Determination of Dissolved Gas Concentrations in Natural Waters using an In-Situ Membrane Inlet Mass Spectrometer

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Dissolved gas concentrations in natural waters can serve as indicators of diverse physical, chemical and biological processes. Traditionally, measurement of dissolved gas concentrations consisted of the collection of a discrete water sample followed by laboratory analysis. This analytical method had both temporal and spatial limitations as well as the risk of sample degradation between the time of collection and analysis. In-situ instrumentation designed to measure dissolved gas concentrations now allows for greater spatial and temporal sampling density but most of these instruments are specific to a single gaseous compound. Measurement of multiple gas concentrations requires a suite of instruments.

The in-situ, membrane inlet mass spectrometer developed at the University of South Florida is an analytical instrument that provides enhanced temporal and spatial sampling density of natural waters and the ability to simultaneously measure the concentrations of multiple dissolved gas species. Past deployments in a variety of environmental settings have produced data sets that display relative changes in the ion intensities (measured in amperes) of argon, nitrogen, oxygen, carbon dioxide, methane and hydrogen sulfide. Recent work has focused on calibration of the instrument, which will relate units of ion intensity to units of concentration. A portable calibration unit has been constructed that allows for both laboratory and field calibration of the mass spectrometer. The calibration technique employs the mixing of two equilibrated solutions with the use of a switching valve. The resulting solution, of which the various dissolved gas concentrations of interest are known, is then pumped directly into the mass spectrometer inlet for analysis. Results of this work will be discussed as well as some of the inherent problems,

Development and construction of a new underwater mass spectrometer at the University of South Florida has been undertaken and will also be discussed. The latest instrument will incorporate design elements that will improve performance and adaptability.