Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12719

StabisoDB, a stable isotope database for Earth system research, and its application to reconstructing Paleozoic ocean temperatures and Earth-system sensitivity

ETHAN L. GROSSMAN[1], MICHAEL M. JOACHIMSKI[2] AND CRISTINA KRAUSE[2]

[1]Texas A&M University

[2]Friedrich-Alexander University of Erlangen-Nuremberg

Presenting Author: e-grossman@tamu.edu

Quantitative study of the Earth system in deep time necessitates easy access to compilations of proxy data placed within a temporal and spatial framework. To this end we have developed StabisoDB [1], a stable isotope database focusing on O, C, Sr, S, and clumped isotope data in fossils. StabisoDB's modular MySQL/PHP system allows straightforward accommodation of other data and expansion to whole rock samples. StabisoDB currently comprises $\delta^{18}O$ and/or $\delta^{13}C$ data for 26,974 Phanerozoic fossil samples including foraminifera, mollusks, brachiopods, fish teeth, and conodonts, building upon the compilation in Grossman and Joachimski [2]. StabisoDB houses a large array of metadata including coordinates/paleocoordinates, stratigraphy, taxonomy, preservation, and analytical metadata. These metadata allow easy searches with filtering of data; tools permit visualization of isotopic trends and sample localities on paleogeographic maps.

Using StabisoDB, we have compiled $\delta^{18}O$ data for Paleozoic carbonate (N = 4,976) and phosphate (N = 3,430) fossils from shallow marine environments [3]. These data facilitate quantitative study of links between the carbon cycle and deep-time climate. In calculating paleotemperatures, we assert a constant hydrosphere $\delta^{18}O$ and correct seawater $\delta^{18}O$ for ice volume and paleolatitude. Low-latitude (0 – 30°) sea-surface temperatures decrease from extreme values (>40°C) in the Early to Middle Ordovician (490-465 Ma) to low values (20-30°C) in the Carboniferous and Permian (359-252 Ma), followed by rapid warming to hothouse temperatures (≥35°C) at the end-Permian event (~252 Ma). Estimates of solar forcing due to pCO_2 doubling based on pCO_2 proxies and models, corrected for changing solar radiation, yield Paleozoic Earth-system sensitivities for low latitudes of 2.5-2.8 K W^{-1}â˜™m^2 (~10 °C per pCO_2 doubling). These values, though based on only half of Earth's surface, are extremely high compared with the best estimate of equilibrium climate sensitivity reported in the IPCC 6th Assessment Report (2.5-4 °C per pCO_2 doubling [4]), suggesting differences in the coupling of climate and the carbon cycle in Earth's deep past.

[1] http://stabisodb.org

[2] Grossman & Joachimski (2020), *in* Gradstein et al., eds., The Geologic Time Scale 2020, 279-307.

[3] Grossman & Joachimski (2022), *Scientific Reports* (in press).

[4] IPCC (2021), Summary for Policymakers, Climate Change 2021.