論文内容の要旨

論文題目：Chaetognaths and planktonic communities

Three approaches of the Early Cambrian water column

（毛顎動物と浮遊性群集：

カンブリア紀初期浮遊生物相への３つのアプローチ）

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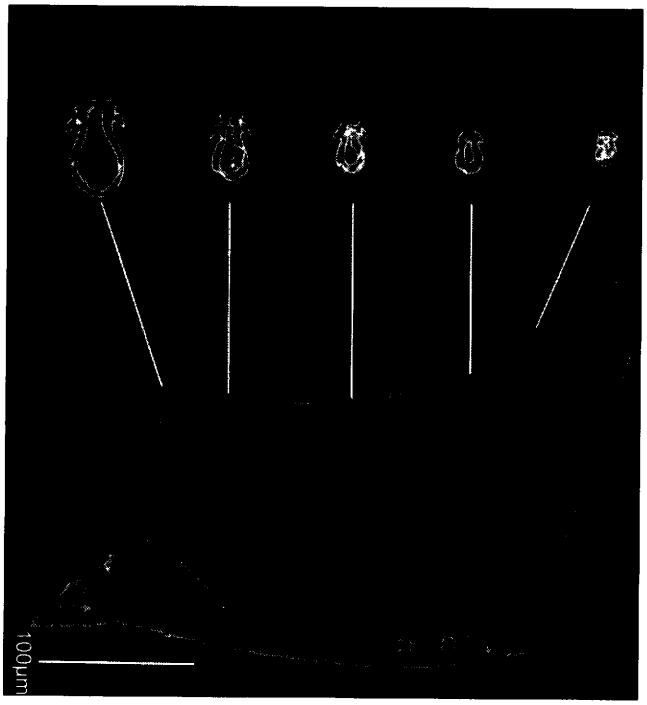
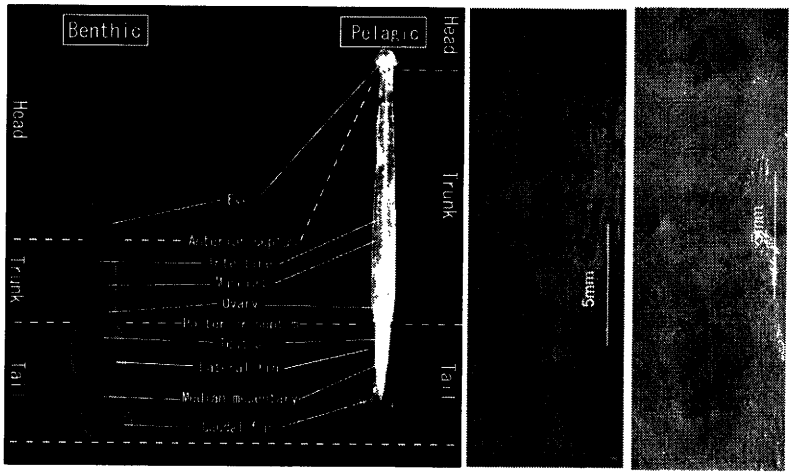
Chaetognaths are small (2-120mm) carnivorous predators of the marine zooplankton. However, they represent the second most important component of the planktonic community in terms of both biomass and abundance. A vigorous debate concerning the classification of chaetognaths has divided biologists and paleontologists ever since their first observation in 1769 but recent molecular data suggest an affiliation to protostomes. As more than 40% of modern phyla, the evolutionary history of these animals likely started during the Early Cambrian but their fossil record remains patchy due to their lack of biomineralized structure.

The present work investigates the origins of chaetognaths by a closer examination of both the full body fossils and isolated phosphatic spines known as protoconodonts. This study will be divided into four parts treating various aspects of the problem. The first summarizes the knowledge about extant chaetognaths and notably their morphology and ecology. As a review, this part will set the base of the following fossil chaetognath studies and stress the tight relations between chaetognaths and their biotic and abiotic environment.

The second part approaches the fossil record of chaetognaths and notably the affiliation of protoconodonts to the Chaetognatha. By re-examining the structural evidence already documented in the literature then strengthening these conclusions by new observations relying on new techniques, I could demonstrate that the fossil spines exhibit characteristic layered cross section, internal lamellae and a fibrous inner structure compatible with the features of modern chaetognath spines. However, the number of layers is not consistent due to a preservation bias and furthermore protoconodont spines exhibit a variety of shapes that is not observed in recent taxa. Therefore, if it is possible to confirm the assignment of protoconodonts to Chaetognaths, the results show that protoconodonts indicate possible functional variations in comparison to recent examples. In addition, the diversity of protoconodonts as soon as the Early Cambrian suggests the appearance of chaetognaths during the Ediacaran.

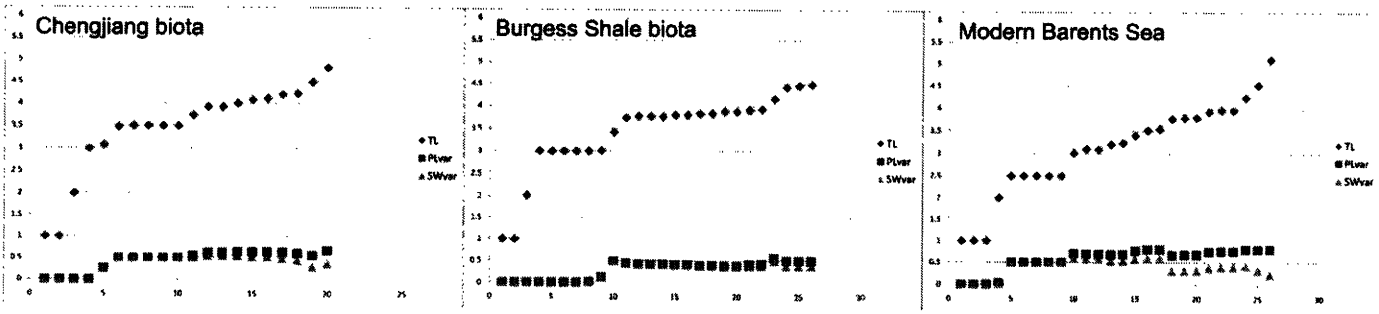


The third part focuses on the lifestyle of fossil chaetognaths. A large majority of chaetognaths are pelagic but 20% of species show a benthic lifestyle. Starting by an evaluation of the characteristic adaptations of pelagic and benthic forms, I try to correlate these features to physical constraints of the viscous fluid in which chaetognaths move. The results demonstrate the possibility of deducing lifestyle from preserved



chaetognath body fossils as a small size and a high tail: body length ratio is a general character of all benthic forms while a longer body and a low ratio are observed among pelagic forms. Therefore, it is possible to assign the oldest full body chaetognath *Eognathacantha ercainella* to a pelagic position in the Early Cambrian water column. This fact has strong ecological implications as the plankton community was supposed to present a simple trophic organization at the beginning of the Phanerozoic.

The fourth and last part is the most abstract and consists of a reconstruction of the Early Cambrian planktonic food web from a size-based model. By assuming that the planktonic ecosystem is organized following the simple rule that predator only predate upon a given range of prey sizes, it was possible to create a selectivity function which, for each predator size, evaluate the proportion of the various possible preys in their diet. The results support a hypothesis stating that Early Cambrian planktonic ecosystems exhibited levels of trophic complexity comparable to modern oceans, and that chaetognaths were already important predators of early pelagic niches.



The combination of these three approaches reveals that 1) chaetognaths appeared probably originated in the Proterozoic; 2) that, during the Early Cambrian, some chaetognaths already show morphological evidence of a pelagic lifestyle and eventually that 3) trophic reconstruction indicate a high level of biotic interaction as well as a hierarchy comparable to modern oceans.