OMG

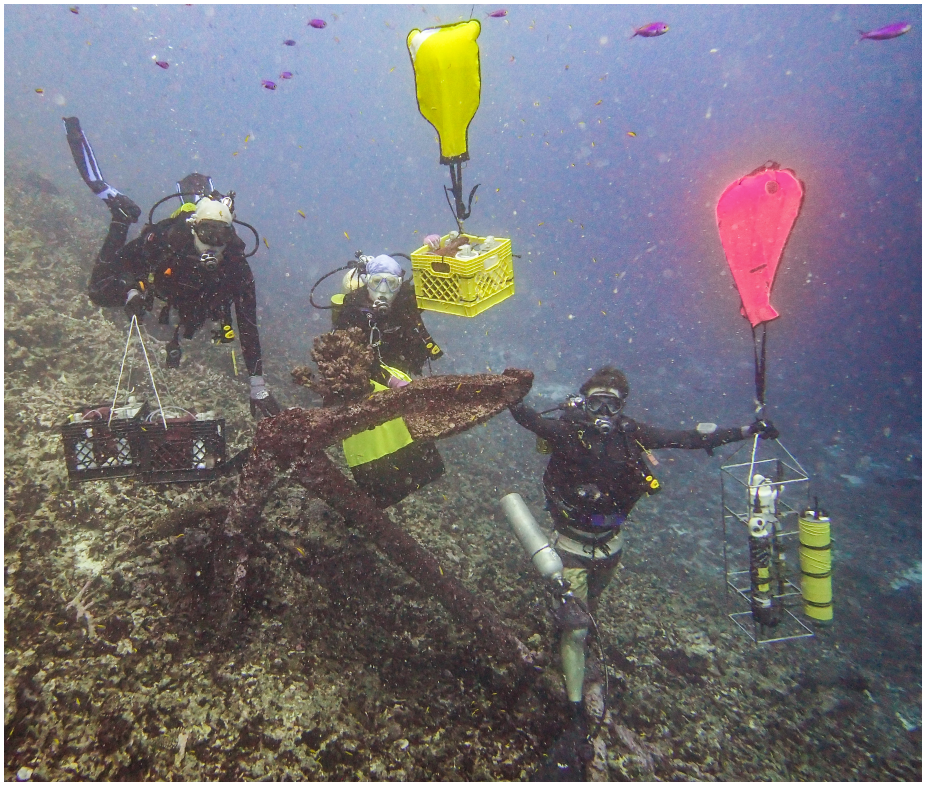
The OCC Knowledge Base

NVP

2020-03-18

Contents

Preface



Welcome to the online knowledge base of the OCC Team. This started as the OCC Mission Guide, a reference manual to help consolidate best practices for conducting OCC team operations at sea. As of 2020, it has evolved into an online living book, written in R Markdown and compiled into book with bookdown,published via GitHub Pages. The current live version of the book that you can bookmark is here. All OCC team members are encouraged to not only use it as a resource but help it grow by adding and editing content as OCC projects, methods and missions continue to change and grow. Anyone may suggest edits to the contents of the OMG by forking the OMG repository from Noah via GitHub, pushing any changes back to GitHub, after which they may be approved for incorporation into the master copy of the

OMG.

Once you have forked the repo onto your local machine, the HTML version of the OMG may be accessed offline by simply opening the index.html file in the folder “OMG/docs” A .PDF file of the book is also generated every time the book is built, that also ends up in the “OMG/docs” folder.

How to Edit this Book

1. Fork the repo from Noah via GitHub.
2. Edit any existing chapter by simply editing its .Rmd file in R studio or create a new chapter by creating a new .Rmd file in the root OMG folder. Build the book to see your edits in the form of the built book.
3. Commit your changes via GitHub Desktop (or via R if you have setup GitHub to play nicely with R.)
4. In GitHub, open a Pull Request to have your edits considered for integration into the master branch.

The Best How to Guide for Authoring Books with R Markdown is written by Yihui Xie and is found right here

If you need some tips for your R Markdown formatting, this cheat sheet is great.

Chapter 1

Preparing for a Research Cruise

1.1 Determine Goals

Determine the team's goals in the region the research cruise is scheduled to visit. Identify all planned retreivals, deployments and specialty projects (such as the diel suite), and the number of days, staff, and boats needed to accomplish these goals.

1.2 Spatial Data Preparation

- Create a single .kml file that includes all planned instrument retrievals and any planned additional deployments and other necessary points (collectively all called "planning points". .kml files are more agile than ArcGIS files; they are easier to use in Google Earth for day to day planning.
- Create an ArcGIS map project that contains the locations of all planning points.

1.3 Garmin 78 Handheld GPS Preparation

- Ensure each handheld unit is setup properly
  - Time to UTC
  - LAT and LONG in decimal degrees
- Test each handheld GPS to be taken on the cruise prior to sailing: take it outside and ensure that it collects waypoints.
- Upload planning points to both the primary and secondary GPS units.

1.4 Datasheet Preparation

- We should make some new field datasheets before MARAMP2020 given the NEW FANCY Oracle DB!!!!!!!!
- Prepare Field Data Binders
  - Print enough data sheets for all activities, including mooring, CAU, CTD/H2O for the OCC team in addition to enough CTD/H20 data sheets for any other team on CTD/H20 Ops.
  - Attach sharp pencils to field binders

1.5 Software Needed at Sea

Software	Team Lead Only	Manufacturer	Needed For	Instrument	Download Location
ARCMap	x	ESRI	planning operations and generating maps	NA	see Tomoko
Google Earth		Google	planning operations	NA	

Software	Team Lead Only	Manufacturer	Needed For	Instrument	Download Location
Keyspan USA Software		Keyspan	serial to USB adapter cable	GPS	https://www.tripplite.com/support/USA19HS
Microsoft Access 2010		Microsoft	mooring and CTD databases	NA	request from ITS
Excel		Microsoft	spreadsheets	NA	you must have this already
DNR Garmin		Minnesota DNR	download of GPS Waypoints	GPS	http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html
DNR GPS		Minnesota DNR	upload of GPS planning points from Google Earth	GPS	http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html
Aquadopp Software - AquaPro v1.37.08		Nortek	instrument interface	Aquadopp ADCP	http://www.nortek-as.com/en/support/software
SoundTrap Host Software Version 2.0.9.x	x	Ocean Instruments	instrument interface	Sound Trap	http://www.oceaninstruments.co.nz/downloads/
Basic Stamp Editor		Paralax Inc.	instrument interface	PUC	https://www.parallax.com/downloads/basic-stamp-editor-software-windows
Python 2.51		Python	scripts that are part of mooring and CTD databases	NA	https://www.python.org/download/releases/2.5.1/
SeaFETCOM 2		Satlantic	instrument interface	SeaFet	http://satlantic.com/seafetcom
Seaterm 1.59		SeaBird	instrument interface	SBE39, SBE19, SBE19+	http://www.seabird.com/software/software
Seaterm V2		SeaBird	instrument interface	sbe19+ V2, SBE56	http://www.seabird.com/software/software
SBE Data Processing		SeaBird	CTD cast processing	SBE CTDs	https://www.seabird.com/software-updates

Software	Team Lead Only	Manufacturer	Needed For	Instrument	Download Location
R and R Studio for STR processing		R Studio	data processing	all	https://www.rstudio.com/products/rstudio/download/
Ruskin		RBR	STR, PAR, DO	RBR Solo	https://rbr-global.com/products/software

Chapter 2

CTD and DIC Water Sampling Field Guide

If available hands on deck and conditions allow, please conduct the CTD downcast and the water sample collection simultaneously.

2.1 Waypoint and metadata collection

Use the OCC provided GPS unit to collect a waypoint when the CTD downcast begins. Record all metadata on provided data sheet.

2.2 CTD CAST

1. Ensure that the CTD line is connected to the top of the CTD frame by 1 shackles.
2. Tie non-CTD end of the CTD line to the boat with a bowline or clip off with carabiner.
3. Flake CTD line on deck.
4. When the coxswain says the CTD can go over the side, raise the CTD switch to the “ON” position, and loudly say, “ON!” then lower it over the side until the top of the frame is 1 meter below the surface of the water to begin the 1 minute soaking period, either holding the line or cleating off the line to maintain the CTD at soaking depth.
5. After 1 minute soak, ask the coxswain for the current depth so you know how far you can lower the CTD without it hitting the bottom (5-10 feet less line than the bottom depth). Un-cleat the CTD line if it was cleated and begin the CTD cast by pulling the CTD frame up until the top ring of the frame emerges from the water, then begin gradually lowering at a consistent rate, hand over hand, until the CTD gets to the target depth (using the markings on the line to estimate depth). Once the target depth is reached, pull the CTD back on board.

6. Once the CTD is back on board, lower the switch to “OFF”, and loudly say “OFF!”

2.3 Water Sample Collection

1. Prime the Niskin Bottle, ensuring the petcock and the air bleed valve are closed.
2. Clip off the boat side of the niskin line to the boat.
3. Near the end of the the CTD soaking time, lower the weight and the open Niskin bottle over the side so the top of the Niskin is at 1m depth (surface of water at the BLACK mark drawn on Niskin line).
4. Clip the messenger on to the line
5. When the CTD begins its downcast, send the messenger to trigger the Niskin to close. Ensure no air bubbles are trapped inside the Niskin and bottle sits vertically in the water column before firing the messenger.

2.4 Water sample Processing

1. Designate roles: bottle filler, mercuric chloride (HgCl2) handler, data recorder. NOTE: Supersaturated mercuric chloride solution is extremely dangerous; use the utmost caution when dealing with the chemical. All personnel working with it are required to wear eye protection. The mercuric chloride handler is also required to where disposable nitrile gloves. In the event of contact with any part of the body, wash the area profusely. If contact is made with eyes, abort operations, rinse continuously with fresh water (or salt if fresh has run out), alert the ship and return ASAP.
2. Remove a bottle and its stopper from the storage tote and insert the tygon tubing to the bottom of the bottle. With the tygon tubing attached to the Niskin bottle dispensing nipple, open the Niskin bottle valve and allow for three complete flushings of the bottle to occur before stopping the sample collection (i.e. start the collection and count how long it takes for the bottle to overflow and then allow that to occur for 2x the required fill time…ie. if the bottle fills in 20 seconds, allow the sample water flow to flush the bottle for 60 seconds). Attention must be given to how the sample water enters the bottle. Care should be given to ensure that smooth water flow into the bottle is maintained and that no bubbles are created during the dispensing of sample. Any bubbles introduced to the sample will alter the pCO2 within the sample water and produce inaccurate DIC results.
3. After the appropriate flushing time, shut off the Niskin valve to stop the water flow, while at the same time ensuring the tygon tubing doesn’t come off the bottom of the sample bottle. Once the flow is shut off, pinch the tubing and in one motion remove it from the bottle. This “pinch and remove” action with the tubing should establish a consistent head-space in all the sample bottles. The meniscus of the sample should be about 1 cm below the neck of the bottle (see picture.)

4. a. Once the proper head space is established, pipette 200ul of HgCl2 saturated solution into the sample bottle b. Use the syringe containing vacuum grease to make 3-5 vertical “stripes” of grease on a clean, dry stopper. Insert the greased stopper until fully seated in the bottle, then twist until the grease completely seals the bottle contents. The vertical stripes of grease allow for gases to escape the bottle neck while the stopper is being inserted. Having the stopper clean/dry ensures that other than sample water isn’t introduced into the bottle. Twisting the stopper, once it has been fully seated into the neck of the bottle, ensures a smooth distribution of grease within the sample bottle’s neck and an air tight seal. c. Use the rubber band and plastic collar to lock down the stopper inside the bottle. Once secured, softly invert the bottle 1-2x to mix the HgCl2 with the water sampleand secure the sample bottle in the field container. d. Complete data sheet including REA Site name or OCC Site Name (if it exists), waypoint name (default), UTC date and time, lat and long, sample depth and DIC bottle #.

2.5 Mercuric Chloride Emergency Procedures

- Eyes: Irrigate immediately with large quantity of water for at least 15 minutes.
- Skin: Immediately flush with plenty of water for at least 15 minutes. Remove any contaminated clothing.
- Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
- Ingestion: Only induce vomiting if directed to do so by medical personnel.
- The MSDS can be seen from any NOAA Google Account via this google drive link

2.5.1 Mercuric Chloride Safety Data Sheet (SDS)

LabChem
performance through chemistry

Mercuric Chloride, Saturated

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 03/30/2015 Version: 1.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture

Product name : Mercuric Chloride, Saturated

Product code : LC16620

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : For laboratory and manufacturing use only.

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Acute Tox. 2 (Oral)	H300
Acute Tox. 3 (Dermal)	H311
Carc. 2	H351
Repr. 2	H361
STOT RE 2	H373
Aquatic Acute 1	H400
Aquatic Chronic 2	H411

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS06 GHS08 GHS09

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H300 - Fatal if swallowed
H311 - Toxic in contact with skin
H351 - Suspected of causing cancer
H361 - Suspected of damaging fertility or the unborn child
H373 - May cause damage to organs (nervous system) through prolonged or repeated exposure
H410 - Very toxic to aquatic life with long lasting effects

Precautionary statements (GHS-US) :
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe mist
P264 - Wash exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P273 - Avoid release to the environment
P280 - Wear protective gloves, protective clothing, eye protection, face protection
P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor
P302+P352 - IF ON SKIN: Wash with plenty of soap and water
P308+P313 - IF exposed or concerned: Get medical advice/attention
P312 - Call a POISON CENTER/doctor if you feel unwell
P330 - If swallowed, rinse mouth
P361 - Remove/Take off immediately all contaminated clothing
P363 - Wash contaminated clothing before reuse

Mercuric Chloride, Saturated
Safety Data Sheet
according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

P391 - Collect spillage
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations

2.3. Other hazards

Other hazards not contributing to the classification : None under normal conditions.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	Classification (GHS-US)
Water	(CAS No) 7732-18-5	93.5	Not classified
Mercuric Chloride	(CAS No) 7487-94-7	6.5	Acute Tox. 1 (Oral), H300 Acute Tox. 1 (Dermal), H310 Carc. 2, H351 Repr. 2, H361 STOT RE 2, H373 Aquatic Acute 1, H400 Aquatic Chronic 1, H410

Full text of H-phrases: see section 16

SECTION 4: First aid measures

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according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate area. Absorb spillage to prevent material damage.

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses. Protective clothing. Gloves.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters. Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Avoid breathing mist.

Hygiene measures : Do not eat, drink or smoke when using this product. Wash exposed skin thoroughly after handling.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep container closed when not in use.

Incompatible products : Strong bases. Strong acids. Strong oxidizers.

Incompatible materials : Sources of ignition. Direct sunlight.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Mercuric Chloride, Saturated		
ACGIH	Not applicable	
OSHA	Not applicable	

Mercuric Chloride (7487-94-7)		
ACGIH	ACGIH TWA (mg/m³)	0.025 mg/m³
OSHA	OSHA PEL (TWA) (mg/m³)	0.1 mg/m³

Water (7732-18-5)	
ACGIH	Not applicable
OSHA	Not applicable

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure adequate ventilation.

Personal protective equipment : Avoid all unnecessary exposure.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or safety glasses.

Skin and body protection : Protective clothing.

Mercuric Chloride, Saturated

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Respiratory protection	:	Wear appropriate mask.
Other information	:	Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Color	:	Colorless
Odor	:	None.
Odor threshold	:	No data available
pH	:	No data available
Melting point	:	No data available
Freezing point	:	No data available
Boiling point	:	No data available
Flash point	:	No data available
Relative evaporation rate (butyl acetate=1)	:	No data available
Flammability (solid, gas)	:	No data available
Explosion limits	:	No data available
Explosive properties	:	No data available
Oxidizing properties	:	No data available
Vapor pressure	:	No data available
Relative density	:	No data available
Relative vapor density at 20 °C	:	No data available
Solubility	:	Soluble in water. Water: Solubility in water of component(s) of the mixture : • Mercuric Chloride: 6.9 g/100ml
Log Pow	:	No data available
Log Kow	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Strong acids. Strong bases. Strong oxidizers.

10.6. Hazardous decomposition products

Hydrogen chloride. mercury.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure	:	Skin and eye contact

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according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Acute toxicity : Oral: Fatal if swallowed. Dermal: Toxic in contact with skin.

Mercuric Chloride, Saturated	
LD50 oral rat	15.4 mg/kg
LD50 dermal rat	631 mg/kg
ATE US (oral)	15.400 mg/kg body weight
ATE US (dermal)	631.000 mg/kg body weight

Mercuric Chloride (7487-94-7)	
LD50 oral rat	1 mg/kg (Rat)
LD50 dermal rat	41 mg/kg (Rat)
ATE US (oral)	1.000 mg/kg body weight
ATE US (dermal)	41.000 mg/kg body weight

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg
ATE US (oral)	90000.000 mg/kg body weight

Skin corrosion/irritation : Not classified

Serious eye damage/irritation : Not classified

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Suspected of causing cancer.

Mercuric Chloride (7487-94-7)	
IARC group	2B - Possibly carcinogenic to humans

Reproductive toxicity : Suspected of damaging fertility or the unborn child.

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : May cause damage to organs (nervous system) through prolonged or repeated exposure.

Aspiration hazard : Not classified

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met. Toxic in contact with skin. Fatal if swallowed.

Symptoms/injuries after inhalation : No data available.

Symptoms/injuries after skin contact : Repeated exposure to this material can result in absorption through skin causing significant health hazard. Toxic in contact with skin.

Symptoms/injuries after eye contact : No data available.

Symptoms/injuries after ingestion : Fatal if swallowed.

Chronic symptoms : Impairment of the nervous system.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water : Very toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Mercuric Chloride, Saturated	
LC50 fish 1	0.46 mg/l 96 hr.
EC50 Daphnia 1	0.05 mg/l 48 hr.

Mercuric Chloride (7487-94-7)	
LC50 fish 1	0.03 mg/l (96 h; Poecilia reticulata)
EC50 Daphnia 1	0.0081 mg/l (24 h; Daphnia magna)
LC50 fish 2	0.04 mg/l (96 h; Cyprinus carpio)
EC50 Daphnia 2	0.003 mg/l (48 h; Daphnia magna)
TLM fish 1	0.82 mg/l (168 h; Carassius auratus)
Threshold limit algae 1	0.08 mg/l (Selenastrum capricornutum)
Threshold limit algae 2	0.07 mg/l (Scenedesmus quadricauda)

12.2. Persistence and degradability

Mercuric Chloride, Saturated	
Persistence and degradability	May cause long-term adverse effects in the environment.
Mercuric Chloride (7487-94-7)	
Persistence and degradability	Biodegradability: not applicable. No test data on mobility of the substance available.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable
Water (7732-18-5)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Mercuric Chloride, Saturated	
Bioaccumulative potential	Not established.
Mercuric Chloride (7487-94-7)	
BCF fish 1	10000 (Pisces)
BCF fish 2	500 - 4620 (Cyprinus carpio; Test duration: 10 weeks)
BCF other aquatic organisms 1	10000 (Ostreidae)
Log Pow	0.1 - 0.22 (Calculated)
Bioaccumulative potential	Potential for bioaccumulation (500 ≤ BCF ≤ 5000).
Water (7732-18-5)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on the global warming : No known ecological damage caused by this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations. Dispose of contents/container to comply with local, state and federal regulations.

Ecology - waste materials : Hazardous waste due to toxicity. Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN2024 Mercury compounds, liquid, n.o.s. (Mercuric chloride), 6.1, II

UN-No.(DOT) : UN2024

Proper Shipping Name (DOT) : Mercury compounds, liquid, n.o.s.

Transport hazard class(es) (DOT) : 6.1 - Class 6.1 - Poisonous materials 49 CFR 173.132

Hazard labels (DOT) : 6.1 - Poison inhalation hazard

Packing group (DOT) : II - Medium Danger

Dangerous for the environment : Yes

Marine pollutant	:	Yes

DOT Packaging Non Bulk (49 CFR 173.xxx)	:	202
DOT Packaging Bulk (49 CFR 173.xxx)	:	243
DOT Symbols	:	G - Identifies PSN requiring a technical name
DOT Special Provisions (49 CFR 172.102)	:	IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	153
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	5 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	60 L
DOT Vessel Stowage Location	:	B - (i) The material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) "On deck only" on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.
DOT Vessel Stowage Other	:	40 - Stow "clear of living quarters"

Additional information

Other information : No supplementary information available.

ADR

No additional information available

Transport by sea

No additional information available

Air transport

No additional information available

SECTION 15: Regulatory information

15.1. US Federal regulations

Mercuric Chloride, Saturated	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

Chemical(s) subject to the reporting requirements of Section 313 or Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and 40 CFR Part 372.

Mercuric Chloride	CAS No 7487-94-7	6.5

Mercuric Chloride (7487-94-7)	
Listed on the United States SARA Section 302 Listed on United States SARA Section 313	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	500 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	500 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard

15.2. International regulations

CANADA

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Mercuric Chloride (7487-94-7)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class D Division 1 Subdivision A - Very toxic material causing immediate and serious toxic effects Class D Division 2 Subdivision A - Very toxic material causing other toxic effects Class E - Corrosive Material

Water (7732-18-5)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

No additional information available

Classification according to Directive 67/548/EEC [DSD] or 1999/45/EC [DPD]

Not classified

National regulations

Mercuric Chloride (7487-94-7)
Listed on the Canadian IDL (Ingredient Disclosure List)

Water (7732-18-5)
Not listed on the Canadian IDL (Ingredient Disclosure List)

15.3. US State regulations

Mercuric Chloride (7487-94-7)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
No	Yes	No	No	

SECTION 16: Other information

Other information : None.

Full text of H-phrases: see section 16:

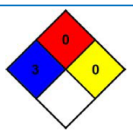
Acute Tox. 1 (Dermal)	Acute toxicity (dermal) Category 1
Acute Tox. 1 (Oral)	Acute toxicity (oral) Category 1
Acute Tox. 2 (Oral)	Acute toxicity (oral) Category 2
Acute Tox. 3 (Dermal)	Acute toxicity (dermal) Category 3
Aquatic Acute 1	Hazardous to the aquatic environment - Acute Hazard Category 1
Aquatic Chronic 1	Hazardous to the aquatic environment - Chronic Hazard Category 1
Aquatic Chronic 2	Hazardous to the aquatic environment - Chronic Hazard Category 2
Carc. 2	Carcinogenicity Category 2
Repr. 2	Reproductive toxicity Category 2
STOT RE 2	Specific target organ toxicity (repeated exposure) Category 2
H300	Fatal if swallowed
H310	Fatal in contact with skin
H311	Toxic in contact with skin
H351	Suspected of causing cancer
H361	Suspected of damaging fertility or the unborn child
H373	May cause damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life
H410	Very toxic to aquatic life with long lasting effects
H411	Toxic to aquatic life with long lasting effects

Mercuric Chloride, Saturated

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

NFPA health hazard	:	3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.
NFPA fire hazard	:	0 - Materials that will not burn.
NFPA reactivity	:	0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health	:	3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given * - Chronic (long-term) health effects may result from repeated overexposure
Flammability	:	0 Minimal Hazard - Materials that will not burn
Physical	:	0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.
Personal Protection	:	D D - Face shield and eye protection, Gloves, Synthetic apron

SDS US (GHS HazCom 2012)

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

LabChem
performance through chemistry

Mercuric Chloride, Saturated

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 03/30/2015 Version: 1.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form	:	Mixture
Product name	:	Mercuric Chloride, Saturated
Product code	:	LC16620

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	For laboratory and manufacturing use only.

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number	:	CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Acute Tox. 2 (Oral)	H300
Acute Tox. 3 (Dermal)	H311
Carc. 2	H351
Repr. 2	H361
STOT RE 2	H373
Aquatic Acute 1	H400
Aquatic Chronic 2	H411

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS06 GHS08 GHS09

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H300 - Fatal if swallowed
H311 - Toxic in contact with skin
H351 - Suspected of causing cancer
H361 - Suspected of damaging fertility or the unborn child
H373 - May cause damage to organs (nervous system) through prolonged or repeated exposure
H410 - Very toxic to aquatic life with long lasting effects

Precautionary statements (GHS-US) :
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe mist
P264 - Wash exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P273 - Avoid release to the environment
P280 - Wear protective gloves, protective clothing, eye protection, face protection
P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor
P302+P352 - IF ON SKIN: Wash with plenty of soap and water
P308+P313 - IF exposed or concerned: Get medical advice/attention
P312 - Call a POISON CENTER/doctor if you feel unwell
P330 - If swallowed, rinse mouth
P361 - Remove/Take off immediately all contaminated clothing
P363 - Wash contaminated clothing before reuse

Chapter 3

Data Processing and the Occ Package

The *occ* package is uploaded to GitHub and can be downloaded directly in R.

1. Open the *devtools* library.

```
library(devtools)
```

2. To download the *occ* package, use the `install_github` command. The repository name is in the form "username/repo". For the *occ* package, the username is "hannah-barkley" and the repo is "occ". This install only need to occur once; however, the *occ* package will need to be reinstalled if there are updates to the package (which is likely).

```
install_github("hannahbarkley/occ")
```

3. Once installed, load the *occ* package.

```
library(occ)
```

Chapter 4

Diel Suite

4.1 Diel Suite Underwater Checklist

PUC

1. Tubes cleared of air and water with swipe of pump
2. Tubes connected to valves
3. Valves opened one full turn

ADCP

1. Ensure ADCP has unobstructed view of the surface
2. Get compass bearing on ADCP head direction after final installation

Instruments

Chapter 5

STR

As of 2020, the OCC team uses two models of temperature sensor, the SBE56 and the RBR Solo v3. All STRs must be programmed prior to deployment and have fresh batteries and dessicant installed. See manual's for specific programming guidance.

5.1 RBR Solo V3 STR

Find the user manual in "Reference" section of OCC files at sea or at this google drive link

Physical Preparation for Deployment

- Use brand new Tadiran Lithium Thionyl Chloride 3.6v batteries
- Wrap instrument housing with yellow “PVC floor marking tape”, leaving the serial number exposed

Programming

1. Open Ruskin
2. Connect to the instrument with the supplies USB C cable, it should appear in the “Navigator” view after a few seconds
3. Ensure that your computer is connected to the internet so that the program can get the correct time from your computer.
4. Click UTC to set the instrument’s time to UTC
5. Click on the “Information” tab and confirm that the battery has 3.6v
6. After programming each instrument, disconnect the USB cable, install a fresh desiccant and close the instrument in a short period of time so that the desiccant does not absorb ambient moisture in the air
7. Parameters

a. Sampling Interval: 1 sample every 5 minutes

b. Sampling mode: Continuous

- "Ruskin_instrument.log" keeps a text file that includes the parameters of each instrument programmed
- .rsk files are sqlight data files which are open source and non-proprietary

Downloading Data from Solo 3

1. Connect to the instrument
2. Select the dataset and download it

Processing RBR Solo 3 Data Files

see Data Processing with the OCC Package

Factory Recalibration of the Solo 3

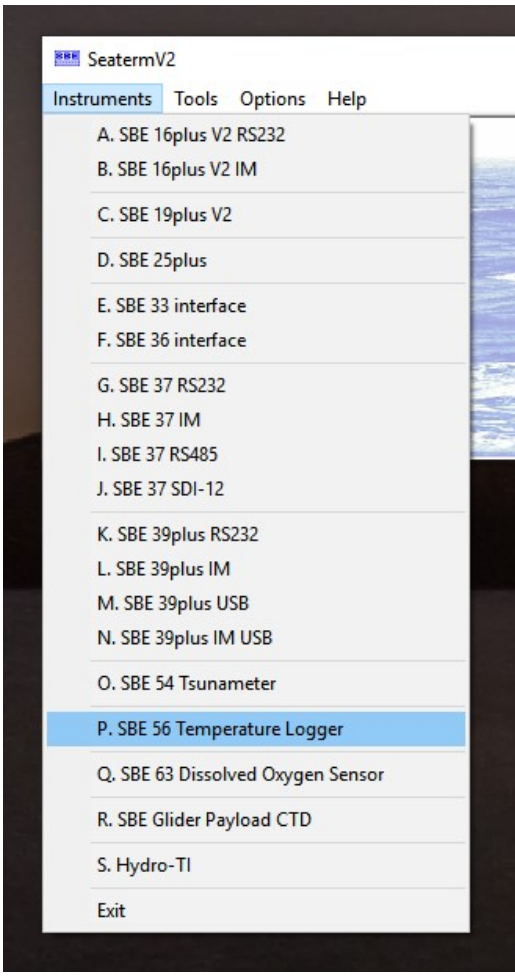
- Call RBR to arrange the re-calibration of each Solo 3, which will cost approx. $120
- Instrument drift over 3 years should be less than .006 C, thus there is no need to re-calibrate the data set with post-cruise calibration coefficients
- In Ruskin, by default, the name of a data file is composed of the following information:
  - The first six digits represent the logger serial number.
  - The next eight digits represent the current year, month, and day.
  - The next four digits represent the current time to the minute.
  - The file extension indicates the file format and should not be changed. If you change it, the file extension that you specify becomes part of the name, and the required extension is appended. For example, the file named 911936_20090522_1613.rsk contains data for a logger with a serial number of 911936 whose data was downloaded in 2009 on May 22 at 4:13 pm.

5.2 Seabird Electronics SBE56 STR

As of 2020, the OCC team is not buying anymore SBE56 sensors due to history of inadequate endurance we've experienced with them. We have determined that units within a certain range of serial number are high risk for low endurance (Ari knows the bad ones!)

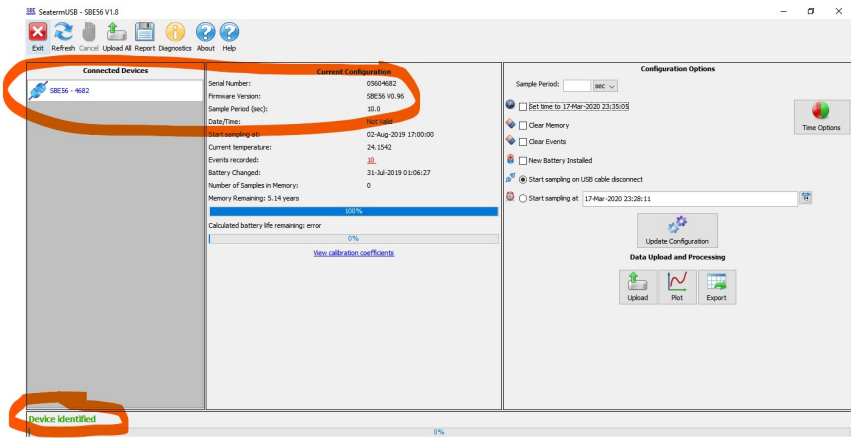
Just like the RBR Solo v3, the SBE56 is programmed to sample every 5 minutes for 30S. The user mnual for the SBE56 can be found here.

Here are the basic steps to program the SBE56:



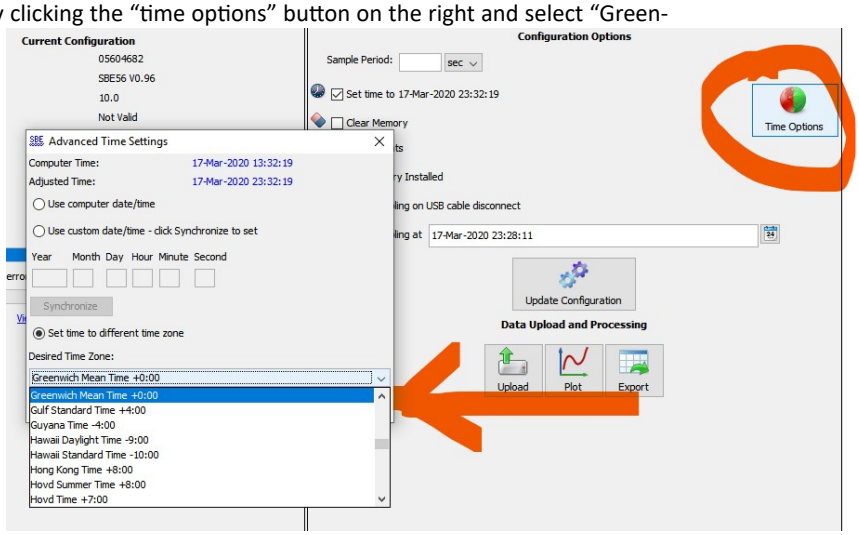
1. Open SeatermV2 and select SBE56 from the instruments menu.
2. Open the housing with the custom endcap remover and connect the SBE 56 to your PC

   via a USB mini cable.
3. When a successful connection is made, you will notice a “Device Identified” notification in the bottom left of the screen and you will see the serial number of the unit you have connected to in the upper left of the application window and in the current con-



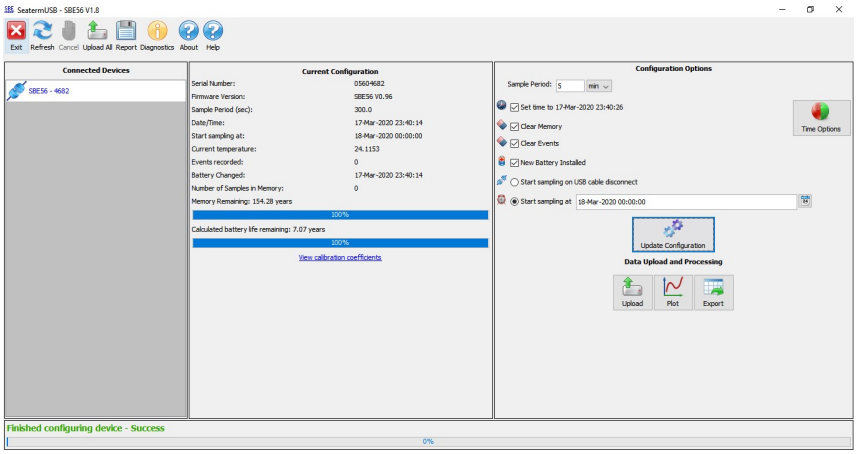
figuration window.

4. Edit the configuration options as follows
5. sample period = 5 minutes (300 seconds)
6. set time to UTC by clicking the “time options” button on the right and select “Green-



Wich Mean Time.”

7. check the box for clear memory
8. check the boxy for clear events
9. check the box for new battery installed (if it is relatively new, which if it is just back from refurbishment, it should be)
10. set the date and time for the unit to begin sampling for a time is prior to the day it will be deployed
11. When you are done editing the configuration of the SBE56, click the “Update Configuration” button and confirm the changes you want to make when the pop-up window asks you to do so. When you have finished, you should see the notification in the bottom left that says, “finished configuring device - success.” At this point double check that the “current configuration” window on the left shows the parameters that you intended to program the instrument with.



12. At this point, you can disconnect the SBE56, install a new dessicant in its endcap, examine its o-rings for any hairs and re-seal the housing. It is now ready for taping and installation in the deployment bracket.

Downloading Data from the SBE56

1. Connect to the instrument

Processing SBE56 Data Files

see Data Processing with the OCC Package

Chapter 6

CTD

6.1 RBR CTD in Profiling Mode

6.2 SBE19 in Profiling Mode

While the SBE 19 is the oldest CTD in the OCC team inventory, it is used as a dedicated shipboard CTD on occaision

- Input commands in upper or lower case letters and register commands by pressing the Enter key.
- If the system does not return an S> prompt after executing a command, press the Enter key to get the S> prompt.
- The SEACAT sends '#' if an invalid command is entered.
- If a new command is not received within 3 minutes after the completion of a command, the SEACAT returns to the quiescent state and the command/data echo area indicates time out. You must reconnect to the instrument before sending any commands.
- For RS-232 communication: If the instrument is transmitting data and you want to stop it, type ^C or press the Esc key or Stop on the Toolbar. Press the Enter key to get the S> prompt.
- Commands marked with * (* is not part of the command) alter the SEACAT's memory and require verification before executing, to prevent accidental modifications. After the command entry, SEATERM responds: 'message' Y/N Type Y and press the Enter key. SEATERM then responds: are you sure ^Y/N Hold down the Ctrl key and type Y (any other response aborts command).
- Braces [ ] indicate optional parameters of the command. Items enclosed in braces need not be entered.

Find a list of commands for the SBE19 HERE

example status output of an SBE19 ready to profile after typing "ds" and hitting enter

SEACAT PROFILER V3.1c SN 3029 06/05/18 20:08:52.998 strain gauge pressure sensor: S/N = 2657401406, range = 1000 psia, tc = 194

clk = 32767.852 iop = 148 vmain = 12.2 vlith = 5.1

mode = PROFILE ncasts = 0

sample rate = 1 scan every 0.5 seconds

minimum raw conductivity frequency for pump turn on = 3257 hertz

pump delay = 40 seconds

samples = 0 free = 174128 lwait = 0 msec

SW1 = C8 battery cutoff = 7.3 volts

number of voltages sampled = 0

logdata = NO

S>ST

date (MMDDYY) = 060518

time (HHMMSS) = 200930

6.3 SBE19Plus in Profiling Mode

1. Remove the dummy plug from the SBE 19plus' Data I/O 4 pin connector and install the Sea-Bird I/O cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the SBE 19plus. Plug the serial connector into a serial to usb (Keyspan) converter and plug the USB cable into the computer.
2. Open SeaTerm.exe. The display shows the main screen.
3. Click Connect on the Toolbar to begin communications with the SBE 19plus. A "S>" should be shown on the display if the connection is successful. If it does not show: +Click Connect again. +Check cabling between the computer and the SBE 19plus. +Verify the correct instrument was selected and the COM settings were entered correctly in the Configure menu.
4. Display SBE 19plus status information by clicking Status on the Toolbar. The display looks like this:

    - SeacatPlus V 1.3 SERIAL NO. 4289 16 July 2005 14:02:13
    - vbatt = 9.6, vlith = 0.0, ioper = 61.2 ma, ipump = 25.5 ma, iext01 = 76.2 ma,
    - status = not logging
    - number of scans to average = 1
    - samples = 5000, free = 376300, casts = 1
    - mode = profile, minimum cond freq = 3000, pump delay = 60 sec
    - autorun = no, ignore magnetic switch = no

- battery type = ALKALINE, battery cutoff = 7.5 volts
- pressure sensor = strain gauge, range = 1000.0
- SBE 38 = no, Gas Tension Device = no
- Ext Volt 0 = yes, Ext Volt 1 = no, Ext Volt 2 = no, Ext Volt 3 = no
- echo commands = yes
- output format = converted decimal
- output salinity = no, output sound velocity = no

- Make sure in the above information it does not say BATTERY LOW. Batteries should be replaced prior to each cruise; however, it is always good to double check. Ensure UTC time is set correctly. The correct time can be taken from the ship clock or a properly calibrated GPS unit.

5. When you have confirmed that all data has been obtained from the instrument and you are ready to clear its memmory, send the SAMPLENUMBER=0 or INITLOGGING (e.g. S>samplenumber = 0 or S>initlogging) command to remove unnecessary data files. If one of these commands is not sent, new data will be stored after the last recorded sample, preventing use of the entire memory capacity and make file management more difficult during the next upload.
6. Disconnect the Sea-Bird I/O cable connector and screw on the dummy plug. The CTD can be properly stowed until redeployment.

6.4 SBE19Plus in Moored Mode Mode

1. Connect instrument and check status: Status > Display status and configuration parameters
2. Set date and time under General Setup > Set Date and Time. Date and time are in mmddyyyyhhmmss format (i.e. 6/12/2018 06:15:00 is 06122018061500).
3. Clear all past data General Setup > Initialize Logging.
4. Set CTD to moored mode under Moored Mode Setup > Set sampling Mode to Moored. Execute command twice to switch to moored mode.
5. Set sample interval under Moored Mode Setup > Set Interval (sec) between Samples. For a short deployment (2-4 days), use a sample interval of 10 seconds. For a longer deployment (> 1 week), use a sample interval of 1 min or 5 min.
6. Set number of measurements to average under Moored Mode Setup > Set number of measurements to average. Set to 4.
7. Set pump mode under Moored Mode Setup > Set Pump Mode to “pump for 0.5 sec before sampling”.
8. Set start date and time under Logging > Set delayed start date and time.
9. Start logging under Logging > Start logging when specified by StartDateTime.]

6.5 Downloading the SBE19Plus

1. Connect to the 19P with the interface cable.

2. Open SeaTerm.exe. From the main screen, select the Configure menu. From this menu, select SBE 19plus. Click on the Upload Settings tab. Make sure the Upload Baud Rate reads 9600. In the same menu, click All separated by cast. This allows a separate file to be written for each cast.
3. Click Connect on the Toolbar to begin communications with the SBE 19plus. You should see “S>” when it connects. If the system does not respond as shown above:

- Click Connect again.
- Check cabling between the computer and the SBE 19plus.
- Verify the correct instrument was selected and the COM settings were entered correctly in the Configure menu.

5. Click the Upload button on the Toolbar to upload stored data

- In the Open dialog box, save the file to the designated location as specified in this Google Drive document

Chapter 7

SeaFet pH Sensor

The OCC team uses the SeaBird SeaFet pH sensor as part of the Diel Suite to capture pH information around the clock over a typical deployment interval of 1 to 2 days.

7.1 Conditioning the SeaFet in seawater at least 24 hours prior to deployment

At least 24 hours prior to deployment, the SeaFet must be activated in polled mode (aka low power, aka sleep mode) in a large volume of solution with a similar pH to the pH of the waters in which the unit will be deployed in order to produce accurate data immediately upon deployment. We call this “conditioning time”. Conditioning in the wetcap with artificial seawater will not work because ionic exchange will quickly change the pH of the small volume of water in the wetcap, thus not actually conditioning the instrument.

##How to Set the SeaFet to polled mode**

1. If needed, install new batteries in the SeaFet (12 Ds)
2. Remove dummy plug from endcap of SeaFet and connect SeaFet to computer with USB cable
3. Open SeaFetCom software
4. Swipe magnet over magnetic switch to “activate” batteries (indicator light by magnetic switch will blink green)
5. Press “connect”
6. Open settings and confirm operational mode is “polled mode”
7. Click “upload” to make sure
8. Click “disconnect”

7.2 Programming the SeaFet for Deployment (After it has already been warming up in polled, aka low power sleep mode for at least 24hrs)

In the dry lab prior to deployment

At least **24 hours** prior to deployment: install and activate internal batteries. To activate internal batteries, swipe the magnet to the target until the indicator LED starts flashing green (this may take a few attempts). Alternatively, connect the instrument to the computer and place in **periodic mode** following instructions below.

1. Remove the dummy plug and connect data logger cable.
2. Open SeaFETCom and select “Connect to SeaFET” to begin communications with instrument.
3. Sync instrument clock with computer clock: Sensor -> Set Clock, “Sync Time” . Instrument time should be in UTC.
4. To access SeaFET deployment settings, select the “SeaFET Settings” button in the dashboard window or Sensor -> “SeaFET Settings”. Use the following settings:

General

Operational Mode: Periodic

Sample Interval : 1 min

Offset : 0 sec

Number of samples in average: 30

Number of frames in burst: 1

Enable Sampling Window : If using, check box and set appropriate start and end dates

We haven’t been able to make this work well, so don’t use sampling interval for now

Internal Device Logging

** Logging level:** INFO

Maximum log file size: 9999 KB

Telemetry

Serial Baud Rate: 57600

Transmitted Frame Format: FULL_ASCII

Instrument Logging Frame Format: FULL_ASCII

Log File Creation Method : By file size

Maximum Size: 9999 KB

Uncheck"legacy format"

Processing

Salinity : 35 psu

External Pump - no external pump in use

CTD – no CTD in use

Note: For RAMP deployments, the SeaFET will be deployed in **periodic mode** , in which it will sample at a specified interval and burst size and go to sleep in between measurements. The instrument can be put in **polled mode,** in which it remains in a low power sleep state until woken by an external command, for long-term storage or shipping. **Continuous mode** should only be used when the instrument is powered by an external power source.

Activiate the instrument prior to getting on the small boat

1. Start deployment by selecting the "Start" button in the SeaFETCom dashboard or Sensor -> "Start".
2. Disconnect from SeaFET, remove data logger cable, and replace dummy plug.

On the small boat

1. Immediately prior to deployment, remove wet cap. Remove two stainless steel plugs and store securely. Invert the instrument to pour the storage solution from the wet cap into a sink. Using a 5/32" hex driver or Allen key, remove the three 10-32 x 5/8" socket head cap screws from the wet cap. Remove the wet cap.
2. Install foul guard. Place instrument on a flat surface with the sensor end cap up. Place the electrode foul guard over the electrode. Insert the three 10-32 x 5/8" socket head cap screws removed from wet cap and tighten completely. Sensor end cap should not be exposed to air for more than a few seconds, so submerge in water if not immediately deploying underwater.

Retrieving the SeaFet

1. Upon recovery of the instrument, stick the wetcap end into a bucket of seawater for return to the ship or remove foul guard and replace wet cap. Ensure wet cap is filled with sterilized, artificial seawater or filtered seawater. Keep the sensor end wet at all times (it can be without water no more than an hour).

7.3 Downloading Data from the SeaFet**

2. Remove dummy plug, attach data logger cable, and connect to SeaFETCOM software.

3. Select “Transfer Files” from the SeaFETCom Dashboard.
4. In the “Local Filesystem” pane, press “Browse” to select the local folder on the computer that will receive downloaded files.
5. In the “Instrument Filesystem” pane, select the files to be downloaded from the SeaFET and press the “<-” button to transfer selected files.

- A Seafet deployment creates 2 file types: a log file that contains metadata about the deployment and the data file (may be more than one data file)

6. If the instrument will be used in the near future, place in **polled mode** following deployment steps above. This low-power stand-by mode will maintain a continuous current flow to the sensing element and eliminate the need for a 24-hour warmup. If the instrument will not be used in the near future, deactivate internal batteries by swiping the magnet over the target until the LED flashes red.

7.4 Properly Store the SeaFet

It is crucial to store the SeaFET sensors with clean seawater in the wet cap. If seawater is not available, artificial seawater will suffice. The internal KCl reference gel in the DuraFET will become dry if left out of water, resulting in calibration drift and potentially causing irreversible damage. **Do not store** the SeaFET with freshwater in the wet cap, as this will change the chemistry of the external reference electrode.

If storing or shipping the SeaFET, disconnect the batteries in SeaFETCOM:

- Connect the SeaFET to SeaFETCom
- Navigate to Sensor > Advanced > Disconnect for Storage.

This will disconnect the isolated battery pack from the external reference sensor to retain battery life.

7.5 Email Exchanges about Seafet for reference

Notes on SeaFet soaking and response time

February 12, 2018 Hi Noah,

Yes indeed, if you are concerned about the time it takes to stabilize, you could combat this by immersing in some seawater that is close to the sites parameters ahead of time.

Know however, that having the SeaFET running in the small volume of water within the wetcap, it will quickly become altered from normal regarding the small volume and ionic exchange.

(This might be the reason why you mentioned the pH value of 6 in the wetcap currently.)

Ideally one would want to have a larger water volume however this might require some creativity to accomplish !

Proposed settings look fine !

Regarding a specific start time:

Within SeaFETCom - SeaFET Settings - In the SeaFET General Settings Tab you can select the desired Start date, but I not Believe you can specify the time of day.

But looking into the firmware commands it appears the SeaFET can be programmed with a start time as well.

At the SeaFET's command prompt, enter the following commands as an example: "set –samplwin true" and then "set –samstart yyyy/mm/dd.hh:mm:ss

Note these commands can be sent using the "Command Terminal" found under Sensor Menu - Advanced in SeaFETCom, or through TeraTerm direct serial connection.

I believe programming in periodic mode, with a delayed start up time would achieve the same effect.

Please let me know if you have any questions or comments.

Kind Regards, Darrell

February 9, 2018 Email from Darrel at Seabird Tech Support:

Hello Noah,

Thank You for your email !

- Is 24hrs adequate for the instrument to "warm up" in polled mode (I believe you've called this "conditioning mode" before) prior to deployment or are multiple days necessary?

The time of ** SeaFET ****'s sensors adjusting to the in-situ environment can vary. Really it depends on how different the water is from the storage solution. When we perform calibration it can take anywhere for a day, to several days - but we are looking for high level of stability. When deploying the **** SeaFET **** the pH values may take a couple of days for the readings to stabilize to the environment.**

- How long can the sensor be exposed to air before damage to the sensor occurs? (We are wondering about best practices for taking the instrument from the small boat into

the water. For instance, the wetcap remains on the instrument until we get to the dive site. We get to the dive site and prepare our SCUB gear, then remove the wetcap and affix the protective copper endcap over the sensor - at this point, 1 to several minutes my pass before it is actually submerged in the ocean when we roll in the water.)

I do not see a problem here. For damage to occur to the ISFET it will have to become dry. I would say best practice would be no more than 1 hour. But a couple of hours will not cause damage, just likely additional time to reach stability in the new environment. The external reference can become dry without damage - but some further conditioning time would be expected.

- Is setting the instrument to periodic mode with a future sample start date considered a low power mode, comparable to “polled mode”

Yes I believe this would achieve the same, however you would need to ensure to switch to polled mode if this is method use during deployment. If you have an external controller, polled is likely the better option for use. If you were using periodic mode and an external device collecting the SeaFET’s data - this would rely on the two systems have no change in the their clocks. Polled mode would be better as the external controller would be able to collect data whenever it chooses.

I hope this helps !

Please let me know if you have any questions or comments.

Kind Regards, Darrell

Greg Ikeda Thu, Oct 1, 2015 at 10:44 AM

Hi Noah,

You’ve brought up some good questions about the SeaFET- I went ahead and consulted our engineer responsible for this instrument to obtain some more concrete answers.

SeaFET soak time:

Craig is correct- the SeaFET requires a “conditioning time” that allows the sensors to stabilize before achieving full accuracy. I’ve attached a paper that explores the best practices for obtaining quality data from the SeaFET. Please reference this document for quality control procedures. From this paper:

Upon first contact with seawater, pH sensor voltages relative to both reference electrodes exhibit an asymptotic drift. This conditioning period arises from several sources:

1) Achieving a stable flow of ions across the liquid junction of the internal reference electrode (nominally hours),

2) replacement of Cl – with Br ? in the solid solution of AgCl of the Cl-ISE (nominally days),

3) an ISFET conditioning component, related to the initial power-up of the chip, the exact basis of which is not fully understood (nominally 1 day), and

4) a pressure effect on the ISFET and internal reference electrode through changes in the liquid junction potential that may become important if the sensor is deployed more than 20 m below the surface (nominally 1 h).

Factors 1–3 can be addressed by operating the pH sensor continuously in seawater (never powering off the ISFET) for one week prior to deployment and taking care to keep the sensor wetted in natural seawater during transport.

SeaFET response time:

It very much depends on the system at hand. After initial conditioning (as described above):

a) With continuous water flow, either naturally occurring or forced, the response is practically instantaneous.

b) If the sensor has to re-condition to a new volume of water for every measurement, it could take up to 30sec to converge to the right number. For the SeapHox we added a configuration parameter to delay the measurement for this reason.

These reasons certainly make the SeaFET a poor match for use on a moving platform. I hope this clarifies your questions about the SeaFET. Please review the attached paper and let us know if you have additional questions.

Regards,

Greg

Greg Ikeda Technical Support Sea-Bird Electronics 13431 NE 20th Street Bellevue, Washington 98005 Telephone: (+1) 425-643-9866 Fax: (+1) 425-643-9954 E-mail: gikeda@seabird.com Web: http://www.seabird.com

Chapter 8

PUC - Portable Underwater Collector

Part of the diel suite, the Programmable Underwater Collector (PUC) is a moored instrument used to collect water samples autonomously at pre-determined times. The OCC team uses the PUC to analyze the diel carbonate cycle at study sites.

8.1 General Notes

- Decide on sampling interval for deployment period
- There are 3 versions of PUCS with different O rings
- See PUC fill time table below to program each PUC with a specific pump time to achieve the desired 800 mL in each tedlar sample bag
- Batteries: use one change of 12 AA alkaline batteries for two deployments
- Red ON/OFF switch mounted on motherboard
  - turn to ON when PUC in to be used.
  - when ON, access Basic stamp Editor using magnet+PUC comm cable.
  - when ON, flush tubing prior to deployment using magnet.
  - turn to OFF when PUC in storage. No need to remove AA batteries.

8.2 Preparation the Day Before Deployment

Mount PUCs to crates with cable tieas, 3 PUCs per crate. Print out the PUC deployment underwater checklist at this Google Drive link

Preparing 1L tedlar sample bags with mercuric chloride

1. Label the bags with a large chisel tip sharpie with the hour they will sample in 24hr time format
2. Open bag valve 1 full turn
3. Evac air out of bag with plastic syringe
4. Close bag valve while syringe is attached and vacuum is apparent
5. Load up glass syringe with 200 ul HGCL2, draw it carefully, tap to remove air
6. Insert syringe needle through septum and inject HGCL2

8.2.1 Programming PUCS with firmware version 2018-JAN-7

Note: This should take place the night before the planned deployment

1. If necessary, install 12 new AA alkaline batteries into the PUC (one set of batteries is used for 2 deployments)
2. Open the PUC carefully with the PUC opener tool
3. Connect the PUC to your PC with the RS232 (serial) cable and a Keyspan USB to serial adapter. NOTE: It may be necessary to plug the USB cable into a “high-power” USB port on your PC. If using the instrument computer PICSC26, this is the USB port that has a lighting bolt symbol over it
4. Turn on the red power on/off switch on the PUC motherboard

Open the Basic Stamp Editor program

1. Select Run then Debug then New to open a programming terminal
2. If the PUC does not connect, try selecting a different com port
3. Individual PUC d1eployment status is displayed
4. Check the date, time, pump time and programmed time (the PUC pump will run for 10 seconds while you review this information, at the end of the 10 sec period, you will have 30 sec waiting period to input commands into the terminal before the pump runs again and re-displays current settings. If you do not enter commands within the 30s window, the program will time out and you must swipe the magnet over the magnetic switch (red dot on endcap) to start a new 30s programming window)
5. Set parameters for the deployment keying and pressing enter for numbers 1-4 that correspond to the following:
    - set Date/Time: MM/DD/YY, HH/MM
    - Display Date/Time: to display the date time programmer has entered.
    - set sample Date and Time: MM/DD/YY, HH/MM (we set PUCs to UTC time, use the PUC deployment planning and data sheet at this Google Drive link to determine the proper UTC time according to the local solar time), and Pump Time (the amount of time in minutes that the pump runs to collect the water sample.

6. If the PUC time reads more than 60 seconds, run the script in the basic stamp editor to correct this: PUC Clock Fix_DS1302_Demo.bs2 found **where is this file, when found we need to put it in the PUC google drive folder?**

- Then open the latest firmware from basic stamp from the PUC Google Drive Folder: PUC firmware upgrade 07Jan18.bs2
- note: You may need to change the comp port number in the top line of code

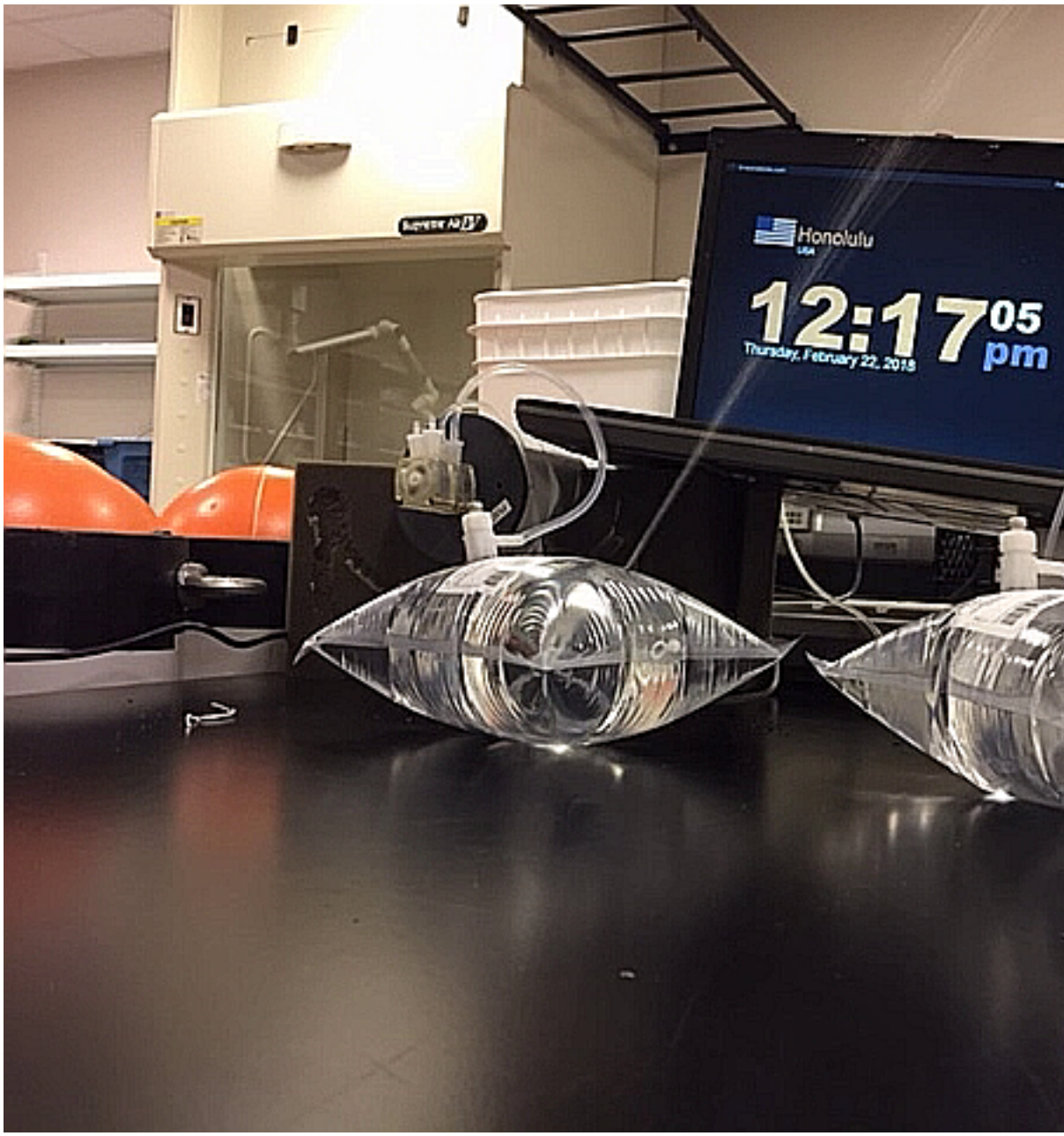
7. Start Sample Program, results in the PUC displaying "Entering sample Mode" + Sample Time + Pump Time + current Date/Time
8. NOTE: all PUCs do not pump at the same rate. We aim to have 800mL of water in each 1L bag. The time it takes for a pump to fill a bag to 800mL varies from 27-36 minutes; see the chart below of PUC times in the next and program each PUC accordingly.
9. The final program step is ALWAYS press #4 to get "Entering sampling Mode" prompt. Confirm sample date/time and pump time.
10. Pre-fill a Diurnal Suite Datasheet Spreadsheet with relevant information for the deployment
11. After programming is complete and all parameters are verified, seal the PUC

- clean/lubricate o-ring.
- Install one large or several small desiccants inside the PUC, ideally rubber banded to the motherboard or battery packs somehow
- hand tighten PUC cap to PUC body using PUC opener tool

8.3 PUC Rates and Fill Times (As of June 2018)

PUC SN	Time to 800mL (minutes)	March 2018 Tested Rate (mL/min)
1	39	20.6
2	30	26.4
3	31	25.5
4	32	24.7
5	33	23.9
6	39	20.6
7	32	25.2
8	29	27.4
9	37	21.8

Don't Overfill Those PUC Bags!



8.4 PUC Deployment

1. Ensure PUCs are fastened securely to the milk crate (maximum 4 PUCs per crate)

2. With tubing connected to “water out” valve tip but NOT YET to the tedlar bag, swipe the magnetic switch (red dot) on PUC endcap to run the pump once to pump ambient seawater through the tubing.
3. Connect the other end of the tubing to the “water in” valve tip of the tedlar bag
4. Open tedlar bags by turning valve one full turn

8.5 PUC Recovery

Print out the PUC retreival underwater checklist at this Google Drive link

1. Gather tools needed
    - Zip tie snips
    - Goody bag for collecting filled Tedlar bags
    - 50lb open bottom lift bag and carabiner to lift milk crates
    - A few extra large (at least 2ft cable ties)
2. Close valves on all sample bags
3. Remove tubing from sample bag valves
4. Use snips Carefully collect tedlar bags and snow in a goody bag dedicated solely to them for safe ascent; be careful when handing them up out of the water to whoever receives them on the small boat
5. Secure the two milk crates together with zip ties if not already fastened together for easier lifting
6. Affix 50lb lift bag with carabiner to milk crates in a secure fashion and make a safe ascent
7. Upon surfacing, instruct whomever is grabbing the tedlar bag samples from you to carefully place them into a CAU bucket filled with water to reduce pressure on the bags

Transfer of Samples from Tedlar Bags to Glass Bod Bottles in Wetlab

8.5.1 Notes from Chris Langdon about PUCs

Notes from Chris Langdon:

- 9/14/15 email: The new boards have a voltage regulator that can be set to 11.0 volts if only one pump is used and to 13.0 volts if two pumps are used (this gives the motor more torque needed to drive two pumps).
- O-rings you need for the two styles of PUCs. Order from McMaster Carr. The o-rings should easily last a year. I would suggest replacing them annually.

Old style cap —- dash# 2-153. McM. 9452K174

New style cap—- dash# 2-236 McM 9452K165

-
- 1/6/2018 email about new firmware: It gives you 30 sec to hit a key about the pump starts running. I also reduced the pump run time to 10 seconds. You can now specify the month, day, hour and minute that the PUC will sample so you can set it up days in advance. You will need the Basic Stamp editor application downloaded from Paralax.

Chapter 9

Aquadopp: Nortek ADCP

- 2MHZ aquadopps have a shorter range (20m I think)

9.1 Programming the Aquadopp

1. Connect to the Aqudopp with the interface cable
2. Open Nortek software
3. From the Communication menu, select the correct com port for the instrument's interface cable (look this up in the device manager)
4. Communications -> connect (if it does not connect, the instrument's batteries may be dead; use the AC power adapter)
5. "Erase Recorder"
6. Set clock to UTC time: On-line -> set clock
7. Deploy->planning-> load from file then chose"PUC_24HR_1Mhz" con file
8. If you can't find the file, use these settings:
9. Frequency: 1 Mhz
10. Profile interval: 300 seconds
11. Number of cells: 20
12. Cell size: 1 m
13. Start logging under Deployment > Start Recorder Deployment. File name and comments should include island code and cruise year.
14. Prep instrument for deployment
15. Clean O-rings, replace battery (if needed) 1. When opening the end cap, make sure to unscrew the screws a bit at a time, alternating screws, so that the end cap comes off evenly
16. Plug in battery and end cap, add dessicant to battery case, close cap 1. Make sure battery fabric doesn't get pinched in end cap 2. Screw on cap a little at a time, alternating screws, to not bend or damage screws/cap
17. Note: Nortek recommends a 10V minimum cutoff voltage.

9.2 Deploying the Aquadopp

- Orient the aquadopp so that the length of it's body is flat in relation to the surface of the ocean and that the head is also rotationally flat relative to the surface of the ocean
- Upon deployment shoot a bearing on positive X, take a picture of compass upon deployment
- Deploy instrument
  - Make sure it is pointing up, relatively flat, and solidly attached to something (NO WIGGLING)
  - The ADCP head should not be closer than 10 instrument diameters to any structure that is taller than the instrument head
    - Otherwise the beams will bounce off of the tall object, giving bad readings
  - Take a compass heading on deployment and record it if instrument is recording in xyz coordinates

9.3 Retrieve the Aquadopp

1. Recover instrument
2. Download and process data
3. Download data using Aquadopp software; Deployment > Recorder Data Retrieval. Saves as .prf file.
4. Process using R package occ 'processADCP' function.

Chapter 10

Shipboard Operations

Note: since the Hiialakai was decommissioned in 2019, no plans have been made to re-install the PCO2 or TA system on another vessel

10.1 PCO2 System

- Perform simple check of system daily (see to-be-developed checklist)
- See detailed documentation in this Google Drive Folder Link

10.2 TA System

Perform simple check of system daily (see to-be-developed checklist)

- See detailed documentation in this Google Drive Folder Link

Chapter 11

Tasks at Sea

11.1 Daily Tasks for the Team

Find Excel version here via Google Drive

STR

- Before Ops
  - assemble, program and stage needed STRs
  - confirm 10 36” cable ties for each STR planned
  - write serial numbers of planned STR deployments on tomorrow’s data sheet
- After Ops
  - download strs
  - enter deployments and retreivals into mooring database
  - import waypoints into mooring database
  - clean STRs, put weights and brackets on fantail or in DD bath

CAU

- Before Ops
  - Pack supplies for planned CAU site swaps
  - write down deploy CAU SNs on tomorrow’s data sheet
- After Ops
  - scrape/record CAU SN’s, re-bag and freeze with cruise & site label
  - dispose of old clips and stakes
  - after CTD/H2O data is entered, give data sheets to data manager

Water Sampling and CTD

- Before Ops
  - DIC bottles and all supplies in each kit
  - Niskin, line, messenger, weight staged for each CTD
- After Ops
  - rinse and stage CTDs
  - Swap full bottles for empties, dispose of waste
  - restock all supplies
  - replace and label any worn ziplocs
  - enter CTD and water sample log into CTD/H2O Database (hopefully this is not a necessary step on MARAMP 2020!)

GPS Units (for OCC and benthic/fish GPS)

- Drop off GPS units with data manager for waypoiont download

Cameras

- Before Ops
  - Ensure cameras are set to UTC time
  - Ensure cameras have memory cards
  - charge camera batteries
  - clean camera housings
  - bake desiccants and install them
- After Ops
  - download and sort photos
  - download and sort photoquad photos
  - charge cameras or swap charged batts for used batts
  - install new dessicants

Stage all Gear

- Action packer packed for day of ops
- Pam float and reel staged
- If deep STR: Marker Float and drop weight
- 1 full bag of large cable ties (keep on boat)
- CTDs and lines

Other

- gauge tanks

Team Lead

- Plan tomorrow's objectives
- Plan and communicate tank needs to team members

11.2 Where to Save Data

Checkout this Excel file on Google Drive for details on where to save data

Chapter 12

Data How To

12.1 How to Gain Access to the OCC Database

As of January 2020, the OCC team is in the process of working with the data management team to migrate all OCC Team data and metadata to an Oracle database. In order to access this database, a new user must submit an ITS support ticket to request an Oracle account in addition to requesting an install of SQL Developer. If you'd like to access data via R, you'll also need to request to have ODBC drivers setup.

12.2 How to Archive Data

After data is qc'd it mus be archived. As of January 2020, the best place to look for all information and guidance related to archiving data is in a google drive folder setup by Annette.

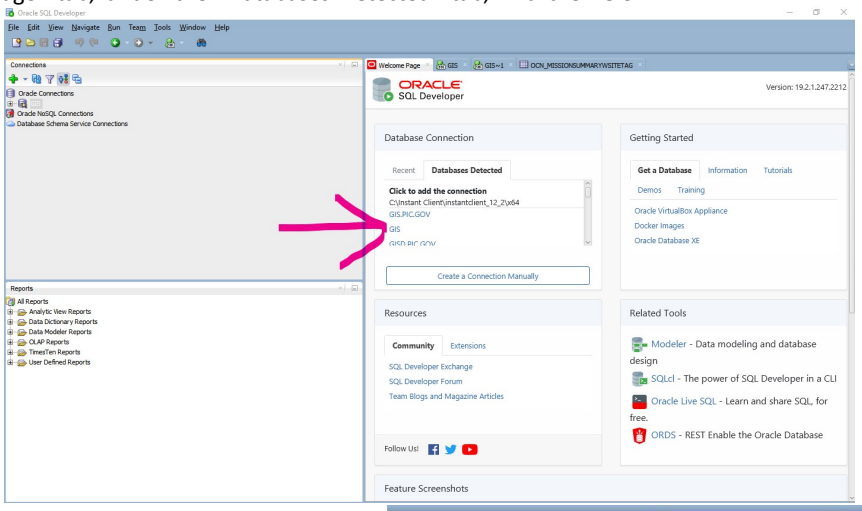
12.3 How to Connect to the Oracle Database

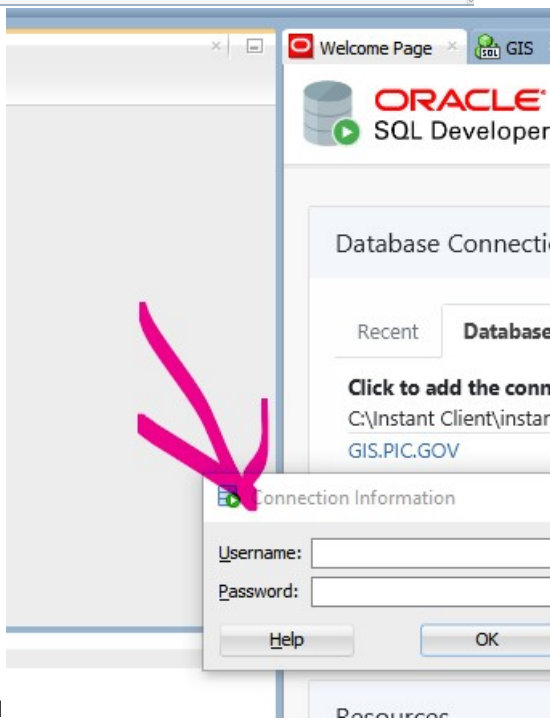
Checkout this live SOP on Google Drive for how to get connected to OCC Data in the oracle database

12.4 How to Connect to the OCC Oracle Databse Via Oracle SQL Developer

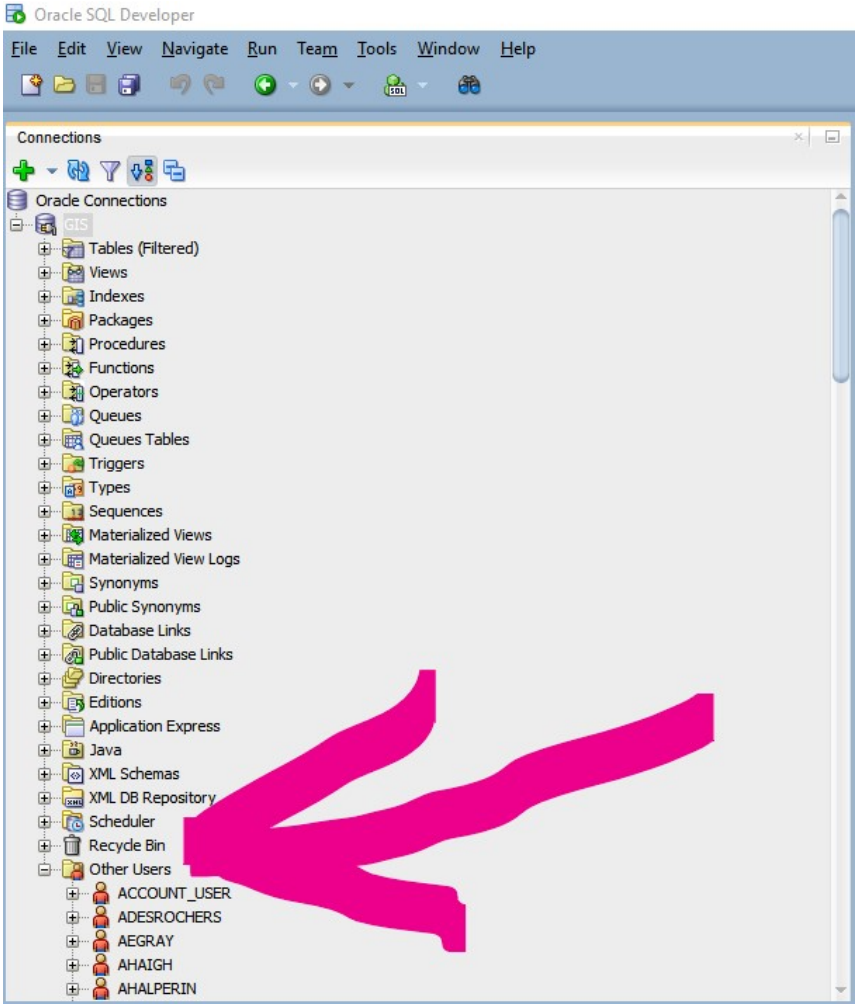
1. Open Oracle SQL Developer

2. On the “Welcome Page” tab, under the “Databases Detected” tab, find the “GIS” database and click it.





3. When prompted, enter your Oracle username and password
4. In the “Connections” pane, expand the “GIS” database and navigate down to “Other


Oracle SQL Developer
File Edit View Navigate Run Team Tools Window Help
Connections
Oracle Connections
Tables (Filtered)
Views
Indexes
Packages
Procedures
Functions
Operators
Queues
Queues Tables
Triggers
Types
Sequences
Materialized Views
Materialized View Logs
Synonyms
Public Synonyms
Database Links
Public Database Links
Directories
Editions
Application Express
Java
XML Schemas
XML DB Repository
Scheduler
Recycle Bin
Other Users
ACCOUNT_USER
ADESROCHERS
AEGRAY
AHAIGH
AHALPERIN

Users”

5. Expand “Other Users” and navigate down to “GISDAT”
6. Within “GISDAT” find OCC tables begining with “OCN” (note as of March 2020, this is soon to be changed to “OCC” prefix when the data team updates the new tables)

Chapter 13

Various Underway resources

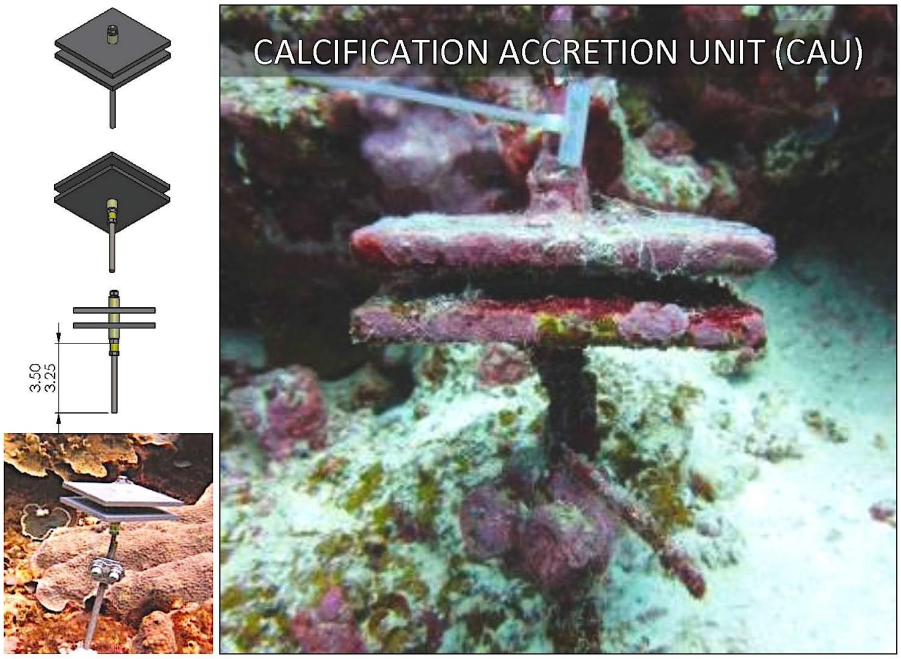
Where to Save Various Data Streams Checkout this google drive file showing the paths of where to save various things

Chapter 14

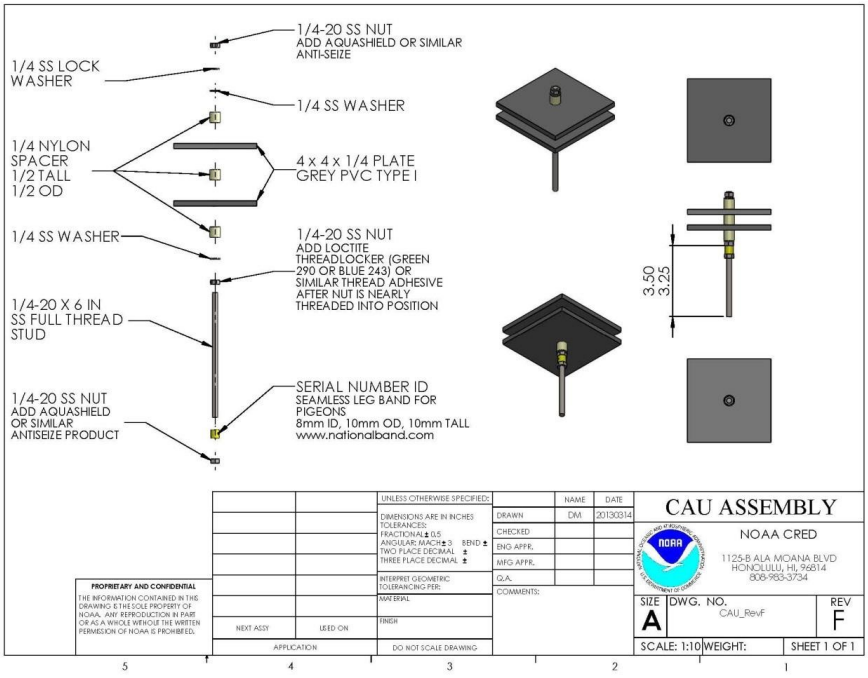
Calcification Accretion Unit (CAU)

##Calcification Accretion Unit (CAU) Laboratory Sample Processing SOP

Authors: Misa PL, Richards CR, Halperin AH, Little AL, and Weible RM (revised March 2020)



14.0.1 Calcification Accretion Unit (CAU) schematic



14.0.2 Preparation Work

14.0.2.1 *ID Tags*

1. Assign a unique ID to both plates of each Calcification Accretion Unit (CAU) using the **CAU Plate ID** naming convention SiteID_RecoveryYear_4-digitSerial#_PlateLocation (“U” - upper plate, “L” - lower plate)

e.g. PAL01_2012_5319_U; PAL01_2012_5319_L

2. Using a pencil, **pre-label the following with the CAU Plate ID (e.g. PAL01_2012_5319_U):**

a) Paper tray A - blank index card 12.7 x 20.32cm (5” x 8”) folded into 12.7 x 12.7cm (5” x 5”) paper tray

b) Paper tray B - same as above

c) Filterpaper 11cm diameter, #1, >11µm particle retention (e.g. Whatman No.1001-110)

3. Insert the corresponding Filter paper into the fold of Paper tray B and store in a container. Place Paper tray A in a separate container. Store both containers away from moisture and direct sunlight. See I. Step 8 for pre-weighing instructions.
4. Print **Glass Dish Labels** on waterproof paper using the template in Section VII.C.1. Attach each label on one side of the glass dish with tape.
5. Print the Plate Photo ID tags on waterproof paper using the template in Section VII.C.2.There are 4 tags, one for each surface of the CAU to be photographed:
   Upper Plate, Top Side
   Upper Plate, Bottom Side
   Lower Plate, Top Side
   Lower Plate, Bottom Side

   An example of a plate photo ID: PAL01_2012_5319_U_T
6. Using an analytical balance, **pre-weigh** the following and record the value (up to 3 decimal points) in the ESD Apex CAU Mission App (or the CAU Data Entry tool for ESD-CREP users, see Section VI p. 20):

a) Paper tray A - record the value in Column ('Paper Tray A Weight [g]')

b) Paper tray B + Filterpaper - record the value in Column ('Filter & Paper Tray B Dry Weight [g]')

14.0.2.2 *Re-sealable Bag ID*

Pre-label **re-sealable plastic bags** 0.95L (1 quart) with the CAU Plate ID. The filter residue will be stored in this bag for archiving

14.0.2.3 Database*

1. Using the **ESD Apex CAU Mission App** (or the CAU Data Entry tool for ESD-CREP users, see Section VI p. 20), have the Data Management team enter the CAU Site IDs (e.g. PAL01) and 4-digit CAU Serial #s (e.g. 5319) for each unit to be processed
2. To calculate the **"Soak Time"** of each unit, record the CAU "Deployment Date" and "Recovery Date" in Column CA and CB, respectively. Record any other additional field data in the spreadsheet (e.g. coordinates, depth, comments, etc.). When using the ESD Apex CAU Mission App, soak time is calculated automatically.

14.0.2.4 *Pre-heat Drying Oven*

Oven (Heratherm OGS-180) settings:

```
Temperature: 70°C (140°F)
Damper: level 3 (mid-high)
```

14.0.2.5 *Prepare 5% HCl acid solution in 2-liter bottles*

One batch (20-30 units) of CAUs will require about 10-15, 2-liter bottles of 5% HCl acid solution in order to completely dissolve calcified materials. More may be needed depending on the amount of accreted CaCO3.

To dilute full-strength HCl acid (1.18 g/mL, 36.5 molar mass, 37% conc.) into 5% solution, use the recommended ratio below:

2L stock: 225 ml HCl
1775 ml deionized/distilled H2O

1L stock: 112.5 ml HCl
887.5 ml deionized/distilled H2O

- ”Be sure to **ADD ACID TO WATER** to avoid excessive heating, violent boiling or splashing of concentrated acid that could result from the exothermic reaction. “Do as you oughta, add acid to water!” - Dr. Anne Cohen, WHOI

** Acid solutions with a higher (>5% HCl concentration) may be prepared and used if desired for processing CAUs from heavily calcified regions (American Samoa, PRIAs), however concentrations **greater than or equal to 15% HCl require special PPE including fume hood utilization.**

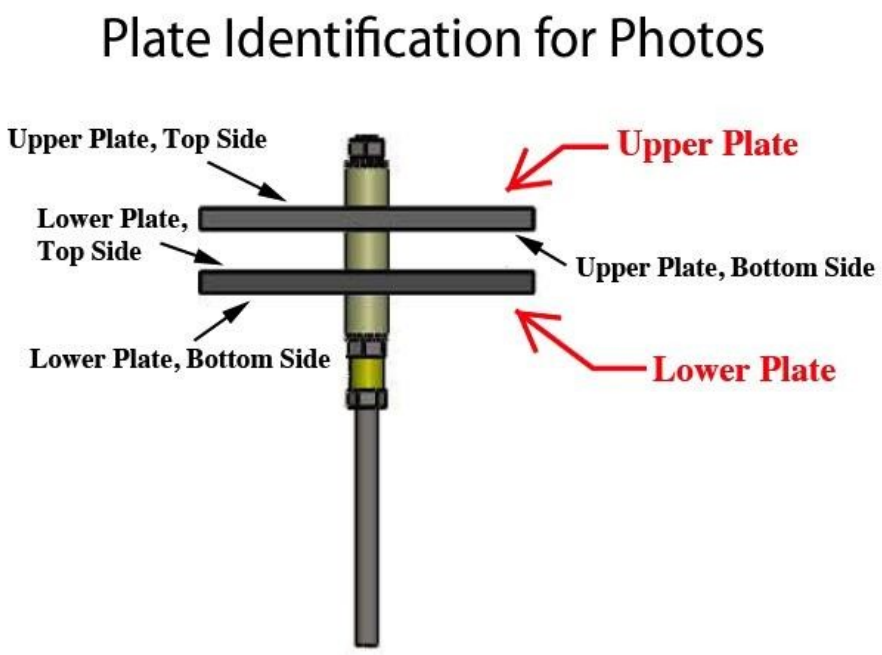
14.1 CAU Processing Steps

- *see Section IV, p.11 for sample processing timeline and Section VII.A, p.36 for sample daily task guide*

14.1.1 A. Dissassembling and Photo-documentation

1. Thaw a batch of CAUs (typically 20-30 units) in the sink for at least 12 hours. Do not thaw over water.

2. Disassemble the plates of each CAU by removing the hex nuts and washers using two 1/4” wrenches (one to hold the unit steady). Make sure to maintain plate identity (upper vs lower plate, top vs bottom side of plate) and the CAU Plate ID.



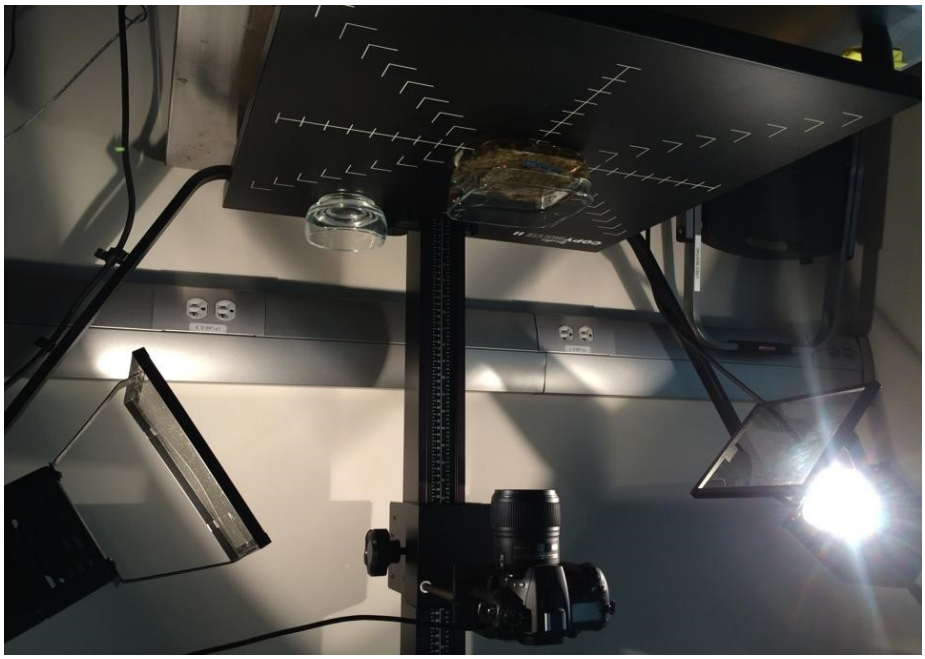
3. Carefully rinse each plate in a saltwater rinse basin (if saltwater is not readily available, freshwater may be used) to remove loose sediment, sand and mobile fauna. Discard any mobile fauna that may have fallen off during rinsing.

4. Fill each pre-labeled glass dish with saltwater(or freshwater).

5. Place each CAU plate with the **top plate facing upwards** into its corresponding glass dish. Ensure that the plate and any encrusting fauna are completely submerged in water. Add more water if necessary (see Section V.C for additional instructions)

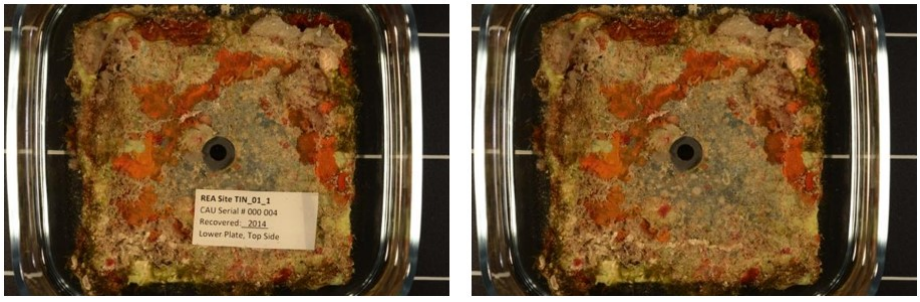
6. Attach a DSLR camera to a camera copy stand or a tripod. Arrange lighting such that the plate is fully illuminated and no glare is visible to the camera

- *If using a Nikon D7000 camera mounted on a copy stand kit with attached lights, see Section V, p. 12 for tethering protocol and recommended settings (**f/8, ISO400, AWB**).*



7. It is recommended to tether the camera to a computer and save the photos directly to the computer's local drive (while using the camera's SD card as a backup drive). Designate a folder where the CAU photoset will be stored directly. (May 2019 - ESD General (T:) Drive at: T:\Oceanography\CAUs\Analysis organized by Year and Cruise Mission, or Island Code for shore-based missions or those from the Atlantic.)

8. Photograph the top and bottom of each plate, first with the Plate Photo ID tag and then a 2nd image without the tag. (If pieces of calcified material fall off during the photographing process, retain the pieces with the plate to be used during the decalcification process).



9. From the designated CAU photoset folder, confirm that both plate photos (with and without the Plate Photo ID tag) are in focus. After photographing both sides of each

plate, each CAU photoset folder should have **8 photos**. The photos should be later on renamed with the following naming convention:

a) With Plate Photo ID tag:
SiteID_RecoveryYear_4-digitSerial#_PlateLocation ("U" - upper plate or "L" - lower plate)_PlateSurface ("T" - top plate or "B" - bottom plate)_ID.jpg

b) Without Plate Photo ID tag:
SiteID_RecoveryYear_4-digitSerial#_PlateLocation ("U" - upper plate, "L" lower plate)_PlateSurface ("T" - top plate, "B" - bottom plate).jpg

```
Example:
PAL01_2012_5319_U_T_ID.jpg      - Upper Plate, Top Side with tag
PAL01_2012_5319_U_T.jpg           - Upper Plate, Top Side
PAL01_2012_5319_U_B_ID.jpg      - Upper Plate, Bottom   Side with tag
PAL01_2012_5319_U_B.jpg         - Upper Plate, Bottom Side
PAL01_2012_5319_L_T_ID.jpg      - Lower Plate, Top Side with tag
PAL01_2012_5319_L_T.jpg           - Lower Plate, Top Side
PAL01_2012_5319_L_B_ID.jpg      - Lower Plate, Bottom Side with tag
PAL01_2012_5319_L_B.jpg           - Lower Plate, Bottom Side
```

10. After photographing all units, if the CAUs were submerged in seawater, carefully rinse each plate in freshwater. If the CAUs were submerged in freshwater, skip the rinsing process.

11. Be sure to remove all hex nuts and washers that may still be attached at the center of the plate. Hex nuts and washers can be covered by calcified material and difficult to see. Inspect each side of each plate to ensure that there are no washers or hex nuts present. If a hex nut or washer is covered in calcified material, remove the hardware and chip off the calcified material from the hardware. Retain the removed material with the rest of the plate.

12. Place each plate and any dislodged pieces of calcified material on its corresponding Paper Tray A, then onto a drying rack and placed in the fume hood. The drying rack can be left in a fume hood to air dry at room temperature indefinitely (**minimum of 24 hours**), until they are dried in the oven.

Drying at room temperature before placing in the oven can help reduce the time the plates remain in the oven.

Wash and rinse the glass dishes but keep the labels on. The same glass dishes will be used during the HCl acid decalcification process.

14.1.2 B. Determining the weight of the CAU plate

1. After a minimum air-drying period of 24 hours, place the **plate assembly (plate, dislodged pieces of calcified material and Paper Tray A)** in the oven labeled "**Non-HCl**" to dry at 60°C for 24 hours.

**Check that the internal temperature remains consistent. If not, minor adjustments should be made to the oven temperature and damper settings.

2. After 24 hours, remove the plate assembly and allow it to come to room temperature (roughly 10 min).
3. Weigh the **entire plate assembly**.
4. In the ESD Apex CAU Mission App (or CAU Data Entry tool for ESD-CREP users), record the weight to at least 3 decimal places under the column '*Drying 1 [24 h] [paper tray + CAU plate] [g]*'.
5. Return the plate assembly in the oven.
6. Dry the CAU plates for another 24 hours.
7. Remove the plate assembly and allow it to come to room temperature (roughly 10 min).
8. Weigh the **entire plate assembly**.
9. In the ESD Apex CAU Mission App (or CAU Data Entry tool for ESD-CREP users), record the 2nd weight to at least 3 decimal places under the column '*Drying 2 [48 h] [paper tray + CAU plate] [g]*'.
10. Compare the current weight from the previous weight:

a) If the difference in weight is less than 0.1g, the plates are considered dry and no further drying needs to occur. This is automatically calculated by the ESD Apex CAU Mission App and denoted by the 'Plate Dry' column on the far right saying 'YES'.

b) If the difference in weight is greater than 0.1 g, return the plates to the oven for another 24 hours.

11. Repeat III.B Steps 5-10 until the difference in weight is less than 0.1 g.

14.1.3 C. Decalcification of CaCO3 in Hydrochloric Acid

- **Be sure to wear proper PPE when handling acid contaminated objects (steps 1-9) including gloves, safety glasses, and lab coat.**

1. Ensure that the plate is fully dry (mass lost between last two weighing will have been less than 0.1g) and the weight of the plate assembly and Paper Tray A has been recorded.
2. Place the individual plates in the pre-labeled glass dishes. Keep Paper Tray A and place under the glass dish.

3. Chip off large pieces of calcified materials (e.g. CCA, coral, shells, etc.) and grind using a mortar and pestle. Return the pulverized forms in the glass dish.

4. Fill the glass dish midway with 5% HCl (or otherwise chosen concentration) acid solution or until the entire CAU plate is fully submerged in acid. **Add HCl acid slowly as the solution may overflow when bubble formation/decalcification begins. The overflow most definitely occurs when dissolving plates from Rose and Swains Atoll.**

5. When decalcification has slowed (12-24 hours):

a) Scrape leftover material from the CAU plates with a razor blade into the glass dish. (See III.C, Step 8-15).

b) Grind pieces of calcified materials that may still be present and return in the glass dish.

c) Using acid-resistant gloves, sort through the scraped fleshy material in the glass dish and feel for any calcified materials.

d) Some calcified material can be completely covered by a boundary layer of fleshy material. If present, manually tease the fleshy material and grind the calcified material to allow decalcification to continue.

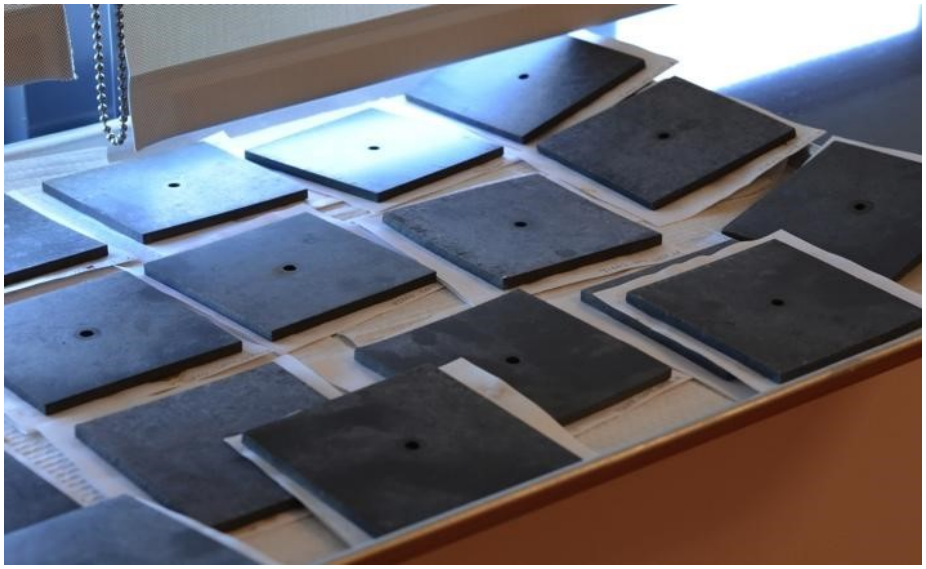
e) If there are more calcified materials in the dish, but no obvious decalcification occurring (no bubble formation), decant the used acid solution and drain the fleshy material into another pre-labeled containers (beakers, glass dish, etc). Add new 5% HCl acid solution (*or desired concentration) in the first glass dish to continue dissolving the remaining calcified materials.

6. Repeat III.C, Steps 5b)-e) until all CaCO3 is fully dissolved. Additional 5% HCl acid solution (*or desired concentration) may need to be added 2-4x, depending on the amount of CaCO3 present.
7. Using 5% HCl acid (*or desired concentration) in a squeeze bottle, thoroughly rinse the tools (gloves, mortar and pestle, razor/scraper) into the glass dish.
8. When the CAU PVC plates have been scraped clean (fleshy/calcified material completely removed from either side and edges of the plate), rinse all sides of the plates with 5% acid (*or desired concentration) into the glass dish.
9. Have a bowl of freshwater ready to scrub and rinse the CAU PVC plates once they are completely clear of particles from the previous step. Pat to dry.

10. Place the CAU PVC plate on its corresponding Paper Tray A.

11. Place the rinsed CAU PVC plates in the oven at 60°C for 24 hours on top of the corresponding Paper Tray A.

12. Remove the plate from the oven and allow to come to room temperature (roughly 10 min).



13. Weigh the clean and dry CAU PVC plate without the underlying paper tray. - *Paper Tray A can be discarded after the CAU PVC plates have been weighed and recorded.

14. In the ESD Apex CAU Mission App, record the weight to at least 3 decimal places under the column '*CAU PVC Dry Weight [g]*'.

15. Collect the clean and weighed CAU PVCs and store for redeployment/archiving.

14.1.4 D. Vacuum filtration of fleshy material

- **Be sure to wear proper PPE when handling acid contaminated objects (steps 1-4) including gloves, safety glasses, and lab coat.**

1. Using a 4-liter Buchner funnel, a plastic mesh layer (with attached pull string) and the corresponding pre-weighed filter paper, vacuum filter the acid bath and remaining fleshy material for each CAU plate. Use a freshwater squeeze bottle to rinse contents of the glass dish into the funnel.

2. If the volume of fleshy material is sufficient to clog the filter paper, a 2nd pre-labeled and pre-weighed filter paper (see III.D, Step 2, a-c) can be used to filter the remaining volume of acid bath and fleshy material:

a) Label an additional filter paper and paper tray with its corresponding CAU Plate ID (e.g. *PAL01_2012_5319_U*).

b) In the ESD Apex CAU Mission App, record the weight of the 2nd filter paper + paper tray to at least 3 decimal places in the column '*Addtl Filter & Paper tray B Dry Weight [g]*'.

3. If filtering has slowed down, use a spatula/teaspoon to gently scrape the surface of the filter paper to allow more solution to filter through. Filtering can take >5 mins depending the amount of fleshy material in the acid bath.

4. When filtration is completed, place the filter paper on its corresponding Paper Tray B and onto a drying rack. The drying rack should be left in a fume hood to air dry at room temperature (minimum of 24 hours). The filter paper can continue to air dry at room temperature, indefinitely, until they are dried in the oven.

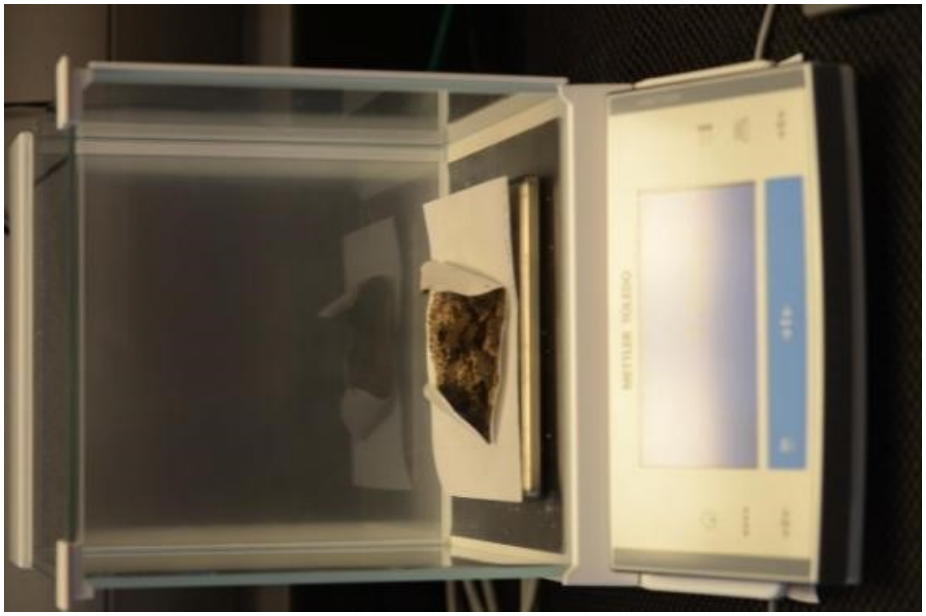
14.1.5 E. Determining the weight of the fleshy material

- **Be sure to wear proper PPE (gloves) when handling acid contaminated filters in this section.**

1. After a minimum air-drying period of 24 hours, place the **filter paper assembly (filter paper and Paper Tray B)** in the oven to dry at 60°C for 24 hours.

- *Check that the internal temperature remains consistent. If not, minor adjustments should be made to the oven temperature and damper settings.*

2. After 24 hours, remove the filterpaper assembly and allow it to come to room temperature (roughly 10min).
3. Weigh the *entire filterpaper assembly.*



4. In the ESD Apex CAU Mission App, record the weight to at least 3 decimal places under "Filters" >'*Drying 1 [24 h] [paper tray + filterpaper] [g]*'.
5. Return the filterpaper assembly to the oven.
6. Dry the filterpaper for another 24 hours.
7. Remove the filterpaper assembly and allow it to come to room temperature (roughly 10min).

8. Weigh the **entire filterpaper assembly.**
9. In the ESD Apex CAU Mission App, record the weight to at least 3 decimal places under "Filters" >'*Drying 2 [48 h] [paper tray + filterpaper] [g]*'.
10. Compare the current weight from the previous weight:

a) If the difference in weight is less than 0.1g, the plates are considered dry and no further drying/weighing needs to occur.

- *In the ESD Apex CAU Mission App, the column to the far right called "Filter Dry" has been formatted to change from 'NO' to "YES" if the difference in weight is less than 0.1g.*

b) If the difference in weight is greater than 0.1 g, return the plates to the oven for another 24 hours.

11. Repeat III.E Steps 5-10 until the difference in weight is less than 0.1 g.
12. After recording the final filterpaper assembly dry weight, place the filterpaper and Paper tray B in its corresponding re-sealable bag for archiving. Ensure the bag is labeled properly using the CAU Plate ID naming convention:

SiteID_RecoveryYear_4-digitSerial#_PlateLocation ("U" - upper plate, "L" - lower plate).

14.2 Processing Timeline

Approximately 25 units or 50 CAU plates can be processed as a batch (at ESD-CREP, this is equivalent to CAUs collected from about 1 island). The processing of each batch is typically completed in 4 weeks. Below is an example of a typical processing timeline