

# A New Look at the Lujiatun: Dinosaur Attrition in Burrows, Not a Cretaceous Pompeii and Not a Shoreline to the Jianshangou Lake

Elaine Chen<sup>1</sup>, Scott MacLennan<sup>2</sup>, Sean Kinney<sup>3</sup>, Clara Chang<sup>3</sup>, Paul Olsen<sup>3</sup>, Jingeng Sha<sup>4</sup>, Yanan Fang<sup>4</sup>, Jun Liu<sup>5</sup>, Blair Shoene<sup>6</sup>

<sup>1</sup>Columbia University, <sup>2</sup>University of Rochester, <sup>3</sup>Lamont-Doherty Earth Observatory, Columbia University, <sup>4</sup>Nanjing Institute of Geology and Paleontology, <sup>5</sup>Institute of Vertebrate Paleontology and Paleoanthropology, <sup>6</sup>Princeton University

Famous for 3D Early Cretaceous dinosaurs and mammals, the Lujiatun Mb of the Yixian Fm (NE, China) has unresolved depositional, taphonomic and stratigraphic settings. LA-ICP-MS dating of zircons extracted from matrix of two Lujiatun blocks with articulated *Psittacosaurus* provide tests of competing hypotheses of taphonomy (catastrophic burial in pyroclastic flows or lahars vs attrition in burrows). Along with previously acquired CA-ID-TIMS ages (1) these data clarify the temporal relationship between the outcropping Lujiatun Mb and nearby lacustrine Jianshangou Mb with flattened, feathered dinosaurs. We subjected Lujiatun zircons to LA-ICP-MS analysis, and the age spectrum shows that the *Psittacosaurus* matrix is neither pyroclastic flow (2) nor lahar (3), but a fluvial deposit with a large admixture of contemporaneous ash as suggested by Rogers et al (4). Given the complete articulation of *Psittacosaurus* and most other dinosaurs and mammals, the simplest hypothesis for their burial is attrition in burrows (5), to be tested by granulometry. CA-ID-TIMS zircon ages from the same outcrop (5) (consistent with LA-ICP-MS) and a sequence of Lujiatun Mb (1 age) overlain by lava, overlain by Jianshangou Mb (2 ages) in the Huangbanjiagou core (6) have overlapping uncertainties at ~126 Ma, with possible total duration of ~160 Kyr, indicating very high deposition rates. In contrast, Chang et al. (3) argue that, given indistinguishable <sup>40</sup>Ar/<sup>39</sup>Ar dates from outcropping Lujiatun and Jianshangou samples, the two units were deposited at the same time, as shore and lake facies. But the high accumulation rate indicated by CA-ID-TIMS ages, with their much lower uncertainties, show that the <sup>40</sup>Ar/<sup>39</sup>Ar dates do not indicate contemporaneity. Rather, as shown by superposition, the simplest hypothesis is that there is one Lujiatun unit and one lava flow unit at both outcrop and core and that the Jianshangou was deposited after the Lujiatun.