Precise calibration of Oxygen isotope paleotemperature equations for several taxa of benthic foraminifera

T.M. MARCHITTO[1]*, S.P. BRYAN[1], W.B. CURRY[2], J. LYNCH-STIEGLITZ[3] AND D.C. LUND[4]

[1]INSTAAR & Dept. of Geological Sciences, University of Colorado, Boulder, CO 80309, USA
(*correspondence: tom.marchitto@colorado.edu)
(sean.bryan@colorado.edu)
[2]Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA (wcurry@whoi.edu)
[3]Georgia Institute of Technology, Atlanta, GA 30332, USA
(jean@eas.gatech.edu)
[4]California Institute of Technology, Pasadena, CA 91125, USA (dlund@gps.caltech.edu)

Benthic foraminiferal $\delta^{18}O$ has been used for several decades to reconstruct bottom water $\delta^{18}O$ (global ice volume and salinity) and temperature. Yet there remains no strong consensus regarding which benthic paleotemperature equation(s) are most accurate, with widely applied equations varying in slope by as much as 20%. This uncertainty arises, at least in part, from a general lack of high-precision calibration studies.

We use a suite of 30 high-quality multicore tops collected in the Florida Straits in 2002 to calibrate benthic foraminiferal $\delta^{18}O$ versus bottom water temperature. Modern water temperatures are unusually well constrained by matching bottom water salinities (measured on waters collected using a Niskin bottle mounted to the multicorer) to nearby CTD casts. Seawater $\delta^{18}O$ was also measured using the Niskin waters, allowing us to precisely regress foraminiferal $\delta^{18}O$ (in the form δ_c - δ_w - 0.27) against temperature. We present calibrations for the benthic taxa *Cibicidoides*, *Planulina*, *Uvigerina*, and *Hoeglundina*, and compare them to published data. In agreement with previous studies, we find that *Cibicidoides* and *Planulina* fall closest to inorganic precipitation data that are believed to approximate "equilibrium." The infaunal *Uvigerina* exhibits higher $\delta^{18}O$ values, and the aragonitic *Hoeglundina* is higher still. Since our sites span a pH range of 0.24 units, we also attempt to evaluate the hypothesis that benthic foraminiferal $\delta^{18}O$ varies with pH, by comparing our regression slopes to those derived from theory and from the planktic foraminifer *Orbulina*.

Br/Cl partitioning in chloride minerals in the Burns Formation on Mars

G.M. MARION[1]*, J.S. KARGEL[2] AND D.C. CATLING[3]

[1]Desert Research Institute, Reno, NV 89512, USA
(*correspondence: giles.marion@dri.edu)
[2]University of Arizona, Tucson, AZ 85721, USA
(kargel@hwr.arizona.edu)
[3]University of Bristol, Bristol, England
(david.catling@bristol.ac.uk)

Introduction and Objectives

Within Gusev Crater and Meridiani Planum on Mars, the Mars exploration rovers have found Br concentrations in soils and rocks in the hundreds of ppm range. Relative to Earth seawater, these are "high" Br concentrations. Because of low Br concentrations on Earth, Br largely precipitates from seawater as a minor constituent in halite crystals rather than as a separate phase mineral. This is also likely to be the case for Mars. But given that the surface chemistries on Mars are significantly different than on Earth, minerals other than halite could serve as sinks for Br. The specific objectives of this presentation are to (1) incorporate Br solution phase chemistries into the FREZCHEM model, (2) integrate the Siemann-Schramm (2000) Br/Cl mineral model into FREZCHEM, and (3) apply this mineral model to Br/Cl partitioning in Burns formation rocks as an indicator of past environments in the Meridiani Planum region of Mars.

Discussion of Results

The main conclusions of this work are: (1) a molar-based model for Br substitution into halite and bischofite provided a better fit to experimental data than the standard mass-based model; (2) all of the soluble salts (Na, Mg, Ca, Cl, Br, and SO_4) in the Burns formation, except for Ca, were significantly related to profile depth (Fig. 1); (3) the likely precipitation of Ca as gypsum on Mars precludes Ca precipitating as a $CaCl_2$ salt; (4) bischofite was a much more important sink for Br than halite; (5) the source of the Burns formation salts most likely came from windblown playa materials, where Br and Cl were fractionated in the playas; and (6) the high concentrations of Br in the surface layers of the Burns formation suggest that there was little water leaching in the late stages of profile development.

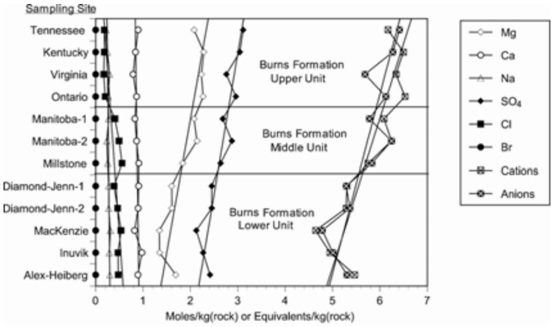

Figure 1: The concentration of individual ions (mol/kg) and cations and anions (equivalents/kg) in the Burns formation.