



Conodont quantitative biochronology (Unitary Associations) of the Smithian-Spathian boundary in South China and the definition of the base of the Spathian (Early Triassic)

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The largest intra-Triassic crisis for the nekton took place at the Smithian-Spathian boundary (SSB), ca. 2.7 Ma years after the end-Permian mass extinction (EPME). Our understanding of the Early Triassic biotic recovery and the SSB crisis is not yet as complete as for the EPME and the SSB crisis was often interpreted as part of a protracted process characterized by persisting environmental stress during the Early Triassic. However, nektonic organisms such as ammonoids and conodonts recovered much faster than other marine clades. Moreover, the high evolutionary rates of conodonts and ammonoids make them ideal tools for constructing a high resolution biochronology around the SSB.

Here we present the most complete conodont biochronology from the Nanpanjiang Basin in South China, with a high-resolution sampling around the SSB from five different sections. The biochronological definition of the SSB is here improved by means of conodont Unitary Associations Zones (UAZs). This new biochronological zonation has a much higher accuracy than previous schemes, which were based on continuous but commonly diachronous interval zones.

The Unitary Association method produced seven robust and discrete UAZs covering the middle Smithian-early Spathian time interval with a high lateral reproducibility in all 5 sections. These UAZs are intercalibrated with lithological and chemostratigraphical (carbon isotope) markers. UAZ1-4 show high turnover rates during the middle and late Smithian, but the most radical faunal change is with UAZ5, which is used to define the base of the Spathian. UAZ5 records the onset of the Spathian conodont radiation with more than 75% of new species, of which *Ic. crassatus*, *Tr. symmetricus*, *Nv. brevissimus* and *Ic. ? zaksi* are characteristic species. In terms of ammonoids, the base of the Spathian (UAZ5) also coincides with the appearance and early evolutionary radiation of tirolitids. In South China and elsewhere, we show that the first occurrence of the widely used base Spathian index conodont *Novispathodus pingdingshanensis* is diachronous due to variable sampling effort and of geographical or ecological exclusion.

The intercalibration of this new south Chinese UA-based zonation with the seemingly global and synchronous carbon positive isotopic excursion shows that the excursion peaked between UAZ4 and UAZ5, thus expanding the potential application and correlation of this new zonation worldwide.