C-isotope chemostratigraphy of a PC/C boundary section,Three Gorge area,S China:Basal-Tommotian regression and Cambrian Explosion

Tomoko Ishikawa[1]; Yuichiro Ueno[2]; Tsuyoshi Komiya[3]; Shigenori Maruyama[4]

[1] Earth and Planetary Sci,TiTech; [2] Dept. Env. Sic. Tech., Tokyo Tech.; [3] Earth & Planet. Sci., Tokyo Inst. Tech.; [4] Earth and Planetary Sci., Tokyo Institute of Technology

The Precambrian/Cambrian (PC/C) boundary is one of the most important intervals for the evolution of life (Knoll&Carroll, 1999). In order to understand the link between animal evolution and global environmental change, it is essential to correlate various Neoproterozoic to Early Cambrian sections over the world. However, biostratigraphy is not sufficient for correlation, since index fossils rarely occur across the PC/C boundary. On the other hand, carbon isotope chemostratigraphy has been developed as an alternative and more powerful tool for precise correlation of the world's PC/C boundary sections (e.g. Kaufman et al, 1997).

We have performed scientific drilling of the PC/C boundary sections in the Three Gorge area, South China scince 2005. This section covers Neoproterozoic dolomite (Dengying Formation) and Early Cambrian muddy limestone (Yanjahe Fm.) and black shale (Shuijintuo Fm.) in ascending order. According to paleontolgical study of Chen (1983) in this area, key fossils of Nemakit-Daldynian stage (Protohertzina anabarica and Anabarites trisulcatus) first appeared at the horizon 11.7m above the Dengying/Yanjahe boundary and Tommotian-type Small Shelly Fossils (e.g. Aldanella) at 2.7m below the Yanjahe/Shuijintuo boundary. Also, trilobites corresponding to Atdabanian stage appear at the upper part of Shuijintuo Formation (Zhu et al, 2003).

It has been known that carbonate carbon isotope ratio (d13Ccarb) shows a negative excursion down to -4 permil - -8 permil at the PC/C boundary (e.g. Narbonne et al, 1994, Amthor et al, 2003). Nevertheless, in previously analyzed sections of South China, the precise position of this d13Ccarb negative excursion has been still controversial (Shen&Schidlowski, 2000, Zhu et al, 2001) mainly due to lack of continuous record. Also in any other sections in the world, across the PC/C boundary interval, high-resolution carbon-isotope chemostratigraphy has rarely been reported particularly for the Early Cambrian, hence, it remains inadequate to correlate the various sections of the interval from Nemakit-Daldynian, through Tommotian, to Atdabanian.

In this study, we conducted carbonate carbon and oxygen isotope analysis of the drill core, sampled on high-resolution intervals about 5mm to 1m (total 174 samples). As a result, we found two negative and one positive carbon isotope excursions through this section. Across the PC/C boundary, d13Ccarb drop gradually from +2 permil to -7 permil (Negative excursion 1: N1). Subsequently, d13Ccarb continuously increases up to about +5 permil in the Nemakit-Daldynian stage. After this positive excursion, d13Ccarb sharply decreases down to about -9 permil towards the base of Tommotian (N2), then rapidly back to about 0 permil. These continuous changes of the d13Ccarb profile and lack of positive correlation between carbon and oxygen isotope ratios both strongly suggest that the d13Ccarb preserves the primary isotopic composition, probably reflecting sea water chemistry at that time. The sharp negative excursion about -9 permil at the basal-Tommotian (N2) is considerably lower than those reported from other sections -2 permil to -4 permil (Brasier et al, 1994, 1996, 1999). This discrepancy may be due to discontinuous record of the strata of this age. Hiatuses near the base of the Tommotian have been suggested by many of the profiles, and probably reflect a lowerling of global sea level (Ripperdan, 1994). Our newly recognized strong negative excursion at the basal-Tommotian (N2) is closely related with this regressive event. This may indicate causal link between the regression (glaciation?) event and dramatic change of carbon cycle just before the sudden appearance of various fauna (Cambrian Explosion).