

# Dissolved and total dissolvable trace metal concentrations, Fe and Cu-binding organic ligands, and Fe-binding humic-like substances from R/V Weatherbird cruise WB1513 and R/V Hogarth cruise HO-1807 along the West Florida Shelf in 2015 and 2018

**Website:** <https://www.bco-dmo.org/dataset/820508>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2020-08-11

## Project

» [Trace metals and metal-binding ligands in the Eastern Gulf of Mexico](#) (GoM\_Metals\_Ligands)

Contributors	Affiliation	Role
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## Abstract

Dissolved and total dissolvable trace metal concentrations, Fe and Cu-binding organic ligands, and Fe-binding humic-like substances from R/V Weatherbird cruise WB1513 and R/V Hogarth cruise HO-1807 conducted along the West Florida Shelf in the eastern Gulf of Mexico in 2015 and 2018. These data have been published in Mellett & Buck, 2020 (doi: 10.1016/j.marchem.2020.103891).

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## Coverage

**Spatial Extent:** N:28.1879 E:-82.34756 S:25.8812 W:-85.6906

**Temporal Extent:** 2015-06-18 - 2018-03-02

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## Dataset Description

Dissolved and total dissolvable trace metal concentrations, Fe and Cu-binding organic ligands, and Fe-binding humic-like substances for two cruises conducted along the West Florida Shelf (WFS) in the eastern Gulf of Mexico in 2015 and 2018.

## Methods & Sampling

The following methods are provided in Mellett & Buck (2020).

### **Sample Collection**

Surface water samples were collected from the West Florida Shelf in the eastern Gulf of Mexico 18-21 June 2015 aboard the R/V Weatherbird II and 27 February to 2 March 2018 aboard the R/V Hogarth. Underway hydrographic data for salinity and temperature were collected on both ships via flow-through systems (SeaBird); flow-through chlorophyll a data were also collected in summer on the R/V Weatherbird II via a calibrated fluorometer. The flow-through system on the R/V Hogarth did not include a fluorescence sensor and discrete samples were collected for chlorophyll a analysis at the University of South Florida (USF). Samples for trace metals, macronutrients, and chlorophyll a were collected from ~2 m depth using a custom surface pump "towfish" system (Bruland et al. 2005) towed alongside the vessels. Our "towfish" sampling system consisted of an all PTFE Teflon air-operated double-diaphragm pump (Jabsco, Cole-Parmer), acid-cleaned tubing (Bev-A-Line IV, ½", Cole-Parmer), and a 35 kg steel and lead "towfish" coated in non-metallic epoxy paint (EPO coat VA, DeCara Inc.). For deployment, the tubing was fed through the towfish such that the tubing opening was located ~10 cm forward of the towfish body, which was suspended in the water from the starboard A-frame using a ~2 m length umbilical of ½" diameter non-metallic line (Vectran) attached to the end of the vessel hydrowire. To collect surface water samples underway, the package was towed at 5-10 knots, which allowed the towfish to sample at the edge of the ship wake with the tubing intake facing into the water ahead of the towfish. The surface water from the towfish was pumped into a positive pressure bubble in the main lab of each ship for sampling.

### **Dissolved Trace Metals**

Samples for dissolved ('d') trace metals were filtered inline through 0.2 µm Acropak capsule filters (Pall) into 125 mL low-density polyethylene (LDPE; Nalgene) bottles. The Acropak capsule filters were cleaned by leaching with 10% TraceMetal Grade (TMG) HCl, rinsing with MQ water (Milli-Q; >18.2 MΩ cm), and then flushing with at least 1 L of surface seawater prior to use. The 125 mL sample bottles used for dissolved and total dissolvable trace metals were cleaned with TMG nitric acid (HNO<sub>3</sub>; Fisher) in accordance with GEOTRACES protocols (Cutter et al. 2017), and stored filled with dilute (0.024 M) TMG HCl (Fisher) until use. Total dissolvable ('TD') trace metal samples were collected immediately after collection of dissolved samples by removing the inline filter capsule and rinsing and filling a 125 mL LDPE bottle with unfiltered water. Both sample types were acidified with the equivalent of 4 mL 6 M high-purity (Fisher Optima) HCl per liter of seawater to 0.024M (~pH 1.7-1.8, NBS scale; Johnson et al. (2007)), and stored for at least 6 months. Prior to preconcentration and analysis, total dissolvable metal samples were filtered through 0.4 µm polycarbonate track etched (PCTE; Whatman) filters on a Teflon filtration rig (Savillex) into 125 mL LDPE bottles. The PCTE filters were cleaned prior to use by soaking in 10% HCl (TMG; Fisher) for at least a week, then rinsed 5 times with MQ water, and were stored in 0.024 M HCl (TMG, Fisher) until use.

Dissolved and dissolvable metals were processed using an automated seaFAST-pico (ESI) preconcentration system (Lagerström et al. 2013). Samples were first UV-oxidized to ensure recovery of any organic-bound Cu and Co (Milne et al. 2010; Biller and Bruland 2012). The metals of interest were then preconcentrated by seaFAST onto a Nobias PA1 chelating resin at pH 6.2 and eluted from the column with 1N triple quartz-distilled HNO<sub>3</sub> with internal reference standards of indium and rhodium. The eluent was then analyzed via a method of standard addition on a Thermo Scientific Element XR Inductively Coupled Plasma Mass Spectrometer (ICP-MS) in medium resolution and counting mode at the USF College of Marine Science (Hollister et al. 2020). The blanks and limit of detection of the seaFAST-pico system were calculated using "air blanks" that encompass both the reagent blank and the manifold blank of the system (Table S1). The accuracy of metal concentrations measured using this method was established by comparison of NASS-7 and SAFe (Johnson et al. 2007) seawater reference material results with consensus values (Table S1). All reference material was within the consensus range for each metal measured with the exception of dCd in SAFe S1, which was quantified as 2.4 ± 3.7 pM (n=4) against a consensus of 1.0 ± 0.3 pM. The average relative standard deviation of samples measured in replicate across the dataset were 7.9% (Fe), 5.7% (Cu), 3.2% (Mn), 10.3% (Zn), 7.0% (Co), 5.9% (Ni), 15.4% (Cd), and 8.7% (Pb), respectively. The limit of detection for each metal was 56.7 pM (Fe), 11.6 pM (Cu), 2.4 pM (Mn), 18.9 pM (Zn), 0.9 pM (Co), 41.1 pM (Ni), 0.7 pM (Cd), and 1.6 pM (Pb), respectively (3s of air blanks; Table S1).

### **Dissolved Cu and Fe speciation**

Filtered (<0.2 µm, Pall Acropak) samples were collected for dissolved Fe-binding and Cu-binding organic ligands in 500 mL fluorinated high-density polyethylene (FPE) bottles (Buck et al. 2012). These sample bottles were cleaned by soaking in a soap bath for at least one week, then in a 10% TMG HCl (1.2 M) bath for at least a month. Bottles were then rinsed at least 3-5 times with Milli-Q water (>18.2 MΩ cm) and stored filled with Milli-Q until use. Prior to filling with sample, bottles were rinsed three times with sample and were stored frozen (-20°C) until analysis on land.

The concentrations and conditional stability constants of Cu- and Fe-binding organic ligands were measured using competitive ligand exchange adsorptive cathodic stripping voltammetry (CLE-AdCSV). The competitive ligand salicylaldehyde (SA; Sigma-Aldrich) was used to compete with natural ligands (Campos and van den Berg 1994; Rue and Bruland 1995). Measurements were made on a BioAnalytical Systems (BASi) controlled-growth mercury electrode interfaced with an Epsilon 2 analyzer (BASi). Final SA concentrations of 2  $\mu\text{M}$  and 25  $\mu\text{M}$  were used for Cu and Fe speciation measurements, respectively (Buck et al. 2012; Jacquot and Moffett 2015). Deposition times of 300 s and 90 s were used for Cu and Fe speciation, respectively.

The full details of the Fe and Cu speciation methods and theory may be found elsewhere (Campos and van den Berg 1994; Rue and Bruland 1995; Buck et al. 2012, 2018). Briefly, for each titration, aliquots of 10 mL were distributed into fifteen lidded Teflon vials (Saville), which had previously been conditioned with Milli-Q, borate buffer, metal additions, and SA prior to use. Each 10 mL aliquot was buffered to pH 8.2 (total scale) with a 1.5 M borate buffer (7.5 mM final concentration) made in 0.4 N ammonium hydroxide (Optima grade; Fisher) and cleaned for trace metals using Chelex resin. For Cu titrations, additions of 0–20 nM Cu were used and for Fe, additions of 0–10 nM Fe were used in separate vials. Metal additions were allowed to equilibrate overnight, and SA additions were equilibrated at least 1 h before analysis (Buck et al. 2012; Abualhaja and van den Berg 2014).

Titration data were processed using ProMCC software (Omanović et al. 2015; Pižeta et al. 2015), which fits the datasets using multiple regression models, both linear and non-linear. A single ligand class was found to be the best fit for the speciation data for both metals. Refer to Mellet & Buck (2020) for full details.

### **Electroactive Fe-binding humic-like substances**

Remaining volume from the speciation samples used for the Fe- and Cu-binding ligand analyses was used for the quantification of naturally occurring electroactive Fe-binding humic-like substances (HS-like ligands). The measurements were made following the method of Laglera et al. (2007) as modified by Bundy et al. (2014). Briefly, a 10 mL sub-sample was amended with Fe (50 nM) to saturate any excess Fe-binding ligands present in the sample, buffered with 1.5 M borate buffer, and allowed to equilibrate for at least 2 hours. After equilibration, 20 mM potassium bromate oxidant was added and the electroactive response of the natural Fe-ligand complexes formed in the sample was measured on a Metrohm model 797 VA in direct current mode. Potential was scanned from -100 mV to -1100 mV with a deposition potential of -100 mV, and a deposition time between 60 s and 180 s depending on peak response. This approach directly detects any Fe-binding ligands in the samples that form electroactive complexes with Fe. Quantification of these electroactive Fe-binding ligands was made by method of standard additions of Suwannee River humic acid standard (SRHA; International Humic Substance Society) ranging from 0–60  $\text{mg L}^{-1}$  or 0–400  $\text{mg L}^{-1}$  (dependent on peak response). The concentrations of the electroactive Fe-binding ligands determined with this approach are thus described as Fe-binding HS-like ligands in the samples.

## **Data Processing Description**

### **Quality Flags:**

The standard Ocean Data View qualifying flags were used (see: [https://www.bodc.ac.uk/data/codes\\_and\\_formats/odv\\_format/](https://www.bodc.ac.uk/data/codes_and_formats/odv_format/)).

- 1: Good Value: Good quality data value that is not part of any identified malfunction and has been verified as consistent with real phenomena during the quality control process.
- 2: Probably Good Value: Data value that is probably consistent with real phenomena but this is unconfirmed or data value forming part of a malfunction that is considered too small to affect the overall quality of the data object of which it is a part.
- 3: Probably Bad Value: Data value recognized as unusual during quality control that forms part of a feature that is probably inconsistent with real phenomena.
- 4: Bad Value: An obviously erroneous data value.
- 5: Changed Value: Data value adjusted during quality control.
- 6: Value Below Detection Limit: The level of the measured phenomenon was too small to be quantified by the technique employed to measure it. The accompanying value is the detection limit for the technique or zero if that value is unknown.
- 7: Value in Excess: The level of the measured phenomenon was too large to be quantified by the technique employed to measure it. The accompanying value is the measurement limit for the technique.
- 8: Interpolated Value: This value has been derived by interpolation from other values in the data object.
- 9: Missing Value: The data value is missing. Any accompanying value will be a magic number representing absent data.
- A: Value Phenomenon Uncertain: There is uncertainty in the description of the measured phenomenon

associated with the value such as chemical species or biological entity.

### BCO-DMO Processing:

- modified parameter names;
- replaced "nda" with "nd" (no data);
- replaced "<LOD" with "BDL" (below detection limit);
- added date/time column in ISO8601 format.

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## Data Files

File
<b>WFS_GoM_2015_2018.csv</b> (Comma Separated Values (.csv), 17.19 KB) MD5:5f1e4741326b39df66a18a6f9e021716
Primary data file for dataset ID 820508

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## Supplemental Files

File
<b>Table S1</b> filename: Table_S1_820508.pdf (Portable Document Format (.pdf), 150.30 KB) MD5:c28dc4c71083c229b3b7004108c1dd19
Table S1. The blanks, limit of detection, and reference material values associated with dataset 820508.

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## Related Publications

Abualhaja, M. M., & van den Berg, C. M. G. (2014). Chemical speciation of iron in seawater using catalytic cathodic stripping voltammetry with ligand competition against salicylaldoxime. *Marine Chemistry*, 164, 60–74. doi:[10.1016/j.marchem.2014.06.005](https://doi.org/10.1016/j.marchem.2014.06.005)  
*Methods*

Buck, K. N., Moffett, J., Barbeau, K. A., Bundy, R. M., Kondo, Y., & Wu, J. (2012). The organic complexation of iron and copper: an intercomparison of competitive ligand exchange-adsorptive cathodic stripping voltammetry (CLE-ACSV) techniques. *Limnology and Oceanography: Methods*, 10(7), 496–515. doi:[10.4319/lo.2012.10.496](https://doi.org/10.4319/lo.2012.10.496)  
*Methods*

Bundy, R. M., Biller, D. V., Buck, K. N., Bruland, K. W., & Barbeau, K. A. (2014). Distinct pools of dissolved iron-binding ligands in the surface and benthic boundary layer of the California Current. *Limnology and Oceanography*, 59(3), 769–787. doi:[10.4319/lo.2014.59.3.0769](https://doi.org/10.4319/lo.2014.59.3.0769)  
*Methods*

Cutter, Gregory, Casciotti, Karen, Croot, Peter, Geibert, Walter, Heimbürger, Lars-Eric, Lohan, Maeve, Planquette, Hélène, van de Flierdt, Tina (2017) Sampling and Sample-handling Protocols for GEOTRACES Cruises. Version 3, August 2017. Toulouse, France, GEOTRACES International Project Office, 139pp. & Appendices. DOI: <http://dx.doi.org/10.25607/OBP-2>  
*Methods*

Hollister, A. P., Kerr, M., Malki, K., Muhlbach, E., Robert, M., Tilney, C. L., Hubbard, K.A., & Buck, K. N. (2020). Regeneration of macronutrients and trace metals during phytoplankton decay: An experimental study. *Limnology and Oceanography*. doi:[10.1002/lno.11429](https://doi.org/10.1002/lno.11429)  
*Methods*

Jacquot, J. E., & Moffett, J. W. (2015). Copper distribution and speciation across the International GEOTRACES Section GA03. *Deep Sea Research Part II: Topical Studies in Oceanography*, 116, 187–207.

doi:[10.1016/j.dsr2.2014.11.013](https://doi.org/10.1016/j.dsr2.2014.11.013)

*Methods*

Johnson, K. S., Boyle, E., Bruland, K., Coale, K., Measures, C., Moffett, J., ... Wu, J. (2007). Developing Standards for Dissolved Iron in Seawater. *Eos, Transactions American Geophysical Union*, 88(11), 131.

doi:[10.1029/2007eo110003](https://doi.org/10.1029/2007eo110003)

*Methods*

Lagerström, M. E., Field, M. P., Séguret, M., Fischer, L., Hann, S., & Sherrell, R. M. (2013). Automated on-line flow-injection ICP-MS determination of trace metals (Mn, Fe, Co, Ni, Cu and Zn) in open ocean seawater: Application to the GEOTRACES program. *Marine Chemistry*, 155, 71–80. doi:[10.1016/j.marchem.2013.06.001](https://doi.org/10.1016/j.marchem.2013.06.001)

*Methods*

Laglera, L. M., Battaglia, G., & van den Berg, C. M. G. (2007). Determination of humic substances in natural waters by cathodic stripping voltammetry of their complexes with iron. *Analytica Chimica Acta*, 599(1), 58–66.

doi:[10.1016/j.aca.2007.07.059](https://doi.org/10.1016/j.aca.2007.07.059)

*Methods*

Lucia, M., Campos, A. M., & van den Berg, C. M. G. (1994). Determination of copper complexation in sea water by cathodic stripping voltammetry and ligand competition with salicylaldoxime. *Analytica Chimica Acta*, 284(3), 481–496. doi:[10.1016/0003-2670\(94\)85055-0](https://doi.org/10.1016/0003-2670(94)85055-0)

*Methods*

Mellet, T., & Buck, K. N. (2020). Spatial and temporal variability of trace metals (Fe, Cu, Mn, Zn, Co, Ni, Cd, Pb), iron and copper speciation, and electroactive Fe-binding humic substances in surface waters of the eastern Gulf of Mexico. *Marine Chemistry*, 227: 103891. doi:[10.1016/j.marchem.2020.103891](https://doi.org/10.1016/j.marchem.2020.103891)

*Results*

Milne, A., Landing, W., Bizimis, M., & Morton, P. (2010). Determination of Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb in seawater using high resolution magnetic sector inductively coupled mass spectrometry (HR-ICP-MS). *Analytica Chimica Acta*, 665(2), 200–207. doi:[10.1016/j.aca.2010.03.027](https://doi.org/10.1016/j.aca.2010.03.027)

*Methods*

Moffett, J. W., & Dupont, C. (2007). Cu complexation by organic ligands in the sub-arctic NW Pacific and Bering Sea. *Deep Sea Research Part I: Oceanographic Research Papers*, 54(4), 586–595.

doi:[10.1016/j.dsr.2006.12.013](https://doi.org/10.1016/j.dsr.2006.12.013)

*Methods*

Omanović, D., Garnier, C., & Pižeta, I. (2015). ProMCC: An all-in-one tool for trace metal complexation studies. *Marine Chemistry*, 173, 25–39. doi:[10.1016/j.marchem.2014.10.011](https://doi.org/10.1016/j.marchem.2014.10.011)

*Methods*

Rue, E. L., & Bruland, K. W. (1995). Complexation of iron(III) by natural organic ligands in the Central North Pacific as determined by a new competitive ligand equilibration/adsorptive cathodic stripping voltammetric method. *Marine Chemistry*, 50(1-4), 117–138. doi:[10.1016/0304-4203\(95\)00031-1](https://doi.org/10.1016/0304-4203(95)00031-1)

*Methods*

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## Parameters

Parameter	Description	Units
Date	Date; format: MM-DD-YY	unitless
Time	Time (GMT-5); format: hh:mm	unitless
ISO_DateTime_UTC	Date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Latitude	Latitude where each sample was collected	deg N
Longitude	Longitude where each sample was collected	deg E
Salinity	Practical salinity from ships flow-through sensor at the time of sample collection	psu
Temperature	Temperature from ships flow-through sensor at the time of sample collection	deg C

Fluor	Chl-a calibrated fluorescence from ship flow-through sensor at the time of sample collection	micrograms per liter (ug/L)
Fluor_Flag	Ocean Data View (ODV) qualifying flag	unitless
Chla_Fluor	Concentration of chlorophyll a	micrograms per liter (ug/L)
Chla_Fluor_Flag	Ocean Data View (ODV) qualifying flag	unitless
Nitrate_Nitrite	Concentration of dissolved (	micromoles per liter (umol/L)
Nitrate_Nitrite_Flag	Ocean Data View (ODV) qualifying flag	unitless
Silicic_Acid	Concentration of dissolved (	micromoles per liter (umol/L)
Silicic_Acid_Flag	Ocean Data View (ODV) qualifying flag	unitless
Phosphate	Concentration of dissolved (	micromoles per liter (umol/L)
Phosphate_Flag	Ocean Data View (ODV) qualifying flag	unitless
Fe_D_CONC	Concentration of dissolved (	nanomoles per liter (nmol/L)
std_Fe_D_CONC	Uncertainty of dissolved iron concentration	nanomoles per liter (nmol/L)
Fe_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Cu_D_CONC	Concentration of dissolved (	nanomoles per liter (nmol/L)
std_Cu_D_CONC	Uncertainty of dissolved copper concentration	nanomoles per liter (nmol/L)
Cu_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Mn_D_CONC	Concentration of dissolved (	nanomoles per liter (nmol/L)
std_Mn_D_CONC	Uncertainty of dissolved manganese concentration	nanomoles per liter (nmol/L)
Mn_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Zn_D_CONC	Concentration of dissolved (	nanomoles per liter (nmol/L)
std_Zn_D_CONC	Uncertainty of dissolved zinc concentration	nanomoles per liter (nmol/L)
Zn_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless

Co_D_CONC	Concentration of dissolved (	picomoles per liter (pmol/L)
std_Co_D_CONC	Uncertainty of dissolved cobalt concentration	picomoles per liter (pmol/L)
Co_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Ni_D_CONC	Concentration of dissolved (	nanomoles per liter (nmol/L)
std_Ni_D_CONC	Uncertainty of dissolved nickel concentration	nanomoles per liter (nmol/L)
Ni_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Cd_D_CONC	Concentration of dissolved (	picomoles per liter (pmol/L)
std_Cd_D_CONC	Uncertainty of dissolved cadmium concentration	picomoles per liter (pmol/L)
Cd_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Pb_D_CONC	Concentration of dissolved (	picomoles per liter (pmol/L)
std_Pb_D_CONC	Uncertainty of dissolved lead concentration	picomoles per liter (pmol/L)
Pb_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Fe_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) iron	nanomoles per liter (nmol/L)
std_Fe_TD_CONC	Uncertainty of total dissolvable iron concentration	nanomoles per liter (nmol/L)
Fe_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Cu_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) copper	nanomoles per liter (nmol/L)
std_Cu_TD_CONC	Uncertainty of total dissolvable copper concentration	nanomoles per liter (nmol/L)
Cu_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Mn_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) manganese	nanomoles per liter (nmol/L)
std_Mn_TD_CONC	Uncertainty of total dissolvable manganese concentration	nanomoles per liter (nmol/L)
Mn_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless

Zn_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) zinc	nanomoles per liter (nmol/L)
std_Zn_TD_CONC	Uncertainty of total dissolvable zinc concentration	nanomoles per liter (nmol/L)
Zn_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Co_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) cobalt	picomoles per liter (pmol/L)
std_Co_TD_CONC	Uncertainty of total dissolvable cobalt concentration	picomoles per liter (pmol/L)
Co_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Ni_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) nickel	nanomoles per liter (nmol/L)
std_Ni_TD_CONC	Uncertainty of total dissolvable nickel concentration	nanomoles per liter (nmol/L)
Ni_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Cd_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) cadmium	picomoles per liter (pmol/L)
std_Cd_TD_CONC	Uncertainty of total dissolvable cadmium concentration	picomoles per liter (pmol/L)
Cd_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
Pb_TD_CONC	Concentration of total dissolvable (unfiltered, acidified) lead	picomoles per liter (pmol/L)
std_Pb_TD_CONC	Uncertainty of total dissolvable lead concentration	picomoles per liter (pmol/L)
Pb_TD_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
L_Fe_D_CONC	Concentration of dissolved iron-binding ligands	nanomoles per liter (nmol/L)
std_L_Fe	Uncertainty of dissolved iron-binding ligands	nanomoles per liter (nmol/L)
L_Fe_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
logK_L_Fe	Log conditional stability constant of dissolved iron-binding ligands with respect to Fe'	unitless
std_logK_L_Fe	95% confidence interval of the log conditional stability constant of dissolved iron-binding ligands	unitless
eL_Fe_D_CONC	Excess dissolved iron-binding ligands: dissolved iron-binding ligand concentration minus dissolved iron concentration ([LFe]-[dFe])	nanomoles per liter (nmol/L)



std_eL_Fe	Propagated uncertainty of excess iron-binding ligands	nanomoles per liter (nmol/L)
eL_Fe_Flag	Ocean Data View (ODV) qualifying flag	unitless
logFe_prime	Log inorganic Fe concentrations	M
log_alpha_Fe	Log complexation capacity	unitless
L_Cu_D_CONC	Concentration of dissolved copper-binding ligands	nanomoles per liter (nmol/L)
std_L_Cu	95% confidence interval of the dissolved copper-binding ligand concentration	nanomoles per liter (nmol/L)
L_Cu_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless
logK_L_Cu	Log conditional stability constant of dissolved copper-binding ligands with respect to Cu <sup>2+</sup>	unitless
std_logK_L_Cu	95% confidence interval of the log of conditional stability constant of dissolved copper-binding ligands	unitless
eL_Cu_D_CONC	Excess dissolved copper-binding ligands: dissolved copper-binding ligand concentration minus dissolved copper concentration ([LCu]-[dCu])	nanomoles per liter (nmol/L)
std_eL_Cu_D_CONC	Propagated uncertainty of excess copper-binding ligands	nanomoles per liter (nmol/L)
logCu2	Log free cupric ion concentration	M
log_alpha_Cu	Log complexation capacity of copper binding ligands	unitless
Fe_HS_like_D_CONC	Concentration of iron-binding electroactive humic-like substances	micrograms per liter (ug/L)
std_Fe_HS_like	Uncertainty of iron-binding electroactive humic-like substances	micrograms per liter (ug/L)
Fe_HS_like_D_CONC_Flag	Ocean Data View (ODV) qualifying flag	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	BioAnalytical Systems (BASi) controlled-growth mercury electrode
<b>Generic Instrument Name</b>	BASi Controlled Growth Mercury Electrode
<b>Generic Instrument Description</b>	Bioanalytical Systems (BASi) Mercury drop electrodes are generated by the BASi Controlled Growth Mercury Electrode (CGME) in three modes: DME (Dropping Mercury Electrode) - mercury is allowed to flow freely from the reservoir down the capillary and so the growth of the mercury drop and its lifetime is controlled by gravity. (The optional 100 um capillary is recommended for this mode.) SMDE (Static Mercury Drop Electrode) - the drop size is determined by the length of time for which the fast-response capillary valve is opened, and the drop is dislodged by a drop knocker. The dispense/knock timing is microprocessor-controlled and is typically coordinated with the potential pulse or square-wave waveform. This mode can also be used to generate the Hanging Mercury Drop Electrode required for stripping experiments. CGME (Controlled Growth Mercury Electrode) - the mercury drop is grown by a series of pulses that open the capillary valve. The number of pulses, their duration, and their frequency can be varied by PC control, providing great flexibility in both the drop size and its rate of growth. This CGME mode can be used for both polarographic and stripping experiments. <a href="http://www.basinc.com/products/ec/cgme.php">http://www.basinc.com/products/ec/cgme.php</a>

<b>Dataset-specific Instrument Name</b>	Epsilon 2 analyzer (BASi)
<b>Generic Instrument Name</b>	BASi EC-epsilon 2 Autoanalyzer
<b>Generic Instrument Description</b>	The Bioanalytical Systems EC epsilon is a family of potentiostat/galvanostats for electrochemistry. The most basic epsilon instrument can be used for standard techniques, as well as chronopotentiometry for materials characterization (e.g., characterization of transition metal complexes by cyclic voltammetry and controlled potential electrolysis, or of biosensors by cyclic voltammetry and constant potential amperometry). Pulse, square wave, and stripping techniques can be added by a software upgrade, and a second channel can be added by a hardware upgrade. <a href="http://www.basinc.com/products/ec/epsilon/">http://www.basinc.com/products/ec/epsilon/</a>

<b>Dataset-specific Instrument Name</b>	Element XR Inductively Coupled Plasma Mass Spectrophotometer
<b>Generic Instrument Name</b>	Inductively Coupled Plasma Mass Spectrometer
<b>Generic Instrument Description</b>	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

<b>Dataset-specific Instrument Name</b>	SeaFAST pico
<b>Generic Instrument Name</b>	SeaFAST Automated Preconcentration System
<b>Generic Instrument Description</b>	The seaFAST is an automated sample introduction system for analysis of seawater and other high matrix samples for analyses by ICPMS (Inductively Coupled Plasma Mass Spectrometry).

<b>Dataset-specific Instrument Name</b>	Metrohm model 797 VA
<b>Generic Instrument Name</b>	Voltammetry Analyzers
<b>Generic Instrument Description</b>	Instruments that obtain information about an analyte by applying a potential and measuring the current produced in the analyte.

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## Deployments

### WB1513

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/820522">https://www.bco-dmo.org/deployment/820522</a>
<b>Platform</b>	R/V Weatherbird II

### HO-1807

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/820525">https://www.bco-dmo.org/deployment/820525</a>
<b>Platform</b>	R/V W.T. Hogarth

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## Project Information

### Trace metals and metal-binding ligands in the Eastern Gulf of Mexico (GoM\_Metals\_Ligands)

**Coverage:** Eastern Gulf of Mexico, West Florida Shelf

The concentrations and bioavailability of trace metals influence marine food web productivity and structure, and are an integral component of ocean biogeochemistry. The Gulf of Mexico is a semi-enclosed basin, and trace metal concentrations in these waters appear to be heavily impacted by margin sources including rivers, continental shelf sediments and seasonal dust deposition, though much of the basin remains understudied for trace metals. In the eastern Gulf of Mexico specifically, dust-derived iron (Fe) has been hypothesized to play a role in the development of harmful algal blooms of *Karenia brevis*. Sources and cycling of trace metals within the eastern Gulf of Mexico may also impact the North Atlantic via Loop Current-Gulf Stream circulation connections. This project examines spatial and temporal variability in the concentrations of Fe and other bioactive trace metals across the West Florida Shelf in the eastern Gulf of Mexico.

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## Funding

<b>Funding Source</b>	<b>Award</b>
Florida Fish and Wildlife Conservation Commission (FWC)	<a href="#">FWC award to K. Buck</a>
Florida Institute of Oceanography (FIO)	<a href="#">FIO award to K. Buck</a>

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