

Chemostratigraphy of the Ediacaran Doushantuo Formation in central Guizhou province

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In the Ediacaran period (635 Ma ~ 542 Ma), the Marinoan and Gaskiers glaciations have been widely recognized as drastic climate changes. Because these changes were temporally associated with evolution of the metazoan, the crucial relationships has been discussed actively. The Ediacaran Yangtze platform in south China is a key locality for understanding the relationship due to well-preserved sedimentary rocks of various environments from shallow to deep ocean. Additionally there are many Ediacaran fossil records from this platform.

There are many sections that yield fossils, such as Miaohu biota and Wenguan biota from the Ediacaran Yangtze platform. The Wenghui section in central Guizhou province is one of them, and exposes a basal facies (Jiang et al., 2011). The fossils from this section include algae, sponges and annelids and are called the Wenghui biota (Jiang et al., 2011; Wang and Wang 2008, 2010). Despite the importance of this biota, geochemical analyses have never performed for the Wenghui section, and therefore the correlation with other Ediacaran sections is poorly understood.

Wenghui section is about 65 m thick and divided into the Nantuo Formation, the Doushantuo Formation and the Liuchapo Formation in ascending order. The Nantuo Formation is extensively distributed as post-Marinoan diamictite in the Ediacaran Yangtze platform. The Doushantuo Formation consists of carbonate-shale sequence, and the occurrences of pyrite throughout this formation indicate a reductive environment. This formation includes the Wenghui biota in black shale of the upper part (Wang and Wang 2008, 2010). Additionally, we found a new fossil horizon of carbonate rock in lower part, which yields algae and sponge spicules from. These fossils are mainly preserved as apatite. The overlying Liuchapo Formation exposed in the upper section consists of the alteration of black chert and black shale. This Formation is correlated with the Dengying Formation distributed in shallow facies of the Ediacaran Yangtze Platform.

We are analyzing inorganic carbon and oxygen isotopes in order to consider paleoenvironment of Wenghui section and provide chemostratigraphic correlation, and will represent the results.

Keywords: Ediacaran, chemostratigraphy, China

Repeated anoxia-extinction episodes progressing from slope to shelf during the latest Cenomanian

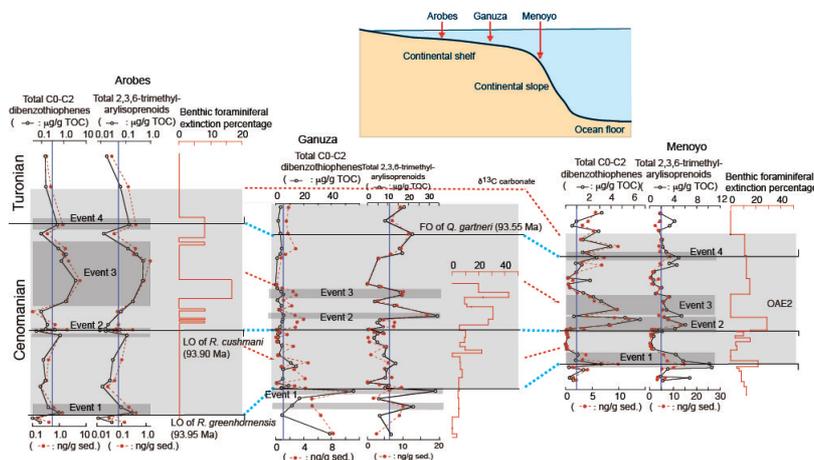
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Oceanic Anoxic Event 2 (OAE 2) during the Cenomanian-Turonian (C/T) transition caused stepwise marine extinctions. Using organic compounds, stable carbon and oxygen isotopes, and foraminifera from three depth-transect sections in northern Spain, this study revealed repeated anoxic/euxinic events coinciding with warming and stepwise extinctions of planktonic and/or benthic foraminifera within intermediate to surface waters in the proto-North Atlantic during the C/T transition. Those short-duration euxinic events occurred four times: at 93.95 Ma, marked by the extinction of *Rotalipora greenhornensis*; at 93.90 Ma, marked by the extinction of *Rotalipora cushmani*; at the mid-time maximum of the plateau of the $\delta^{13}C$ of carbonates (93.70 Ma); and at the time of the C/T boundary (93.55 Ma). Furthermore, the main benthic foraminiferal extinctions occurred during the first and second euxinic events in the upper slope, during the second and third euxinic events in the outer to middle shelf, and during the third and fourth events in the middle shelf. The main euxinic events in each section also showed a progression to the shallow shelf. The main anoxia-extinction events occurred in the upper slope and outer shelf then moved to the middle shelf. The shallowest section had relatively weak anoxia and a proportionally low extinction rate. These new findings indicate that foraminiferal extinctions started from the intermediate water and the continental slope and then moved to the continental shelf. This was the result of the repeated progression of euxinic-anoxic water from the upper slope to the middle shelf on the eastern continental margin of the proto-North Atlantic four times during a 400 kyr period, to the end of the Cenomanian.

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Keywords: biomarker, Oceanic Anoxic Event 2, extinction, anoxia, surface temperature



Kerogen analysis of sedimentary rocks deposited during the Cretaceous OAEs

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Some of the formations deposited during the mid-Cretaceous, which is extremely warm period, are characterized by organic-rich laminated black shale which was thought to be deposited as a result of repeated expansion of ocean anoxia, called 'the oceanic anoxic events (OAEs)'. Organic matter in the black shales from the levels of the OAEs is well preserved and abundantly contains organic microfossil (palynomorph). Palynomorph analysis under transmitted light microscope has been performed in the sedimentary rocks from the levels of the OAEs (e.g., Heimhofer et al., 2006), although most of the analyses were focused on only a few specific organic microfossils such as spore, pollen and marine algal cyst. In the present study, we analyze palynofacies and palynomorph including very-small size palynomorph such as acritarch of kerogens in sedimentary rocks from the levels of the OAEs in the Vocontian Basin.

Black shales were collected from the outcrops of the Goguel (OAE1a), Jacob, Kilian, Paquier, Leenhardt (OAE1b), unnamed (OAE1c), Breistroffer (OAE1d) and Thomel (OAE2) levels in SE France. These crushed samples were extracted with ultrasonication and their residues were sequentially treated by HCl and HF in a water bath shaker (Sawada et al., 2012).

From results of palynofacies analyses, it is found that amorphous organic matter (AOM) account for more than 80 % in whole kerogen. The relative abundances of weakly-fluorescent AOM (WFA), which is thought to be marine origin, were higher at the Goguel, Breistroffer and Thomel levels, while non-fluorescent AOM (NFA), which may be terrigenous origin was abundant at the Paquier and unnamed OAE1c levels. Moreover, the Thomel level is characterized by abundant fluorescent AOM (FA), which is thought to be fragment of terrestrial phytotissue, and phytoclasts (particle of cuticle and wood) were abundant at the Paquier, OAE1c and Thomel levels. We suppose that terrestrial input was enhanced during the OAE1b, 1c and 2. Above the Paquier level, trilete and monolet-type spores (spore of bryophyte or pteridophyte) were dominant in spore/pollen assemblage. These results imply that eutrophic condition at sea surface water in the Vocontian Basin after the OAE1b, because they favored wetter environment and their spore might be efficiently transported by fluvial system. The Paquier and more upper levels were predominated by dinocyst and related small acritarch, whereas Sphaeromorph-type acritarch that is related to Chlorophyta was mainly identified at the Goguel level. These cysts were thought to be originated from marine autotroph algae. Hence, it indicated that marine producer was different between these OAEs.

Keywords: oceanic anoxic events (OAEs), kerogen, dinoflagellate, acritarch, palynomorph, palynofacies

Analysis of shell beds from Yabu Formation in Semata, Ichihara City, Chiba Prefecture, Japan.

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This is study of shell beds in the Middle Plesitocene Yabu Formation of the Shimousa Group. Many studies have been done for the Yabu Formation(e.g. Aoki and Baba, 1970 ; Nishikawa et al. , 2000). However, these literatures didn't focus on detailed scale of shell beds in the Yabu Formation. So, we studied detailed analysis of the shell beds using oriented block sample.

In Semata, Ichihara City, Chiba Prefecture, a part of Yabu Formation(ca, 3m thick) has been exposed. The Yabu Formation is composed of sandstone. The exposed strata can be classified into lower and upper parts. Boundary between upper and lower parts are 1.3m above the bottom of outcrop. There are HCS and SCS in the lower part,shells parallel to their bedding planes. Shell beds are frequently intercalated in the upper part. We took oriented block sample (40cm*40cm*30cm) from the outcrop. The Yabu Formation is not enough to consolidate for block sampling. Thus, we made wooden frame(called " GOSSON ") to prevent collapsing of the strata. Base of the sample is same as boundary of upper and lower units.

We brought oriented specimen in the laboratory, and carefully removed sediments parallel to the bedding plane from upper side of the sample. On this occasion, we defined section as that a layer including shells, i.e. boundary between each section is a layer with no fossils. We described following information; a convex-up/down of bivalve, horizontal position, species, apex orientation, maximum shell length(=L),articulation. In addition we calculatate convex-up rate, number of individuals, area density of fossil (=the area that a fossil accounts for / whole area in each section), size distribution(three demarcation: $L \geq 40\text{mm}$, $40\text{mm} > L > 20\text{mm}$, $20\text{mm} \geq L$) in each section.

Totally 60 section were recognized in the sample. The thickness of each section was 3 ? 12mm. 427 specimens(425 specimens with 13 species for bivalve, 2 specimens with 2 species for gastropod and 2 specimens with 1 species for scaphopod) have been identified from the sample. All the bivalves were disarticulated. Thus, the all shells were transported from their original living place. The convex-up rate was more than 80% in 48 sections. The results suggest that the shells were deposited not under influence of turbulent flow, but unidirectional flow. In contrast, the convex-up rate in section 10, 58, 59 was less than 50%. It indicates that shells didn't deposit by unidirectional flow in this horizons. The number of individuals and area density of fossil increased from section 01 to section 44. It tends to decrease above section 44. The results indicate that conditions of transportations and sea floor were changed several times during the shell accumulated beds were forming. According to shell size distribution, i.e. the large ($L \geq 40\text{mm}$) shells are rare when the small ones ($20\text{mm} \geq L$) are abundant in the section, the shells are well sorted during transportations.

It is concluded that 1) by using the abovementioned method, it is possible to take oriented block samples even from the unlithified sandstone. 2) as a careful and detailed analyses within a shell bed revealed that the shell bed was formed by a multiple sedimentation event.

Keywords: oriented block sampling, shell beds, Yabu Formation, taphonomy

Measuring morphological richness in morphospace: another look at disparity

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Detecting patterns of change in biodiversity has been at the center of paleontological studies during the past quarter-century. Recently, there has been much interest in relationship between taxonomic diversity and morphological disparity. Studies on diversity change need an appropriate measure of diversity as well as removal of sampling overprints. The taxonomic diversity is assessed through compilations of the number of taxa, i.e., taxonomic richness. Meanwhile, the morphological disparity is commonly based on measurements of morphological distance between objects, e.g., sum of variance, mean pairwise distance, range of variation etc. Richness and distance (or dissimilarity) are different properties of diversity and cannot be compared on an equal plane. Comparison between taxonomic diversity and disparity needs to develop measures of morphological richness such as number of pairwise character-state combinations and participation ratio. Counting the number of pairwise characters requires the division of the morphospace up into discrete bins. However, measures of morphological richness hitherto been available highly depends on how to bin the morphospace as well as on sample size.

Here, I would propose a method to assess morphological richness and morphological evenness that are robust with respect both to option for analysis and sampling effort. At the first step, the probability density of data in a morphospace is estimated using multi-dimensional kernel density estimation instead of depicting a histogram. In the next step, randomized subsampling of data is designed to remove sampling intensity biases using the probability densities at the positions where the sampled data occupy in the morphospace. Subsampling is carried out until the data that have been sampled have a summed total of the probability densities which equals a fixed proportion. This approach is closely related to the shareholder quorum sampling rather than classical rarefaction. A morphological richness is assessed by an extent of the Bayesian highest posterior density region of the probability density of the subsample in the morphospace. Conventional participation ratio based on discrete criteria is extended to a case of continuous variables so as to define a new measure of morphological evenness.

Keywords: disparity, richness, evenness, morphospace