

Underwater Mass Spectrometry: Developments and Calibration

Ryan J. Bell¹, Strawn K. Toler¹, Peter G. Wenner², R. Timothy Short¹, Robert H. Byrne²

¹ SRI International, 140 7th Ave S, COT 100, St Petersburg, Florida, 33701

² University of South Florida, 140 7th Ave S, St Petersburg, Florida, 33701

An underwater mass spectrometer that employs a 200-amu linear quadrupole mass filter and a high-pressure membrane inlet system has been developed for in-situ chemical analysis of marine and freshwater systems. Analyte permeation through a silicone membrane allows introduction of dissolved gases and volatile organic compounds into the analyzer's vacuum chamber for analysis. The membrane is supported against ambient hydrostatic pressure by a sintered rod. Presently, the depth rating of the mass spectrometer is limited to 1200 m by the instrument's external aluminum pressure housing.

Prior to deployments, for analysis of dissolved gases (e.g. methane, nitrogen, oxygen, argon and carbon dioxide) the mass spectrometer is calibrated using water samples equilibrated with gas standards. Since it is inconvenient to control hydrostatic pressure within an underwater instrument, measurement of gas concentrations are influenced by compression of the silicone membrane at depth. Gas concentrations must be obtained through calibrations with respect to pressure.

The underwater mass spectrometer has been deployed in a number of locations for a variety of applications. Recent deployments include depth profiling of dissolved gas concentrations in the Gulf of Mexico, surface contouring of gas concentrations related to primary productivity in Hillsborough River (Tampa, FL) and multi-day monitoring of the sediment-water interface to estimate real-time biogenic gas production within the sediment. Details about deployments and underwater mass spectrometer calibration methodologies will be presented.