six species, five genera and six families have been recognized. These are *Oncorhynchus masou* subsp. of Salmonidae, *Hemibarbus barbus x labeo*, *Zacco* cf. *Z. temminckii* (= *Nipponocypris* sp.) and *Acheilognathus* sp. of Cyprinidae and *Rhinogobius brunneus* and *R. similis* of Gobiidae.

These fossils are important to study about the origin and history of the Recent freshwater fish fauna of Japan and East Asia, because many well preserved specimens allow us to accomplish the phylogenetic and paleobiogeographical studies of each species based on the comparison with Recent ones. In the present study, we conducted the phylogenetic and paleobiogeographical studies of Recent opsariichthins and the fossils from the Middle Pleistocene Nogami Formation in Oita Prefecture, Northern Kyushu, Japan.

The opsariichthin group is one of the common Asian endemic cyprinid fishes, which is distributed in China, Southeastern Asia, Korea, eastern Russia, Taiwan and Japan, and consists of following five genera: *Zacco*, *Opsariichthys*, *Parazacco*, *Candidia*, and *Nipponocypris*. Fossils of opsariichthins have been found from the Pleistocene Nogami Formation of Kusu Basin in Oita, the Miocene deposits in Ishikawa Prefecture, Japan, the Lower Eocene Buxin Formation in China and others.

The fossil opsariichthin from the Nogami Formation is assigned to the genus *Nipponocypris* because of eight supraneurals, the posterior margin of the opercle concave and 42-44 vertebrae. The genus consists of following three species: *Nipponocypris temminckii*, *N. sieboldii* and *N. koreanus*.

The result of the cladistic analysis of Recent and fossil opsariichthins suggest that the fossil opsariichthin from the Nogami Formation is the sister species of *Nipponocypris temminckii*. It indicates the possibility that the ancestor of *N. temminckii* appeared at latest the Middle Pleistocene time. The existence of this fossil and *N. temminckii* distributed in the western part of Japan and the southern part of Korean Peninsula suggest that *N. temminckii* probably derived in Japan and migrated to Korean Peninsula after the Middle Pleistocene. This is significant to understand the origin and speciation of other Japanese freshwater fishes having the same distribution pattern like *Coreoperca kawamebari*.

Keywords: Cyprinid fishes, Pleistocene, Nogami Formation, freshwater fishes, *Nipponocypris*, opsariichthins

Living Polycystine Radiolarian Vertical Distribution in Southern Japan

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Polycystine radiolarians are one of the planktic micro-organism (Protista), bearing siliceous test, widely distributed in the world ocean. Their geographic and vertical distributions have been investigated in many regions, such as tropical and equatorial area of the Atlantic Ocean, Gulf of Mexico, Western Equatorial Pacific and subarctic area of the Northwest Pacific. However, we have a lack of studies, which aim to clarify radiolarian vertical distributions in area influenced by the Kuroshio Current (Northwest Pacific). The Kuroshio Current (KC) is a western boundary current of the Pacific Ocean, which bifurcates from the northward flow of the North Pacific Equatorial Current, carrying warm and oligotrophic water to the northeastern Asia. The KC is well-known for be relatively thick (could reach few hundred meters of thickness depending on area) and thus have a consequent influence on the regional oceanography and distribution of marine organisms. Therefore, in this study, we propose to elucidate how the KC influence the radiolarian species vertical distribution analyzing plankton tow samples collected off southern Japan. We have investigated samples collected during the cruise KT08-10 of R/V Tansei-maru and cruise KS15-4 R/V Shinsei-maru in spring 2008 and 2015 respectively. During the KT08-10, plankton tow samples could be collected at five stations in the northern East China Sea (ECS), an area influenced by a branch of the KC the so-called Tsushima Warm Current, while during the KS15-04, plankton tows samples could be collected at three stations in the Kyushu Palao-Ridge, an area influenced by the KC. The deepest samples collected in ECS reach 700 m (near the seafloor of this area), while in the Kyushu Palao Ridge, we could collect samples until 3000 m. In both area, the surface water is characterized by subtropical species such as *Tetrapyle circularis* group and *Didymocyrtis tetrathalamus*. However, colonial radiolarians seem to be more abundant in the Kyushu Palao Ridge. The sub-surface of the ECS is characterized by high abundances of *Eucecryphalus* sp. (200-300 m). However, the abundances of this species are much lower in the Kyushu Paleo Ridge, inferring that a *Eucecryphalus* sp. likely suggest sub-surface water proper to the ECS. For these water depths (200-300 m), *Pterocorys carnitatum* dominate the assemblage in Kyushu Paleo Ridge. *Pterocorys* group is generally associated to the sub-surface of the North Pacific Subtropical Gyre, so we may speculate that in Kyushu Paleo Ridge we have some influence of the Subtropical Gyre. Intermediate to deep-water depths are characterized by relatively high abundances of *Cycladophora davisiana* in the Kyushu Paleo Ridge, while this species is absent in the ECS. Few factors may be considered such as the depth of the seafloor in the ECS, and provincialism.

Keywords: Radiolaria, Vertical Distribution, Kuroshio Current

Geology and siliceous microfossil biostratigraphy of the Miocene formations near the whale fossil locality, Hae River, Hidaka district, Hokkaido

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A calcareous concretion containing whale bones was discovered as a float during the riparian works on the Hae River, Hidaka Town in 2005. Radiolarian and diatom assemblages recovered from the concretion indicate the *Lipmanella redondoensis* Zone and the *Rouxia californica* Zone, respectively, suggesting an age of 7.7 to 7.4 Ma. This age is concordant with the age range of the Nina Formation which is distributed near the locality of the concretion and was previously dated as ca. 10.1 to 3.5 Ma based on the diatom stratigraphy in the surrounding area. However, because of very few biostratigraphic data for the sedimentary rocks exposing along the Hae River, the location of the original home of the concretion is unknown. In order to detect the home locality, we surveyed geology along the river and analyzed diatom and radiolarian biostratigraphy for the sedimentary sequence. The Nina Formation exposing along the Hae River mainly consists of diatomaceous mudstone, sandy mudstone and sandstone. Many of the studied samples yielded common to abundant fossil diatoms that include various index species, *Denticulopsis praedimorpha*, *Denticulopsis dimorpha*, *Denticulopsis katayamae*, *Thalassionema schraderi* and *Neodenticula kamtschatica*. The occurrences of these species indicate that the Nina Formation encompasses the Middle Miocene through the Pliocene. However, we have not found diatom assemblages indicative of the *Rouxia californica* Zone from the studied samples, and, thus, the home locality of the whale fossil is still an unsolved question.

Keywords: Diatom, Radiolaria, whale fossil