Real time monitoring of processes in permeable sediments by underwater mass spectrometry

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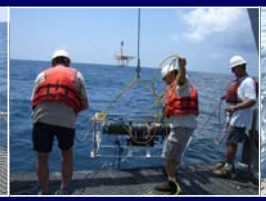
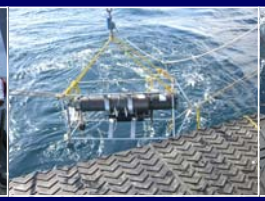
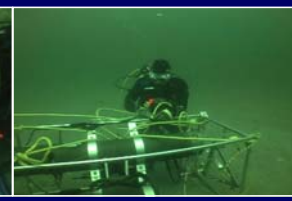
As part of a larger collaborative project to study benthic boundary layer processes, some of our work has recently focused on understanding processes in permeable sediments on the continental shelf off the coast of Georgia by measuring biogenic gas production with an *in situ* mass spectrometer. The overall project, headed by the Skidaway Institute of Oceanography, is an instrumentation observatory designed to span a wide range of spatial and temporal scales in order to achieve an understanding of benthic exchange processes in a permeable sand environment. The underwater membrane inlet mass spectrometer will be deployed during seasonal instrument deployment and recovery cruises to measure real time dissolved gas concentrations (O_2, CO_2, CH_4, N_2 and Ar) in the porewaters.

During recent cruises on the R/V Savannah an underwater mass spectrometer was deployed on the seafloor at a depth of approximately 30 m for 43 hour on the first cruise and 60 hours on the next. It was connected by a 200m tether to the Naval R2 tower in the South Atlantic Bight and communication was established via Ethernet radio between the tower and the ship. For the initial experiments, sampling occurred from within a benthic chamber.







Mass Spectrometry Deployment - The mass spectrometer was lowered overboard to the seafloor by the ship's winch. The benthic chamber was deployed into the sediment by divers. Divers also connected the power. communication tether to the mass spectrometer.

Benthic chamber – Benthic flux chambers are widely used for in situ measurements of marine sediments. The chamber encloses a sediment core plus the overlying water column allowing measurement of dissolved gas exchange across the sediment water interface. The cylindrical clear acrylic (15cm diameter x 9.5cm high) chamber was connected to the mass spectrometer by 1.8m of Peek tubing. The MIMS inlet was protected by a 100um stainless steel suction strainer.

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Data - In June 2007, the difficult logistics of deployment of the in situ mass spectrometer on the ocean floor and establishing real time communication were figured out. The mass spectrometer was deployed for approximately 43 hours sampling water in the flux chamber continuously for the entire deployment period. Dissolved gas data showed a gradual decline in concentration for most dissolved gases (e.g., nitrogen argon and oxygen), with the exception of carbon dioxide, which showed an increase during the two day period. The oxygen concentration dropped off more rapidly than the other gases.

In August 2007, the mass spectrometer was again deployed from the R/V Savannah to 30m depth. This time it was on the seafloor for 60 hours. During that time 2 sets of data were collected.

Correlation of mass spectrometer data with physical oceanographic data simultaneously collected is still under investigation.