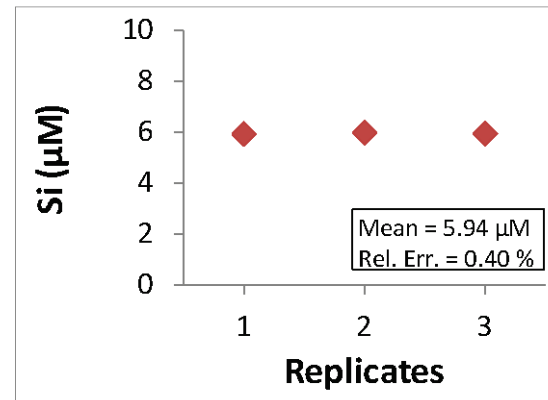
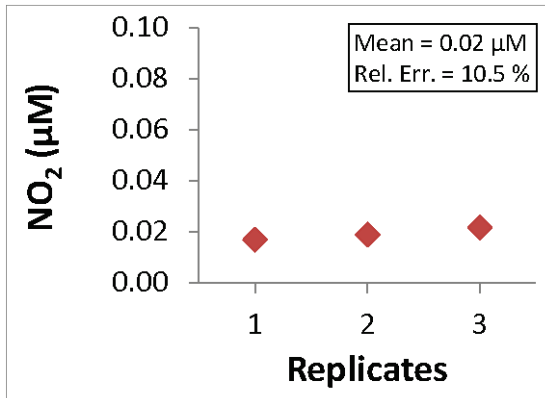
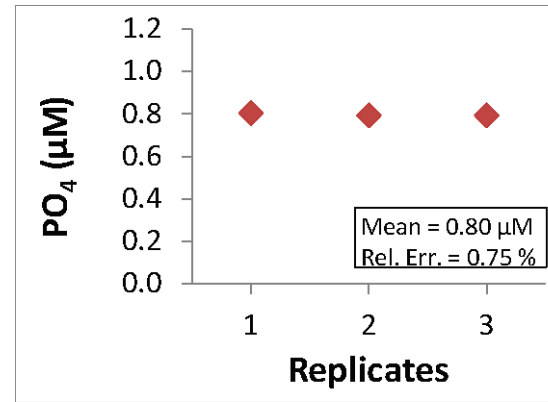
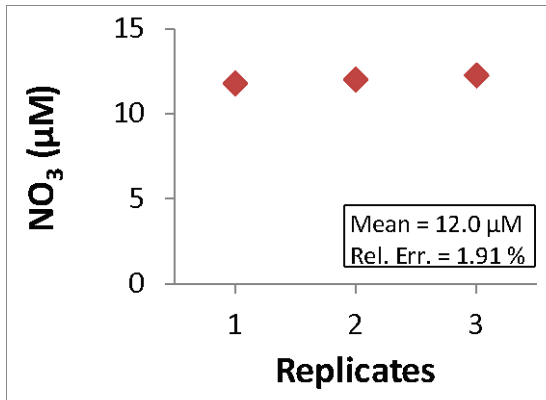
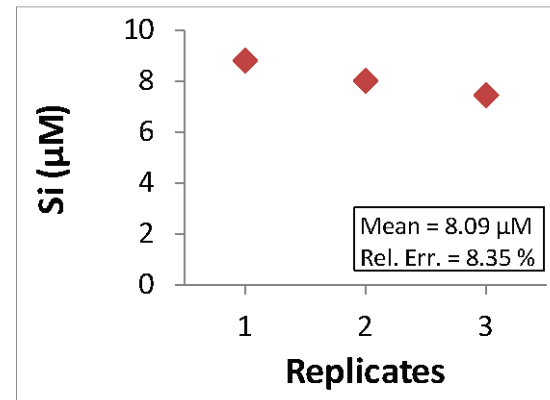
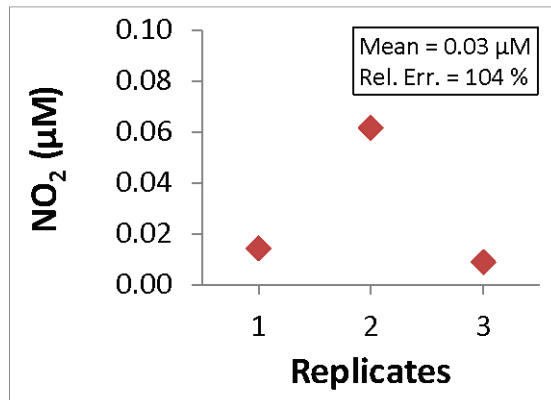
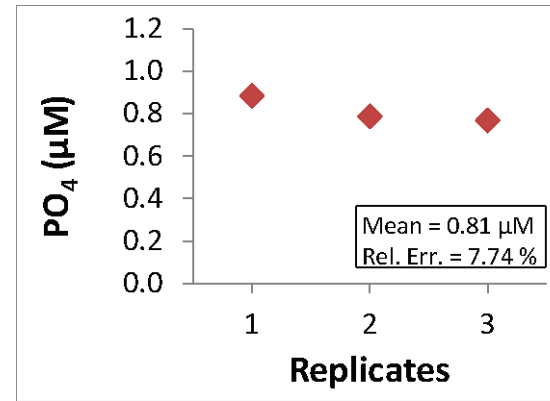
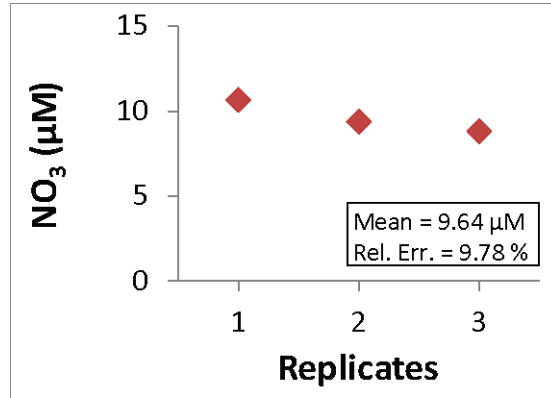


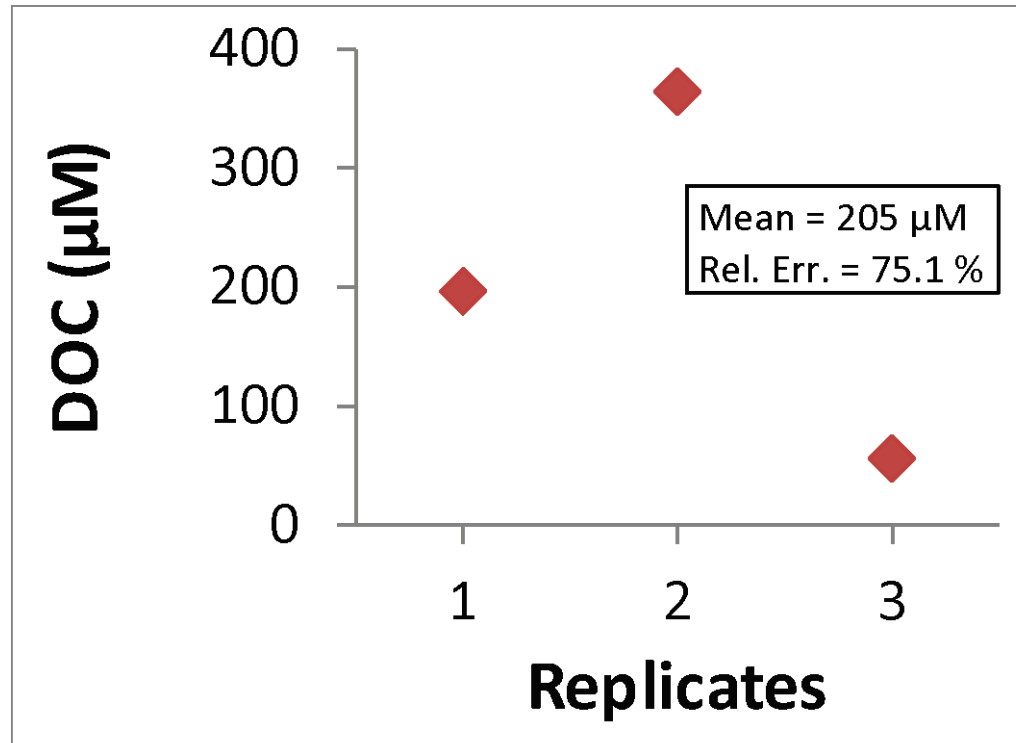
# Nutrients - Connecticut (Sea Wolf class; 219m)



# Nutrients – New Hampshire (Virginia class; 180m)

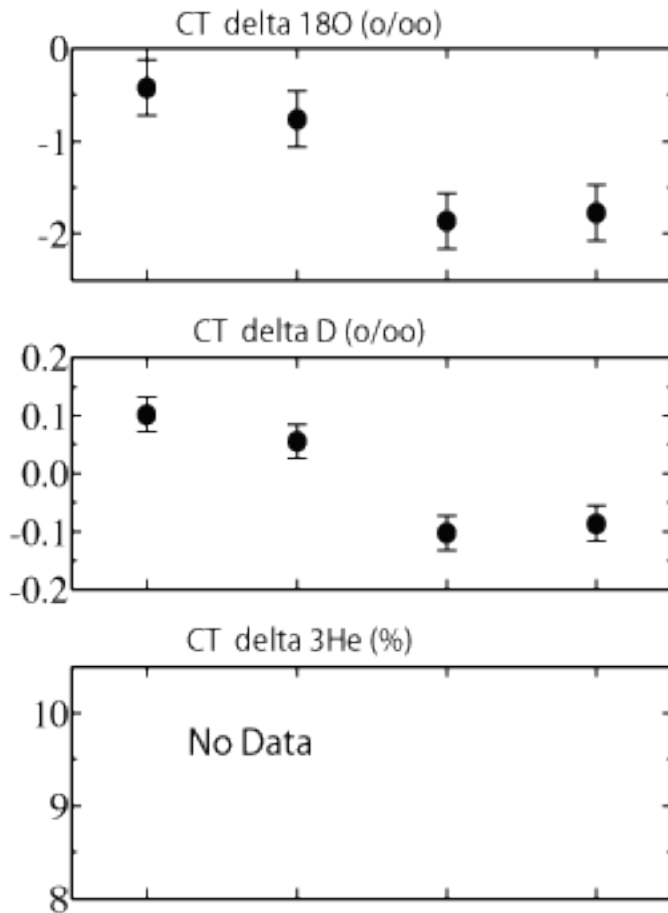


# Dissolved Organic Carbon –Connecticut (219m)

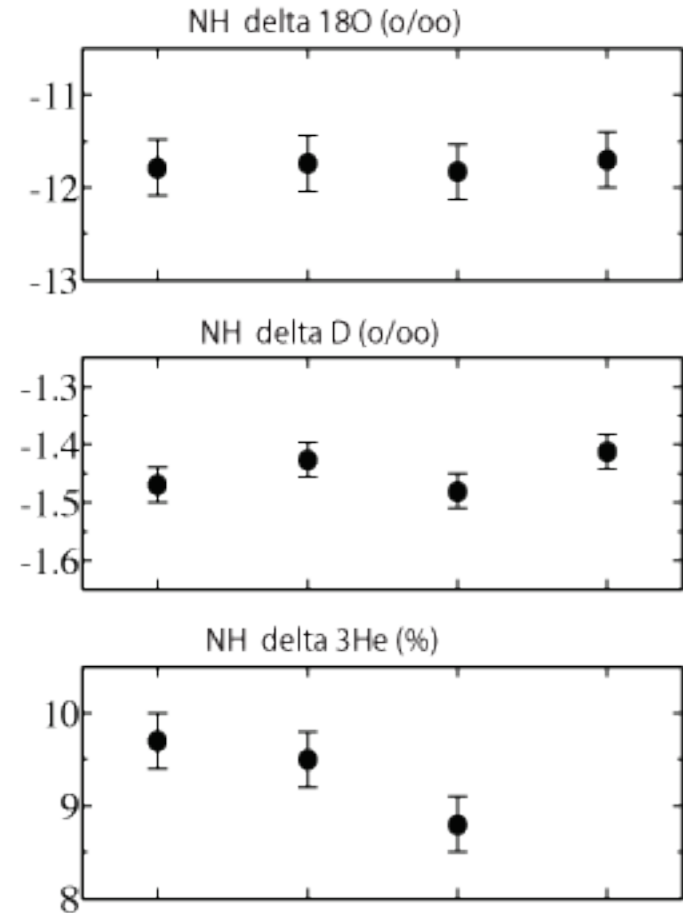


# Tracer data (1)

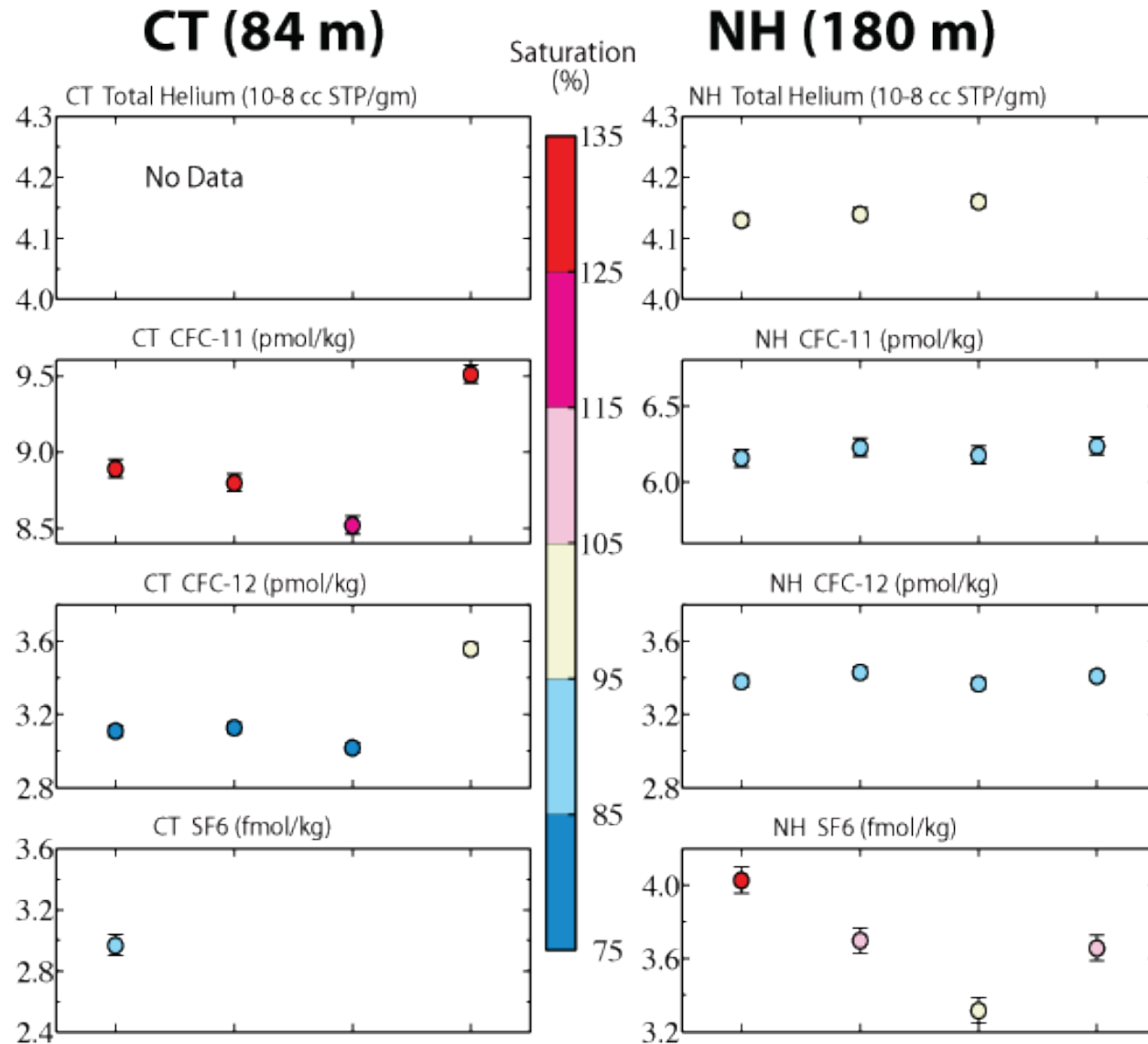
## CT (84 m)



## NH (180 m)



# Tracer Data (2)



# DISCRETE WATER SAMPLES

Salinity	Core water property; calibrate salinity sensor on CTD	200 ml	Rinse, fill, and cap a 200 ml glass bottle	Can be stored for shore-based measurement or measured on board with an Autosal	Room temperature
Oxygen	Water mass tracer; Biological production and recycling; calibrate $O_2$ sensor on CTD	120 ml	Rinse and fill 120 ml flask	Add reagents, follow Winkler titration procedures	Room temperature covered with water for up to one day prior to titration
Chl <i>a</i> , HPLC pigments	Phytoplankton levels and community composition; calibrate Chl <i>a</i> fluorometer on CTD	500 ml (Chl <i>a</i> only) or 1–3 L for HPLC	Chl <i>a</i> —filter and place filter into 10 ml 90% acetone; HPLC samples—freeze filter	Chl <i>a</i> can be measured in an on-board fluorometer or stored for shore based measurement like HPLC	–20°C, must not thaw (–80° if possible for HPLC)
Flow cytometry	Microbial abundance	10 ml	Rinse and fill 15 ml tube	Add formalin and freeze	–20°C, must not thaw (–80° if possible)
Nutrients (PO <sub>4</sub> , NO <sub>3</sub> , SiO <sub>2</sub> )	Water mass tracers; biological production and recycling	50 ml	Rinse, partially fill, and cap a 50 ml plastic tube; keep upright and ensure cap is tight	Quick freeze as soon as possible at –20°C	–20°C, must not thaw
<sup>18</sup> O	Determine freshwater sources	100 ml	Rinse, fill, and cap 100 ml glass bottles	None	Room temperature
Alkalinity	CO <sub>2</sub> uptake, ocean acidification	250 ml	Rinse and fill 250 ml glass bottle with screw cap leaving a 2 ml headspace	None	Keep in dark at room temperature
SF <sub>6</sub> , CFCs	Age information; calculation of anthropogenic C <sub>2</sub> water mass tracer	1–2 L	Rinse and fill a 250–500 ml glass stoppered bottle, insert glass stopper, place the bottle in a jar and fill the jar with sample water	None	Refrigerated at a temperature of 0–2°C
Helium isotopes	Age information; water mass tracer	50 ml	Flush a 50 ml copper tube with the sample and crimp the ends of the tube with the water flowing; rinse the crimped ends with freshwater	None	Room temperature
Tritium	Age information; water mass tracer	500 ml	Fill a 500 ml bottle without rinsing and cap	None	Room temperature
<sup>129</sup> I	Circulation time of Atlantic water	1 L	Rinse, fill, and cap a 1 L plastic bottle	None	Room temperature
Radium isotopes	Circulation of shelf water into the interior	130 L	Filter water through a cartridge while the submarine is underway	Change cartridge approx every three hours while submarine is underway	Room temperature

DISCRETE WATER SAMPLES					
Salinity	Core water property; calibrate salinity sensor on CTD	200 ml	Rinse, fill, and cap a 200 ml glass bottle	Can be stored for shore-based measurement or measured on board with an Autosal	Room temperature
Oxygen	Water mass tracer; Biological production and recycling; calibrate $O_2$ sensor on CTD	120 ml	Rinse and fill 120 ml flask	Add reagents, follow Winkler titration procedures	Room temperature covered with water for up to one day prior to titration
Chl <i>a</i> , HPLC pigments	Phytoplankton levels and community composition; calibrate Chl <i>a</i> fluorometer on CTD	500 ml (Chl <i>a</i> only) or 1–3 L for HPLC	Chl <i>a</i> —filter and place filter into 10 ml 90% acetone; HPLC samples—freeze filter	Chl <i>a</i> can be measured in an on-board fluorometer or stored for shore based measurement like HPLC	–20°C, must not thaw (–80° if possible for HPLC)
Flow cytometry	Microbial abundance	10 ml	Rinse and fill 15 ml tube	Add formalin and freeze	–20°C, must not thaw (–80° if possible)
Nutrients (PO <sub>4</sub> , NO <sub>3</sub> , SiO <sub>2</sub> )	Water mass tracers; biological production and recycling	50 ml	Rinse, partially fill, and cap a 50 ml plastic tube; keep upright and ensure cap is tight	Quick freeze as soon as possible at –20°C	–20°C, must not thaw
<sup>18</sup> O	Determine freshwater sources	100 ml	Rinse, fill, and cap 100 ml glass bottles	None	Room temperature
Alkalinity	CO <sub>2</sub> uptake, ocean acidification	250 ml	Rinse and fill 250 ml glass bottle with screw cap leaving a 2 ml headspace	None	Keep in dark at room temperature
SF <sub>6</sub> , CFCs	Age information; calculation of anthropogenic CO <sub>2</sub> water mass tracer	1–2 L	Rinse and fill a 250–500 ml glass stoppered bottle, insert glass stopper, place the bottle in a jar and fill the jar with sample water	None	Refrigerated at a temperature of 0–2°C
Helium isotopes	Age information; water mass tracer	50 ml	Flush a 50 ml copper tube with the sample and crimp the ends of the tube with the water flowing; rinse the crimped ends with freshwater	None	Room temperature
Tritium	Age information; water mass tracer	500 ml	Fill a 500 ml bottle without rinsing and cap	None	Room temperature
<sup>129</sup> I	Circulation time of Atlantic water	1 L	Rinse, fill, and cap a 1 L plastic bottle	None	Room temperature
Radium isotopes	Circulation of shelf water into the interior	130 L	Filter water through a cartridge while the submarine is underway	Change cartridge approx every three hours while submarine is underway	Room temperature

Calibration &  
Diss. & Part. Pools

Phyto & Bacteria

Diss. & Part. Pools

Tracer

Diss. & Part. Pools

Tracer

Tracer

Tracer

Tracer

Tracer



# Sample Collection & Shipping

DISCRETE WATER SAMPLES			
Salinity	Core water property; calibrate salinity sensor on CTD	200 ml	Rinse, fill, and cap glass bottle
Oxygen	Water mass tracer; Biological production and recycling; calibrate O <sub>2</sub> sensor on CTD	120 ml	Rinse and fill 120 ml bottle
Chl a, HPLC pigments	Phytoplankton levels and community composition; calibrate Chl a fluorometer on CTD	500 ml (Chl a only) or 1-3 L for HPLC	Chl a—filter and into 10 ml 90% HPLC samples
Flow cytometry	Microbial abundance	10 ml	Rinse and fill 15 ml bottle
Nutrients (PO <sub>4</sub> , NO <sub>3</sub> , SiO <sub>2</sub> )	Water mass tracers; biological production and recycling	50 ml	Rinse, partially fill a 50 ml plastic bottle upright and empty
<sup>18</sup> O	Determine freshwater sources	100 ml	Rinse, fill, and cap glass bottles
Alkalinity	CO <sub>2</sub> uptake, ocean acidification	250 ml	Rinse and fill 250 ml bottle with screw cap and a 2 ml headspace
SF <sub>6</sub> , CFCs	Age information; calculation of anthropogenic CO <sub>2</sub> water mass tracer	1-2 L	Rinse and fill a glass stoppered glass stopper, place in a jar and fill to sample water
Helium isotopes	Age information; water mass tracer	50 ml	Flush a 50 ml container with the sample, crimp the ends of the water flow line, and crimp ends vial
Tritium	Age information; water mass tracer	500 ml	Fill a 500 ml bottle, rinse, and cap
<sup>129</sup> I	Circulation time of Atlantic water	1 L	Rinse, fill, and cap plastic bottle
Radium isotopes	Circulation of shelf water into the interior	130 L	Filter water through cartridge while is underway

Calibration & Diss. & Part. Pools

Phyto & Bacteria

Diss. & Part. Pools

Tracer

Diss. & Part. Pools

Tracer

Tracer

Tracer

Tracer

Tracer

ml	Can be stored for shore-based measurement or measured on board with an Autosol	Room temperature
ml	Add reagents, follow Winkler titration procedures	Room temperature covered with water for up to one day prior to titration
ml filter	Chl a can be measured in an on-board fluorometer or stored for shore based measurement like HPLC	-20°C, must not thaw (-80° if possible for HPLC)
ml	Add formalin and freeze	-20°C, must not thaw (-80° if possible)
ml is tight	Quick freeze as soon as possible at -20°C	-20°C, must not thaw
ml	None	Room temperature
ml aving	None	Keep in dark at room temperature
ml insert bottle with	None	Refrigerated at a temperature of 0-2°C
ml mp in the water	None	Room temperature
ml ut	None	Room temperature
ml	None	Room temperature
ml	Change cartridge approx every three hours while underway	Room temperature

SAMPLE	PURPOSE	SIZE	COLLECTION PROCEDURE	ON BOARD PROCESSING	STORAGE REQUIREMENTS
<b>UNDERWAY CONTINUOUS SAMPLING VIA SENSORS</b>					
Temperature	Core water property	N/A	Hull-mounted CTD	None	N/A
Salinity	Core water property	N/A	Hull-mounted CTD	None	N/A
Oxygen	Water mass tracer; biological production and recycling	N/A	Hull-mounted CTD	None	N/A
Nitrate	Water mass tracer; biological production and recycling	N/A	Hull-mounted CTD	None	N/A
DOC	Water mass tracer	N/A	Hull-mounted CTD	None	N/A
Alkalinity, pH, pCO <sub>2</sub>	CO <sub>2</sub> uptake, ocean acidification	N/A	Pumped stream from hull-mounted CTD	None	N/A
Chl a, variable fluorescence	Phytoplankton abundance, photosynthetic capacity	N/A	Pumped stream from hull-mounted CTD	None	N/A
Spectral radiometry, light scattering, and absorption	Chemical and biological properties (CDOM; overlying phytoplankton levels, particulate characterization)	N/A	Upward-looking sensors; pumped stream from hull- mounted CTD	None	N/A

# Issues from initial SCICEX SAM

- 1 Better training procedures and materials
- 2 Earlier submittal & proper routing of MSDS sheets for HAZMAT
- 3 Better labeling and water handling
- 4 Sampling problems with organics & perhaps some tracers
- 5 Need to standardize shipboard storage and shipping & handling from Bremerton & Groton