Induan-Olenekian Boundary correlations, new proposal, or how to calibrate a Carbon isotope curve.

Aymon Baud*

**c/o Baud Geological Consultant*
Parc de la Rouvraie 28, CH-1018 Lausanne, Switzerland

Introduction: in 2004, the wind was blowing with the magnetostratigraphy

In the Germanic basin, the Olenekian lower boundary IOB) published by Bachman & Kozur (2004) was firmely based on magnetostratigraphy correlated with Chaohu magnetostratigraphy and conchostracan. It was placed between the *E. nodosocostata* Zone s. s. and the *C. germari-M. subcircularis* A. Z, correlated with the upper part of the only normal magnetozone Sn3 of the Bernburg Formation, which ends around the base of cycle 8 (Szurlies et al. 2003). In these continental beds, the biostratigraphically and magnetostratigraphically correlated base of the Olenekian (IOB) was also confirmed with carbon isotopes by comparison with the Pufels (Bulla) section, where occurs a distinct positive δ13C excursion somewhat more than 3 of a so called short eccentricity cycles above the Olenekian base, as published by Bachman & Kozur (2004) followed by Korte & Kozur, (2005b). In the Germanic Basin lacustrine sediments, a distinct positive δ13C excursion is present in the lower M. truempyi Zone, likewise of somewhat more than 3 of their so called short eccentricity cycles above the base of the Olenekian.

In the shallow marine section Pufels (Bulla) of the Southern Alps, the Olenekian lower boundary published by Korte & Kozur. 2005a, was based on the FAD of *Pachycladina oblique*, a facies controlled conodont. In Bachmann and Kozur, 2004, this base was checked on Scholger et al. (2000) very precise palaeomagnetic data, a little below the top of N3 palaeomagnetic zone, a very good palaeomagnetic marker for correlation with continental beds in the Germanic Basin.

But from the dawn of 2007, the wind changes and the correlations have to be done on carbon isotopes stratigraphy.

As explained in p. 147 of Kozur and Weems, 2007, Kozur

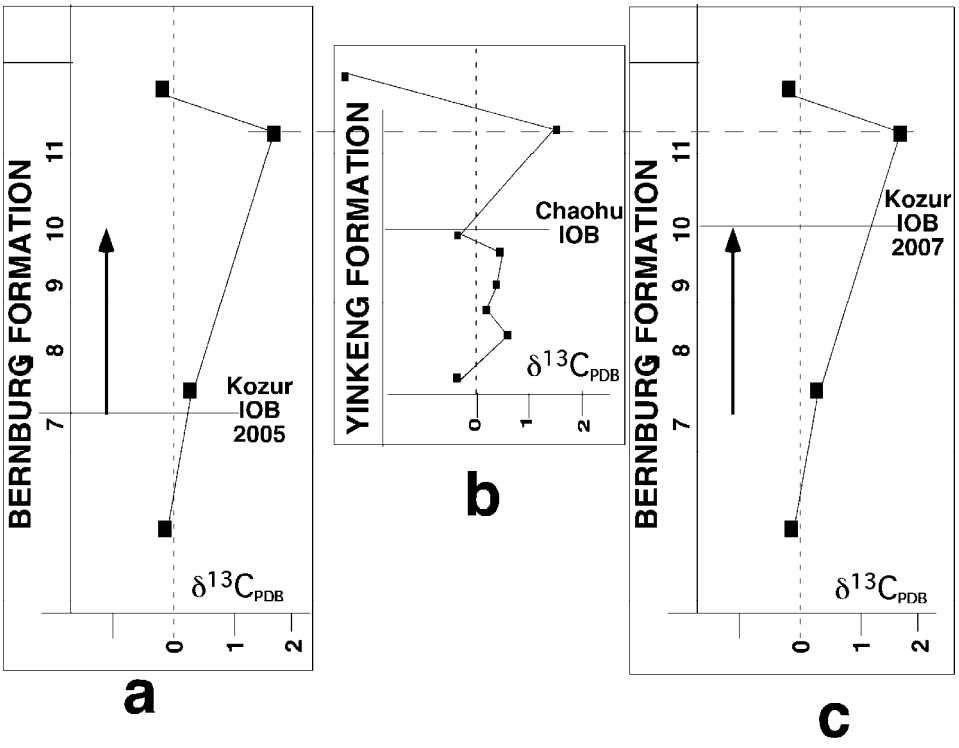

Figure 1: Carbon isotope peak correlation close to IOB, Bunsandstein (Germany) - Chaohu (China). No vertical scale
a: Carbon isotope trends at the IOB from the Germanic Lower Buntsandstein from Korte & Kozur, 2005b, with the position of the IOB based on magnetostratigraphy and conchostracan zonation. Cycles number 7 to 11,
b: δ13C-curve for the West Pingdingshan section (Chaohu, China, according to Tong et al. 2007, with the position of the IOB defined by the FAD of Neospathodus waageni s.l.
c: Carbon isotope trends at the IOB from the Germanic Lower Buntsandstein from Korte et al. 2007 with the new position of the IOB shift up of 3 cycles (arrow), based on carbon isotope peak correlation and conchostracan zonation.

discovered a distinct positive carbon isotope peak at the IOB, described from Losar, Spiti in the Atudorei, (1999) thesis. More precisely Richoz et al., 2007, in the Mud section, confirmed this peak about 60 km S of Losar. But for Korte, Kozur and Bachmann, their distinct positive δ13C excursion was entirely within their Olenekian. It is why, as written in Korte et al 2007, they remember suddenly that the conchostracan loose spines at the IOB in the Buntsandstein and accordingly, they have to shift the former published boundary, from cycle 7 to cycle 10 (Korte et al. 2007, p. 4), exactly the 3 needed cycles. They blow up the IOB boundary both in Buntsandstein (fig. 1c) and in Pufels (fig. 2c), make it corresponding not to Mud but to Chaohu distinct C isotope peak published by Tong et al. 2007. Then they were able to wrote, p. 5, that the distinct positive shift at Chaohu resemble in the marine Pufels and in the continental Buntsandstein data, and the distinct peak at the IOB in Spiti does not fit with any other IOB transition section.

New proposals

Following this new and promising method for stratigraphy, I just remember that the *Magniestheria truempyi* species occurs in Madagascar immediately below the *Flemingites* beds (Korte et al. 2007, p. 4). It means that in the Buntsandstein, the IOB must be just above the *Magniestheria truempyi* zone. It is my new proposal in Figure 3a. With this, the Sn3 palaeomagnetic zone of Szurlies et al., 2003 is late Induan (Dienerian) as it was published.

Also, in the correlative Bulla (Pufels) section, the IOB must be shift up of more than 4 cycles (figure 3c). With this, the N3 palaeomagnetic zone of Scholger et al. (2000) will be entirely Induan, as it was published and the conodont *Pachycladina obliqua* is appearing in the late Induan (Dienerian) as written by Orchard (2007). Now the correlation with the Mud proposed stratotype fit perfectly as shown by the figure 3. Concerning the Chaohu proposed stratotype, he lost, in Horacek et al, 2007 as shown in fig. 3c, his

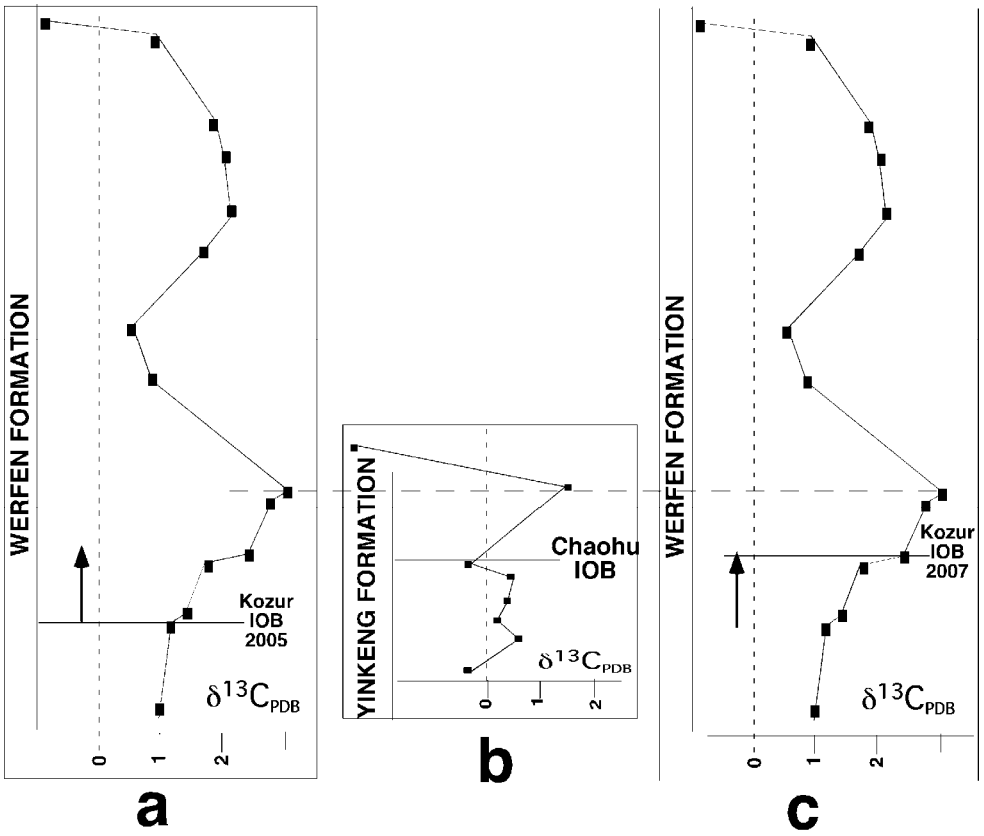

Figure 2: Carbon isotope peak correlation close to IOB, Pufels (Bulla, Italy) - Chaohu (China). No vertical scale.
a: Carbon isotope trends at the IOB from the shallow marine section Pufels (Bulla) of the Southern Alps according to Korte & Kozur. (2005a). The position of the IOB is based on the FAD of Pachycladina obliqua and checked on Scholger et al. (2000) very precise palaeomagnetic data, a little below the top of N3 palaeomagnetic zone.
b: δ13C-curve for the West Pingdingshan section (Chaohu, China, according to Tong et al., 2007, with the position of the IOB defined by the FAD of Neospathodus waageni s.l.
c: Carbon isotope trends at the IOB from the shallow marine section Pufels (Bulla) of the Southern Alps according to Korte et al. (2007). The position of the IOB is no more based on very precise palaeomagnetic data, nor on biostratigraphy, but has been shifted up of 3 “cycles” (arrow), to correspond to the new shifted IOB in the Buntsandstein (fig. 1 in Korte et al. 2007).

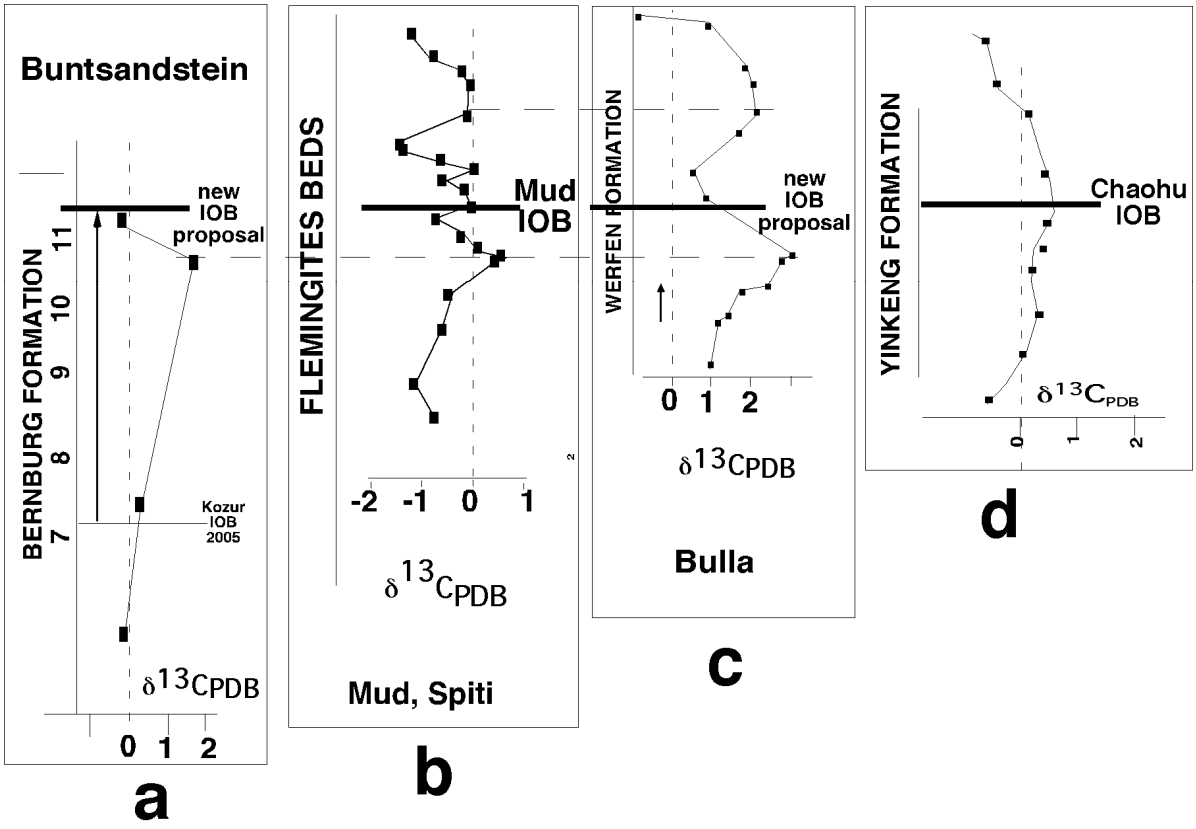

Figure 3: Carbon isotope peak correlation close to IOB, Bunsandstein (Germany) -Mud (Spiti, India) - Pufels (Bulla, Italy) -Chaohu (China). No vertical scale
a: Carbon isotope trends at the IOB from the Germanic Lower Buntsandstein from Korte et al. 2007 with the new position of the IOB adapted from conchostracan zonation.
b: : δ13C-curve for the Mud section, Spiti, from Richoz et al., 2007, and Indo-Austrian Working Group, in press, with the position of the IOB defined by the FAD of Neospathodus waageni s.l
c: Carbon isotope trends at the IOB from the shallow marine section Pufels (Bulla) of the Southern Alps according to Korte et al. (2007). The position of the IOB is shifted up of 4 cycles (according to Korte et al. 2007) and now well correlated with the 2 separated C isotope peaks of Mud
d: Carbon isotope trends (plateau) at the Chaohu IOB according Horacek et al., 2007.

distinct C isotope peak published by Tong et al. 2007 and the large C isotope plateau is indistinctly correlated with all IOB sections.

Conclusion

Thanks to Korte, Kozur and Bachmann for the promising method for stratigraphy. Before, the Buntsanstein age calibration appeared as a sandcastle. With my new proposal, it is becoming “eine feste Burg”.

Now I can write that the distinct positive shift at Mud, Spiti, resemble in the marine Pufels and in the continental Buntsandstein data and fit with most of the other IOB transition sections as do also the large C isotope plateau from Chaohu.

References

Atudorei, N.-V., 1999, Constraints on the upper Permian to upper Triassic marine carbon isotope curve. Case studies from the Tethys, PhD Thesis, Lausanne University, 155 p.

Bachmann, G. H. & Kozur, H. W. (2004): The Germanic Triassic: correlations with the international chronostratigraphic scale, numerical ages and Milankovitch cyclicity.– Hallesches Jahrbuch für Geowissenschaften, **B 26**: 17–62

Horacek, M., Wang, X.-D., Grossman E. L., Richoz, S. & Cao, Z. (2007b): The carbon-isotope curve from the Chaohu section, China: different trends at the Induan-Olenekian Boundary or diagenesis?– Albertiana, **35**: 41–45.

Indo-Austrian Working Group, in press, The Induan-Olenekian Boundary (IOB) in Mud – final results, Albertiana

Korte, C. & Kozur, H. W. (2005a): Carbon isotope stratigraphy across the Permian/Triassic boundary at Jolfa (NW-Iran), Peitlerkofel (Sas de Pütia, Sass de Putia), Pufels (Bula, Bulla), Tesero (all three Southern Alps, Italy) and Gerennavár (Bükk Mts., Hungary).– Journal of Alpine Geology, **47**: 119–135.

Korte, C. & Kozur, H. W. (2005b): Carbon isotope trends in continental lake deposits of uppermost Permian to Lower Olenekian Germanic Lower Buntsandstein (Calvörde and Bernburg Formations).– Hallesches Jahrbuch für Geowissenschaften, B, Beiheft **19**: 87–94.

Korte, C., Kozur, H., and Bachmann, G. H., 2007, Carbon isotope values of Triassic lacustrine and hypersaline playa-lake carbonates: Lower Buntsandstein and Middle Keuper (Germany): Hallesches Jahrb. Geowiss. Reihe B, v. Beiheft **29**, p. 1-10.

Kozur, H. W. & Weems, R. E. (2007): Upper Triassic conchostracan biostratigraphy of the continental rift basins of eastern North America: Its importance for correlating Newark Supergroup events with the Germanic Basin and the international geological time scale. In: Lucas, S. G. & Spielmann, J. A. [eds.]: The Global Triassic.– New Mexico Museum of Natural History and Science, Bulletin, **41**: 137–188

Richoz, S., Krystyn, L., Horacek, M. & Spötl, C. (2007): Carbon isotope record of the Induan Olenekian candidate GSSP Mud and comparison with other sections.– Albertiana, **35**: 35–40

Scholger, R., Mauritsch, H. J. & Brandner, R., (2000): Permian-Triassic boundary magnetostratigraphy from the Southern Alps (Italy).– Earth Planet. Sci. Lett., **176**: 495–508.

Szurlies, M., Bachmann, G. H., Menning, M., Nowaczyk, N. R., and Kading, K. C., 2003, Magnetostratigraphy and high-resolution lithostratigraphy of the Permian-Triassic boundary interval in Central Germany: Earth and Planetary Science Letters, **212**, p. 263-278.

Tong Jinnan, Zuo Jingxun & Chen Z. Q. (2007) Early Triassic carbon isotope excursions from South China: Proxies for devastation and restoration of marine ecosystems following the end-Permian mass extinction.– Geological Journal, **42**: 371–389