

**ELLERY D. INGALL (4/23/19)**  
**Professor, School of Earth and Atmospheric Sciences**  
**Georgia Institute of Technology**

**I. Earned Degrees**

Ph.D. Geology	1991	Yale University (Advisor: Robert A. Berner)
M.S. Geology	1985	University of Utah (Advisor: William T. Parry)
B.A. Geology	1981	University of California Santa Barbara

**II. Employment History**

2000-present	Professor/Associate Professor EAS, Georgia Institute of Technology
1993-2000	Associate Professor/Assistant Professor, Marine Science, UTexas Austin
1991-1993	Postdoc, Skidaway Institute. of Oceanography (Advisor: Richard Jahnke)

**III. Honors and Awards**

2017	Judy Curry Award, Georgia Tech
2015	Faculty Award for Academic Outreach, Georgia Tech
2014	Paul A. Duke GIFT Action Plan Achievement Mentor Award
2009	Sigma Xi – Best Faculty Paper, Georgia Tech
1999	University of Texas at Austin - College of Natural Sciences Teaching Excellence Award
1991	Philip M. Orville Prize for Outstanding Research and Scholarship (Yale University)
1989	William E. Ford Prize in Mineralogy (Yale University)
1988	Alan M. Bateman Fellowship (Yale University)

**IV. Research, Scholarship and Creative Activities**

h-index=36, 5402 Citations, Google Scholar

Peer-reviewed publications, 67 published, 1 in review, 1 in preparation

\*next to item indicates work done at Georgia Tech

#indicates corresponding author

boldface indicates student or postdoctoral co-authors

**A. Published Books, Book Chapters, and Edited Volumes**

**A1. Books** No data

**A2. Refereed Book Chapters**

1. Berner, R.A., Ruttenger, K.C., **Ingall, E.D.** and Rao, J. 1993. The nature of phosphorus burial in modern marine sediments. In: R. Wollast et al. (ed.), Interactions of C, N, P and S. Biogeochemical Cycles and Global Change, pp. 366-378. Springer-Verlag.

**A3. Edited Volumes** No data

## B. Refereed Publications and Submitted Articles

### B1. Published and Accepted Journal Articles

#### ORIGINAL PAPERS

- 68\*. **Castorina, E., Ingall, E.D.**, Morton, P.L., Tavakoli, D.A., Lai, B. Zinc K-edge XANES spectroscopy of mineral and organic standards. 2019. In Press Journal of Synchrotron Radiation
- 67\*. **Ingall, E.D.**, Feng, Y., **Longo, A.F.**, Lai, B., Shelley, R.U., Landing, W.M., Morton, P.L., Nenes, A., Mihalopoulos, N., Violaki, K., Gao, Y., Sahai, S., **Castorina, E.**, 2018. Enhanced Iron Solubility at Low pH in Global Aerosols. *Atmosphere* 9, 201. doi:10.3390/atmos9050201
- 66\*. Huang, R.X., Zhang, B., Saad, E.M., **Ingall, E.D.**, Tang, Y.Z. 2018. Speciation evolution of zinc and copper during pyrolysis and hydrothermal carbonization treatments of sewage sludges. *Water Res.* 132, 260-269, doi.org/10.1016/j.watres.2018.01.009.
- 65\*. Glass, J.B., Chen, S., Dawson, K.S., Horton, D.R., Vogt, S., **Ingall E.D.**, Twining, B.S., Orphan, V.J. 2017. Trace metal imaging of sulfate-reducing bacteria and methanogenic archaea at single-cell resolution by synchrotron X-ray fluorescence imaging. *Geomicrobiology J.* 35: 81-89. doi.org/10.1080/01490451.2017.1321068.
- 64\*. Fassbender, A.J, Palevsky, H.I., Martz, T.R., Ingalls, A.E., Gledhill, M., Fawcett, S.E., Brandes, J.A., Aluwihare, L.I. and the participants of COME ABOARD. Perspectives on Chemical Oceanography in the 21st century: Participants of the COME ABOARD Meeting examine aspects of the field in the context of 40 years of DISCO. *Marine Chemistry* 196, 181-190. doi.org/10.1016/j.marchem.2017.09.002
- 63\*. Bell, D.W., Pellechia, P., **Chambers, L.R., Longo, A.F., McCabe, K.M., Ingall, E.D.**, and Benitez-Nelson, C.R. 2017. Isolation and molecular characterization of dissolved organic phosphorus using electro dialysis-reverse osmosis and solution <sup>31</sup>P-NMR. *Limnology and Oceanography Methods* 10.1002/lom3.10171
- 62\*. Yager, P.L., Sherrell, R.M., Stammerjohn, S.E., Ducklow, H.W., Schofield, O.M.E., **Ingall, E.D.**, Wilson, S.E., Lowry, K.E., Williams, C.M., Riemann, L., Bertilsson, S., Alderkamp, A.C., Dinasquet, J. Logares, R., Richert, I., Sipler, R.E., Melara, A.J., Mu, L., Newstead, R.G., Post, A.F., Swalethorp, R. and van Dijken, G.L. 2016. A carbon budget for the Amundsen Sea Polynya, Antarctica; estimating net community production and export in a highly productive polar ecosystem. *Elem. Sci. Anth.* 4(1): 000140. doi: 10.12952/journal.elementa.000140.
- 61\*. **Chambers, L.R., Ingall#, E.D., Saad, E.M., Longo, A.F., Takeuchi, M.**, Tang, Y., Benitez-Nelson, C., Haley, S.T, Dyhrman, S.T., Brandes, J., Stubbins, A. 2016. Enhanced Dissolved Organic Matter Recovery from Saltwater Samples with Electro dialysis. *Aquatic Geochemistry* 22, 555–572. DOI 10.1007/s10498-016-9306-2.

- 60\*. **Diaz, J.M.**, Bjorkman, K.M., Haley, S.T., **Ingall, E.D.**, Karl, D.M., **Longo, A.F.**, Dyhrman, S.T., 2016. Polyphosphate dynamics at Station ALOHA, North Pacific subtropical gyre. *Limnology and Oceanography* 61, 227-239.
- 59\*. **Longo, A.F.**, Feng, Y., Lai, B., Landing, W.M., Shelley, R.U., Nenes, A., Mihalopoulos, N., Violaki, K., **Ingall#, E.D.**, 2016. Influence of Atmospheric Processes on the Solubility and Composition of Iron in Saharan Dust. *Environmental Science & Technology* 50, 6912-6920. 10.1021/acs.est.6b02605
- 58\*. Dale, A.W., Boyle, R.A., Lenton, T.M., **Ingall, E.D.**, Wallmann, K., 2016. A model for microbial phosphorus cycling in bioturbated marine sediments: Significance for phosphorus burial in the early Paleozoic. *Geochimica Et Cosmochimica Acta* 189, 251-268.
- 57\*. **Longo, A.F.**, Vine, D.J., **King, L.E.**, Oakes, M., Weber, R.J., Huey, L.G., Russell, A.G., **Ingall#, E.D.** 2016. Composition and oxidation state of sulfur in atmospheric particulate matter. *Atmospheric Chemistry and Physics* 16, 13389-13398. 10.5194/acp-16-13389-2016
- 56\*. **Saad, E.M., Longo, A.F., Chambers, L.R.**, Huang, R.X., Benitez-Nelson, C., Dyhrman, S.T., Diaz, J.M., Tang, Y.Z., **Ingall#, E.D.**, 2016. Understanding marine dissolved organic matter production: Compositional insights from axenic cultures of *Thalassiosira pseudonana*. *Limnology and Oceanography* 61, 2222-2233.
- 55\*. **Diaz, J.M.**, Bjorkman, K.M., Haley, S.T., **Ingall, E.D.**, Karl, D.M., **Longo, A.F.** and Dyhrman, S.T. 2016. Polyphosphate dynamics at Station ALOHA, North Pacific subtropical gyre. *Limnol. Oceanogr.* 61:2016, 227–239 doi: 10.1002/lno.10206.
- 54\*. Schoepfer, S.D., Shen, J., Tyson, R.V., **Ingall, E.** and Algeo, T.J. 2015. Total organic carbon, organic phosphorus and biogenic barium fluxes as proxies for marine primary productivity and export flux. *Earth Science Reviews* 149, 23-52. DOI 10.1016/j.earscirev.2014.08.017.
- 53\*. **De Santiago, A. Longo, A.F., Ingall#, E.D., Diaz, J.M., King, L.E., Lai, B., Weber, R.J., Russell, A. and Oakes, M.** 2014. Characterization of Selenium in Ambient Aerosols and Primary Emission Sources: *Environmental Science & Technology*. DOI: 10.1021/es500379y.
- 52\*. **Longo, A.F., Ingall#, E.D., Diaz, J.M., Oakes, M., King, L.E., Nenes, A., Mihalopoulos, M., Violaki, K., Avila, A., Benitez-Nelson, C.R. Brandes, J.A., McNulty, I., and Vine, D.J.** 2014. P-NEXFS Analysis of Aerosol Phosphorus Delivered to the Mediterranean Sea. *Geophysical Research Letters*. DOI: 10.1002/2014GL060555.
- 51\*. **Ingall#, E.D., Diaz, J.M., Longo, A.F., Oakes, M., Finney, L., Vogt, S., Lai, B., Yager, P.L., Twining, B.S., and Brandes, J.A.** 2013 Role of biogenic silica in the removal of iron from Antarctic Seas. *Nature Communications* 4:1981 doi: 10.1038/ncomms2981
- 50\*. Krom, M.D., Ben David, A., **Ingall, E.D.**, Benning, L.G., Clerici, S., Bottrell, S. Davies, C., Potts, N.J., Mortimer, R.J.G. and van Rijn, J. 2014. Bacterially mediated removal of phosphorus and cycling of nitrate and sulfate in the waste stream of a zero-discharge

recirculating mariculture system. *Water Research*. doi: 10.1016/j.watres.2014.02.049.

- 49\* **Liao, J.**, Huey, L.G., Liu Z. Tanner, D.J., Cantrell, C.A., Orlando J.J., Flocke, F.M., Shepson, P.B., Weinheimer, A.J., Hall, S.R., Beine, H.J., Wang, Y., **Ingall, E.D.**, Stephens, C.R., Hornbrook, R.S., Apel, E.C, Riemer, D., Fried, A., Mauldin III, R.L., Smith, J.N., Staebler, R.M., Neuman, J.A., and Nowak, J. B. 2014. High levels of molecular chlorine in the Arctic atmosphere. *Nature Geoscience* doi: 10.1038/ngeo2046.
- 48\* **Diaz, J., Ingall, E.D., Snow, S.D.**, Benitez-Nelson, C.R., Taillefert, M. and Brandes, J.A. 2012. Potential role of inorganic polyphosphate in the cycling of phosphorus within the hypoxic water column of Effingham Inlet, British Columbia. *Global Biogeochemical Cycles* vol. 26, doi:10.1029/2011GB004226.
- 47\* **Oakes, M., Ingall, E.D.**, Lai, B., Shafer, M.M., Hays M.D., Liu, Z.G. and Weber, R.J. 2012. Iron Solubility Related to Particle Sulfur Content in Source Emission and Ambient Fine Particles. *Environmental Science & Technology* 46:6637-6644.
- 46\* **Mitchell, K.**, Mason, P.R.D., Van Cappellen, P., Johnson, T.M., Gill, B.C., Owens, J., **Diaz, J., Ingall, E.**, Reichart, G-J. and Lyons, T.W. 2012. Selenium as paleo-oceanographic proxy: A first assessment. *Geochimica et Cosmochimica Acta* 89:302-317.
- 45\* **Oakes, M.**, Weber, R.J., Lai, B., Russell, A. and **Ingall, E.D.** 2012. Characterization of iron speciation in urban and rural single particles using X-ray fluorescence measurements: investigating the relationship between speciation and fractional iron solubility. 2012. *Atmos. Chem. Phys.* 12:745-756. doi:10.5194/acp-12-745-2012.
- 44\* **Liao, J.**, Huey, L.G., Scheuer, E., Dibb, J.E., Stickel, R.E., Tanner, D.J., Neuman, J.A., Nowak, J.B., Choi, S., Wang, Y., Joiner, J., Salawitch, R.J., Canty, T., Weinheimer, A.J., Shetter, R.E., Fried, A., Brune, W., Anderson, B., **Zhang, X.**, Chen, G., Crawford, J., **Hecobian, A.** and **Ingall, E.D.** 2012. Characterization of soluble bromide measurements and a case study of BrO observations during ARCTAS. *Atmospheric Chemistry and Physics* 12:1327-1338. doi:10.5194/acp-12-1327-2012.
- 43\* **Rastogi, N., Zhang, X.**, Edgerton, E.S., **Ingall, E.** and Weber, R.J. 2011. Filterable Water-Soluble Organic Nitrogen in Fine Particles over the Southeastern USA During Summer. *Atmos. Environ.* doi:10.1016/j.atmosenv.2011.07.045.
- 42\* **Ingall#, E.D.**, Brandes, J.A., **Diaz, J.M.**, de Jonge, M.D., Paterson, D., McNulty, I., Elliott, W.C. and Northrup, P. 2011. Phosphorus K-edge XANES spectroscopy of mineral standards. *J. of Synchrotron Radiation* 18:189-197. doi:10.1107/S0909049510045322.
- 41\* **Diaz, J.M.** and **Ingall#, E.D.** 2010. Fluorometric Quantification of Natural Inorganic Polyphosphate. *Environmental Science & Technology* 44:4665-4671.
- 40\* **Wang, X., Ingall, E.**, Lai, B. and Stack, A.G. 2010. Self-Assembled Monolayers as Templates for Heme Crystallization. *Crystal Growth and Design* 10:798–805.

- 39\*. de Jonge, M., Paterson, D., McNulty, I., Rau, C., Brandes, J.A. and **Ingall, E.** 2010. An energy and intensity monitor for X-ray absorption near-edge structure measurements, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 619:154-156. doi:10.1016/j.nima.2010.01.001.
- 38\*. **Young, C.L.** and **Ingall#, E.D.** 2010. Marine dissolved organic phosphorus composition: New insights from samples recovered using combined electro dialysis/reverse osmosis. *Aquatic Geochemistry* 16:563-574. doi:10.1007/s10498-009-9087-y.
- 37\*. **Koprivnjak, J.F.**, Pfromm, P.J., **Ingall, E.**, Vetter, T. A., Schmitt-Kopplin, P., Hertkorn, N., Frommberger, M., Knicker, H. and Perdue, E.M. 2009. Isolation and characterization of marine dissolved organic matter using the coupled reverse osmosis–electrodialysis method *Geochim. Cosmochim. Acta.* 73:4215-4231.
- 36\*. **Diaz, J., Ingall#, E.**, Vogt, S., de Jonge, M.D., Paterson, D. and Brandes, J.A. 2009. Characterization of phosphorus in organisms at sub-micron resolution using x-ray spectromicroscopy. *Limnology and Oceanography Methods* 7:42-51.
- 35\*. Gurtler, B.K, Vetter, T.A., Perdue, E.M., **Ingall, E.**, Koprivnjak, J.-F. and Pfromm, P.H. 2008. Combining reverse osmosis and pulsed electrical current electro dialysis for improved recovery of dissolved organic matter from seawater. *J. Membrane Sci.* 323:328-336.
- 34\*. **Diaz, J., Ingall#, E.**, Benitez-Nelson, C., Paterson, D., de Jonge, M.D., McNulty, I. and Brandes, J.A. 2008. Marine polyphosphate: A key player in geologic phosphorus sequestration. *Science* 320:652-655.
- 33\*. **Moore, R.H., Ingall, E.D.**, Sorooshian, A. and Nenes, A. 2008. Molar mass, surface tension, and droplet growth kinetics of marine organics from measurements of CCN activity, *Geophys. Res. Lett.*, 35:L07801, doi:10.1029/2008GL033350
- 32\*. Algeo, T.J. and **Ingall, E.** 2007. Sedimentary Corg:P ratios, paleocean ventilation, and Phanerozoic atmospheric pO<sub>2</sub>. *Palaeogeogr. Palaeoclim. Palaeoecol.* 256:130-155.
- 31\*. Vetter, T.A., Perdue, E.M., **Ingall, E.**, Koprivnjak, J.-F. and Pfromm, P. H. 2007. Combining reverse osmosis and electro dialysis for more complete recovery of dissolved organic matter from seawater. *Sep. Purification Tech.* 56:383-387.
- 30\*. Brandes, J.A., **Ingall, E.** and Paterson D. 2007. Characterization of minerals and organic phosphorus species using soft X-ray fluorescence spectromicroscopy. *Marine Chemistry* 103:250-265.

- 29\*. **Sannigrahi, P., Ingall, E.D.** and Benner, R. 2006. Organic phosphorus composition and cycling at station Aloha: Insights from  $^{31}\text{P}$  NMR spectroscopy and elemental analyses. *Geochimica et Cosmochimica Acta* 70:5868-5882.
- 28\*. **Sannigrahi, P., Sullivan, A.P., Weber, R.J. and Ingall, E.D.** 2006. Characterization of water-soluble organic carbon in urban atmospheric aerosols using solid-state  $^{13}\text{C}$  NMR spectroscopy. *Environmental Science and Technology* 40:666-672.
- 27\*. **Ingall, E.D., Kolowitz, L., Lyons, T. and Hurtgen, M.** 2005. Sediment carbon, nitrogen and phosphorus cycling in an Anoxic Fjord, Effingham Inlet, British Columbia. *American Journal of Science* 305:240-258.
- 26\*. **Sannigrahi, P. and Ingall, E.D.** 2005. Polyphosphates as a source of enhanced P fluxes in marine sediments overlain by anoxic waters: Evidence from  $^{31}\text{P}$  NMR. *Geochemical Transactions* 6:52-59.
- 25\*. **Sannigrahi, P., Ingall, E.D.** and Benner, R. 2005. Cycling of dissolved and particulate organic matter at station Aloha: Insights from  $^{13}\text{C}$  NMR spectroscopy coupled with elemental, isotopic and molecular analyses. *Deep Sea Research* 52:1429-1444.
- 24\*. **Vance-Harris, C. and Ingall, E.** 2005. Denitrification pathways and rates in the sandy sediments of the Georgia continental shelf, USA. *Geochemical Transactions* 6:12-18.
- 23\*. Suzumura, M. and **Ingall, E.D.** 2004. Distribution and dynamics of various forms of organic phosphorus in seawater: insights from field observations in the Pacific Ocean and a laboratory experiment. *Deep Sea Research* 51:1113-1130.
- 22\*. **Wilborn, U., Pyrtle, A.J., Ingall, E.D., Grantham, M.C., Smith, J. and Elliott, W.C.** 2003. Cs-137 Distribution and Geochemistry in Savannah (Georgia) Riverine, Estuarine and Marsh Environments, in *Oceans 2003 MTS/IEEE* 2921-2926.
21. **Kolowitz, L.L., Ingall, E.D.** and Benner, R. 2001. Composition and cycling of marine organic phosphorus. *Limnology and Oceanography* 46:309-320.
20. Thoman, E.S., **Ingall, E.D.**, Davis, D.A. and Arnold, C.R. 2001. A nitrogen budget for a closed, recirculating mariculture system. *Aquacultural Engineering* 24:195-211.
19. Suzumura, M and **Ingall, E.D.** 2001. Concentrations of lipid phosphorus and its abundance in dissolved and particulate organic phosphorus in coastal seawater. *Marine Chemistry* 75:141-149.
18. Hurtgen, M.T., Lyons, T.W., **Ingall, E.D.** and Cruse, A.M. 1999. Anomalous enrichments of iron monosulfide in euxinic marine sediments and the role of  $\text{H}_2\text{S}$  in iron sulfide transformation: Examples from Effingham Inlet, the Orca Basin and the Black Sea. *American Journal of Science* 299:556-588.

17. **Clark, L.L., Ingall#, E.D.** and Benner, R. 1999. Marine organic phosphorus cycling: Novel insights from nuclear magnetic resonance. *American Journal of Science* 299:724-737.
16. **Clark, L.L., Ingall#, E.D.** and Benner, R. 1998. Marine phosphorus is selectively remineralized. *Nature* 393:426.
15. **Ingall, E.** and Clark, L. 1998. Redox dependent phosphorus cycling: microbial and abiotic processes. *Mineralogical Magazine* 62A:677-678.
14. Van Cappellen, P., Viollier, E., **Roychoudhury, A., Clark, L., Ingall, E., Lowe, K.** and DiChristina, T. 1998. Biogeochemical cycles of manganese and iron at the oxic-anoxic transition of a stratified marine basin (Orca Basin, Gulf of Mexico). *Environmental Science and Technology* 32:2931-2939.
13. **Ingall, E.** and Jahnke, R. 1997. Influence of water column anoxia on the elemental fractionation of carbon and phosphorus during sediment diagenesis. *Marine Geology* 139:219-229.
12. Van Cappellen, P. and **Ingall, E.** 1997. Reply to comment of Coleman A.S., Mackenzie F.T., and Holland H.D. - Redox stabilization of the atmosphere and oceans by phosphorus-limited marine productivity. *Science* 275:406-408.
11. Van Cappellen, P. and **Ingall, E.** 1996. Redox stabilization of the atmosphere and oceans by phosphorus-limited marine productivity. *Science* 271:493-496.
10. Calvert, S.E., Bustin, R.M. and **Ingall, E.D.** 1996. Influence of water column anoxia and sediment supply on the burial and preservation of organic carbon in marine shales. *Geochimica Cosmochimica Acta.* 60:1577-1593.
9. **Ingall, E.** and Jahnke, R. 1994. Evidence for enhanced phosphorus regeneration from sediments overlain by oxygen depleted waters. *Geochimica et Cosmochimica Acta* 58:2571-2575.
8. Van Cappellen, P. and **Ingall, E.** 1994. Benthic phosphorus regeneration, net primary production, and ocean anoxia: A model of the coupled marine biogeochemical cycles of carbon and phosphorus. *Paleoceanography* 9:677-692.
7. Schroeder, P.A. and **Ingall, E.D.** 1994. A method for the determination of nitrogen in clays, with application to the burial diagenesis of shales. *J. Sediment. Res.* A64:694-697.
6. **Ingall, E.D.,** Bustin, R.M. and Van Cappellen, P.. 1993. Influence of water column anoxia on the burial and preservation of carbon and phosphorus in marine shales. *Geochimica et Cosmochimica Acta* 57:303-316.
5. **Ingall, E.D.,** Duchamp, J.C., and Zilm, K.W. 1993. <sup>31</sup>P and <sup>13</sup>C NMR characterization of organic phosphorus and carbon during aerobic decomposition of marine plankton. *ACS*

Symposium on NMR Spectroscopy in Environmental Science and Technology -Denver, CO. 186-189.

4. **Ingall, E.D.**, Schroeder, P.A and Berner, R.A. 1990. The nature of organic phosphorus in marine sediments: New insights from  $^{31}\text{P}$  NMR. *Geochimica et Cosmochimica Acta* 54:2617-2620.
3. **Ingall, E.D.**, Schroeder, P.A. and Berner, R.A. 1990. Characterization of organic phosphorus in marine sediments by  $^{31}\text{P}$  NMR. *Chemical Geology* 84:220-223.
2. **Ingall, E.D.** and Van Cappellen, P. 1990. Relation between sedimentation rate and burial of organic phosphorus and organic carbon in marine sediments. *Geochimica et Cosmochimica Acta* 54:373-386.
1. Potts, R., Shipman, P. and **Ingall, E.** 1988. Taphonomy, paleoecology and hominids of Lainyamok, Kenya. *Journal of Human Evolution* 17:597-614.

## **B2. Conference Presentation with Proceedings (Refereed)**

None

## **B3. Other refereed material**

2\*. Ingall, E.D. 2010. Phosphorus Burial. *Nature Geoscience* 8:521-522.

1\*. Ingall, E.D. 2008. Making methane. *Nature Geoscience* 7:419-420.

## **B4. Submitted Journal Articles**

1\* **Castorina, E, Ingall, E.D.**, Morton, P.L., Tavakoli D., Lai, B. 2019. Zinc K-edge XANES spectroscopy of mineral and organic standards. *Journal of Synchrotron Radiation*. In Review.

## **C. Other Publications and Creative Products**

**Ingall E.D.** Book Review - BIOGEOCHEMISTRY OF MARINE DISSOLVED ORGANIC MATTER (Second Edition) Edited by Dennis A. Hansell and Craig A. Carlson, 2014, Academic Press, Oceanography Vol.28, No.318.

## **D. Presentations**

### **D1. Invited or Keynote Presentations**

Synchrotron Based Exploration of Aerosol Phosphorus and Iron Composition: Implications for Ocean Productivity December 2016 Denver X-ray Conference (Chicago Illinois)

Nature and Dynamics of Marine Dissolved Organic Phosphorus September 2106 Rostock Germany 8<sup>th</sup> International Phosphorus Workshop (IPW8)



Synchrotron Based Exploration of Aerosol Phosphorus and Iron Composition: Implications for Ocean Productivity July 2016 Argonne National Laboratory

Aerosol Phosphorus and Iron: Insights into Solubility Controls from Synchrotron Based Spectroscopy February 2016 Stony Brook University

Role of biogenic silica in the removal of iron from the Antarctic seas February 2016 Stony Brook University

Reevaluating iron budgets: The significant role of diatoms in removing iron from Antarctic Seas Nutrient Cycling on the Modern and Ancient Earth Conference. July 2015 Leeds University.

Aerosol Phosphorus Delivered to the Mediterranean Sea: Insights from Synchrotron Based Spectroscopy. July 2015 Aerosol nutrient workshop Leeds University.

Aerosol phosphorus delivered to the Mediterranean Sea: Insights from synchrotron based spectroscopy Symposium of the Leibniz Science Campus Phosphorus Research, Rostock Germany. March 2014.

Role of diatoms in the removal of iron from Antarctic Seas Synchrotron Environmental Science VI meeting Argonne National Laboratory September 2014

Role of biogenic silica in the removal of iron from Antarctic Seas. March 2014 University of Connecticut Avery Point Marine Lab.

Role of biogenic silica in the removal of iron from Antarctic Seas. October 2014 University of Illinois Chicago.

Role of biogenic silica in the removal of iron from Antarctic Seas. Biological Applications of X-ray Fluorescence Microscopy” 2013 meeting at Northwestern University.

Exploring phosphorus transformations in natural systems using synchrotron-based XAFS spectromicroscopy. IsoPhos Meeting. 2012 Ascona, Switzerland.

Polyphosphate: A Key Player in Marine Phosphorus Cycling, (2009) University of Georgia

New Insights into Ocean Phosphorus Cycling: Science Highlights 2-ID-B & 2-ID-E (2008) Argonne National Labs.

Ocean Phosphorus Cycling: New Insights from X-ray Spectromicroscopy, (2007) University of South Carolina

Polyphosphate: a novel mechanism for transport and sequestration of marine phosphorus over geologic time (2007) Leeds University, England.

Ocean Phosphorus Cycling: New Insights from X-ray Spectromicroscopy, (2006) University of Georgia

Insights into Marine Phosphorus Geochemistry using X-ray Spectromicroscopy (2005) Argonne National Laboratory.

The role of oxygen on sediment carbon, nitrogen and phosphorus cycling: A study of Effingham Inlet, British Columbia (2005) University of Cincinnati.

Sources, Fates and Transformations of Marine Organic Matter: Insights from Spectroscopy. (2004) Georgia State University.

The Influence of Oxygen on Sedimentary Carbon, Nitrogen and Phosphorus Cycling (2004) Georgia State University.

Phosphorus Cycling in Marine Sediments: A Link Between Marine Productivity, Atmospheric Oxygen and Oceanic Redox State (2003) Institut für Meereskunde, Kiel Germany.

Sources, Fates and Transformations of Marine Organic Matter: Insights from NMR Spectroscopy. (2003) GEOMAR, Kiel Germany.

Sediment Carbon, Nitrogen and Phosphorus Cycling in an Anoxic Fjord, Effingham Inlet, British Columbia. (2003) Oregon State University.

Sources, Fates and Transformations of Marine Organic Matter: Insights from Nuclear Magnetic Resonance Spectroscopy (2003) Tulane University.

Cycling of Organic Carbon and Phosphorus in the Ocean (2002) University of Georgia, Athens – Department of Geology.

Organic Matter Diagenesis in an Anoxic Fjord, Effingham Inlet (Vancouver Island, British Columbia) (2001) University of Georgia, Athens – Department of Geology.

Forms of phosphorus in the sea: New insights from nuclear magnetic resonance (2000) University of South Carolina, Columbia – Department of Marine Science.

Forcing of atmospheric and oceanic oxygen levels by the marine phosphorus cycle. (1999) The University of Texas at Austin Symposium. Integrated Life and Earth Science Approaches to Understanding Global and Environmental Change.

Forms of phosphorus in the sea: New insights from nuclear magnetic resonance. (1999) Texas A&M University 50<sup>th</sup> Anniversary Seminar Series.

Redox stabilization of the atmosphere and oceans by phosphorus-limited marine productivity. (1999) Georgia Institute of Technology.

Redox stabilization of the atmosphere and oceans by phosphorus-limited marine productivity. (1998) Alfred Wegner Institute-Bremmerhaven, Germany.

Redox dependent phosphorus cycling: microbial and abiotic processes (1997) Northwestern University.

Burial and preservation of phosphorus in marine sediments: response to bottom water oxygenation. (1996) Fourth International Symposium on the Geochemistry of the Earth's Surface - International Association of Geochemistry and Cosmochemistry.

Views from the bottom: the phosphorus story from Peru and other places. (1996) American Chemical Society - South Texas Section Meeting.

Views from the bottom: the phosphorus story from Peru and other places. (1995) Southwest Texas State University, San Marcos - Department of Biology.

## **D2. Submitted Conference Presentations**

boldface indicates student or postdoctoral co-authors

**Ingall E.D., Brewer L.A., McDaniel, M.F.M.,** and Morton P.L. Incorporation of Zinc into Frustules of Antarctic Diatoms. AGU/ASLO Ocean Science Meeting Portland Oregon.

**McDaniel, M.F.M., Ingall, E.D., Longo, A.** Shelley, R., Landing, W.M. and Lai, B. 2018. Relation Between Atmospheric Aerosol Particle Size and Iron Chemistry. AGU/ASLO Ocean Science Meeting Portland Oregon.

**Ingall E.D., Saad E., and Chambers, L.** 2017. Composition of Dissolved Organic Phosphorus Produced by Marine Phytoplankton. Goldschmidt Geochemistry Meeting Paris France

**Ingall, E.D., Longo, A. F.,** Feng, Y., Lai, B., Landing, W., Shelley R., Nenes, A., Mihalopoulos, N., and Violaki, K. 2016 Influence of Atmospheric Processes on the Solubility and Composition of Iron in Saharan Dust. AGU Fall Meeting San Francisco.

**Ingall, E. D.; Longo , A. F.; Diaz, J. M.; King, L. E.;** Nenes, A.; Mihalopoulos, N.; Violaki, K.; Avila, A.; Benitez-Nelson, C. R.; Brandes, J. 2015. Aerosol Phosphorus Delivered to the Mediterranean Sea: Insights from Synchrotron Based Spectroscopy AGU Ocean Science Meeting Granada Spain.

**Longo, A. F.,** Feng, Y., Lai, B., Landing, W., Nenes, A., Mihalopoulos, N., Violaki, K. and **Ingall, E.D.** 2015. Key Factors Controlling the Solubility of Iron in Saharan Dust. AGU Ocean Science Meeting Granada Spain.

**Longo, A.F., Ingall, E.D., Diaz, J.M., Oakes, M., King, L.E.,** Nenes, A., Mihalopoulos, M., Violaki, K., Avila, A., Benitez-Nelson, C.R. Brandes, J.A., McNulty, I., and Vine, D.J. 2014 Using Synchrotron Techniques to Analyze Iron and Phosphorus in Aerosols Synchrotron Environmental Science VI meeting Argonne National Laboratory.

**Valett, J.G.** Ito, T., **Ingall, E.D.** 2014 The Paradox of iron Demand Due to Diatom Productivity in the Southern Ocean, AGU Ocean Science Meeting (Abstract ID: 15508) Honolulu Hawaii.

Bell, D.W., Benitez-Nelson, C.R., **Ingall, E.D.**, **Longo, A.**, **Chambers, L.R.** 2014 Dissolved Organic Phosphorus Characterization Across a Riverine/Oceanic Interface Isolated Using Electrodialysis and Reverse Osmosis., AGU Ocean Science Meeting (Abstract ID: 15525) Honolulu Hawaii.

**Ingall, E. D.** **Diaz, J. M.**, **Longo, A. F.**; Yager, P. L.; Brandes, J. A.; 2014 Role of Diatoms in the Removal of Iron From Antarctic Seas, AGU Ocean Science Meeting (Abstract ID: 16531) Honolulu Hawaii.

Yager, P. L., Sherrell, R. M., Alderkamp, A. C., **Ingall, E. D.**, Ducklow, H. W. Net Community Production and Export in the Amundsen Sea Polynya (Western Antarctica); with Comparisons to Arctic Polynyas and a Link to Climate Sensitivity, 2014 AGU Ocean Science Meeting (Abstract ID: 17007) Honolulu Hawaii

**Oakes, M.**, **Ingall, E.D.**, Shafer, M.M, Lai, B. and Weber, R.J. (2011) Insight on the Relationship between Iron Solubility and Speciation in Ambient and Source Particles. AAAR meeting Orlando Fl.

**Rastogi, N.**, Weber, R.J., **Zhang, X.**, Edgerton, E.S., **Ingall E.** (2010) Characteristics of Water-Soluble Organic Nitrogen in Ambient Aerosols over Southeast USA during AMIGAS Study. AAAS meeting.

**Oakes, M.**, Weber, R.J. **Ingall, E.D.**, Lai, B. Russell, T., (2010) Characterization of Iron in Urban Aerosols Using Synchrotron-Based Technology AMS meeting Atlanta

Sherrell, R.M., Planquette, H., **Ingall, E.D.** and **Diaz J** (2010) Trace Element Composition of Phytoplankton and Suspended Particles in the Amundsen Sea, Antarctica, and Potential Climate Change Effects. AGU Ocean Sciences Meeting Portland Oregon.

**Diaz, J.** **Ingall, E.D.**, Vogt, S., Finney, L., Sherrell, R.M., Brandes J.A. (2010) Excess Accumulation of Zinc Relative to Silicon in Southern Ocean Diatoms and Silicoflagellates. AGU Ocean Sciences Meeting Portland Oregon.

**Ingall, E.D.**, **Diaz, J.** and Sambrotto R. (2010) Impact of Polyphosphates on Marine Dissolved Phosphorus Composition and Cycling in the Amundsen Sea. AGU Ocean Sciences Meeting Portland Oregon.

**Diaz, J.M.**, **Ingall, E.D.**, Benitez-Nelson, C.R., and Brandes, J.A. (2008) A novel mechanism for marine phosphorus sequestration via burial and transformation of diatom-derived polyphosphate in sediments. Am. Soc. of Limnology and Oceanography, Orlando Meeting.

- Ingall, E.D. and Jackson, C.L.** (2008) Composition and transformation of estuarine dissolved organic matter from samples recovered using combined electro dialysis and reverse osmosis. Am. Soc. of Limnology and Oceanography, Orlando Meeting.
- Perdue, E.M., **Koprivnjak, J.F., Ingall, E.**, Vetter, T.A., Pfromm, P.H., Schmitt-Kopplin, P., Hertkorn, N., Frommberger, M., and Knicker, H. (2008) Chemical properties of marine dissolved organic matter isolated using the coupled method – insights from  $^{13}\text{C}$  NMR and FTICR mass spectrometry. Am. Soc. of Limnology and Oceanography, Orlando Meeting.
- Ingall, E D.** (2007) Insights into the composition of marine DOM from samples recovered using electro dialysis and reverse osmosis. Chemical Oceanography, Gordon Research Conference.
- Diaz, J.M., Ingall, E.D.,** and Brandes, J.A. (2007) Distribution and speciation of particulate phosphorus in organisms and marine sediments: patterns revealed by x-ray spectromicroscopy. Chemical Oceanography, Gordon Research Conference.
- Moore, R. Ingall, E.** and Nenes, A. (2007) The Impact of Surface Ocean Organics on Surface Tension, CCN Activity and Droplet Growth Kinetics of Marine Aerosol. Amer. Assoc. for Aerosol Research, Reno Meeting.
- Ingall E., Sannigrahi P., Koprivnjak J. F.,** Vetter T., Perdue E. M., and Pfromm P. 2007. New insights into the composition of marine dissolved organic matter from samples recovered using combined electro dialysis and reverse osmosis. American Society of Limnology and Oceanography. Santa Fe NM Meeting.
- Brandes J.A., **Ingall E.D.,** Paterson D., and De Jonge M. 2006. Nanoscale geochemistry of phosphorus within marine sediments. *Geochimica et Cosmochimica Acta* 70 (18): A63-A63 Suppl. S.
- Pfromm P., Vetter T., Perdue E.M., **Ingall E., and Koprivnjak J.F.** 2006. Electro dialysis/Reverse Osmosis to Recover Dissolved Organics from Seawater. American Institute of Chemical Engineers Annual Meeting San Francisco.
- Ingall, E., Sannigrahi, P.,** Brandes, J. and Paterson, D. 2006. Evidence for Mechanisms of Redox Sensitive Phosphorus Cycling in Marine Sediments from Transmission and Fluorescence X-ray Microscopy, NMR and XANES *Eos Trans. AGU*, 87(36), Ocean Sci. Meet. Suppl., Abstract OS34D-01
- Sannigrahi, P., Ingall, E.** and Benner, R. 2006. Relation Between Carbon and Phosphorus Cycling at Station Aloha as Revealed by NMR Spectroscopy and Elemental Analyses *Eos Trans. AGU*, 87(36), Ocean Sci. Meet. Suppl., Abstract OS35C-08.
- Ingall, E. and Sannigrahi, P.** 2005. Effect of bottom water oxygen on phosphorus composition and diagenesis in marine sediments. 15th Annual Goldschmidt Conference Moscow, Idaho.

- Vance-Harris C. and Ingall E.** 2005. Denitrification pathways and rates in the sandy sediments of the Georgia continental shelf. 15th Annual Goldschmidt Conference Moscow, Idaho.
- King, J.D., Vance-Harris, C., Ingall, E.,** and Taillefert, M. 2005. Evidence for coupling of manganese, nitrogen, and carbon cycling in saltmarsh sediments. American Society of Limnology and Oceanography. Spring Meeting Salt Lake City Utah.
- Chang, V., Koprivnjak, J., Ingall, E.,** Pfromm, P. and Perdue, E.M. 2004. Evaluation of Electrodialysis as Part of an Improved Method to Concentrate Dissolved Organic Matter from Seawater. Eos Trans. AGU 85, Fall Meeting Suppl. Abstract OS44B-07.
- Ingall, E.,** Brandes, J.A., Paterson, D., Northrup, P., Benitez-Nelson, C. 2004. Microscale Phosphorus Distribution and Chemistry in Marine Particles: New Insights From X-ray Absorption Near Edge Structure (XANES) Spectroscopy and X-ray Microscopy. Eos Trans. AGU 85, Fall Meeting Suppl. Abstract OS44B-08.
- Weber, R.J., **Sullivan, A., Sannigrahi, P.** and Ingall, E. 2004. Composition of atmospheric particulate matter. American Chemical Society Southeast Regional Meeting.
- Ingall, E.,** Brandes, J.A., Paterson, D., Northrup, P., Benitez-Nelson, C. 2004. Examination of marine organic matter using x-ray microscopy and phosphorus x-ray absorption near edge structure (P-XANES) spectroscopy. American Society of Limnology and Oceanography. Summer Meeting.
- Ingall, E., Sannigrahi, P.,** Benner R. and Suzumura M. 2003. Cycling of marine DOP and POP. Symposium on new approaches in organic geochemistry, Friday Harbor Laboratories.
- Sannigrahi, P., Ingall, E.D.** and Benner, R. 2003. Sources, fates and transformations of dissolved and particulate organic matter from Station Aloha: Insights from  $^{13}\text{C}$  NMR spectroscopy coupled with molecular analyses. Symposium on new approaches in organic geochemistry, Friday Harbor Laboratories.
- Wilborn, U., Pyrtle, A.J., Ingall, E.D.,** Grantham, M.C., Smith, J. and Elliott, W.C. 2003. Cs-137 Distribution and Geochemistry in Savannah (Georgia) Riverine, Estuarine and Marsh Environments, in MTS/IEEE OCEANS San Diego.
- Ingall, E.** 2003. Role of manganese in redox dependent phosphorus cycling. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.
- Kolowitz, L. and Ingall, E.** 2003. The marine phosphorus cycle: A revised budget. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.
- Sannigrahi, P. and Ingall, E.** 2003. Sources, fates and transformations of dissolved and particulate marine organic matter: Insights from  $^{13}\text{C}$  NMR spectroscopy. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.

**Vance-Harris, C.A. and Rao, A.** 2003. Denitrification in sandy sediments of the Georgia continental shelf, USA. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.

**Wilborn, U., Achudume, A. and Pyrtle, A.J.** 2003. Savannah estuary sediment geochemistry. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.

**Achudume, A., Wilborn, U. and Pyrtle, A.J.** 2003. Preliminary investigation of radionuclides and geochemistry in the Savannah (Georgia) riverine-estuarine system. American Society for Limnology & Oceanography, National Meeting, Salt Lake City Utah.

## **E. Grants and Contracts**

### **E1. Grants As Principal Investigator**

Collaborative Research: Iron Incorporation into Biogenic Silica, \$309,729 NSF Chemical Oceanography 3/17-2/20.

P-NEXFS investigation of the influence of aerosol phosphorus on marine environments, \$288,928 NSF Chemical Oceanography 2/14-7/18.

Probing the Chemistry of Atmospheric Dust Particles Using X-ray Spectromicroscopy, US Department of Energy, Argonne National Labs, ≈\$129,000.00 3/14 – 9/16.

Collaborative Research: Chemical and biological characterizations of phosphonate and polyphosphate dynamics in marine phytoplankton. \$216,484 NSF Chemical Oceanography 5/11-4/15.

Clayton County – Georgia Tech math science partnership for teacher professional learning ≈\$25,000 12/1/14-9/30/15.

Newton County – Georgia Tech math science partnership for teacher professional learning \$58,063 4/15/12-8/31/14.

A combined experimental, theoretical and computational approach to mineral growth and dissolution. \$69,180.00 U.T. Battelle (Oak Ridge National Laboratory).

Dekalb County – Georgia Tech math science partnership for teacher professional learning \$35,211 6/1/11-5/31/12.

Investigations of the role of polyphosphates in P cycling in marine sediments. Principal Investigator \$167,304 US-Israel Binational Science Foundation.

A combined experimental, theoretical and computational approach to mineral growth and dissolution. \$20,672.00 U.T. Battelle (Oak Ridge National Laboratory).

Mechanisms behind non-Redfieldian P cycling in water masses of the Southern Ocean, new insights from x-ray spectromicroscopy and electro dialysis. \$96699 09/08-08/11 NSF Polar Programs.

Investigations of the role of polyphosphates in P cycling in marine sediments. \$129,000 8/09-08/12 US-Israel Binational Science Foundation.

A Workshop for Teachers: Implementing the New High School Earth Systems Course, SCD49-2410809. \$48,889 Principal Investigator. 05/08-05/09. “No Child Left Behind” Title II Part A Higher Education Improving Teacher Quality program.

Collaborative Research: Examining redox-sensitive phosphorus speciation and remineralization using X-ray and NMR spectroscopic methods. \$215,989 Principal Investigator. 09/05-08/08. NSF Chemical Oceanography.

Collaborative Research: Electrodialysis/reverse osmosis – Development of an improved method to concentrate dissolved organic matter from seawater. \$281,485 Principal Investigator. 07/04-06/07. NSF Chemical Oceanography.

Chemical composition of marine dissolved phosphorus: Characterization by NMR and chemical analysis. NSF 4/1/98-9/30/00. \$272,732. Principal Investigator.

Burial and preservation of phosphorus in marine sediments: Response to bottom water oxygenation. NSF 11/1/94-10/30/97 \$322,407. Principal Investigator.

An automated  $^{15}\text{N}$ ,  $^{13}\text{C}$  analyzer for the University of Texas Marine Science Institute, Port Aransas Texas. NSF 1/1/96-12/31/97. \$102,988. Principal Investigator.

## **E2. Grants as co-Principal Investigator**

Oceans across space and time. NASA PI Britney Schmidt. Approximately 7 million dollars split between 15 investigators.

Signatures of the Toba Super-eruption in Borneo Stalagmites. NSF AGS Div. of Atmospheric and Geospace Sciences 7/1/15-6/30/18. \$435,467. PI is Kim Cobb.

Development of instrumentation and methods for measurement of water-soluble organic chemical compounds in ambient aerosol particles. NSF Atmospheric Chemistry. \$50,000. PI is Rodney Weber

FSML request for a gas chromatographic interface for compound specific isotopic analysis at UTMSI. NSF 10/1/00-9/30/01. \$60,000. PI is Jay Brandes.

## **E3. Grants as senior Personnel or Contributor No Data**

## **E4. Pending proposals No data**



**E5. Grants not funded past 2 years** No data

## **F. Other Scholarly and Creative Accomplishments**

**F1.** Designed and constructed a new reverse osmosis/electrodialysis system for the processing of small (1 to 5 liter) sample volumes. This new system allows for the highly efficient separation of organic molecules from high salinity matrices. Many state of the art spectroscopic methods for organic matter characterization are confounded by high salinities. This new system now makes analysis of organic matter found in high salinity environments (seawater, lab cultures, industrial waste) possible. Judging by the comments of colleagues there is commercial potential for this device.

## **G. Societal and Policy Impacts**

**G1.** Research work has led to new understanding of key nutrient elements, phosphorus, iron and nitrogen, in the ocean and mariculture systems. My research papers have been cited not only by those interested in marine nutrient cycles but also those interested in global climate, biological productivity, systems ecology, geoengineering, and the coupled global cycles of carbon, nitrogen, iron, and oxygen.

**G2.** Recent research work has focused on the development and application of synchrotron-based technologies to characterize chemistry at submicron scales. This research is yielding exciting science and new opportunities. In addition to showing how these techniques can be applied to oceanographic systems, much of my recent work has explored the composition of atmospheric aerosols. New approaches developed as part of this research have been applied to both urban pollution and ocean productivity questions. This research has been the first to directly reveal changes in redox state and composition of aerosol particles with transport.

## **H. Other Professional Activities** No data

**H1.** Member of the International Advisory Board for the Leibniz Science Campus on Phosphorus Research, Rostock Germany. This “Science Campus” is an approximately 3.5 year old consortium of a number of academic institutions in Northern Germany all focused on investigation of the essential element phosphorus, its diverse chemical compounds and its modes of action in agriculture and the environment as well as in technical and industrial processes. As a member of the international advisory council I attend meetings in Germany to advise on the development of the program and to evaluate the scientific work of the Science Campus.

**H2.** Member of International Evaluation Panel for Helmholtz Centre for Ocean Research in Kiel Germany. The evaluation of this panel determined whether funding for this large institute in Germany by the Helmholtz organization would continue.

## V. Teaching

### A. Courses Taught

			<b>CIOS Effective Score</b>	<b>Students</b>
Fall 18	EAS 2600	Earth Processes	4.5/5.0	250
Fall 18	EAS 3603	Thermodynamics of Earth Systems	4.8/5.0	21
Fall 17	EAS 3603	Thermodynamics of Earth Systems	4.8/5.0	25
Fall 17	EAS 6211	Geochemical Thermodynamics	4.3/5.0	3
Fall 16	EAS 2600	Earth Processes	4.5/5.0	263
Fall 16	EAS 3603	Thermodynamics of Earth Systems	4.8/5.0	27
Fall 15	EAS 3603	Thermodynamics of Earth Systems	4.9/5.0	25
Fall 15	EAS 6140	Thermodyn. Atmosphere & Ocean	4.9/5.0	15
Fall 14	EAS 2600	Earth Processes	4.5/5.0	207
Fall 14	EAS 3603	Thermodynamics of Earth Systems	4.7/5.0	22
Fall 13	EAS 3603	Thermodynamics of Earth Systems	4.8/5.0	26
Fall 13	EAS 6211	Geochemical Thermodynamics	4.8/5.0	8
Fall 12	EAS 2600	Earth Processes	4.5/5.0	204
Fall 11	EAS 3603	Thermodynamics of Earth Systems	4.6/5.0	36
Fall 11	EAS 2600	Earth Processes	4.0/5.0	226
Fall 10	EAS 3603	Thermodynamics of Earth Systems	4.9/5.0	32
Fall 10	EAS 2600	Earth Processes	4.3/5.0	198
Fall 09	EAS 3603	Thermodynamics of Earth Systems	4.7/5.0	32
Fall 09	EAS 6211	Geochemical Thermodynamics	4.1/5.0	8
Fall 08	EAS 2600	Earth Processes	4.2/5.0	145
Fall 08	EAS 4300	Oceanography	4.2/5.0	35
Spring 08	EAS 2600	Earth Processes	4.1/5.0	146
Fall 07	EAS 4300	Oceanography	4.4/5.0	32
Fall 06	EAS 6405	Intro. Atm. and Aqueous Chem.	4.9/5.0	8
Fall 06	EAS 6211	Geochemical Thermodynamics	4.5/5.0	8
Fall 05	EAS 6405	Intro. Atm. and Aqueous Chem.	4.3/5.0	9
Fall 05	EAS 3603	Thermodynamics of Earth Systems	4.2/5.0	17
Fall 05	EAS 6211	Geochemical Thermodynamics	4.9/5.0	6
Fall 04	EAS 8803	Intro. Atm. and Aqueous Chem.	4.1/5.0	8
Fall 04	EAS 3603	Thermodynamics of Earth Systems	4.0/5.0	12
Fall 03	EAS 6211	Geochemical Thermodynamics	5.0/5.0	3
Fall 03	EAS 8803	Intro. Atm. and Aqueous Chem.	5.0/5.0	6
Fall 02	EAS 2601	Earth Processes	4.1/5.0	48
Fall 02	EAS 6211	Geochemical Thermodynamics	5.0/5.0	2
Spring 02	EAS 6214	Aqueous Geochemistry	4.8/5.0	6
Fall 01	EAS 6211	Geochemical Thermodynamics	5.0/5.0	6
Spring 01	EAS 6211	Geochemical Thermodynamics	5.0/5.0	3

## **B. Individual Student Guidance**

### **B1. Ph.D. Students**

Erin Castorina, Ph.D candidate. Thesis: Zinc incorporation in Antarctic Diatoms

Amelia Longo, Ph.D.

Thesis Title: Synchrotron-based Spectromicroscopic Characterization of Aerosol Chemistry

Graduation Date: 5/2016

Michelle Oakes (Co-Advisor with Rodney Weber) Ph.D.

Thesis Title: Understanding the Sources and Atmospheric Processes of Soluble Iron in Aerosols Using A Synergistic Measurement Approach

Graduation Date: 12/2011

Current Employer: Tennessee Department of Environment and Conservation

Julia Diaz PhD

Thesis Title: Inorganic Polyphosphate in the Marine Environment: Field Observations and New Analytical Techniques

Graduation Date: 5/2011

Current Employer: Skidaway Institute of Oceanography

Cynthia Adia Vance-Harris (Hall), Ph.D.

Thesis Title: Insights into Marine Nitrogen Cycling in Coastal Sediments: Inputs, Losses, and Measurement Techniques

Graduation Date: 2009

Current Employer: West Chester State University

Alex Rao, (Co-Advisor with Richard Jahnke) Ph.D.

Thesis Title: Carbon and Nitrogen Cycling in Permeable Continental Shelf Sediments and Porewater Solute Exchange Across the Sediment-Water Interface

Graduation Date: 12/2006

Current Employer: Netherlands Institute of Ecology.

Poulomi Sannigrahi, Ph.D. 2005, Now a research scientist with Conoco Phillips.

Thesis Title: Composition and Cycling of Natural Organic Matter: Insights from NMR Spectroscopy

Graduation Date: 12/2005

Current Employer: Dupont Inc

Lauren Clark (Kolowith), University of Texas

Thesis Title: Composition and Cycling of Marine Organic Phosphorus

Graduation Date: 5/2000

Current Employer: University of South Carolina

### **B2. M.S. Students**

Luke Chambers, MS

Thesis Title: Enhanced Dissolved Organic Matter Recovery from Saltwater Samples with Coupled Electrodialysis and Solid Phase Extraction

Graduation Date: 12/2015

Current Employer: Waste Management Inc.

Arlette De Santiago, Environmental Engineer BS/MS program

Research Topic: Characterization of Selenium in Ambient Aerosols and Primary Emission Sources

Graduation Date: 2014

Current Employer: Brown and Caldwell

Jacquelyn Bracco, MS

Thesis Title: Calcite Growth Rates As a Function of Aqueous Calcium-to-Carbonate Ratio, Saturation Index, and Inhibitor Concentration: Insight into the Mechanism of Reaction and Poisoning by Strontium

Graduation Date: 2012

Current Employer: Wright State University Ph.D. candidate

Morgan Warren (Co-Advisor with Dr. Andrew Stack)

Thesis Title: Molecular Dynamics Simulations of Barite and Celestite Ion Pairs

Graduation Date: 8/2011

Cindy Jackson (Young), MS

Thesis Title: Marine dissolved organic phosphorus composition: insights from samples recovered using combined electro dialysis/reverse osmosis

Graduation Date: 7/2009

Current Employer: Georgia Tech

Christopher Bartley, MS

Thesis Title: A search for chemolithotrophic denitrification

Graduation Date: 6/2004

Current Employer: Environmental Scientist at Terracon

### **B3. Undergraduate Students**

Evangeline Raulston, Georgia Tech

Evelyn Chen, Georgia Tech

Elise Koepke, Georgia Tech

Mary Francis McDaniel, Georgia Tech

Lesley Brewer, Georgia Tech

Masuyuki Takeuchi, Georgia Tech

Tyler Druhot, Georgia Tech

Lindsey Morgan, Georgia Tech

Amelia Longo, Georgia Tech

Samuel Snow, Georgia Tech

Hannah Stewart, Georgia Tech

Anna Williams, Georgia Tech

Ursula Wilborn, Georgia Tech

Anthony Achudume, Georgia Tech

Hunter Oates, Georgia Tech

Vivian Chang, Georgia Tech

Jenny Van Mersbergen, Georgia Tech

Cindy Young, Georgia Tech

Kim Elkins, University of Texas

Marisa Garza, University of Texas

Vangie Tersol, University of Texas

#### **B4. Ph.D. Committees**

**Lots!**

#### **B5. Postdoctoral Fellows and Visiting Scholars**

Ashanti Johnson Pyrtle

Poulomi Sannigrahi

Kaliopé Violaki (Visiting Scholar)

Michael Krom (Visiting Scholar)

#### **C. Other Teaching Activities** No data

### **VI. Service**

#### **A. Professional Contributions**

##### **A1. Middle and High School Teacher Outreach Activities**

I have been organizing and teaching intensive short courses to middle and high school teachers from the Atlanta region since 2005. The goal of these courses is to provide an intensive (but also fun!) professional learning experience to improve Earth Science education in Georgia Schools. Hands on exercises, field trips and lesson plan development, are key components of these courses. So far, I have spent 1000 contact hours working with approximately 85 teachers over the last several years (Table 1).

Table 1. Summary of outreach courses

Year	Contact Hours	Teachers	Teacher Counties	Notes
2005	120	14	Fulton, DeKalb	4 week - Summer Workshop
2008	180	16	Fulton, Cobb, Bartow, Rockdale, Dekalb	Two 2 week Summer Workshop + 8 sessions during school years
2008-2009	80	14	DeKalb, Fulton	2 week Summer Workshop + 2 follow up sessions during school year
2010-2011	120	10	Fulton	Two 2 week Summer Workshops
2011-2012	200	22	DeKalb	Two 2 week Summer Workshops + 10 sessions during school years
2013-2014	200	22	Newton	Two 2 week Summer Workshops + 10 sessions during school years
2015-2016	100	24	Clayton	2 week Summer Workshop + 5 sessions during school year

2017-2018	160	45	Fulton	Two 2 week Summer Workshops + 4 sessions during school years
Total	1160	167		

**Overview:** During a typical workshop classroom/laboratory day we have morning discussions on a wide variety of earth science topics (see Table 2, for examples) followed by discussions led by a highly experienced K-12 teacher covering the details of standard implementation and effective teaching tips. In the afternoon, laboratory exercises reinforce the topics covered in morning discussions. In addition, to the classroom and laboratory activities several field trips are taken to expose the teachers to local earth science teaching resources and to generally widen their appreciation for earth science. Additionally, these trips provided opportunities for teachers to collect rock and fossil specimens to use as classroom materials. A key goal of the class was to provide the teachers with a wide array of teaching materials to take back to their schools. In addition to the materials collected on the field trips, teachers assembled large collections of minerals, rocks and fossils in the lab. I estimate that at least 4000 individual rock, mineral and fossil specimens have been given to teachers as part of these workshops. Teachers were also given copies of mapping software, books and equipment useful for teaching earth science. These materials can be used for many years thus providing a long-term benefit to K-12 education.

A key concern of school system administrators is that the content of these workshops directly covers Georgia Performance Standards (GPS). These standards are the basis for the all important standardized tests given to middle school students. Care was taken to make sure all topics covered addressed one or more of these standards.

**Field Trips:** Geology is a subject that is best appreciated in the field, as such; a number of field sites are visited during a typical workshop. Below is a list of some of the sites visited during these workshops over the last several years. A short video of teachers at some of the following sites can be viewed at:

[http://shadow.eas.gatech.edu/~ingall/Ellery\\_Ingalls\\_Site/Outreach.html](http://shadow.eas.gatech.edu/~ingall/Ellery_Ingalls_Site/Outreach.html)

- Tellus Museum
- Vulcan Materials Quarry (See Figure 1)
- Arabia Mountain
- Stone Mountain
- Panola Mountain USGS water monitoring site
- Local Atlanta Sites including the 16<sup>th</sup> Street Parking Deck, Tanyard Creek
- Fernbank Science Center Planetarium
- Fernbank Museum
- Raccoon Mountain Caverns
- Ringgold and Trenton Georgia Fossil collecting/sedimentary rock sites
- Cloudland Canyon and nearby fossil site
- Elberton Georgia – Quarry museum and visit to working quarry
- Lake Lanier – Floating Classroom, Drinking water treatment facility
- Gwinnett Environmental and Heritage Center, sewage treatment facility

Charlie Elliott Wildlife Center  
Conasauga River Trilobite Site  
Barite Mine near Cartersville GA (See Figure 1)  
Sandersville Kaolin Mines  
Hamburg Mill State Park  
Elachee Nature Science Center

**Project Support:** Logistical support for these workshops has been provided through CEISMC at Georgia Tech. Funding for materials and activities has been obtained through the “Leave No Child Behind” and “Race to the Top” grant programs. Meg Grantham, a research scientist, in Earth and Atmospheric Sciences, has also provided content and logistical support.

**Program Impacts:** The recent workshop given in Newton County was professionally evaluated. Comparing the Life, Physical and Earth Science groups in parallel workshops. The Earth Science group showed the greatest improvements in standardized test scores. For other past workshops, I often hear from teachers that their students are very impressed and amazed that they personally collected some of the neat fossil and rock samples used in class. At the end of the class teachers present complete lesson plans covering different elements of an earth science teaching standard. These ready to use lesson plans are collected and distributed electronically to the teachers. Additionally all other class materials including PowerPoint presentations, lab exercise documents, mini quizzes, videos and photographs are distributed to the teachers.

**A2. Georgia Intern Fellowship for Teachers** Worked closely with 2 Georgia high school teachers and four of their students as part of the Georgia Intern Fellowship for Teachers program. The students and teachers collected samples, designed experiments and performed analyses for a project intended for the Siemens Science (formerly Westinghouse) competition. I am now serving on the advisory board of this program.

**A3. Minority Student Lab Experiences** Mentored two minority students in my lab over several semesters as part of the Georgia Tech Facilitating Academic Careers in Engineering and Sciences (FACES) Program.

**A4. Research Experience for Undergraduates Hosted** a total of five undergraduate students participating in NSF sponsored research experiences for undergraduates programs. These students worked on various research projects in my lab in order to enhance their interest in choosing scientific careers. One of the student participants, Vivian Chang, wrote and presented an American Geophysical Union abstract based on her summer work.

**A5. Minority Student Mentor Mentored** students at the American Geophysical Union National Meeting and American Society for Limnology and Oceanography National Meeting as part of the Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science (MS PHD’S) program. The MS PHD’S Professional Development Program provides professional development experiences to facilitate the advancement of minorities committed to achieving outstanding Earth system science careers.

#### **A6. Grant Review Panels**

NSF Polar Programs Arctic Panel Member, 2015

NSF Polar Programs Antarctic Panel Member 2014

NSF Polar Programs Arctic Panel Member, 2012

NSF Geoscience Education Panel Member, March 2005.

NSF Chemical Oceanography Panel Member, November 2003.

NSF Coastal ocean processes and observatories: Advancing coastal research, 2002.

NSF Biocomplexity workshop - Integrated research approaches to better understand and model complexity that arises from the interaction between biological, physical and social systems, 2002.

#### **A7. Scientific Journal and Grant Reviewer**

American Chemical Society

American Journal of Science

Aquatic Geochemistry

Aquatic Microbial Ecology

Biogeochemistry

Chemical Geology

Deep-Sea Research

Eclogae Geologicae Helvetiae

Estuaries

Estuarine and Coastal Shelf Science

Geochemical Transactions

Geochimica et Cosmochimica Acta

Global Biogeochemical Cycles

Journal of the World Aquaculture Society

Limnology and Oceanography

Marine Chemistry

Marine Geology

National Science Foundation

Nature

NOAA Seagrant

Paleoceanography

US Israel Binational Science Foundation

#### **A8. Special Session Organizer**

Goldschmidt Geochemistry meeting Paris 2017, Geochemistry and geobiology of Phosphorus session

Organizing Committee – Unknown Knowns and Known Unknowns: Chemical Oceanography in a Changing World. A symposium on the future of Chemical Oceanography Feb 2009, Savannah Georgia

Oxidation-reduction reactions in marine sediments, 2005. Goldschmidt Conference, Moscow Idaho.



Geologic Record of Phosphorus Cycling, 2003. American Society for Limnology and Oceanography National Meeting, Salt Lake City, Utah.

**B. Public and Community Service** No data

**C. Institute Contributions**

**C1. Departmental Service**

Awards Committee 2018 to present  
Promotion and Tenure Committee 2018 to present  
Director of Teaching Effectiveness (DOTE) 2009 to present  
Seminar Chair 2005-2015

**C2. University System of Georgia Committee**

Board of Regents Geology/Geography Committee

**C3. Georgia Tech Committees**

Rhodes, Marshall, Fulbright and Goldwater fellowship committees 2011 to Present  
Evaluate files and conduct mock interviews

Grand Challenges Faculty Fellow. Meet with undergraduate students from this program and evaluate student projects for this program. Have students do research experiments in my lab for their projects

Past Activities:

GIFT (Georgia Intern Fellowships for Teachers) Advisory Board  
Provost's Taskforce on Defining Undergraduate Technological Education for the 21st Century  
Provost's Taskforce on Reevaluating the Academic Calendar.  
Sigma Xi Young Faculty Award Selection Committee  
Georgia Tech Sigma Xi, Committee Chair to select best paper.  
Georgia Tech Committee to select Faculty Outreach Award  
Evaluation and Ranking of NSF IGERT proposals  
Chair Search Committee