Sustained high-Mg Precambrian ocean conditions: a two billion year hangover?

A.V.S. HOOD*[1], S. ZHANG[2], N.J. PLANAVSKY[2], AND M.W. WALLACE[1]

[1]School of Earth Sciences, University of Melbourne, Parkville, VIC, 3010, Australia (*correspondence: hood.a@unimelb.edu.au)(mww@unimelb.edu.au)
[2]Geology and Geophysics, Yale University, New Haven, CT, 06511 USA. (shuang.zhang@yale.edu, noah.planavsky@yale.edu)

The primary mineralogy and geochemical composition of marine carbonates has been a crucial factor in constraining the major element composition of ancient oceans. While secular changes in Phanerozoic marine chemistry, including seawater Mg/Ca, have been derived from sedimentary records, and tied into both the global climate state and rates of ocean crust production, the Precambrian record has not yet been well-documented. A compilation of new analysis and literature data from the Archean to Neoproterozoic marine carbonate record reveals the dominance of aragonite, dolomite and high-Mg calcite primary marine mineralogies through the Precambrian. The precipitation of these minerals implies high-Mg seawater conditions for several billion years of Earth's history, with little evidence for Phanerozoic-like secular variation or "aragonite-calcite seas". Tied to this new record, we present a model for seawater Mg/Ca conditions through the Precambrian. We suggest sustained high Mg/Ca seawater conditions may be linked to evolving crustal composition, as well as the impact of ferruginous ocean conditions on hydrothermal Mg cycling in Precambrian oceans. Widespread marine dolomite precipitation during the Precambrian may also be a result of abundant Mg in seawater. Further, we suggest that with Mg buffering in anoxic oceans, the weathering of the Mg-rich Archean crust may have provided enough Mg input into the oceans to sustain a high-Mg 'hangover' through the Proterozoic.