Ceramah Teknik (Technical Talk)

Age and correlation of the Permian-Triassic boundary and mass extinction in China

IAN METCALFE

Laporan (Report)

Prof. Ian Metcalfe of the Research & International Division, University of New England, Armidale, Australia gave the above talk on 29th September 2003 at 5.30 pm at the Geology Department, University of Malaya.

Abstrak (Abstract)

This paper presents results of a seven year project aimed to provide biostratigraphically controlled robust multi-method radio-isotopic ages for the Permian-Triassic boundary, end Permian Mass Extinction, and vital new tie points for the Permian-Triassic geological time scale. Integrated high-resolution geochronometry, biostratigraphy chemostratigraphy and magnetostratigraphy was undertaken to determine synchroneity/diachroneity and time-duration of mass extinction and biotic recovery in the sea and on land. Provision of constraints on proposed catastrophic causes of the greatest punctuation in the history of life on earth was also a principal aim of the project. We have conducted work on the International Global Stratotype Section and Point (GSSP) for the base of the Triassic (Permian-Triassic/Palaeozoic-Mesozoic boundary) at Meishan, (Zhejiang Province, China), on the ancillary P-T boundary section at Shangsi, Sichuan Province, on terrestrial sequences at Dalongkou and Lucaogou, Xinjiang Province, and on non-marine to marginal marine sections in Yunnan and Guizhou Provinces, China.

Our studies have confirmed that the first appearance of the conodont microfossil species *Hindeodus parvus* (Kozur & Pjatakova), used to define the base of the Triassic, is synchronous in all studied marine/paralic sections in China (Nicoll *et al.*, 2002).

Definitive ages for the GSSP defined Permian-Triassic boundary (253 Ma) and main Permian-Triassic Mass Extinction (at around 254 Ma) have been established (Mundil *et al.*, 2001; Metcalfe *et al.*, 2001; Mundil and Metcalfe, 2002).

Our radio-isotopic age data indicate that the final stage of the Permian (Changxingian) is considerably longer than previously thought — as long as 5 Myr.

The claimed <165,000y short duration for the negative carbon isotope excursion at the P-T boundary (Bowring *et al.*, 1998) cannot be confirmed by our data. In fact, according to our new findings the duration of the carbon excursion might have lasted as much as 1–2 Myr (Mundil *et al.*, 2001).

Our isotopic dating confirms the temporal coincidence of the main P-T Mass Extinction with the Siberian Traps massive volcanic eruptions indicating a causative link (if a systematic bias between Ar/Ar and U/Pb isotopic systems is taken into account, see below). In view of these findings, a very short single catastrophic cause (such as an extra-terrestrial bolide impact) as suggested by recent publications, for the P-T Mass extinction has to be reconsidered.

The project work in China has confirmed the systematic bias between the U-Pb and Ar-Ar isotopic decay systems with Ar-Ar ages being 1–2% younger than U-Pb ages, which translates to 2.5 to 5 Myr for ages around 250 Ma. This is most likely due to a miscalibration of the 40K decay constant and has important fundamental implications for isotopic dating in general.

Work on palynological microfossils and on carbon isotopes of organic matter have confirmed that the so-called "fungal spike" at the P-T boundary, suggested to be caused by saprophytic metabolisation of dead vegetation following extinction, is in fact algal in nature, occurs at multiple horizons, and extends over a period of 10 million years (Foster *et al.*, 2002).

Palaeomagnetic data consistently shows a reverse to normal polarity change just below the P-T boundary, coincident with the P-T Mass Extinction. The upper Permian Changxingian and at least part of the Wuchiapingian stages belong to the Illawarra mixed interval (Glen *et al.*, 2002).

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