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Diagenetic influences on Early Paleozoic marine oxygen isotopes

Extracting useful marine delta 18-O values from Early Paleozoic sequences is not a trivial undertaking. The vast majority of marine calcite components have been overprinted by diagenesis at least to some extent. However, with careful work meaningful delta 18-O values can be extracted from the Early Paleozoic. A commonly used tool to discriminate whether marine components have been altered is to examine Mn and Fe contents of these components. Diagenesis unquestionably can add these elements to marine components during alteration. However, the uniforminitistic assumption that seawater Mn and Fe concentrations were always low may be in error. There is abundant evidence for the presence of widespread oceanic stratification during the Early Paleozoic with stagnant reducing bottom waters. I will discuss how simplistically interpreting Mn and Fe concentrations (and cathodoluminescence, CL) of marine calcite can result in an incorrect assessment of the isotopic record. I advocate a holistic approach when delineating the extent of diagenetic alteration that can degrade primary isotopic signals in all marine components. Assessment of diagenetic alteration must be based on analysis of the wide range of diagenetic constituents (marine, meteoric, and burial) that are present in most carbonate sequences. Additionally, marine components associated with regressive sequences should be avoided as it is in these settings that meteoric diagenesis is most likely to overprint marine isotopic values. For example, the delta 18-O values associated with marine cement from the Boda Limestone have been overprinted by meteoric alteration associated with a sea-level lowstand that occurred soon after Boda deposition during Hirnantian glaciation at the end of the Ordovician. In conclusion, with diligent work a coherent signal can be extracted from the vast spectrum of diagenetic noise characteristic of ancient time periods like the Early Paleozoic.