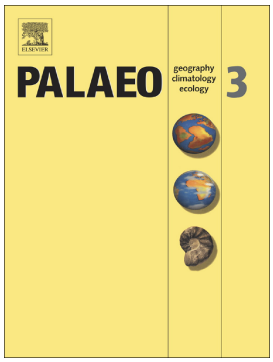

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A Smithian (Early Triassic) ichnoassemblage from Lichuan, Hubei Province, South China: implications for biotic recovery after the latest Permian mass extinction

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Abstract

A late Smithian ichnoassemblage is reported from the Lower Triassic succession from the Lichuan section, western Hubei Province, South China. This ichnoassemblage comprises 13 ichnogenera, which include simple, horizontal traces (*Cochlichnus*, *Cosmorhaphe*, *Didymaulichnus*, *Gordia*, *Circulichnis*, and *Planolites*), vertical traces (*Arenicolites*, *Laevicyclus*), oblique- or horizontal branching traces (*Palaeophycus*), slightly complex burrow networks (*Thalassinoides*, and *Treptichnus*), and grazing traces (*Cosmorhaphe* and *Gyrochorte*). These traces are also categorized into fodinichnia, domichnia, pascichnia, and repichnia ethologic types, suggesting a fairly high degree of behavioral complexity. Of these, the fodinichnia traces are most abundant. The ichnoassemblage horizons usually have rather high ichnofabric indices (ii), reaching ii 4–5. Bedding plane coverage is up to 70–90%, resulting in high bedding plane bioturbation index as well (BPBI 4–5). The Lichuan ichnoassemblage traces have mean and maximum diameters of 4.8 mm and 9 mm, respectively (n = 342). The traces penetrate to a depth of up to 30 mm into the sediment, with an average depth of penetration of 15 mm, indicating third to fourth tiering levels (3–4). Overall, the Lichuan ichnofauna shows an abrupt increase in ichnodiversity, burrow width, behavioral complexity, and ecologic tiering level, which are indicative of recovery stages of 2–3 in the late Smithian. When compared to five coeval ichnoassemblages from other sections in South China (Yashan, Susong, Daxiakou, Gaimao, and Tianshengqiao) and coeval ichnoassemblages from elsewhere (northern Italy, Western Australia, western US), the Lichuan trace-fossil assemblage reaches similar level of diversity during this time interval. Paleoenvironmental analysis indicates that the late Smithian recovery pulse is typically confined to the offshore transition setting, whereas more distal zones record much lower levels of recovery. Therefore, time and environmental conditions were the two crucial factors controlling the rate and degree of recovery of trace-making organisms in the aftermath of the latest Permian mass extinction.