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Monster polar shift, shifts back: paleoclimate and CA-ID-TIMS evidence from northern China

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The two great lacustrine fossil Konservat-Lagerstätten of northeastern China producing feathered dinosaurs, the Jurassic Yanliao Biota and the Jehol Biota, were deposited during relatively humid times and are separated by a major redbed interval, typified by the Tuchengzi Formation deposited under a much more arid climate (1). We present new zircon CA-TIMS U-Pb ages for the peaks of the Yanliao [~160 Ma] and the Jehol biotas [Yixian Fm ~125 Ma] constraining a shift in that region from a higher-latitude temperate zone to a lower-latitude semiarid zone consistent with a ~30° arc distance shift true polar wander shift (1, 2, 3). The Yanliao Biota and the Jehol Biota are preserved in remarkably similar facies almost lacking signs of desiccation, while the Tuchengzi Formation has abundant evidence for desiccation and even eolian dune sands. This suggests, under a simple zonal climate model, a rapid shift to the south from Jurassic times and a shift back into Early Cretaceous times. A very similar and even more dramatic shift is seen in northwest China in the Junggar Basin where Triassic-Middle Jurassic coal bearing sequences with evidence of seasonal freezing (4) is replaced by a Late Jurassic [~150 Ma (5)] redbed sequence [including the famous dinosaur- and crocodiliomorph-bearing Shishugou Formation], and again replaced by coal-bearing strata in the Early Cretaceous, suggesting a similar magnitude shift south and back north of the region. The hypothesis that the monster polar shift is transient, swinging south and then north in ~35 million years necessitates rigorous testing by inclination-error-corrected paleomagnetic data to cleanly separate rapid latitudinal effect from rapid global climate change or regional orographic effects.

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