

Early Ocean pH Transition from Strong Acidity to Neutrality by 4.0 Ga: Insights from a Coupled Model of Global Carbon Cycle and Ocean Chemistry

MENG GUO¹ AND JUN KORENAGA²

¹Nanyang Technological University

²Yale University

Presenting Author: meng.guo@ntu.edu.sg

The ocean pH is a fundamental property that regulates various aspects of Earth system evolution. However, the early ocean pH remains controversial, with estimates ranging from strongly acidic to alkaline. Here we show that, by coupling global carbon cycle with ocean charge balance, and by using Earth interior processes to specify the history of volatile distribution and ocean chemistry, a rapid increase in ocean pH is likely during the Hadean to early Archean, with the pH evolving from 5 to neutral by ~4.0 Ga. These rapid changes in surface conditions are primarily attributed to the elevated rates of both seafloor and continental weathering during the Hadean, which in turn result from high surface temperatures, efficient CO₂ supply, rapid formation and destruction of both continental and oceanic crusts, and elevated levels of divalent cations in the crust. Earth likely transformed from a hostile state to a habitable one by the end of Hadean, which has important implications for planetary habitability and the origin of life.