

Natural-abundance stable carbon isotopes of small-subunit ribosomal RNA (SSU rRNA): first results from Guaymas Basin (Mexico)

BARBARA J. MACGREGOR*, HOWARD MENDLOVITZ,
DANIEL ALBERT, AND ANDREAS P. TESKE

University of North Carolina, Dept. of Marine Sciences
*bmacgreg@unc.edu, mendlovitz@unc.edu,
dan_albert@unc.edu, teske@email.unc.edu

Introduction

Small-subunit ribosomal RNA (SSU rRNA) is a phylogenetically informative molecule found in all cells. Being poorly preserved in most environments, it is a useful marker for active microbial populations. At Guaymas Basin, hydrothermal fluids interact with abundant sedimentary organic carbon to produce natural gas and petroleum. Where this reaches the sediment surface, it can support dense patches of seafloor life, including *Beggiatoa* mats. We report here on the stable carbon isotopic composition of SSU rRNA from a *Beggiatoa* mat transect, a cold background site, and a warm site with high oil concentration. Our initial hypotheses were that rRNA isotopic composition would be strongly influenced by methane supply, and that archaeal rRNA might be lighter than bacterial due to contributions from methanogens and anaerobic methane oxidizers.

Results and Conclusion

The central part of the mat overlay the steepest temperature gradient, and was visually dominated by orange *Beggiatoa*. This was fringed by white *Beggiatoa* mat and bare, but still warm, sediment. Methane concentrations were saturating beneath the mat and at the oily site, lower beneath bare sediment, and below detection at the background site.

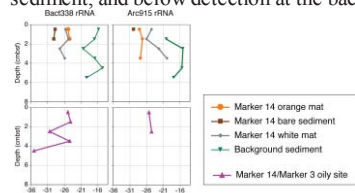


Figure 1. Stable carbon isotope composition of rRNA captured by magnetic bead capture hybridization [1].

We used biotin-labeled oligonucleotides to capture Bacterial and Archaeal SSU rRNA for isotopic determination (Fig. 1). Background-site rRNA was isotopically heaviest, and bacterial RNA from below 2 cm at the oily site was lightest, consistent with control by methane. Within the mat, however, rRNA from the bare periphery was lightest. There was no consistent isotopic difference between the probes, although RNA recoveries were too low for capture at depths where methanogens and methane oxidizers are expected.

Our prediction that rRNA isotopes would correlate directly with methane supply was clearly oversimplified. Future work will include the isotopic characterization of other potential carbon substrates. We are also investigating Gulf of Mexico sediments, where methane is significantly more ^{13}C -depleted than at Guaymas Basin.

[1] Miyatake et al. (2009) *Appl. Environ. Microbiol.* **75**, 4927-4935.

Surface complexation modeling of Na^+ and Rb^+ adsorption by rutile to 250°C

MICHAEL L. MACHESKY^{1*}, MILAN PŘEDOTA², MOIRA K. RIDLEY³, AND DAVID J. WESOŁOWSKI⁴

¹Univ. of Illinois, Illinois State Water Survey, Champaign IL, USA,
machesky@illinois.edu (* presenting author)

²Univ. South Bohemia, České Budějovice, Czech Republic,
predota@prf.jcu.cz

³Texas Tech Univ., Dept. of Geosciences, Lubbock, TX, USA,
moira.ridley@ttu.edu

⁴Oak Ridge National Laboratory, Oak Ridge, TN, USA,
dqw@ornl.gov

Surface complexation models (SCMs) provide the means to rationalize and extend (to uncharacterized conditions) cation adsorption data, and increasing use is being made of molecular level experimental and/or modeling results to constrain SCM parameter space. One rather surprising finding of this molecular-level information is that monovalent alkali metal cations can bind in inner-sphere fashion to oxides such as rutile. Given the very common use of alkali metal salts as background electrolyte media for adsorption experiments, it therefore becomes necessary to incorporate inner-sphere adsorption of alkali metal cations into SCMs to best represent molecular-level reality.

Ridley et al [1] demonstrated that the CD-MUSIC model of Hiemstra, van Riemsdijk and co-workers can successfully accommodate inner-sphere binding of Na^+ , K^+ , and Rb^+ , as gleaned from ab initio constrained classical molecular dynamics (CMD) simulations (for Na^+ , Rb^+) and X-ray reflectivity measurements (for Rb^+) in fitting 25°C rutile surface titration data. We have extended this CD-MUSIC approach to rutile surface titration data collected to 250°C in NaCl, NaTr (Tr=triflate) and RbCl electrolyte solutions. CMD results that track Na^+ and Rb^+ adsorption by the 110 surface of rutile at 25, 150, and 250°C and several charge states are used to constrain the allowable CD-MUSIC model parameters and it is shown that the resulting SCM can adequately mirror most of the CMD results over the broad ambient to hydrothermal temperature range.

[1] Ridley et al. (2009) *Geochim. Cosmochim. Acta* **73**, 1841-1856.