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Multiproxy constraints on recovery processes during the hyperthermal Toarcian Oceanic Anoxic Event

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Extreme and rapid climatic and environmental perturbations have punctuated Earth history. The causes and consequences of these past global-change events are relatively well constrained, but how the system can naturally recover through feedbacks remain largely unconstrained. The Toarcian in the Early Jurassic is an ideal time interval to understand the response of Earth system to rapid climate change. Indeed, it was marked by one of the most extreme hyperthermal events of the Phanerozoic accompanied by major environmental changes, named the Toarcian Oceanic Anoxic Event (T-OAE, ca. 183 Ma). Most studies have focused on the triggering mechanisms and the palaeoenvironmental response, whereas the recovery phase has been less studied. Increased chemical weathering of silicate rocks and burial of organic carbon are the two primary natural mechanisms generally proposed as negative feedbacks controlling the recovery. However, to date, the response of these feedbacks, their efficiency, and their timing are still uncertain, hampering an accurate view of the carbon cycle-climate dynamics. This study aims to tackle this lack of empirical data by providing a multi-proxy dataset combining sedimentological observations, mineralogical and geochemical analyses. Four worldwide distributed sites have been selected for this study: Fontaneilles in France (Grand Causses Basin), Vilyui in Siberia (Siberian Basin), Agua de la Falda in Chile (Andean Basin), and Ait Athmane in Morocco (High Atlas Basin). Our high-resolution carbon isotope records allow us to correlate the studied sites to trace the global carbon cycle dynamics in the aftermath of the Toarcian event. Lithium isotope ratios are used to trace global weathering rates and to understand processes that control the long-term carbon cycle. Our results indicate that higher silicate weathering rates during the Toarcian hyperthermal likely helped the climate system recover and return to cooler climatic conditions. High mercury and tellurium concentrations recorded after the T-OAE interval suggest that protracted Karoo-Ferrar volcanic

activity may have played a role in the recovery.