Astronomically forced lake level fluctuations during the Toarcian Oceanic Anoxic Event (Sichuan Basin, China)

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Abstract

The Toarcian Oceanic Anoxic Event (T-OAE) is characterized by one of the largest carbon cycle perturbations of the Mesozoic Era, with associated climatic and environmental change, most notably the widespread development of anoxia in epicontinental marine basins. On land, an enhanced hydrological cycle led to the development of major lakes, or significantly elevated lake levels, in continental basins in China, such as in the Sichuan, Tarim and Junggar Basins. Stratified lacustrine water columns and the development of anoxic–euxinic lake bottom- water conditions initiated a negative feedback mechanism in Earth's climate system through increased lacustrine (lake) carbon burial. The sheer size of these lakes possibly allowed for lacustrine carbon burial to have a significant impact on Earth's carbon cycling at that time. Here, we show new geochemical data from the Sichuan Basin and show that lake levels rose at the onset of the T-OAE. Importantly however, lake levels were likely not stable, but rather fluctuated on astronomical timescales, possibly in response to periodic changes in the hydrological cycle and the transport of moisture into continental interiors. Furthermore, the lacustrine climate records spanning the T-OAE provide crucial continental constraints on the duration of the T-OAE, which remains heavily debated, as based on marine climate archives.

Keywords: Astrochronology, Lake, level, Toarcian Oceanic Anoxic Event, Sichuan Basin

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