United States Department of the Interior

GEOLOGICAL SURVEY

To: Dick Butler, Aanderaa Instruments
From: Marinna Martini
Date: June 2nd, 2003
Subject: Oxygen sensor beta test, deployment #2, report of results and observations

Introduction:

I have completed processing the data from the second beta deployment of the Aanderaa oxygen optode at the MWRA/USGS long term mooring site in Massachusetts Bay. This deployment had a few problems, not with the Aanderaa instrumentation, but with the recovery and comparative data.

As before, I want to make clear that this experiment does not constitute an endorsement or recommendation of any manufacturer's instrumentation. We are happy to present our results and observations for others to make their own decisions about the applicability of these sensors for their work. Please do not distribute the accompanying data, plots and m-files without this letter.

Deployment Method:

The optode was deployed on a tripod at a depth of 31.2 m, 10 nm east of Boston (42-22-41.01N, 070-47-05.276W) from Oct 24, 2002 through May 21, 2003. A Seabird model 43 oxygen sensor and YSI 6600-M Sonde were also deployed on the same platform. The deployment period was three months longer than we expected. Our cooperator, the U.S. Coast Guard, was unable to assist us at all after October due to Homeland Security duties. When we did finally get a ship, at the end of March, the tripod floats did not surface. We were unable to mount a dive operation until the end of May, for reasons of both weather, ship and personnel availability. The recovery system failed because the strong winter storms had sucked the recovery line from the covered line cannister, a problem we thought we had solved with a lid design. No Seabird data was recorded due to a data logger failure.

The optode was attached to a USGS data logger which sampled oxygen every 3.75 min. This logger simply applied power to the optode, then recorded the returned data string with the time and record number. Data were recorded through the entire 6 month deployment. The YSI Sonde recorded data until mid January.

Data:

Figure 1 below shows oxygen and temperature data recorded by the Aanderaa optode and salinity data recorded by the YSI Sonde. The Sonde's data ends in January when that instrument ran out of power. Oxygen data have been corrected for in-situ temperature using the optode's temperature data and an assumed constant salinity of 32.5 ppt, using the same processing routine as the last deployment (optodecalc.m).

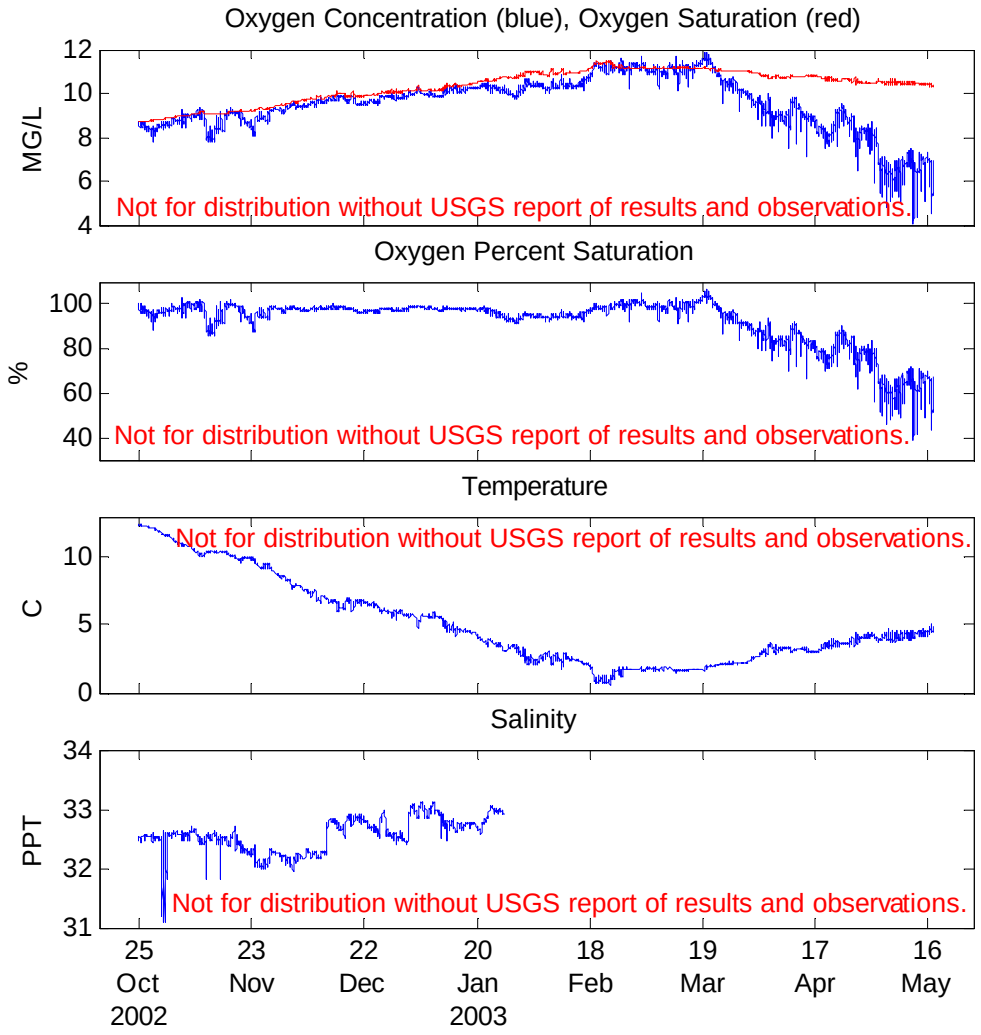

Figure 1: Winter 2002-2003 oxygen data, 2.3 mab from the USGS long term mooring site near the MWRA outfall. Salinity data is from the YSI Sonde.

Observations:

1) The entire surface of the optode, including the window, was completely coated with a fine layer of fouling, shown in Figures 2 and 3. It is unclear when this fouling started.

Figure 2: Biofouling on the Aanderaa optode shown as recovered.

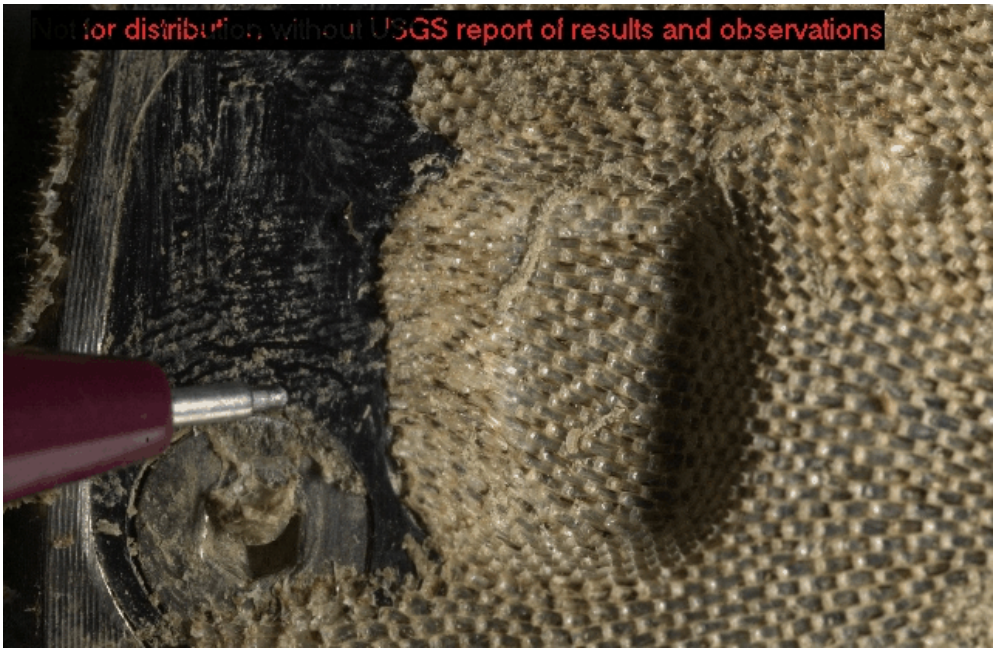

Figure 3: Closeup of biofouling on the Aanderaa optode, some of the organisms were removed when the sensor was dismounted from the tripod.

2) According to observations at the GOMOOS site, the spring bloom starts at the end of March.
3) Other than biofouling, there do not appear to be any issues with the data.
4) The organism covering the optode in Figures 2 and 3 is a colonial encrusting bryozoan, which does consume oxygen and it is unclear how much oxygen can pass through their exoskeletons. Figure 3 shows them to have effectively covered and sealed the entire surface of the optode window.
5) On the March 30th deployment cruise, a Winkler titration was performed on a water sample taken 2 mab at 42-22.540N, 070-47.145W, a position 273 m bearing 197°T from the optode location. Three repetitions on a single sample resulted in an oxygen concentration of 12 mg/l at the same time the optode measured 10 mg/l.

Conclusion:

The optode seems to have performed very well over an unusually long deployment. Due to the failure of the USGS data logger, we do not have any Seabird oxygen data to study, however, that data was expected to be biased low because the data logger did not have enough power to pump the sensor for the optimum amount of time. This problem was discovered when analyzing the data from the first beta test, after this tripod was deployed.

An optode is currently deployed for the period of March through September 2003 attached to an RCM logger. It has a copper ring around the window, but no antifouling on the window itself. A Seabird sensor is not deployed at this time.

It is not clear to me if the 2 mg/l difference between the optode and winkler titration taken on March 30th is significant. Both sensors will be sent to the USGS Hydrologic Instrumentation Facility for testing and evaluation, then redeployed at the USGS long term mooring site in September, 2003. The seabird sensor will be sampled by a separate USGS MIDAS data logger with enough power to accommodate longer pump times.

Thanks again to everyone who helped with this effort!

Marinna Martini
U.S. Geological Survey
Woods Hole Field Center
(508) 457-2326

Cc: Mike Mickelson, Jim Carlson, Brad Butman, Mike Bothner, Trond Gulbrandsoy, Anders Tengberg, Fran Lightsom, Dave Armstrong, Terry Donoghue, Paul Dragos
Attachments: ASCII output of data, 6971ysi-m.txt & 6972aa-m.txt, and optodecalc.m