Determination of Suitable Sediments for Deployment of a Novel Porewater Sampling Underwater Mass Spectrometer

E.J. Chua[1], M. Rodrigo[2], R.W. Fulweiler[1,3], R.T. Short[4], A. M. Cardenas-Valencia, and, W. Savidge[5]

[1]Boston University (BU), Department of Earth and Environment, 685 Commonwealth Avenue, Boston, MA 02215
[2]Boston University (BU), Department of Mechanical Engineering, 110 Cummington Mall, Boston, MA 02215
[3]Boston University (BU), Department of Biology, 5 Cummington Mall, Boston, MA 02215
[4]SRI International (SRI), 450 Eighth Avenue SE, St. Petersburg, FL 33701
[5]Skidaway Institute of Oceanography (SkIO), University of Georgia, 10 Ocean Science Circle Savannah, GA 31411

The continental shelves are predominantly covered in sediments with high permeabilities (>10^{-12} m^2). In these sandy sediments, solute-containing porewater transport is dominated by advection. Although it is now recognized that they are important in biogeochemical cycling, sampling difficulties in permeable sediments have inhibited accurate measurements of chemical fluxes. Previous permeable sediment sampling methods (*e.g.,* flow-through reactors, stirred benthic chambers) may not accurately replicate the dynamic advective flows that drive fluxes in these environments. We are developing a novel porewater sampling underwater mass spectrometer system which enables the *in situ* analysis of biologically-important dissolved gases (*e.g.,* N_2, O_2, CO_2, CH_4) in permeable sediments. The sampler is designed to cause minimal interference to ambient advective flow fields. Recent laboratory experiments have focused on evaluating the current prototype's performance by determining the sediment types in which it can sample. A needle valve, which allows fine-tuned control of flow, was used as a proxy for sediment permeability. The needle valve was first calibrated with various well-sorted sands to correlate the number of valve turns to sand permeability, providing a relationship between valve settings and sediment type (*e.g.,* a more open valve represents a coarser sand). The needle valve was then placed upstream of the porewater sampler inlet, and the pressure at the inlet was monitored as the needle valve was used to vary the "permeability". Failure of the sampler was defined as occurring when the fluid started cavitating, indicated by large drops in pressure. In practice, sediments which cause cavitation in the porewater sampler will be more challenging to analyze as they can reduce instrument performance or possibly induce mechanical failure. These experiments help define the range of sediments in which the instrument can be deployed.