

DISCUSSION

Discussion of ‘The Triassic U–Pb age for the aquatic long-necked protorosaur of Guizhou, China’

Keywords: Panxian, reptile, extinction, recovery.

Y. B. Wang, D. T. Yang, J. Han, L. T. Wang, J. X. Yao & D. Y. Liu reply: We thank Liu Jun for his comment on our recent paper (Wang *et al.* 2014) and are grateful for his calling our attention to this apparent contradiction, and we welcome the opportunity to reply. Based on the sensitive high-resolution ion microscope (SHRIMP) U–Pb zircon age for a volcanic tuff bed within the upper part of the Guanling Formation, we suggested in our study that the age of the fossil horizon of the Panxian fauna is 244 ± 1.3 Ma, which is 14 Ma earlier than the previously estimated age that Li, Rieppel & LaBarbera (2004) published in *Science*. However, Liu Jun argued that this conclusion is confused, that there is no 14 Ma difference and that there is agreement between the biostratigraphic data and the new radiometric age.

As Liu noted in the comment, ‘It remains unclear why Li, Rieppel & LaBarbera (2004) said that the new *Dinocephalosaurus* specimen is dated to 230 Ma’; in fact, there was no conodont evidence or radiometric age for the age of the strata yielding *Dinocephalosaurus* when Li, Rieppel & LaBarbera (2004) published their paper. But Sun, Hao & Jiang (2003) had reported conodont stratigraphic evidence for the age of the Guanling fauna. The Guanling fauna is also a famous fauna in SW China, which was excavated earlier than the Panxian fauna, and unearthed in the Xiaowa Formation. The study result showed that the conodont zones correlate with the middle or late Carnian of the Late Triassic period. Because there is no radiometric age for that time, the time scale is also based on an uncalibrated biostratigraphy. We conjectured that the ‘230 Ma’ is a relatively conservative estimated age, and possible based on the previous conodont evidence that correlates to the Late Triassic. The age we have presented aims to provide a better comparison and to improve understanding of the age of the Panxian fauna. In our view, the age of the tuff rock from the fossil layers can best explain the age of the fossil-bearing strata.

More and more important Triassic marine faunas in SW China have received considerable attention in recent years; conodonts as an effective tool are used to define the age of marine reptile faunas. Sun *et al.* (2006) concluded that the age of the Panxian fauna is early Pelsonian based on the recognition of the *Nicoraella kockeli* conodont zone. In spite of much progress achieved in recent years, particularly in SW China, the precise ages of the intriguing Triassic marine faunas are almost unknown. We therefore concluded that the new U–Pb age data presented by Wang *et al.* (2014), in conjunction with a wealth of previously published biostratigraphic data, supports the age of the Panxian fauna as Anisian (Middle Tri-

assic). When we saw the age Li, Rieppel & LaBarbera (2004) reported in *Science*, we doubted that the age was matched to the time scale in the current work. So we pointed out the difference and thought that the conodont biostratigraphic work had progressed a little. Liu is concerned that the radiometric dating matches with the result of the conodont study by Sun *et al.* (2006), and claimed that there is no 14 Ma difference between the new age and what was expected. We agree with Liu Jun and acknowledge that we have made an unclear interpretation in the paper. But in summary, we are presenting solid data to provide an absolute age constraint on the Panxian fauna and improve the understanding of the timing of recovery from the end-Permian mass extinction. To better understand the evolution of Triassic marine reptiles, further geochronological work for the Triassic marine faunas in SW China is required.

References

- LI, C., RIEPPEL, O. & LABARBERA, M. C. 2004. A Triassic aquatic protorosaur with an extremely long neck. *Science* **305**, 1931.
- SUN, Z. Y., HAO, W. C. & JIANG, D. Y. 2003. Conodont stratigraphic evidence for the age of the Guanling fauna, Guizhou Province, China. *Acta Scientiarum Naturalium Universitatis Pekinensis* **39**, 118–25 (in Chinese with English abstract).
- SUN, Z. Y., SUN, Y. L., HAO, W. C. & JIANG, D. Y. 2006. Conodont evidence for the age of the Panxian Fauna, Guizhou, China. *Acta Geologica Sinica* **80**, 621–30.
- WANG, Y., YANG, D., HAN, J., L., W., YAO, J. & LIU, D. M. 2014. The Triassic U–Pb age for the aquatic long-necked protorosaur of Guizhou, China. *Geological Magazine* **151**, 749–54.
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