

Habitat of the Cretaceous nautiloid *Eutrephoceras*; isotopic evidence for depth segregation of the late Cretaceous biota

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Though early evolutionary history of Nautiloidea (Cephalopoda) within Mollusca has still been debated, the very first fossil nautiloids have been reported from the late Cambrian. After that origination, despite nautiloids have experienced many huge mass extinction events, their descendants are represented in the modern ocean by several species of *Nautilus* and *Allonautilus*. Their diversity has flourished in the early Paleozoic, and Ammonoidea and Coleoidea were derived from Nautiloidea in the mid-Paleozoic via Bactritida. Among these three groups of cephalopods, ammonoids and nautiloids share an ectocochliate body plan, whose shells consist of a phragmocone and a subsequent body chamber. Considering the fact that these two groups coexisted in the Mesozoic ocean, and only ammonoids completely disappeared in the end Cretaceous extinction event, it is hypothesized that ecological niches, such as depth habitat, food habit, and/or reproductive strategy, of these two groups were segregated within an ancient water column. Habitat depth of the Cretaceous ammonoids has been analyzed by Moriya et al. (2003), who concluded that ammonoids were demersal organisms dwelling on the bottom of the ocean. However, habitat depth of the Cretaceous nautiloids has never been systematically analyzed to date. Therefore our knowledge for depth habitat segregation of these two groups is still uncertain. Here, we present oxygen isotopic records of the Cretaceous nautiloid *Eutrephoceras dekeyi*. Because genus *Eutrephoceras* survived the end Cretaceous extinction event and belongs to the Nautilidae which include modern chambered nautilus, it is the best representative for understanding the niche segregation between the Cretaceous ammonoids and nautiloids. We calculated shell secreting temperature from isotopic records of *E. dekeyi*. Then we discussed depth habitat of the Cretaceous nautiloid by superimposing those isotopic temperature on thermal structure of the Cretaceous water column in which the analyzed nautiloid occurred.

We utilized a well-preserved specimen of *E. dekeyi* recovered from the late Campanian Coon Creek Formation in McNairy County, Tennessee, USA. Coon Creek Formation was deposited at a part of Western Interior Seaway, and paleo-depth of this basin is estimated at 30 degreeN. Shell diameter of a specimen analyzed is 42.4 mm. For isotopic analyses, aragonitic nacreous outer shell layer was milled with micro-drill of 300 micrometer diameter at almost every 1 mm interval. In addition with this *E. dekeyi* specimen, we also analyzed co-occurring planktic foraminifers *Rugoglobigerina rugosa* and *R. hexacamerata*. Sea surface water temperature calculated from these foraminiferal oxygen isotopes is 30 degreeC. Isotopic temperatures of *E. dekeyi* show almost constant through the interval analyzed at 16 degreeC. While oxygen isotopic composition stays almost constant, carbon isotopic composition indicates sigmoidal fluctuation in the interval analyzed. $\delta^{13}C$ of the adoral end indicates -1.5 per mil (VPDB), and it is gradually decreasing toward adapical direction. Once $\delta^{13}C$ reaches at its minimum of -2.5 per mil (VPDB), it is gradually increasing and showing its maximum of -1.2 per mil (VPDB). After that maximum value, $\delta^{13}C$ is decreasing toward adapical end, and it shows -1.5 per mil (VPDB) at the adapical end. Therefore we observed one cyclic fluctuation whose amplitude is 1.3 per mil within the interval analyzed.

Significant isotopic temperature offset of 14 degreeC between E. dekeyi and planktic foraminifers obviously indicates that E. dekeyi inhabited much cooler water mass than planktic foraminifers. This significant temperature offset and constant isotopic temperature of E. dekeyi imply that the late Cretaceous E. dekeyi dwelled near the seafloor in the interval analyzed.

Keywords: Cretaceous, Coon Creek Formation, Eutrephoceras, Oxygen isotope, Paleotemperature, Depth habitat