Enhanced hydrological cycling and continental weathering during the T-OAE archived in a lake system in the Sichuan Basin, China

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Abstract

Studies on the perturbations of hydrological cycling and continental weathering under greenhouse climate conditions in the historical geological period are helpful to understand the current extreme climatic events. Previous studies on marine sequences have reported that there was an enhanced hydrological cycling and continental weathering during the T-OAE (_˜183 Ma; the Toarcian Oceanic Anoxic Event). Herein, we performed sedimentology and geochemistry researches on deep to semi-deep lacustrine deposits correspondding to the T-OAE interval (the Da'anzhai Member, Well LQ104X) in the Sichuan Basin. Results showed that the bioclastic limestone, discrete shell-bed and shell-laminar interbedded mudstones, and shell-lenticle and -aggregation mudstones represented shell-enriched tempestites. Sandstone and siltstone with normally and inverse-normally graded beddings represented hyperpycnites caused by floods. Sedimentological statistic results demonstrated that tempestities and hyperpycnites mainly occurred in the T-OAE interval suggesting enhanced hydrological cycling. Multiple weathering indices (CIA, PIA, CIW) showed that there was generally intensified continental weathering during the T-OAE interval. Comprehensive and detailed geochemical studies, such as K/Na, Na/Ti, and Rb/K ratios, showed that there was wetter climate and enhanced hydrological cycling but lower chemical weathering intensity in the upper part of T-OAE interval. The enhanced hydrological cycling elevated the rate of denudation of source rocks and transportation of weathered material, which shortened the time for chemical weathering in the source area. The correlation between continental weathering and the development of tempestites and hyperpycnites in the Da'anzhai Member in the Sichuan Basin with surface seawater temperature implied that the high temperature during the T-OAE interval enhanced hydrosphere cycling, increased the frequency of storms and floods, and intensified continental weathering.

Keywords: Toarcian, Jenkyns Event, Continental weathering, Hydrological cycling, Expanded lake, Sichuan basin.

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