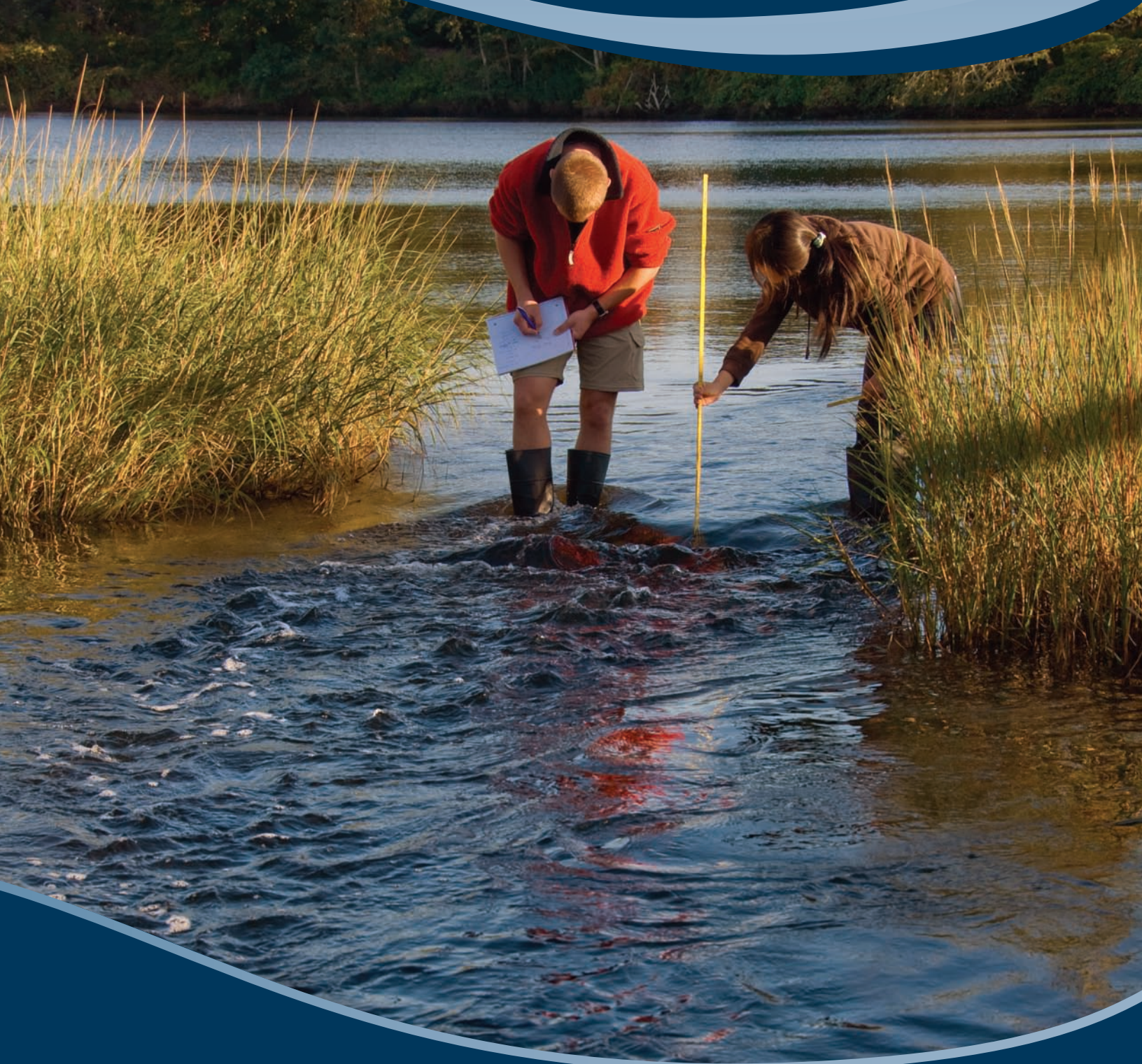


# Next wave

Recognizing Excellence in Education



2009 ACADEMIC PROGRAMS





Front cover: Wilken-Jon von Appen and Ping Zhai studying fluid flows during a class field trip to Oyster Pond, West Falmouth, Massachusetts. Photo by Tom Kleindinst, WHOI.

Above: JP student Abigail Noble drills a sea-ice core for trace metal and proteomic analyses of sea ice diatoms in front of Tent Island in McMurdo Sound, Antarctica. Photo by Mak Saito, WHOI.

## Letter from the Vice President for Academic Programs and Dean

WHOI's undergraduate, graduate and postdoctoral programs continue to turn out leaders in the ocean sciences. In 2009, Daniel Sigman, a 1997 graduate of the MIT-WHOI Joint Program and a 1990 participant in the WHOI Summer Student Fellow program and Peter Huybers, a former WHOI postdoc, were among the 24 artists, writers, and scientists receiving John D. and Catherine T. MacArthur Foundation fellowships. These fellowships, known informally as "genius grants," include a \$500,000 no-strings-attached grant over a five-year period. Daniel is currently a Professor at Princeton and Peter is currently an Assistant Professor at Harvard.

Students and postdocs are essential to WHOI's mission and bring new ideas to our research portfolio and help us move in new directions. We appreciate the support we receive from individual donors and foundations that support these fine education and training programs. Please take a moment to review in this brochure some of the MIT/WHOI Joint Program student accomplishments during 2009, as well as information on WHOI's postdoctoral and summer student fellow programs. All three of our formal education and training programs are important to the WHOI mission and bring much appreciated youthful energy and enthusiasm to the institution.

Most sincerely,



James A. Yoder  
Vice President for Academic Programs and Dean



Jim Yoder

CHRISTINE CHARETTE, WOODS HOLE OCEANOGRAPHIC INSTITUTION

# Joint Program Student Published Papers



COURTESY OF RU CHEN, WOODS HOLE OCEANOGRAPHIC INSTITUTION

Ru Chen at the helm of the sailing vessel *Corwith Cramer*, during the 2009 Jake Peirson summer cruise.

## Alexander Bahr

Bahr, A., Leonard, J. J. & Fallon, M. F. (2009). Cooperative localization for autonomous underwater vehicles. *International Journal of Robotic Research*, 28(6), 714-728.

DeRuiter, S. L., Bahr, A., Blanchet, M., Hansen, S. F., Kristensen, J. H., Madsen, P. T., Tyack, P. L. & Wahlberg, M. (2009). Acoustic behaviour of echolocating porpoises during prey capture. *Journal of Experimental Biology*, 212(19), 3100-3107.

## Maya Bhatia

Longnecker, K., Da Costa, A., Bhatia, M. & Kujawinski, E. B. (2009). Effect of carbon addition and predation on acetate-assimilating bacterial cells in groundwater. *FEMS Microbiology Ecology*, 70(3), 456-470.

## Ru Chen

Jiang, H., Farrar, T., Beardsley, R. C., Chen, R. & Chen, C. (2009). Zonal surface wind jets across the Red Sea due to mountain gap forcing along both sides of the Red Sea. *Geophysical Research Letters*, 36, L19605.

## Sophie Clayton

Bracco, A., Clayton, S. & Pasquero, C. (2009). Horizontal advection, diffusion, and plankton spectra at the sea surface. *Journal of Geophysical Research-Oceans*, 114, C02001.

## Paula Echeverri

Echeverri, P., Flynn, M. R., Winters, K. B. & Peacock, T. (2009). Low-mode internal tide generation by topography: an experimental and numerical investigation. *Journal of Fluid Mechanics*, 636, 91-108.

## Lynne J. Elkins

Elkins, L. J., Sims, K. W. W., Prytulak, J., Mattioli, N., Elliott, T., Blichert-Toft, J., Blusztajn, J., Devey, C., Mertz, D., Kelemen, P., Murrell, M. & Schilling, J.-G. (2009). ( $^{234}\text{U}/^{238}\text{U}$ ) and ( $^{230}\text{Th}/^{238}\text{U}$ ) disequilibria in fresh and altered Kolbeinsey Ridge basalts. *Geochimica et Cosmochimica Acta*, 73(13), A325-A325.

## H. Carter Esch

Esch, H. C., Sayigh, L. S., Blum, J. E. & Wells, R. S. (2009). Whistles as potential indicators of stress in bottlenose dolphins (*Tursiops truncatus*). *Journal of Mammalogy*, 90(3), 638-650.

Esch, H. C., Sayigh, L. S. & Wells, R. S. (2009). Quantifying parameters of bottlenose dolphin signature whistles. *Marine Mammal Science*, 25(4), 976-986.

Patrician, M. R., Biedron, I. S., Esch, H. C., Wenzel, F. W., Cooper, L. A., Hamilton, P. K., Glass, A. H. & Baumgartner, M. F. (2009). Evidence of a North Atlantic right whale calf (*Eubalaena glacialis*) born in northeastern US waters. *Marine Mammal Science*, 25(2), 462-477.

## Jessica Fitzsimmons

Boyle, E. A., Zhang, R. F., Fitzsimmons, J., Lee, J. & Ito, T. (2009). Iron distribution in the surface and oxygen minimum waters of the tropical North Atlantic. *Geochimica et Cosmochimica Acta*, 73(13), A153-A153.



## David R. Griffith

Griffith, D. R. (2008). Ownership and incentives: a response to Ban et al. *Frontiers in Ecology and the Environment*, 6(10), 521-522.

Griffith, D. R., Barnes, R. T. & Raymond, P. A. (2009). Inputs of fossil carbon from wastewater treatment plants to US rivers and oceans. *Environmental Science & Technology*, 43(15), 5647-5651.

## Laura Hmelo

Hmelo, L. & Van Mooy, B. A. S. (2009). Kinetic constraints on acylated homoserine lactone-based quorum sensing in marine environments. *Aquatic Microbial Ecology*, 54(2), 127-133.

## Michael Holcomb

Holcomb, M., Cohen, A. L., Gabitov, R. I. & Hutter, J. L. (2009). Compositional and morphological features of aragonite precipitated experimentally from seawater and biogenically by corals. *Geochimica et Cosmochimica Acta*, 73(14), 4166-4179.

Cohen, A. L. & Holcomb, M. (2009). Why corals care about ocean acidification: uncovering the mechanism. *Oceanography*, 22(4), 118-127.

## Michael J. Krawczynski

Krawczynski, M. J., Behn, M. D., Das, S. B. & Joughin, I. (2009). Constraints on the lake volume required for hydro-fracture through ice sheets. *Geophysical Research Letters*, 36, L10S01.

Grove, T. L. & Krawczynski, M. J. (2009). Lunar Mare volcanism: where did the magmas come from? *Elements*, 5(1), 29-34.

## Clayton Kunz

Kunz, C., Murphy, C., Singh, H., Pontbriand, C., Sohn, R. A., Singh, S., Sato, T., Roman, C., Nakamura, K., Jakuba, M., Eustice, R., Camilli, R. & Bailey, J. (2009). Toward extraplanetary under-ice exploration: robotic steps in the Arctic. *Journal of Field Robotics*, 26(4), 411-429.

Jakuba, M. V., Roman, C. N., Singh, H., Murphy, C., Kunz, C., Willis, C., Sato, T. & Sohn, R. A. (2008). Long-baseline acoustic navigation for under-ice autonomous underwater vehicle operations. *Journal of Field Robotics*, 25(11-12), 861-879.

## Naomi M. Levine

Levine, N. M., Bender, M. L. & Doney, S. C. (2009). The  $\delta^{18}\text{O}$  of dissolved  $\text{O}_2$  as a tracer of mixing and respiration in the mesopelagic ocean. *Global Biogeochemical Cycles*, 23, GB1006.

## Andrea L. Llenos

Llenos, A. L., McGuire, J. J. & Ogata, Y. (2009). Modeling seismic swarms triggered by aseismic transients. *Earth and Planetary Science Letters*, 281(1-2), 59-69.



TOM KLEINDINST, WOODS HOLE OCEANOGRAPHIC INSTITUTION

PhD students Chris Murphy and Clay Kunz modify a battery controller, which will charge the batteries and monitor the battery charge on a new SeaBED-class Autonomous Underwater Vehicle. SeaBED AUV's use Lithium Ion batteries similar to those in a laptop, but have up to 100 times more battery capacity.

# Joint Program Student Published Papers

## Kelton W. McMahon

Skomal, G. B., Zeeman, S. I., Chisholm, J. H., Summers, E. L., Walsh, H. J., McMahon, K. W. & Thorrold, S. R. (2009). Transequatorial migrations by basking sharks in the Western Atlantic Ocean. *Current Biology*, 19(12), 1019-1022.

Carroll, M. L., Johnson, B. J., Henkes, G. A., McMahon, K. W., Voronkov, A., Ambrose, W. G., Jr. & Denisenko, S. G. (2009). Bivalves as indicators of environmental variation and potential anthropogenic impacts in the southern Barents Sea. *Marine Pollution Bulletin*, 59(4-7), 193-206.

## Christian A. Miller

Miller, C. A., Peucker-Ehrenbrink, B. & Ball, L. (2009). Precise determination of rhenium isotope composition by multi-collector inductively-coupled plasma mass spectrometry. *Journal of Analytical Atomic Spectrometry*, 24(8), 1069-1078.

Fiege, K., Miller, C. A., Robinson, L. F., Figueroa, R. & Peucker-Ehrenbrink, B. (2009). Strontium isotopes in Chilean rivers: The flux of unradiogenic continental Sr to seawater. *Chemical Geology*, 268(3-4), 337-343.

## Christopher Murphy

Kunz, C., Murphy, C., Singh, H., Pontbriand, C., Sohn, R. A., Singh, S., Sato, T., Roman, C., Nakamura, K., Jakuba, M., Eustice, R., Camilli, R. & Bailey, J. (2009). Toward extraplanetary under-ice exploration: robotic steps in the Arctic. *Journal of Field Robotics*, 26(4), 411-429.

Jakuba, M. V., Roman, C. N., Singh, H., Murphy, C., Kunz, C., Willis, C., Sato, T. & Sohn, R. A. (2008). Long-baseline acoustic navigation for under-ice autonomous underwater vehicle operations. *Journal of Field Robotics*, 25(11-12), 861-879.

Christian Miller working in the PicoTrace Clean Lab on the roof of Clark Laboratory. The PicoTrace clean laboratory was built to offer scientists a contamination-free environment for analysis of ultra-trace-elements in their samples.



TOM KLEINDINST, WOODS HOLE OCEANOGRAPHIC INSTITUTION

## Elizabeth D. Orchard

Orchard, E. D., Webb, E. A. & Dyhrman, S. T. (2009). Molecular analysis of the phosphorus starvation response in *Trichodesmium* spp. *Environmental Microbiology*, 11(9), 2400-2411.

Casey, J. R., Lomas, M. W., Michelou, V. K., Dyhrman, S. T., Orchard, E. D., Ammerman, J. W. & Sylvan, J. B. (2009). Phytoplankton taxon-specific orthophosphate ( $P_i$ ) and ATP utilization in the western subtropical North Atlantic. *Aquatic Microbial Ecology*, 58(1), 31-44.

Dyhrman, S. T., Benitez-Nelson, C. R., Orchard, E. D., Haley, S. T. & Pellechia, P. J. (2009). A microbial source of phosphonates in oligotrophic marine systems. *Nature Geoscience*, 2(10), 696-699.

## Kristin C. Pangallo

Pangallo, K. C. & Reddy, C. M. (2009). Distribution patterns suggest biomagnification of halogenated 1'-methyl-1,2'-bipyrroles (MBPs). *Environmental Science & Technology*, 43(1), 122-127.

Hoh, E., Lehotay, S. J., Mastovska, K., Ngo, H. L., Vetter, W., Pangallo, K. C. & Reddy, C. M. (2009). Capabilities of direct sample introduction-comprehensive two-dimensional gas chromatography-time-of-flight mass spectrometry to analyze organic chemicals of interest in fish oils. *Environmental Science & Technology*, 43(9), 3240-3247.

Hoh, E., Lehotay, S. J., Pangallo, K. C., Mastovska, K., Ngo, H. L., Reddy, C. M. & Vetter, W. (2009). Simultaneous quantitation of multiple classes of organohalogen compounds in fish oils with direct sample introduction comprehensive two-dimensional gas chromatography and time-of-flight mass spectrometry. *Journal of Agricultural and Food Chemistry*, 57(7), 2653-2660.

## Colleen M. Petrik

Petrik, C. M., Kristiansen, T., Lough, R. G. & Davis, C. S. (2009). Prey selection by larval haddock and cod on copepods with species-specific behavior: an individual-based model analysis. *Marine Ecology-Progress Series*, 396, 123-143.

## Desiree L. Plata

Flores-Cervantes, D. X., Plata, D. L., MacFarlane, J. K., Reddy, C. M. & Gschwend, P. M. (2009). Black carbon in marine particulate organic carbon: Inputs and cycling of highly recalcitrant organic carbon in the Gulf of Maine. *Marine Chemistry*, 113(3-4), 172-181.

## Claire Willis Pontbriand

Kunz, C., Murphy, C., Singh, H., Pontbriand, C., Sohn, R. A., Singh, S., Sato, T., Roman, C., Nakamura, K., Jakuba, M., Eustice, R., Camilli, R. & Bailey, J. (2009). Toward extraplanetary under-ice exploration: robotic steps in the Arctic. *Journal of Field Robotics*, 26(4), 411-429.

Jakuba, M. V., Roman, C. N., Singh, H., Murphy, C., Kunz, C., Willis Pontbriand, C., Sato, T. & Sohn, R. A. (2008). Long-baseline acoustic navigation for under-ice autonomous underwater vehicle operations. *Journal of Field Robotics*, 25(11-12), 861-879.



PHOTO COURTESY OF KIM POPEENDORF

Kim Popendorf during the 2008 Oc443 cruise aboard the R/V *Oceanus* from Woods Hole to the Sargasso Sea and back. Kim is filtering whole seawater to analyze the intact polar membrane lipids, particularly looking at the response of the lipid composition to the change in phosphate concentration. Her broader research aim is to develop a method to use membrane phospholipid production as a measure of heterotrophic bacterial production.



## Joint Program Student Published Papers



PHOTO COURTESY EMILY ROLAND, MIT WHOI JOINT PROGRAM

While working in the Salton Trough of the San Andreas Fault in Southern California, Emily Roland holds a geophone attached to a data logging and power supply device. Geophones are small seismometers that are buried just beneath the surface, where they are coupled to the ground, and measure seismic waves traveling within the Earth. The data collected should help characterize the physical properties of the subsurface surrounding the fault, and possibly image the fault itself.

### Kimberly J. Popendorf

Vardi, A., Van Mooy, B. A. S., Fredricks, H. F., Popendorf, K. J., Ossolinski, J. E., Haramaty, L. & Bidle, K. D. (2009). Viral glycosphingolipids induce lytic infection and cell death in marine phytoplankton. *Science*, 326(5954), 861-865.

### Mark A. Rapo

Rapo, M. A., Jiang, H., Grosenbaugh, M. A. & Coombs, S. (2009). Using computational fluid dynamics to calculate the stimulus to the lateral line of a fish in still water. *Journal of Experimental Biology*, 212(10), 1494-1505.

### Eoghan Reeves

Reeves, E. & Seewald, J. S. (2009). Methanethiol: A geochemical link between carbon and sulfur in hydrothermal systems? *Geochimica et Cosmochimica Acta*, 73(13), A1079-A1079.

Seewald, J. & Reeves, E. (2009). Chemical equilibria involving aqueous carbon compounds in submarine hydrothermal systems. *Geochimica et Cosmochimica Acta*, 73(13), A1190-A1190.

### Adam R. Rivers

Rivers, A. R., Jakuba, R. W. & Webb, E. A. (2009). Iron stress genes in marine *Synechococcus* and the development of a flow cytometric iron stress assay. *Environmental Microbiology*, 11(2), 382-396.

Teske, A., Edgcomb, V., Rivers, A. R., Thompson, J. R., Gomez, A. d. V., Molyneaux, S. J. & Wirsén, C. O. (2009). A molecular and physiological survey of a diverse collection of hydrothermal vent *Thermococcus* and *Pyrococcus* isolates. *Extremophiles*, 13(6), 905-915.

### Emily Roland

Roland, E. & McGuire, J. J. (2009). Earthquake swarms on transform faults. *Geophysical Journal International*, 178(3), 1677-1690.

### Tatiana Rykova

Rykova, T., Straneo, F., Lilly, J. M. & Yashayaev, I. (2009). Irminger Current anticyclones in the Labrador Sea observed in the hydrographic record, 1990-2004. *Journal of Marine Research*, 67(3), 361-384.

### Casey Saenger

Saenger, C., Chang, P., Ji, L., Oppo, D. W. & Cohen, A. L. (2009). Tropical Atlantic climate response to low-latitude and extratropical sea-surface temperature: A Little Ice Age perspective. *Geophysical Research Letters*, 36, L11703.

### James P. Saenz

Pearson, A., Leavitt, W. D., Saenz, J. P., Summons, R. E., Tam, M. C. - & Close, H. G. (2009). Diversity of hopanoids and squalene-hopene cyclases across a tropical land-sea gradient. *Environmental Microbiology*, 11(5), 1208-1223.

Coolen, M. J. L., Saenz, J. P., Giosan, L., Trowbridge, N. Y., Dimitrov, P., Dimitrov, D. & Eglinton, T. I. (2009). DNA and lipid molecular stratigraphic records of haptophyte succession in the Black Sea during the Holocene. *Earth and Planetary Science Letters*, 284(3-4), 610-621.



### Toby Schneider

O'Gorman, P. A. & Schneider, T. (2009). The physical basis for increases in precipitation extremes in simulations of 21st-century climate change. *Proceedings of the National Academy of Sciences of the United States of America*, 106(35), 14773-14777.

O'Gorman, P. A. & Schneider, T. (2009). Scaling of precipitation extremes over a wide range of climates simulated with an idealized GCM. *Journal of Climate*, 22(21), 5676-5685.

### Katherine E. Silverthorne

Silverthorne, K. E. & Toole, J. M. (2009). Seasonal kinetic energy variability of near-inertial motions. *Journal of Physical Oceanography*, 39(4), 1035-1049.

Marshall, J., Andersson, A., Bates, N., Dewar, W., Doney, S., Edson, J., Ferrari, R., Forget, G., Fratantoni, D., Gregg, M., Joyce, T., Kelly, K., Lozier, S., Lumpkin, R., Maze, G., Palter, J., Samelson, R., Silverthorne, K., Skillingstad, E., Straneo, F., Talley, L., Thomas, L., Toole, J., Weller, R. & Climode Grp (2009). Observing the cycle of convection and restratification over the Gulf Stream system and the subtropical gyre of the North Atlantic Ocean: preliminary results from the CLIMODE field campaign. *Bulletin of the American Meteorological Society*, 90(9), 1337-1350.

### Anne W. Thompson

Frias-Lopez, J., Thompson, A., Waldbauer, J. & Chisholm, S. W. (2009). Use of stable isotope-labelled cells to identify active grazers of picocyanobacteria in ocean surface waters. *Environmental Microbiology*, 11(2), 512-525.

Tatiana Rykova preparing a CTD for deployment on an *Oceanus* CLIMODE (CLIVar MOde water Dynamics Experiment) cruise.



COURTESY OF TATIANA RYKOVA, WOODS HOLE OCEANOGRAPHIC INSTITUTION

## Joint Program Student Published Papers

### Jacob R. Waldbauer

Waldbauer, J. R., Sherman, L. S., Sumner, D. Y. & Summons, R. E. (2009). Late Archean molecular fossils from the Transvaal Supergroup record the antiquity of microbial diversity and aerobiosis. *Precambrian Research*, 169(1-4), 28-47.

Frias-Lopez, J., Thompson, A., Waldbauer, J. & Chisholm, S. W. (2009). Use of stable isotope-labelled cells to identify active grazers of picocyanobacteria in ocean surface waters. *Environmental Microbiology*, 11(2), 512-525.

### Jonathan D. Woodruff

Woodruff, J. D., Donnelly, J. P. & Okusu, A. (2009). Exploring typhoon variability over the mid-to-late Holocene: evidence of extreme coastal flooding from Kamikoshiki, Japan. *Quaternary Science Reviews*, 28(17-18), 1774-1785.

Mann, M. E., Woodruff, J. D., Donnelly, J. P. & Zhang, Z. (2009). Atlantic hurricanes and climate over the past 1,500 years. *Nature*, 460(7257), 880-U115.

Done, J., Hu, A., Farmer, E. C., Yin, J., Bates, S., Frappier, A. B., Halkides, D. J., Kilbourne, K. H., Sriver, R. & Woodruff, J. (2009). The thermohaline circulation and tropical cyclones in past, present, and future climates. *Bulletin of the American Meteorological Society*, 90(7), 1015-1017.

### Min Xu

Xu, M., Canales, J. P., Tucholke, B. E. & DuBois, D. L. (2009). Heterogeneous seismic velocity structure of the upper lithosphere at Kane oceanic core complex, Mid-Atlantic Ridge. *Geochemistry Geophysics Geosystems*, 10, Q10001.

Jon Woodruff is interested in ancient bits of grit and shell that he pulls from lagoons and marshes using hollow metal tubes, called corers. The mud cores tell stories of ancient hurricane patterns, information that could prove useful for predicting future hurricanes. Here, Jon gathers cores in Japan, with help in the field from his wife, Akiko Okusu (right), and his mother-in-law, Masako Okusu.



COURTESY OF JON WOODRUFF, WOODS HOLE OCEANOGRAPHIC INSTITUTION



**Skylar Bayer**, National Science Foundation Graduate Research Fellowship

**Michael Brosnahan**, 2009 Outstanding Student Poster, Mycotoxins/Phycotoxins Gordon Conference, New London, NH

"Reproductive barriers in *Alexandrium tamarense* species and their implications for global biogeography and bloom mitigation"

**H. Carter Esch**, North Pacific Research Board Graduate Student Research Award

"Monitoring marine mammal occurrence in the Bering Sea using passive acoustics"

**Jessica Fitzsimmons**, National Science Foundation Graduate Research Fellowship

**Michael J. Krawczynski**, Best Student Presentation - Honorable Mention, NSF MARGINS, 2008 AGU Meeting, San Francisco, CA

"Magma processing in the lower crust as recorded in mafic inclusions from Mt. Shasta, CA"

2009 GSA Dornik Award Winner for Best Student Presentation at 40th Lunar and Planetary Science Conference, TX

"Titanium oxidation state and coordination in the lunar high-titanium glass source mantle"

2009 NASA Earth and Space Science Fellowship (NESSF) Recipient

"Conditions of Early Solar System Volcanism"

**Wu-Jung Lee**, Best Student Paper - Second Prize in Acoustical Oceanography, 157th Meeting of the Acoustical Society of America, Portland, OR

"Broadband acoustic backscattering from live squid: experiment and analysis"

Outstanding Poster Presentation Award, the 5<sup>th</sup> Animal Sonar Symposium, Kyoto, Japan

"Broadband acoustic scattering from squid: implications for toothed-whale foraging"

**Kelton W. McMahon**, Best Student Paper Award, 4<sup>th</sup> International Otolith Symposium, Monterey, CA

"Stable Carbon Isotope Analysis of Amino Acids in Otolith Protein: A New Tool for Tracking Fish Movement."

Sally Richardson Best Student Paper Award, 33<sup>rd</sup> Annual Larval Fish Conference, Portland, OR

"Carbon Isotope Fractionation of Amino Acids of a Marine Fish."

**Holly V. Moeller**, National Science Foundation Graduate Research Fellowship

**Kathleen Munson**, National Science Foundation Graduate Research Fellowship

**Kimberly J. Popendorf**, Outstanding Student Poster Award, 2009 ASLO Meeting, Nice, France

"Functionally and Taxonomically Defined Planktonic Sources of Intact Polar Lipids in the Sea"

**Eoghan Reeves**, The Sherwood Chang/Eliot Kalmbach Award for Student Poster Presentation

2010 Gordon Research Conference on the Origin of Life, Galveston, TX

"Methanethiol: A Geochemical Link Between Carbon and Sulfur in Seafloor Hydrothermal Systems"



CHRIS LINDER, WOODS HOLE OCEANOGRAPHIC INSTITUTION

MIT/WHOI Joint Program graduate student Mike Krawczynski is dwarfed by exposed columns of basalt in Skaftafell National Park of Iceland. Krawczynski and two dozen colleagues visited the North Atlantic island nation in the summer of 2006 as part of the WHOI Geodynamics Program.

## 2009 Joint Program Degree Recipients

### Doctor of Philosophy

**Alexander Bahr**, Oceanographic Engineering, *Cooperative Navigation for Autonomous Underwater Vehicles*

**Kate L. Buckman**, Biological Oceanography, *Biotic and Abiotic Interactions of Deep-Sea Hydrothermal Vent-endemic Fish on the East Pacific Rise*

**Phoebe Dreux Chappell**, Chemical Oceanography, *The Relationship Between Iron and Nitrogen Fixation in *Trichodesmium* spp.*

**Paul R. Craddock**, Chemical Oceanography, *Geochemical Tracers of Processes Affecting the Formation of Seafloor Hydrothermal Fluids and Deposits in the Manus Back-Arc Basin*

**Paula Echeverri Mondragón**, Mechanical and Oceanographic Engineering, *Internal Tide Generation by Tall Ocean Ridges*

**Lynne J. Elkins**, Geochemistry, *Basalt Petrogenesis Beneath Slow and Ultraslow-Spreading Arctic Mid-Ocean Ridges*

**Sharon S. Hoffmann**, Marine Geology, *Uranium-Series Radionuclide Records of Paleooceanographic and Sedimentary Changes in the Arctic Ocean*

**Hristina G. Hristova**, Physical Oceanography, *Stability of Large-Scale Oceanic Flows and the Importance of Non-Local Effects*

Stephanie Waterman at the MIT hooding ceremony in June 2009, along with her advisor (and former JP student) Associate Scientist Steven Jayne.



MARSHA GOMES, WOODS HOLE OCEANOGRAPHIC INSTITUTION



## 2009 Joint Program Degree Recipients

TOM KLEINDINST, WOODS HOLE OCEANOGRAPHIC INSTITUTION



**Annette M. Hynes**, Biological Oceanography, *Diversity of the Marine Cyanobacterium Trichodesmium: Characterization of the Woods Hole Culture Collection and Quantification of Field Populations*

**Hyun Joe Kim**, Mechanical and Oceanographic Engineering, *Forward Sound Propagation around Seamounts: Application and Acoustic Models to the Kermit-Roosevelt and Elvis Seamounts*

**Cara E.G. LaPointe**, Mechanical and Oceanographic Engineering, *A Parallel Hypothesis Method of Autonomous Underwater Vehicle Navigation*

**Christian A. Miller**, Chemical Oceanography, *Surface-Cycling of Rhenium and Its Isotopes*

**Maxim A. Nikurashin**, Physical Oceanography, *Radiation and Dissipation of Internal Waves Generated by Geostrophic Motions Impinging on Small-Scale Topography*

**Kristin C. Pangallo**, Chemical Oceanography, *Halogenated 1'-methyl-1, 2'-bipyrroles (MBPs) in the Northwestern Atlantic*

**Desirée L. Plata**, Chemical Oceanography and Environmental Chemistry, *Carbon Nanotube Synthesis and Detection: Limiting the Environmental Impact of Novel Technologies*

**Mark A. Rapo**, Oceanographic Engineering, *CFD Study of Hydrodynamic Signal Perception by Fish Using the Lateral Line System*

**Adam R. Rivers**, Biological Oceanography, *Iron Limitation and the Role of Siderophores in Marine Synechococcus*

Front Row: Hristina Hristova, Anne Thompson, Phoebe Dreux Chappell, Desirée Plata, Lynne Elkins and Sharon Hoffmann  
Back Row: Jonathan Blythe, Adam Rivers, Christian Miller, Stephanie Waterman, Joseph Sikora III, Alex Bahr, Harold Jensen III, Cara LaPointe, Paul Craddock. This photo was taken at the 2009 WHOI graduate reception.

# 2009 Joint Program Degree Recipients



NEIL CANTIN, WOODS HOLE OCEANOGRAPHIC INSTITUTION

Casey Saenger and Assistant Scientist Ann Tarrant collect coral tissue samples as part of a project with King Abdullah University of Science and Technology (KAUST) to assess the impact of physical stress on reef health in the Red Sea. Analysis of the lipids and photosynthetic pigments in these samples will help determine the link between the coral's energy reserves, growth and ability to adapt to climate change.

**Casey P. Saenger**, Paleoceanography, *Low-Latitude Western North Atlantic Climate Variability During the Past Millennium: Insights from Proxies and Models*

**Joseph John Sikora III**, Electrical Engineering and Computer Science, *Sound Propagation around Underwater Seamounts*

**Anne W. Thompson**, Biological Oceanography, *Iron and Prochlorococcus*

**Stephanie N. Waterman**, Physical Oceanography, *Eddy-Mean Interactions in Western Boundary Current Jets*

**Jonathan D. Woodruff**, Marine Geology, *Tropical Cyclones Within the Sedimentary Record: Analyzing Overwash Deposition from Event to Millennial Timescales*

**Yu Zhang**, Physical Oceanography, *Slope/Shelf Circulation and Cross-Slope/Shelf Transport Out of a Bay Driven by Eddies from the Open Ocean*

## Master of Science

**Alexis Dumortier**, Oceanographic Engineering, *Detection, Classification and Localization of Underwater Mines Using a Virtual Time Reversal Mirror*

**Patricia Engel**, Physical Oceanography, *Spatial and Temporal Variability of Tide-Induced Salt Flux in a Partially Mixed Estuary*

**Harold F. Jensen III**, Mechanical Engineering, *Variable Buoyancy System Metric*

**Heather R. Hornick**, Oceanographic Engineering, *Environmental Analysis and Prediction of Transmission Loss in the Region of the New England Shelfbreak*

**Joseph C. Papp**, Electrical Engineering and Computer Science, *Physically Constrained Maximum Likelihood (PCML) Mode Filtering and Its Application as a Pre-Processing Method for Underwater Acoustic Communication*

**Jared Severson**, Oceanographic Engineering, *Modeling and Frequency Tracking of Marine Mammal Whistle calls*

**Shaoyu Yuan**, Physical Oceanography, *Comparison of Wind Stress Algorithms, Datasets and Oceanic Power Input*







*Joint Program students on the sailing vessel Corwith Cramer are ready to depart on the 2009 Jake Peirson summer cruise.*



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