

# The soniDOME Project

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## Introduction

The soniDOME project (Sonification of Deep Ocean Microbial Ecology) innovates a sensorial path of inquiry for artist-scientist collaborations related to polar and deep ocean microbial ecologies.

This unique collaboration spans data development and analysis through display, interaction, open-source software toolkit distribution and public engagement.

We are expanding the sensoria of existing methods of complex data interpretations from visual forms to interactive soundscapes to explore and interpret structures, interactions and dynamics of remote microbial communities.

## Materials & Methods

We are investigating the use of sonic sensoria for the comparative interpretation of *Colwellia spp.* in microbial communities from sea ice to the deep ocean. In prior research (1) *C. psychrerythraea* 34H was selected as a model organism for genomic studies of bacterial cold adaptation. In tandem, we are applying the transcoding of digital raster images for the sonic interpretation/comparison of deep oceanic sediment core samples collected from 4827 m water depth in the Peru Basin (2).

Our methods employ two software programming approaches for the custom transcoding of datasets to sound. The visual programming language MAX/MSP (3) was utilized for transcoding of amino acids and their physiochemical properties to sonic frequencies. Transcoding of physiochemical properties to frequency include: molecular weight; residue weight ( $-H_2O$ ); acid and base dissociation constants (pKa, pKb, pKx); isoelectric point (pI); and relative hydrophobicity w/pH (pH 2 & 7). The range of frequencies for transcoding of these properties spans 40 Hz to 2000 Hz. The Processing open source programming language (4) was employed to author software for transcoding of digital raster images of deep ocean sediment core samples to sound output.

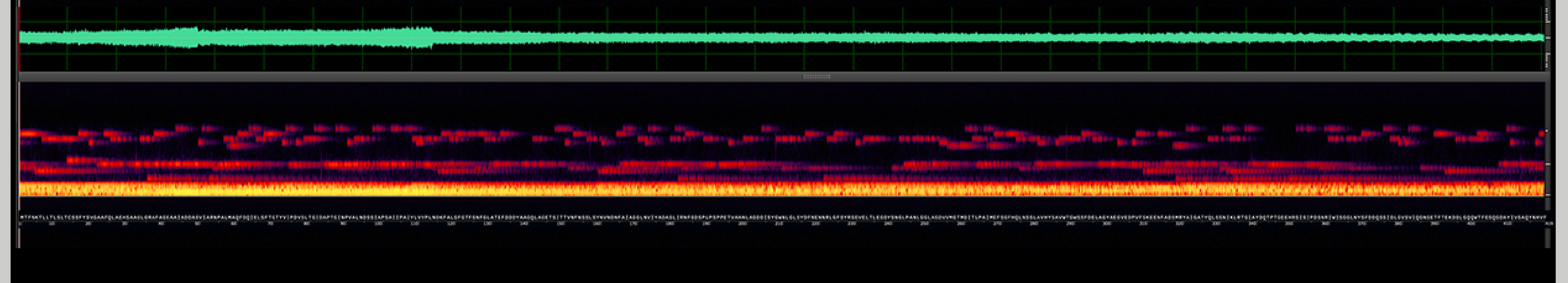
Exemplary datasets for applying these transcodings are: 1) *C. psychrerythraea* 34H long chain fatty acid (LCFA) transport protein sequence (5) and 2) deep ocean sediment core samples collected by the R/V *Joides Resolution* from Site 1231 during Leg 201 of the Ocean Drilling Program (2).

## References

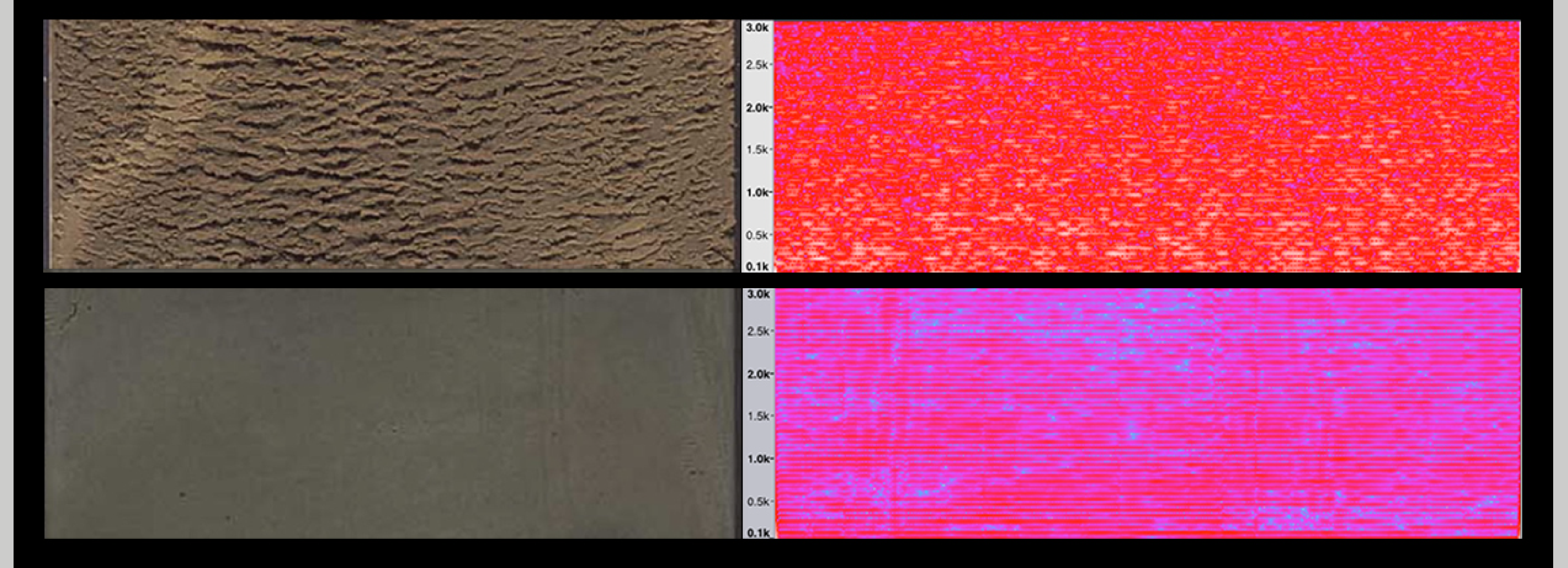
- 1) Methe et al., (2005), Proc. Nat. Acad. Sci. USA, 102, 10913–10918
- 2) D'Hondt, S.L et al., 2003. Proc. ODP, Init. Repts., 201: College Station, TX (Ocean Drilling Program). doi:10.2973/odp.proc.ir.201.2003
- 3) Max 7.3.5 [Computer software] (2018). Available from <<https://cycling74.com/downloads>>
- 4) Processing 3.3.7 [Computer software] (2018). Available from <<https://www.processing.org/download/>>
- 5) GenBank accession number CP000083.1 (5/2018). Retrieved from <<https://www.ncbi.nlm.nih.gov/nuccore/CP000083>>

## Results

Spectral frequency display of *C. psychrerythraea* 34H long chain fatty acid (LCFA) transport protein sonification (amino acid to frequency).



Two comparative deep ocean sediment core samples and corresponding sonic spectrograms from raster image sonification.



Resulting sound samples are available for online listening at: <<https://soundcloud.com/bioticastudio/colwellia-psychrerythraea-34h-lcfa-transport-protein-sonification>>, <<https://soundcloud.com/bioticastudio/sonidome>> and <<https://soundcloud.com/bioticastudio/sonidomedep-oceanic-sediment-sonificationv1>>

## Conclusions

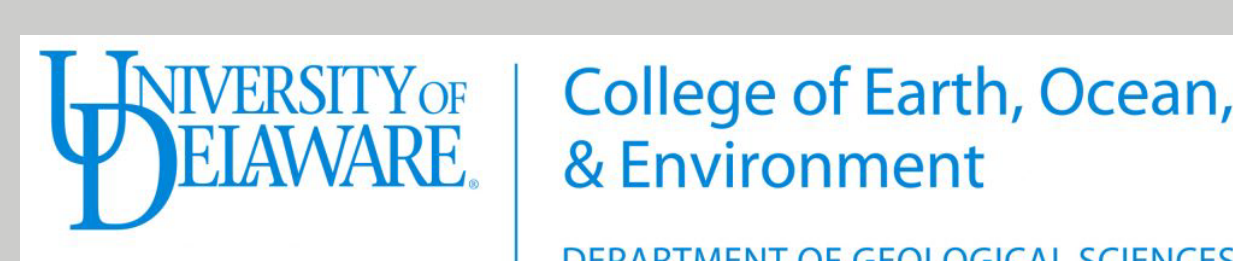
Visual and code-based software programming approaches were successfully utilized for the sonic transcoding and interpretation of ocean microbial ecology bioinformatic and environmental samples from two remote biomes.

Through our art-science collaboration and processes the 'reduction-to-practice' of methods and vehicles for expressing sonic representations of 'master ecological narratives' were realized, and 'case studies' for workshop production, software toolkit distributions, exhibitions, concert performances and journal articles have progressed to elevate consciousness to polar oceans and the deep ocean biosphere.

This progress includes linking our novel sonification products to outputs from another NAKFI-supported project, one that seeks to define the concept of Ocean Memory in all possible ways. The genomic and geochemical data from the two remote biomes addressed by soniDOME are inherently rich with memories of a past ocean.

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