

Lithium isotopic systematics of the Main Endeavour Field vent fluids, Northern Juan de Fuca Ridge.

D.I. FOUSTOUKOS¹, R.H. JAMES² AND
W.E. JR. SEYFRIED³

¹Dept. of Geology and Geophysics, University of Minnesota, USA (fous0009@umn.edu)

²Dept. of Earth Sciences, The Open Univesity, UK, (R.H.James@open.ac.uk)

³Dept. of Geology and Geophysics, University of Minnesota, USA (wes@umn.edu)

Vent fluids from the Main Endeavour Field (MEF), Juan de Fuca Ridge have been analyzed for $\delta^7\text{Li}$ to help constrain subsurface hydrothermal alteration processes. The vent fluids reveal extreme variability of Cl and alkalis suggesting supercritical phase separation in the MEF reaction zone, likely linked to magmatic activity associated with seismic events that occurred just prior to sampling in 1999 (Seyfried et al., 2003). The $\delta^7\text{Li}$ composition of the vent fluids, however, ranges from 7.6 ± 0.8 to 8.9 ± 2.6 ‰, for relatively low and high chloride fluids, respectively, which is consistent with the experimentally established absence of lithium isotope fractionation during supercritical phase separation. Differences in boron concentrations and Li/Cl ratios suggest mixing between pure vapors (Sully, Cantilever vents) and evolved seawater (Hulk, Dante, Bastille vents). The relative constancy in the Li isotope data, however, indicate that the mixing reactions occur at temperatures sufficiently high to preclude large scale fractionation effects. Li isotopic data for MEF vent fluids are broadly consistent with a MORB-hosted reaction zone and alteration at relatively low fluid/rock mass ratios, which is somewhat surprising in light of the vapor-dominated nature of vent fluids, especially following the 1999 seismic event.

Vent	T °C	$\delta^7\text{Li}$ ‰	Li/Cl um/mm	B/Cl um/mm	Cl mm
Hulk	347	7.9 ± 0.8	0.88	1.87	426
Dante	350	7.2 ± 0.7	0.75	1.97	418
Bastille	368	7.9 ± 2.0	0.77	3.84	208
Cantilever	375	8.9 ± 2.6	0.78	30	32
Sully	379	7.6 ± 0.8	0.77	25.1	39

References

Seyfried W. E., Jr., Seewald J. S., Berndt M. E., Ding K., and Foustoukos D. I. (2003) *Journal of Geophysical Research* (accepted).

Ternary metal-bacteria interactions: The role of the bacterial electric field

DAVID A. FOWLE¹, LACHLAN C. MACLEAN¹ AND
NATHAN YEE²

¹Department of Earth Sciences, University of Windsor, Windsor, Canada, N9B 3P4; fowle@uwindsor.ca

²School of Earth Sciences; University of Leeds; Leeds LS2 9JT, United Kingdom; nyee@earth.leeds.ac.uk

Introduction

Bacteria are abundant in nearly all geologic settings and clearly influence metal mass transport in many of these systems. The affinity of bacterial cell walls for metal cations has been well established [1]. Current adsorption models have focused on the interactions between positively charged metal cations and bacterial surfaces, yet in many near surface environments metals and metalloids such as Cr, Se, and As exist as anions or anionic complexes. To date there has been very little research into the adsorption of anionic complexes onto bacterial surfaces and the mechanistic role of cations in anion adsorption [2].

Results

To address these research questions we have studied the ability of non-metabolizing cells of the bacterial species *Bacillus subtilis* to adsorb aqueous Cr(VI), As(V), Se(V) and I⁻ in the presence of background electrolyte and aqueous La(III), Cd(II), or Ca(II). We utilize a unique blend of electrophoretic mobility and aqueous geochemistry measurements to quantify the mechanisms of anion removal from solution and to model changes in the bacterial electric field. Our results indicate the removal of anions is highly dependent on solution pH with significant removal at low pH and diminishing removal at higher pH values. However, in the presence of aqueous Ca(II) which adsorbs from pH 3.5-8, the removal of Cr(VI) and I⁻ increases appreciably. Electrophoretic mobility data demonstrate increased shielding of the negative charge of the ionized cell wall functional groups with increasing cation concentration and/or charge. The addition of La(III) leads to complete charge reversal of the cell wall at pH values greater than 4 which may lead to enhanced anion uptake at near neutral pH values.

Conclusions

Considering that many geologic environments include both cationic and anionic metal contaminants, our results suggest that the mass transport of Cr(VI), I⁻, and other anions may be affected by ternary complexation or other cation mediated surface reactions in bacteria-bearing systems.

References

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