Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

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The age correlation of carbon isotopic ratios from terrestrial woody material in the Late Cretaceous Mifune Group

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The age correlation of sedimentary sequence has been based on bio- and magnetostratigraphy. However it is difficult to correlate between marine and non-marine sequence due to the absence of marine fossils such as planktonic foraminiferas, ammonites and inoceramids in non-marine sedimentary rocks. Recent studies have suggested that comparing the fluctuations of carbon isotopic ratios from the carbonates or the organic matters in sedimentary rocks is assumed to be a tool of direct correlation between marine and non-marine sequence. For example, Takashima et al. (2010) have supported that the fluctuations of carbon isotopic ratios from the terrestrial woody materials on the marine sequence in Pacific region correspond well with those from marine carbonates in Tethyan and Atlantic regions. Thus, there is the possibility that carbon isotopic ratios from the terrestrial woody materials in non-marine sequence show a similar fluctuation pattern.

In this study, sedimentary rocks mainly of mudstones and sandy-siltstones were collected from the lower part of the Lower Formation of Mifune Group, which formed non-marine condition, distributed in middle Kyushu. From these samples, woody materials were picked out under the binocular and carbon isotopic ratios (delta-13C) of woody materials were measured by EA/irMS.

The study section has been considered near the Cenomanian/Turonian boundary (Ikegami et al., 2007). delta-13C^{wood} values fluctuated from -27.2permil to -21.5permil with an average of -24.3permil in this section.delta-13C^{wood} curve showed two features: anomalous low values of delta-13C^{wood} (-27.2permil) followed by abrupt increasing of delta-13C values to over -22permil in upper part of section. As compare to the carbon isotope staratigraphy of delta-13C^{wood} from Yezo Group in Hokkaido which is marine sequence and its age correlation with European region is established based on biostratigraphy of planktonic foraminifera, fluctuation pattern of carbon isotope ratios in this studied section seems to be correlated to late Cenomanian. And it is not contradiction to the estimated age in the past study. The result support that comparing the fluctuation of carbon isotopic ratios from detrital woody materials is a useful tool to correlate directly marine and non-marine sequence and it is expected that the comparison of both can be established by an accumulation of carbon isotope data of terrestrial organic matter.

Keywords: carbon isotope, cretaceous

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The age correlation of carbon isotopic ratios from terrestrial woody materials in Lower Cretaceous Sasayama Group

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The Earth has experienced lots of environmental changes in the past. Especially, during Cretaceous period in Mesozoic, the average global surface temperatures were 14 degree higher than today, therefore, this period was called Greenhouse Earth. Under such a condition, it has been documented various global events such as sea level raise and absence of permanent ice sheets. On the other hand, it is reported that absence of geomagnetic anomaly (Cretaceous superchron) lasted for almost 40 million years from about 120Ma to 83Ma. Therefore, age correlation using paleomagnetism is difficult during the period. To overcome the difficulty, stable carbon isotope stratigraphy, come to use progressively recently as a new stratigraphic tool.

The plants use atmospheric $^{12}CO_2$ preferentially during the photosynthetic processes. It is expected that stable carbon-isotope fluctuations by plants precisely trace that of atmospheric CO_2. Stable carbon isotopic compositions in plants could be affected by various factors more than once such as increasing or decreasing of vegetation. Hence, carbon-isotope fluctuations preserved in plant tissues serve as a good correlative tool.

Here, we measured stable carbon-isotopic compositions of isolated terrestrial plant fragments, fossil wood, in the sedimentary rocks through the non-marine Sasayama Group, distributed western Honshu, Japan, and then we evaluated the potential of stable carbon-isotope stratigraphy.

The carbon-isotopic values obtained from the fossil woods varied ranging from -19.0 to -25.9 permil, with an average of -22.0 permil. At the two stratigraphic level, carbon-isotopic ratios of fossil wood exhibit significant shifts toward relatively high value. We correlate ages comparing carbon isotope fluctuations within 93-125Ma, the Fission-track (F.T.) age previously published.

In Aptian-Cenomanian, carbon-isotope records obtained from the fossil wood fragments vary ranging from -20 to -25 permil and only during Aptian period, major positive excursions exhibit. Our data closely consistent with that of the marine Lower Greensand Formation, England and the apparent patterns agree with in mid-Aptian trends.

Accordingly, it may be assumed that the age of Sasayama Group, based on stable carbon-isotope stratigraphy, could become detailed much more than F.T. dating. Our data also coincide well with previous study (114Ma) and it may support the applicability of stable carbon-isotope stratigraphy. The combination of both carbon-isotope stratigraphy and radiometric age allows more significant and detailed correlation.

Keywords: Sasayama Group, terrestrial organic carbon, carbon isotope, age correlation

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Which type of morphospace does work well?: dimensional artifacts revisited

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Theoretical morphological models have been used for morphometric analyses as well as for simulation studies of organic morphogenesis. Among a number of theoretical morphological models, the most widely applied one is Raup's (1966) model, in which molluscan shell form is defined by whorl expansion rate, relative width of umbilicus, and rate of translation of the whorl along the coiling axis. The Raup's morphospace is usually depicted as a geometric hyperspace in which a particular shell form is plotted with orthogonal axes representing his model parameters. However, recent specialists on theoretical morphology are highly critical of the Raup's parameters because they are not algebraically independent one another and the dimensions of his morphospace are not truly orthogonal (Schindel 1990; Stone 1996; McGhee 1999). Such a property of his model makes the range in the morphospace unreliable as a metric for disparity or morphological variation.

Here I assessed the impact of algebraic interdependency among parameters for the following models theoretically and empirically. In Okamoto's (1988) model, a positive correlation is theoretically supposed between standardized curvature and enlarging ratio of the generating curve; this type of correlation was observed in biometric data obtained from ammonoids specimens. In Schindel's (1990) model, the umbilical expansion rate should be equal to the whorl expansion rate in the case of logarithmic spiral; a positive correlation between them was found in actual ammonoids. In Ubukata's (2000) model, translation rate of the generating curve should be correlated with the position of the center of the translation due to the dimensionality of the morphospace; the dimensional artifact well explains the distribution of actual data collected from limpet shells. The algebraic interdependency among parameters may be a common defect of most theoretical morphologic models ever proposed.

Keywords: theoretical morphospace