Continental Crises of the Jurassic: Major Extinction Events and Environmental Changes within Lacustrine Ecosystems

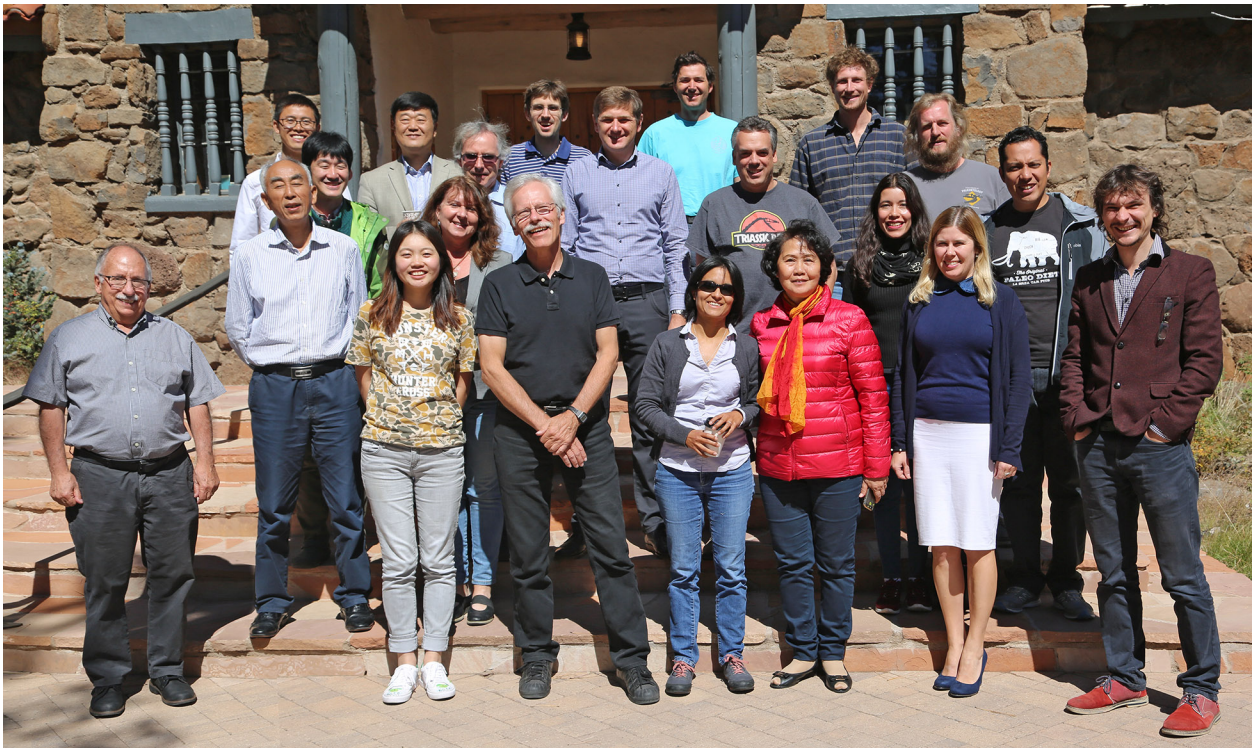
5th Symposium of IGCP 632

Jurassic Tropical to Polar Biotic and Climatic Transects

Museum of Northern Arizona, Flagstaff, Arizona, USA

September 28 - October 2, 2017

SYMPOSIUM ABSTRACTS WITH PROGRAM



Symposium Presenters

ICE AND THE ECOLOGICAL RISE OF DINOSAURS

Olsen, Paul E.[1] (polsen@ldeo.columbia.edu), SHA, Jingeng[2], FANG, Yanan[2], Kinney, Sean T.[1], Whiteside, Jessica H.[3]

[1] *Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York 10964 USA.*

[2] *State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology (NIGPAS), Chinese Academy of Sciences, Nanjing 210008, China.*

[3] *Ocean and Earth Science, National Oceanography Centre Southampton, University of Southampton, Southampton SO14 3ZH, United Kingdom.*

The Triassic (253-202 Ma) world is usually imagined as having a warm, equable, and ice-free "greenhouse" climate driven by very high CO_2, during which time dinosaurs and pterosaurs evolved. However, the degree to which high-latitude winter freezing actually occurred during this time has been unknown. We document the presence of abundant lake-ice-rafted debris (L-IRD) at a paleolatitude of 60° N (NW China), showing that not only was winter freezing normal in highly vegetated high-latitudes, despite the extreme CO_2, but that adaptations to seasonal cold in the form of insulation pre-adapted dinosaurs and pterosaurs to survive volcanic winters caused by massive eruptions of the Central Atlantic Magmatic Province (CAMP) during the end-Triassic mass extinction (ETE). These extinctions nearly wiped out non-insulated pseudosuchians in low latitudes, allowing dinosaurs to become globally ecologically dominant after the ETE some 30 million years after they evolved.

Dinosaurs and their relatives within the Avimetarsalia, including the flying pterosaurs, have been traditionally viewed as having evolved and thrived in the warm and equable climes of the Mesozoic. Dinosaurs had evolved by the early part of the Late Triassic (by 232 Ma) but remained a relatively minor part of terrestrial communities for the rest of the period. Herbivorous dinosaurs were entirely restricted to mid and high latitudes for at least 30 million after they evolved, while in the tropics pseudosuchian (crocodile-line) herbivores dominated. The survival of relatively large dinosaurs and their nearly immediate spread globally after ETE, while crocodile-line forms became nearly extinct, stands in dramatic contrast to the mass extinction at the end of the Cretaceous in which all non-avian dinosaurs became extinct and crocodilians were relatively unaffected. This dramatic difference in pattern has been unexplained

The abrupt increase in atmospheric CO_2 caused by CAMP eruptions is synchronous with the ETE. However this increase in CO_2 stands as unusual in the Triassic only because it was preceded by a drop in CO_2 in the last 6 My of the epoch. Yet crocodile-line forms and more basal archosauromorphs which were overwhelmingly dominant in the tropics for the proceeding 30 million years of high-CO_2 were nearly wiped out during the end-Triassic return to high CO_2 levels. While the abruptness of the event may have contributed to the decimation of the crocodile-line groups, the principle cause of the continental extinctions was the series of volcanic winters, not global warming. Dinosaur and pterosaurs were already adapted to freezing temperatures and thus accidently preadapted to survive the volcanic winters.