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INTENSIFICATION OF MILANKOVITCH CYCLES ASSOCIATED WITH THE TRIASSIC-JURASSIC SUPER-GREENHOUSE.

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Empirical data on stomatal density (1) and geochemical models (2) suggest that the mass extinction at the Triassic-Jurassic boundary was driven by a major increase in atmospheric CO_2. In the Pangean tropics of eastern North America and Morocco lacustrine rift strata record lake level cycles attributed to Milankovitch climate forcing. A dramatic feature of all of these basins is an amplification of the expression of these cycles associated with the palynologically identified Triassic-Jurassic extinction level. The change is marked by an upward transition from predominately red clastic rocks expressing a muted Milankovitch signal to red, gray, and black dramatically cyclical strata. The change appears to begin one to two climatic precession cycles before the boundary and the enhanced cyclicity lasts for more than one million years. Lava flows of the Central Atlantic Magmatic Province (CAMP) are interbedded with the best-developed cyclical strata just above the extinction level. Two negative δ^{13}Corg anomalies, themselves a signal of the disrupted carbon cycle that characterized the Triassic-Jurassic boundary, occur at the extinction level, associated fern spike and Ir anomaly, and endure through nearly the entire interval of enhanced cyclicity. Bulk organic δ^{13}C measurements reflect the enhanced cyclicity and also suggesting an import of an equatorial 10 ky climate signal. Although the large fluctuations seen in the δ^{13}Corg record partly represent mixing between two main sources of carbon (cyanobacterial vs. vascular plant), the syn-basalt lacustrine cycle values are virtually non-overlapping (more negative) than those of the background Triassic, including values of isolated vascular plant fragments (3). Macrofloral assemblages from the cyclical strata associated with the δ^{13}C anomalies are characterized by microphyllus conifers with thickened cuticles and sunken stomata, and the initial phases of the anomaly have unusually abundant remains of the thick leaved dipteridaceous fern *Clathropteris*, both suggestive of intense continental temperatures. While the tectonic changes associated with the eruption of the CAMP may have contributed to an apparent enhancement of the lacustrine cycles by increased tilting of the basin floor, the apparent increase in humidity seen in these strata goes against the apparent increasing trend toward aridity caused by the accelerating northward drift of central Pangea. This increase in wetness, as well as the associated δ^{13}C and floral changes, strongly argues for an intensification of the hydrological associated with a transient super-greenhouse event condign with recent climate models (4).

References: (1) McElwain et al., 1999, Science, 285:1386-1390; (2) Beerling & Berner, 2002, Global Biogeochemical Cycles 16:101-113; (3) Spiker, et al., 1998, U.S. Geological Survey Bulletin 1776:63-68; (4) Huynh & Poulsen, 2004, Palaeogeography, Palaeoclimatology, Palaeoecology, in press.