

 BRUCE MUSEUM



**Last Days of Pangea
Triassic-Jurassic Research Symposium
May 16th, 2017**

Lake ice rafted debris from the Late Triassic of the Junggar Basin China: Implications for dinosaur survival through the ETE

Paul E. Olsen, Lamont-Doherty Earth Observatory of Columbia University
Jingeng Sha, and Yanan Fang, Nanjing Institute of Geology and Palaeontology.

The Late Triassic is nearly unique in the Phanerozoic in lacking evidence of high latitude ice. However, in October 2016 we discovered abundant lake-ice-rafted debris (LIRD) in the Late Triassic, coal- and black shale-bearing Haojiagou Formation, at $\sim 60^{\circ}\text{N}$ paleolatitude. These otherwise typical lacustrine mudstones are very laterally continuous, but they contain randomly distributed, usually isolated, sand grains, granules, and rare small pebbles, in even the most fine-grained, thin bedded units. These grains show no sorting, and they are not associated with roots, or woody debris. Distinct from clusters of granules of algal- and root-rafted debris seen in coeval tropical lacustrine strata, these granules most closely resemble LIRD from lakes with seasonal freezing. LIRD comprise a new climate proxy for the early Mesozoic and show that the high latitudes of Late Triassic Pangea had diverse plant communities despite freezing winters. The Late Triassic is characterized by profound continental biotic provinciality with herbivorous (and large) dinosaurs restricted to latitudes greater than 30° where they are amongst the most abundant tetrapods. We contend, that the abundant and predictable plant resources of the Pangean high latitudes were critical for these large herbivores, despite seasonal freezing conditions, and the Avemetarsalia were fundamentally adapted to seasonal cold, primitively insulated with filamentous feather homologues. A phylogenetic bracket approach suggests this applies to basal sauropodomorphs as well. We predict that sauropodomorphs and other ornithomirans will be found in the strata associated with LIRD and these strata will lack large pseudosuchians and other large non-insulated amniotes. A corollary is that dinosaur and pterosaur adaptations to seasonally freezing temperatures accidentally allowed them to survive the intense and frequent volcanic winters of the Central Atlantic Magmatic Province during the end-Triassic extinction. Lacking insulation, pseudosuchians nearly went extinct with only small, plausibly burrowing protosuchians and sphenosuchians surviving.