

Detailed age determination of Cretaceous shallow marine - non-marine strata

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Introduction

It is very difficult to determine detailed age of pre-Quaternary shallow marine and non-marine sequences because they are usually very poor in age diagnostic fossils. However, age determination of such sequences is important to demonstrating past sea level changes as well as evolution of terrestrial fauna and flora. Since the shallow marine and non-marine sequences contain abundant wood fragments, carbon isotope stratigraphy is appropriate method for determining the age of those strata. This study attempted to determine the detailed age of the Cretaceous shallow marine?non-marine sequence of the Kuji Group using carbon isotope stratigraphy and U-Pb ages of tuffs.

Geologic outline of the Kuji Group

The Kuji Group is about 800-m-thick sequence exposed in the eastern coast of Iwate Prefecture. This group overlies unconformably the Jurassic accretionary complex (Rikuchu Group) and is unconformably overlain by the Paleogene non-marine sequence (Noda Group). The group consists mainly of sandstone and conglomerate with subordinate amount of coal and coaly mudstone, and is composed of the Tamagawa, Kunitan and Sawayama Formations in ascending order.

Since the Kuji Group yields abundant well-preserved plant and terrestrial vertebrate fossils such as dinosaur and reptiles (e.g., Hirayama et al., 2010), detailed age determination of this strata is critical for reconstructing terrestrial fauna and flora of the Cretaceous East Asia. The group also intercalates a lot of felsic tuff beds throughout the sequence which provides good anchor points for correlation of carbon isotope curves between the Kuji Group and other marine sequences.

Method

About 500 sandstone and coaly mudstone samples for carbon isotope analysis and 8 felsic tuff samples for U-Pb dating were taken from the sections of the Tamagawa coast, Edanari, Osawada, Natsui and Sawayama streams. For the tuff samples, zircons were separated using heavy liquid, and zircons of 50 grains randomly by a handpicking were pressed into soft PFA sheet, and their surfaces were polished using 3- and 1- μ m diamond paste. The U-Pb isotopic age of zircons were determined using LA-ICP-MS at the Nagoya University. For the carbon isotope analyses, wood fragments were picked up from the disaggregated sediments, and the carbon isotope of the wood fragments of the sample was then measured using a mass spectrometer (IsoPrime) in line with an elemental analyzer EuroEA3000.

Result and discussion

The U-Pb isotopic ages of tuffs from the Kuji Group range from 95 to 80 Ma, and the carbon isotope ratio of the fossil wood fragments of this group changes between -27.0‰-20.9‰. We correlated the carbon isotope curves among the Kuji and the Yezo groups and the English Chalk with the help of many anchor points of the U-Pb isotopic ages and several macro fossils. As the result, we identified exact Cretaceous stage boundaries of the Cenomanian/Turonian, Turonian/Coniacian, Coniacian/Santonian and Santonian/Campanian in the Kuji Group. The bone bed containing dinosaur in the Osawada stream is assigned to be lower Coniacian.

Keywords: Cretaceous, Carbon isotope, U-PB age, tuffs