# Forum

## Timing of recovery from the end-Permian extinction: Geochronologic and biostratigraphic constraints from south China: COMMENT AND REPLY

**COMMENT:** doi: 10.1130/G23609C.1

**Hugo Bucher**
**Peter A. Hochuli**
*Paläontologisches Institut, Universität Zürich, 8006 Zürich, Switzerland*
**Urs Schaltegger**
**Maria Ovtcharova**
*Department of Mineralogy, University of Geneva, 1205 Geneva, Switzerland*
**Thomas Galfetti**
*Paläontologisches Institut, Universität Zürich, 8006 Zürich, Switzerland*
**Arnaud Brayard**
*Paläontologisches Institut, Universität Zürich, 8006 Zürich, Switzerland, and UMR 5125 CNRS, Université Claude Bernard Lyon I, 69622 Villeurbanne, France*
**Nicolas Goudemand**
*Paläontologisches Institut, Universität Zürich, 8006 Zürich, Switzerland*
**Jean Guex**
*Department of Geology, University of Lausanne, 1015 Lausanne, Switzerland*

Lehrmann et al. (2006) recently interpolated a new age of 247.2 Ma for the Early-Middle Triassic boundary in Guandao (Guizhou Province, south China) where four new U-Pb ages were measured from ash layers bracketing this boundary as defined by conodonts. Along with previous data of Lehrmann et al. (2005a, 2005b), these new results illustrate the current difficulties in obtaining consistent correlations for the Early-Middle Triassic boundary while constrained by first occurrences of conodonts only. These difficulties became apparent in the comparison of the lower Guandao section, as revised by Lehrmann et al. (2006), with the upper Guandao section published by Lehrmann et al. (2005b). It is worth stressing that these two sections are located ~200 m apart (see Lehrmann et al., 2005a, their Fig. 9).

In the two Guandao sections, the Early-Middle Triassic boundary was placed and correlated on the basis of the first occurrence (FO) of the conodont species *Chiosella timorensis* Nogami, 1968 (Lehrmann et al., 2005b, 2006). This correlation implies that the 15-m-thick tuff with minor limestone intercalations at upper Guandao passes within a distance of 200 m into two to three thin (dm) ash layers separated by thick carbonate beds (ca. 15 m) at lower Guandao. Although not impossible, such an abrupt lateral change in thickness of ash layers within this very short distance appears to be unusual and requires further substantiation in order to be coherent with the proposed conodont-based correlation of the Early-Middle Triassic boundary.

The published radioisotopic ages provide further constraints to test the consistency of the Early-Middle Triassic conodont correlation between the two mentioned sections. In the upper Guandao section, the FO of *Cs. timorensis* is located ~3 m below the thick ash layer (Lehrmann et al. 2005b, their Fig. 17). The base of this ash layer (GDGB-O) yields a U-Pb age of 247.8 ± 0.074 Ma, providing an upper age limit for the FO of *Cs. timorensis*. In the supposedly coeval part of the lower Guandao section, Lehrmann et al. (2006) dated a series of four thin ash layers ranging in age from 247.38 ± 0.10 Ma (PGD tuff-1) to 246.77 ± 0.13 Ma (PGD tuff-4). The FO of *Cs. timorensis* is bracketed by PGD tuff-2 (247.32 ± 0.08 Ma) and PGD tuff-3 (247.13 ± 0.12 Ma). These age constraints imply that the FO of *Cs. timorensis* is significantly older in the upper Guandao section compared to the lower Guandao section. Subtracting the proposed interpolated age of 247.2 (±0.2) Ma for the FO of *Cs. timorensis* at lower Guandao from the upper age limit of 247.8 (±0.1) Ma for the same FO at upper Guandao yields a minimal difference of 0.6 ± 0.3 m.y.

Considering the inconsistencies between the two Guandao sections as published by Lehrmann et al. (2005b, 2006), one is forced to conclude that the radiometric age constraints, as well as the paleontological and lithological correlations between these two sections, need further clarification. Until all these contradictions are solved, the proposed age and the position of the Early-Middle Triassic boundary in Guandao will remain equivocal. Either the radiometric ages are correct and the FO of *Cs. timorensis* is diachronous, or the FO of *Cs. timorensis* is synchronous, and some of the radiometric ages are wrong. In the worst case both may be wrong.

Assuming that all U-Pb ages from the two Guandao sections are correct, the FO of *Cs. timorensis* appears to be diachronous, hence unsuitable to define any boundary. In a more general perspective, it is worth emphasizing that the use of first appearances of index species for defining the base of biochronologic units is known to be pervaded by diachronism (e.g., Guex, 1991; Monnet and Bucher, 2002). The origin of such diachronism is to be sought in varying local ecological conditions shaping the distribution of a species in time and space, in selective preservation, and in sampling bias. Oppel zones, Assemblage zones, Concurrent-range zones, and Unitary Associations, which are all based on associations, are the only reliable alternatives to circumvent such problems inherent to the fossil record.

Lehrmann et al. (2006) also used their interpolated Early–Middle Triassic boundary age of 247.2 Ma to assess an ~5 m.y. duration for the Early Triassic. However, the above-mentioned incoherencies pertaining to their estimation of the age of the Early-Middle Triassic boundary prevent refining previous estimates of the duration of the Early Triassic (e.g., Ovtcharova et al., 2006). The latter authors proposed a minimal duration of 4.5 ± 0.6 m.y. based on their new U-Pb age of a tuff bracketed by the penultimate Early Triassic ammonoid assemblage zone (248.1 ± 0.4 Ma) and the 252.6 ± 0.2 Ma age given by Mundil et al. (2004) for the Permian-Triassic boundary.

### REFERENCES CITED

Guex, J., 1991, Biochronologic Correlations: (Berlin), Springer-Verlag, 252 p.

Lehrmann, D.J., Enos, P., Payne, J.L., Montgomery, P., Wei, J., Yu, Y., Xiao, J., and Orchard, M.J., 2005a, Permian and Triassic depositional history of the Yangtze platform and Great Bank of Guizhou in the Nanpanjiang basin of Guizhou and Guangxi: South China: Albertiana, v. 33, p. 149–168.

Lehrmann, D.J., Payne, J.L., Enos, P., Montgomery, P., Wei, J., Yu, Y., Xiao, J., and Orchard, M.J., 2005b, Field Excursion 2: Permian-Triassic boundary and a Lower-Middle Triassic boundary sequence on the Great Bank of Guizhou, Nanpanjiang basin, southern Guizhou Province: Albertiana, v. 33, p. 169–186.

Lehrmann, D.J., Ramezani, J., Bowring, S.A., Martin, M.W., Montgomery, P., Enos, P., Payne, J.L., Orchard, M.J., Hongmei, W., and Jiayong, W., 2006, Timing of recovery from the end-Permian extinction: Geochronologic and biostratigraphic constraints from south China: Geology, v. 34, p. 1053–1056, doi: 10.1130/G22827A.1.

Monnet, C., and Bucher, H., 2002, Cenomanian (early Late Cretaceous) Ammonoid faunas of western Europe, Part 1: Biochronology (Unitary Associations) and diachronism of datums: Eclogae Geologicae Helvetiae, v. 95, p. 57–79.

Mundil, R., Ludwig, K.R., Metcalfe, I., and Renne, P.R., 2004, Age and timing of the Permian mass extinctions: U/Pb dating of closed-system zircons: Science, v. 305, p. 1760–1763.

Ovtcharova, M., Bucher, H., Schaltegger, U., Galfetti, T., Brayard, A., and Guex, J., 2006, New Early to Middle Triassic U-Pb ages from South China: Calibration with ammonoid biochronozones and implications for the timing of the Triassic biotic recovery: Earth and Planetary Science Letters, v. 243, p. 463–475, doi: 10.1016/j.epsl.2006.01.042.