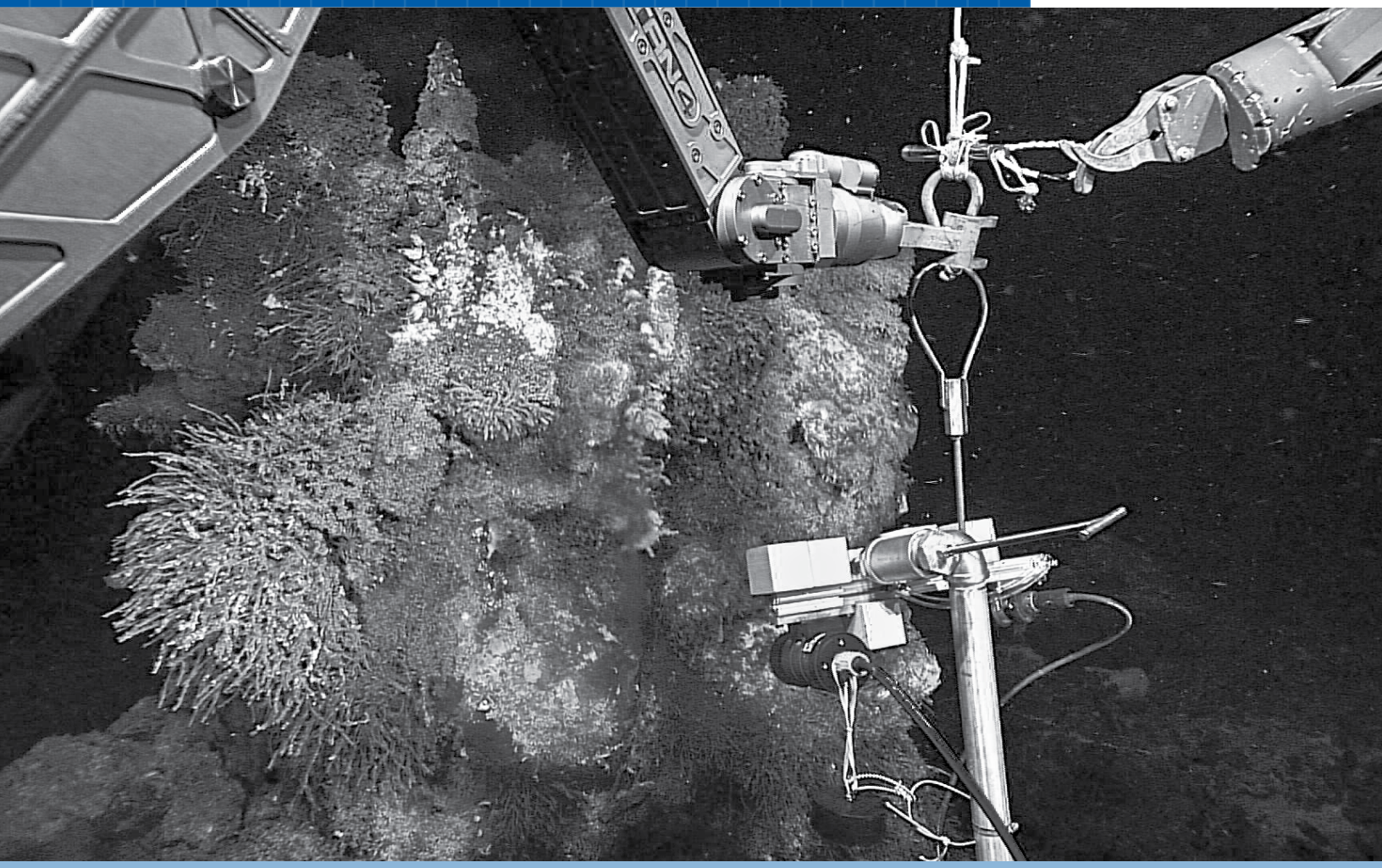
LDEO

ALUMNI AND FRIENDS NEWS

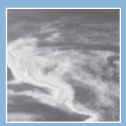
FALL 10

Issue 16



FEATURE ARTICLE

From Underwater Vents to Oil Spills: Measuring Fluid Flow at the Ocean Bottom



Lamont-Doherty Earth Observatory
COLUMBIA UNIVERSITY | EARTH INSTITUTE

Issue 16
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61 Route 9W, Palisades, NY 10964
Tel: 845-365-8850
E-mail: alumni@LDEO.columbia.edu

Director of the Observatory
G. Michael Purdy

Director for Development
Barbara Charbonnet

Development Officer
Stacey Vassallo

Communications Manager
Dove Pedlosky

Administrative Assistant and Staff Photographer
Ronnie Anderson

Editor, Dove Pedlosky

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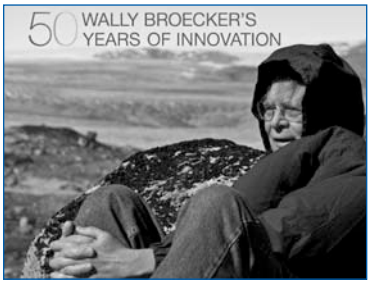
Front cover: The image shows the deployment of Timothy Crone's VentCam at a hydrothermal vent along the Juan de Fuca Ridge. Crone's camera is specifically designed to collect optical properties to analyze liquid's flow rate at these hydrothermal vents.

Bruce Gilbert

Letter from the Director



A celebration to mark Wally's 50 years as a Columbia professor. Read more on page 5.

Bruce Gilbert

An engaged kid at LDEO's Open House

Chris Walker

The Tule Desert. Read about graduate student John Templeton's fieldwork there on page 8.

Dear Friends,

As this newsletter goes to press, the Lamont campus is bustling with the usual activity that characterizes the fall semester. Of course, the summer months were eventful as well: another successful conclusion to our summer internship program; trips by our scientists to the Gulf of Mexico to study the breadth of the spill and its impact on local ecosystems (as well as innumerable other field expeditions all over the world); and, after overcoming engine control problems, the return to full operational capacity of our research vessel, the *Marcus G. Langseth*.

At the moment, researchers and staff are in the midst of assembling their exhibits for October's Open House. It is heartening to reinstate this annual tradition after we were forced to forego last year's event due to the economic downturn. Open House attracts nearly 4,000 visitors from the wider community, and it allows Lamont-Doherty scientists to share their research with school groups, grandparents, and science enthusiasts of all ages.

The eagerness and skill with which our scientists communicate their knowledge to the public should not be a surprise. The importance placed on education here has long defined the Observatory. The more than 80 PhD students in the University's Department of Earth and Environmental Sciences (DEES) resident here at Lamont-Doherty are at the very heart of the intellectual vitality of this institution. Over the past year, graduate students have accompanied scientists to conduct fieldwork in such places as Haiti, Puerto Rico, and the Antarctic. You can read one graduate student's account of his summer fieldwork on page 6. Involving students in every aspect of the research process has been a Lamont tradition and is critical to the quality of the education we strive to provide. In the National Research Council's new assessment of 140 PhD programs in the United States, LDEO/Columbia received the highest ratings of any Earth Sciences program in the country.

Once these talented PhDs graduate, they continue to channel their energy and insight to good end, as evident in this issue's profiles of alumni Brad Clement and Kevin Vranes. And I think the articles and news featured in the following pages will give some idea about the place that helped foster their interests and shape their careers.

I cannot end this letter without a few personal comments about the tragedy that was the loss of John Diebold earlier this year. He was a good friend to me, an inspiration to practically everyone he met, and an irreplaceable asset to Lamont-Doherty. His ashes were spread this fall in the eastern Pacific Ocean, where he had done so much important science. I shall miss him.

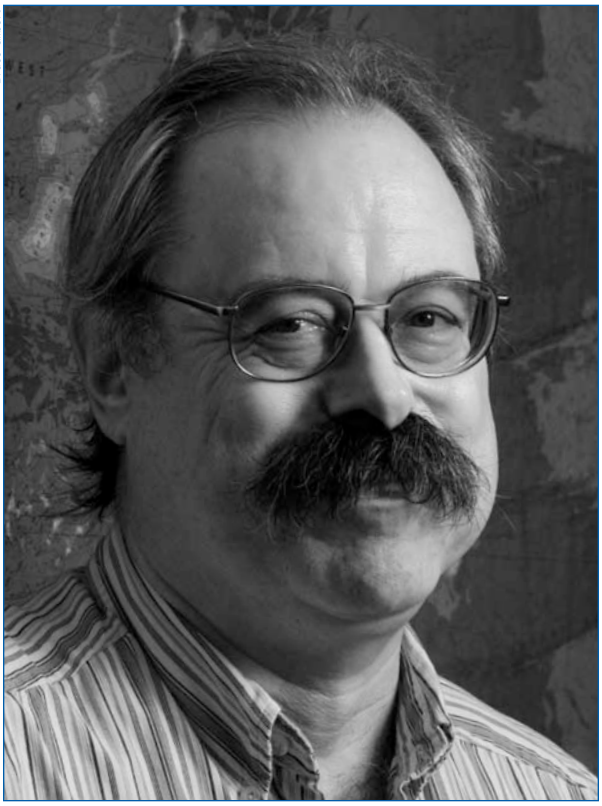
For additional news stories, please subscribe to our biannual electronic newsletter, or become a fan of LDEO on Facebook. As always we appreciate and value your interest in the Observatory.

Sincerely,

G. Michael Purdy

A Tribute to John B. Diebold

1944–2010



Bruce Gilbert

When news of John's death first broke, many of us here felt a sense of disbelief. In the days after, when John did not frequent the cafeteria at lunch or Friday afternoon's TG, his absence was palpable. It was strikingly clear just how much he had enriched daily life at Lamont-Doherty.

As a marine geophysicist, John was peerless in the area of marine seismology data acquisition, having spent decades refining techniques to study the structure of the sea floor. Director Mike Purdy writes, "On the subject of air gun array design and source signatures, John was the 'go to' in all of international academia." John was also unique in his ability to brighten the lives of those around him. He was ever eager to assist a colleague, repair a piece of machinery, or lend a sympathetic ear.

If you did not have the pleasure of knowing John personally, we'd encourage you to read his autobiographical essay, available on his website: www.LDEO.columbia.edu/~johnd. There you will also find the recipe for his award-winning chili, his tutorials on air gun mechanics, his treatise on beanbag juggling, and his musings on playing the guitar.

We'd be hard pressed to capture in words the inimitable John. But the following excerpted testimonials—just a selection from those sent in by people from around the world— help give some idea of the man he was.

G. Michael Purdy, *Director, LDEO*

In terms of practical knowledge about active marine seismology I would claim that there was no one else in the world with such breadth and understanding as John.

But the reason for his popularity was not the mountain of knowledge he so freely shared, it was because of his wonderful personality. He was warm, congenial, open, and honest—always with a smile and a joke to bring light to the darkest day.

Dale Chayes, *Lamont Research Engineer, LDEO*

John was equally proud of accomplishments you won't find on his CV, including fighting forest fires with the McCall Idaho Hot Shots; conquering his stage fright by playing his music in public in preparation for the defense of his thesis; and his time as a machinist and instrument maker in the Lamont (pre-Doherty) Machine Shop under Angelo Ludas's guidance.

In his inauguration speech, Barack Obama complimented folks like John, saying "it has been the risk-takers, the doers, the makers of things—some celebrated, but more often men and women obscure in their labor—who have carried us up the long, rugged path."

John was a doer and a maker of things in addition to being a musician, a geophysicist, and a friend of mine.

John Templeton, *PhD student, Department of Earth and Environmental Sciences, Columbia University*

I am just a first-year graduate student, and did not even work in John's Oceanography Building or field of study, but his gregarious personality and rich life stories, along with a willingness to share those stories, brought us together. . . I was delighted to get invited on the R/V *Endeavor* cruise to Haiti this spring, partly because I was told that John would be along and would likely bring his guitar.

In the short time that I have known him, he helped make Lamont-Doherty a more welcoming place for me, a place where work life and social life could mingle freely and happily, and his broad interests and experience were inspiring to a young scientist who some day would like to be as well-rounded, friendly, and wise as John Diebold.

Thanks, John, for a year of friendship.

Paul Richards, *Mellon Professor of Natural Science, Emeritus, LDEO*

John was so much better than most of us, at many of the ways we humans try to learn and communicate. He was a bit less than a year younger than I, yet found ways to manage the grad school courses in geophysical theory and advanced seismology I took with him as a student without the need to bring out—to me and the other students in those courses—the obvious fact that he knew far more about practical geophysics than I did.

In the early 1980s he came to me with a piece of paper from Columbia lawyers purporting to lay out his future with the University. I told him that regardless of this paper he had a good future with the University and with the Observatory, and that we were lucky to have him. Which, indeed, we were.

Gus Correa, *Lead Systems Analyst/ Programmer, LDEO*

Following the trend set by Galileo, who spent time in the Venice shipyards learning mechanics, who ground lenses and built telescopes to discover the moons of Jupiter, the phases of Venus, and the Sun spots, John Diebold also thought that good craftsmanship enables great science, that what your eyes can't see, your instruments may unravel.

Behind every discovery from the R/V *Ewing* and the R/V *Langseth* cruises are John D's air guns, and the sharp seismic images they enabled.

Once we were talking about cinema, a common interest we had. Specifically about the French Nouvelle Vague movement and the movie director Jean-Luc Goddard. When I misquoted Goddard a bit, John D came up with this one: "What Goddard really said was:

'Photography is truth. Cinema is truth twenty-four frames per second.' But you know what, Gus? 'Multichannel seismics is truth 500 times per second in 256 channels.'"

Missy Pinckert, *Administrative Aide, Department of Earth and Environmental Sciences, Columbia University*

I didn't know John the Scientist or John the Musician, but I did know John the Human Being. We first met at Lamont in 1982, when the multichannel seismic group was housed in the Geoscience building. At that time I knew John as a devoted father who was very involved in his children's well-being.

I probably would never have known John very well, except that he met my lovely neighbor, Glenna, who became his long-time companion. Two very nice people had found each other.

After I became a widow, there were a number of problems in maintaining my house, and John, also a Nyack neighbor, was very helpful with advice on such things as furnaces, windows, electricity, and plumbing. His last kindness to me was to get a new antenna for my radio the same week he was planning a trip to Hawaii.

Ken Kostel, *Web Science Writer/Editor, Woods Hole Oceanographic Institution*

That photo of John in the Lamont 50th anniversary book is one of my favorites—a big, burly guy (though much younger at the time) wholly engrossed in a delicate little wind-up ship model. He never lost that air of genuine inquisitiveness. He was an easy person to be around, a comfortable soul. The world seems like a harder-edged place now that he's gone, but it is certainly better for having had him pass through.

Günay Çifçi, *Professor, Dokuz Eylül University, Turkey*

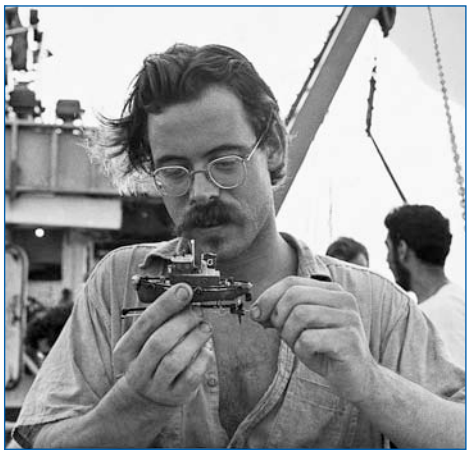
I saw how my team was working with John in harmony and good humor during the Turkish American Marmara Multichannel Cruise in the summer of 2008. When we were working on the data during our visit to Lamont in New York, we saw how he added very critical questions and input. We all understood that John was very special.

He and his son invited us to his home and made a great barbecue and played guitar with Savas and sang songs in English and Turkish. He asked the meaning of the Turkish songs with curiosity. He gave his guitar to Savas as a gift that night.

Savas Qurcay, *Research Assistant, Dokuz Eylül University, Turkey*

I have just learned the tragic news about John and I still cannot believe that. I am really so sad. He was not only a good friend but also like a father for me.

I will never forget his help. I will always remember and miss him. I wish everybody in Lamont and his son all the best. If there is anything that I can do from here, please let me know.



David Wentworth

The John B. Diebold Student Fellowship

In honor of John's many contributions to science and, especially to life at sea, Lamont-Doherty will establish the John B. Diebold Student Fellowship Fund, an endowed fund, to provide support for Columbia University students to go to sea and participate in research expeditions. Recipients of the award will be recognized as John B. Diebold Fellows.

If you would like to make a gift to the fund, please send your check, made out to Trustees of Columbia University, to Barbara Charbonnet, director for development, at PO Box 1000, Palisades, NY 10964.

The Office of Academic Affairs and Diversity


Ronnie Anderson

As this office nears completion of a second eventful year, I thought I'd update the Lamont-Doherty community on what has been an important journey. This office was created in 2008 to institutionalize the progress made by Columbia's ADVANCE program (headed by Lamont-Doherty senior scientist Robin Bell and funded by the National Science Foundation), which seeks to advance the careers of women scientists and engineers within the University. That the efforts of this office are being felt at various levels of the Observatory is clear from the magnitude of responses we've received, and by the integration of this office into key policy arenas.

Over the last decade or so, institutions across the country have sought to diversify their scientific staff. Yet women and minorities remain underrepresented in the physical sciences. Research shows mounting evidence of "leaks in the pipeline," as more and more women leave academic and research institutions before attaining senior positions.

At the Observatory more than half of all PhD graduates in the earth sciences are female (this figure was 58 percent female vs. 42 percent male in 2008–2009), and at the postdoctoral level there remains an approximate 50/50 ratio. However, this number decreases to 15 percent at the senior level! This begs the questions: Where do these women go? And why are they leaving?

A key starting point for us was to identify the specific problems Lamont-Doherty faces and to devise strategies to introduce necessary changes. For such changes to be sustainable, we understood that they should be adopted gradually, one step at a time.

One of our first tasks was to change the way search procedures for research positions were conducted. For example, we now include the assistant director for academic affairs and diversity on all search committees and attempt to announce available positions in diverse venues. The results were dramatic and far exceeded our expectations. The number of women and/or minorities within the applicant pool nearly doubled. The ultimate indicator of success here rests on two things: whether this increase in applications translates into increased hires, and whether the diversity of the applicant pool is sustained—both of which can only be assessed over time. However, current results show promise, as four of the seven most recent hires are either women or represent a racial minority.

Another step we took was to focus on the career advancement of our postdoctoral researchers and junior scientists—currently the most diverse group at Lamont-Doherty—and to develop a strategy for retaining them. A recent study by UC Berkeley indicates that the greatest leak in the academic pipeline occurs during the postdoctoral years and then again during the transition from junior to senior positions, a pattern confirmed here at Lamont-Doherty. This year's creation of the Lamont Research Professor title, which confers enhanced benefits on junior scientists, will likely improve retention rates. Recently we also devised a postdoctoral mentoring plan.

In addition, our office launched two new initiatives meant to benefit junior scientists at the Observatory. One is the Women Scientists Networking Event, where junior women meet with senior women (from both Lamont-Doherty and the outside) to gain insights on furthering their careers in a male-dominated field. The first of these was held in April 2010, and brought together nearly sixty women scientists from fourteen institutions in the Northeast. It was tremendously appreciated by all present, with the most common feedback being that it did not last long enough! Energy levels were palpably high as scientists shared their personal experiences and offered advice. This event was so well received that there were requests to make it an annual occurrence and to encourage other institutions to host similar events.

Another event, the Postdoctoral Lunch with the Director, invites postdocs to raise concerns with Director Mike Purdy in a casual setting. Many postdocs don't know one other, so the luncheon also allows them to meet colleagues from other divisions at Lamont-Doherty. Input collected at one of these sessions provided the basis for the above-mentioned postdoctoral mentoring program.

In another initiative, we decided to disseminate information comparing male and female salaries by rank at the Observatory. To spread awareness on issues of diversity (and related topics such as biases and implicit associations based on gender and race), we have started to host seminars on the subject.

With each step, we have begun to sow the seeds of change, gradually moving Lamont-Doherty into a future with far greater diversity. While the answers to the questions posed earlier are complex and do not have any "magic solutions," we believe we are slowly but surely resolving some of the issues responsible for these inequalities. We are delighted that the responsibilities of this office have grown in nature and scope in less than two years. This is indeed testament to the strong endorsement received from the LDEO community. Thank you for your support! This, combined with this office's ongoing efforts, will eventually transform the Observatory into a diverse institution and, in the process, improve the quality of the work environment for everyone.

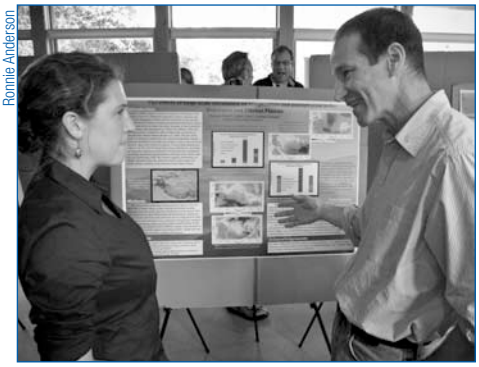
—Kuheli Dutt, Assistant Director, Office of Academic Affairs and Diversity

Lamont-Doherty Summer Intern Program 2010

Another group of bright and energetic interns populated the Observatory's campus this past summer for a ten-week undergraduate research internship. Students enrolled at universities throughout the United States worked alongside Lamont-Doherty scientists on a wide variety of projects. This summer's topics included the ice-age mega-floods of the Pacific Northwest, the relationship between climate change and precipitation in various sites around the globe, and biogas emissions in the Hudson River.

Ronnie Anderson

Ronnie Anderson



Summer interns James Fleming (l) and Hannah Perls (r) answer questions relating to their final research posters.

A Celebration for Wally Broecker's Fiftieth Anniversary as a Columbia Professor

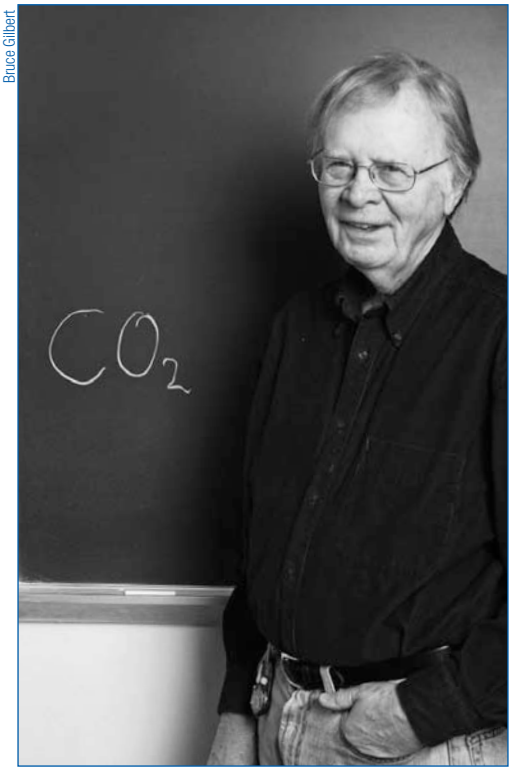
For more than half a century, Wally Broecker's pioneering climate research and his legendary reputation as a revered mentor to generations of young scientists have been a magnet attracting exceptional students and postdocs to Columbia's Lamont-Doherty Earth Observatory.

Broecker first came to Lamont in 1952 as a summer college lab assistant and stayed on under the tutelage of geochemist J. Laurence Kulp. The topics Broecker explored in his Columbia PhD thesis—questions pertaining to climate history, ocean mixing, and the mechanisms through which chemicals navigate the Earth system—are ones that engage him to this day.

On April 16, 2010, the Lamont-Doherty community celebrated the fifty years Broecker has spent teaching in the University's Department of Earth and Environmental Sciences, which he joined in 1959. The daylong event featured talks on Broecker's scientific contributions by Professors George Denton and Michael Bender, a video tribute from Al Gore, commemorative remarks by Columbia president Lee Bollinger and Earth Institute director Jeffrey Sachs, and musical performances by Tom Chapin and Richard Alley.

It should be noted that this year marks another anniversary for the man many consider to be the father of climate science. Thirty-five years ago, Broecker published a paper in *Science* titled "Climate Change: Are We on the Brink of a Pronounced Global Warming?" This was the first time the phrase "global warming" ever appeared in the scientific literature.

Bruce Gilbert



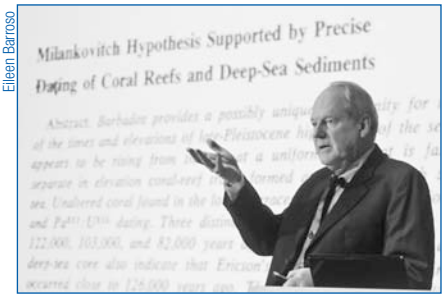
Eileen Barroso

Professor Richard Alley surprises audience members with a special song he wrote for the occasion.

Eileen Barroso

Al Gore addresses the audience by video.

Eileen Barroso



Professor George Denton speaks about Wally's climate research.

Lamont-Doherty 2010 Award Winners

Research papers written by graduate students **Danielle Sumy** and **Kaori Tsukui** were selected by the American Geophysical Union for an Outstanding Student Paper award. Sumy is writing her PhD thesis with marine geophysicist Maya Tolstoy on the relationship between tides and microearthquakes along the East Pacific Rise. Tsukui works with advisers Sidney Hemming and John Flynn (from the American Museum of Natural History) on questions relating to paleoenvironment and mammalian evolution.

The Geochemical Society awarded geochemist **Robert Anderson** the 2010 Clair C. Patterson Award, which honors a recent breakthrough in environmental geochemistry. The award committee recognized Anderson for his considerable contributions in the field of past ocean geochemistry and referred to his 2009 *Science* paper, "Wind-driven Upwelling in the Southern Ocean and the Deglacial Rise in Atmospheric CO_2," as the "culmination" of seminal work on the topic.

Professor Emeritus **James Hays** was the recipient of the 2010 Milutin Milankovic Medal for his reconstructions of past climates—in particular, work done in collaboration with John Imbrie and Nick Shackelton that proved the centrality of Earth's orbit in dictating the timing of major ice ages. Their 1976 paper, "Variations in the Earth's Orbit: Pacemaker of the Ice Ages," relied on data in the sediment record to help validate Milankov's theories of the ice ages.

The United Nations presented geochemist **Taro Takahashi** with its highest honor for environmental leadership, the Champions of the Earth award, for his research on the oceans' uptake of carbon dioxide and its implications for global warming. Achim Steiner, executive director of the UN Environment Programme, said Takahashi's work "not only underlines the threats but also the policy choices governments and investors must make to ensure the marine realm remains healthy, productive, and an ally against climate change."


Danielle Sumy


Kaori Tsukui


Robert Anderson


James Hays


Taro Takahashi

LDEO's Seventh Excellence in Mentoring Award

When Michela Biasutti and Suzana Camargo decided to nominate their colleague, Professor **Adam Sobel**, for this year's mentoring award, they had to act quickly. The deadline had crept up, and they had two days to organize a letter-writing campaign. This did not turn out to be a problem, as nearly everyone they contacted—past students or younger colleagues now positioned at universities around the world—dropped everything to write letters attesting to the many ways Sobel had helped launch their careers.

"He shares his expertise with you while still conveying curiosity and respect for your point of view, and mentors you while treating you as a peer. The man has no ego and no need for flattery," one grateful individual wrote. "My work is far enough away from his area of expertise that its publication will likely have little influence advancing his career. In short, Adam has mentored and supported me even when he derives no benefit from doing so," another stated.

Others spoke of Sobel's leadership at committee meetings, his tireless encouragement of younger students, and his thoroughness when providing feedback on papers. Some acknowledged Sobel for covering a portion of their salary during rough patches in funding.

> "Adam has been known to inspire epiphanies with his blackboard and chalk."

Marit Larson


Sobel, center, is flanked by colleagues Suzana Carmago (l) and Michela Biasutti (r).

The Truth Beneath the Surface

Lamont-Doherty Scientists Help the Media Put the Gulf Spill in Perspective

By Kim Martineau, Media Relations, Lamont-Doherty

In an editorial for Science, *Christopher Reddy, a marine chemist at the Woods Hole Oceanographic Institution, summarizes the current state of science communications. "The once linear transmission of research findings from the scientific community to the media, public, or policy makers has been transformed into a chaotic realm in which information (and disinformation) are voiced . . . not necessarily by the scientific community."*

The importance of steering the scientific conversation to preserve the integrity of the facts under debate was evident when, during what is now considered to be America's worst environmental disaster, estimates put forth by officials in industry and government often did not accord with those made by research scientists. In response, Lamont-Doherty researchers joined others of the nation's leading scientists to deliver accurate scientific information.

With the oil leak in the Gulf plugged, the story has moved on to the aftermath. But for the nearly three months it took BP to cork its gushing well, Lamont-Doherty scientists played a leading role in the news coverage, questioning official estimates of the spill's size, illuminating the geology and explaining the complexities of capping and cleaning up a spill a mile beneath the water's surface.

In the days after BPs Deepwater Horizon rig exploded on April 20, the oil company and the government estimated that 1,000 barrels a day were gushing from the well. Later, they upped their estimate to 5,000 barrels a day. For scientists examining the video footage, that number seemed absurdly low. Lamont-Doherty scientist Timothy Crone put pressure on BP and the government to substantially revise their figures (see the feature article for more details).

"No surgeon in an operating room would neglect an unvarnished assessment of a bleeding patient," Crone and his co-authors wrote in an op-ed for the *New York Times*. "In this disaster, an accurate measurement of the oil spill is no less important."

Unfolding in deep water, the spill was different from previous environmental disasters such as the 1989 *Exxon Valdez* spill off Alaska. This was the first spill where large plumes of crude oil and methane could be seen spreading undersea where its effects are largely unknown, Lamont-Doherty oceanographer Andreas Thurnherr wrote in an opinion piece for CNN.com.

Spills at the surface can be measured by satellite or infrared imaging, but plumes oozing through deep water are much trickier to detect. This point was driven home by Lamont-Doherty oceanographer Chris Zappa when asked to analyze infrared footage of the spill for CBS News. An oil slick hundreds of miles long could be seen in the pictures, but "we can't tell anything about how deep this oil patch is," he explained.

These hidden plumes of oil are toxic to marine life and deplete life-giving oxygen in the water column. "The organisms most likely to be harmed by the oil plumes are those at the base of the food chain," Lamont-Doherty oceanographer Andrew Juhl told *Newsweek*. "Most of the primary producers, such as phytoplankton, live throughout the water column. Effects on them would cascade to the larger species we care about."

The Gulf of Mexico owes its deep oil deposits to its unique geology. Over millions of years, rivers drained large swaths of the area that is now the United States, dumping enormous loads of dead organisms into the Gulf. Bounded by Florida and Cuba to the east, and the Yucatán Peninsula to the west, its waters mix very little with the Atlantic Ocean, creating oxygen-poor dead zones that stop organisms from decaying—a condition ripe for making an oil field.

"Oil and gas [are] undecayed dead organisms," Lamont-Doherty scientist Roger Anderson told *The Washington Post.* "The small foraminifera and algae that lived in the ocean and in the Mississippi River died and got swept out to sea and got buried under all the mud coming out of the Mississippi. As it got deeper and deeper, it got hotter and hotter and got cooked into oil."

Recently, President Obama announced that most of the nearly 5 million barrels of oil thought to have leaked into the Gulf had been accounted for, with much of it gone or diluted. The government's report has been greeted with optimism but also some skepticism. In the months ahead, Lamont scientists may have more to say.

In an expedition set to leave August 21, Lamont-Doherty oceanographers Alexander Chekalyuk, Andy Juhl, Ajit Subramaniam, and Andreas Thurnherr will help map the extent of the undersea oil plumes and their effect on the tiny marine plants that form the base of the food chain. The scientists will also be looking at the aftereffects of the chemical dispersants used to break up the sticky globs of oil.

In another project, scientists are examining how chemicals still floating at the surface may alter weather patterns. Lab studies show that substances floating on water surfaces can cut the normal exchange of heat and gases, potentially changing rainfall and wind patterns over land as well as the ocean chemistry. Lamont-Doherty geochemist Wade McGillis is currently off Alabama's Dauphin Island taking measurements. Whatever results they uncover should help ensure that the spill remains a central topic for public officials long after the story stops being a national headline.

Spills at the surface can be measured by satellite or infrared imaging, but plumes oozing through deep water are much trickier to detect.

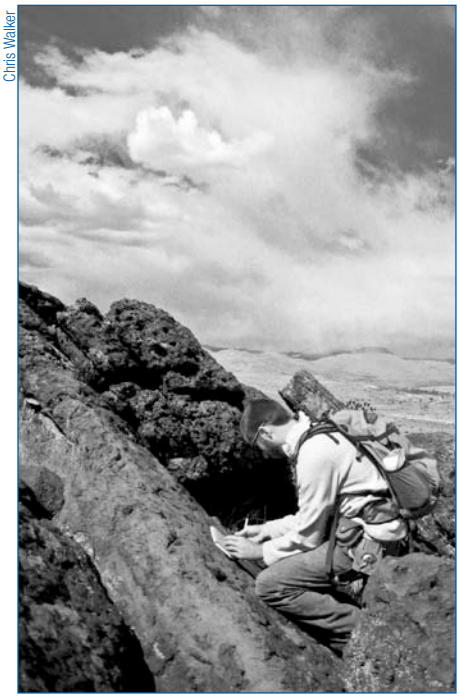
Solving Puzzles in the Tule Desert

By John Templeton, PhD '14, Department of Earth and Environmental Sciences, Columbia University

Cowboys, and Mormons on weekend pilgrimages to border casinos, appear to be the only other people who visit Nevada's Tule Desert. A few dusty geologists like myself are here because of the rocks.

The place reminds me of home: like the South of my youth, the desert is full of paradoxes.

Vast, empty reaches of desert are broken sporadically by the glaring neon lights of towns like Las Vegas, or Mesquite. The stillness of the air on sun-baked sands contrasts with the raw violence of a storm gusting across the flats. The desert's silence is worlds away from the incessant ringing of slot machines inside the nearby Virgin River Casino. Cowboys, living on the edge of an old way of life, still herd cattle through the cactus, sage, and Joshua trees much as they did a century ago. These paradoxes befuddle me, but I do not let them distract me from the puzzles I have come to decipher.


Chris Walker

The geologist's paradox is one of time: How can someone, accustomed to operating on a human time scale, make sense of events that occur in geological time? What is a day measured against a million years? Or 540 million years, when warm, shallow seas covered this land and, imperceptibly slowly, layers of limestone began to accumulate on the sea floor? Or 200 million years, when the entire western United States had risen above sea level, only to be covered by a flotilla of windswept dunes, much like the Sahara desert or the Arabian peninsula of today? Or 120 million years, when, during the Sevier Orogeny, the collision of continental plates thickened Earth's crust here by thrusting thin sheets of sandstone, limestone, and dolomite on top of one another, building mountains and creating puzzles that geologists have yet to solve?

In truth, I can only comprehend my own thirty-two years with any accuracy. My imagination allows me to stretch this, so that maybe a thousand years come roughly into focus. But millions?

In geologic time, it is late-breaking news to report that 16 million years ago Earth's crust began, curiously, to stretch and break apart here in the Basin and Range—the geological name for this landscape in the desert Southwest. I am here to report on that story and perhaps shed some light on how this is happening.

Over the last century, geologists working in this area have put together many seemingly disparate pieces of evidence about this mystery, creating an overarching narrative. Is the narrative correct? Are details missing? Have elements been overlooked or misinterpreted? In geology, new evidence can open a story to reinterpretation, or further support the accepted explanation.

A span of 540 million years is enough time to create a complex geologic picture, and the ridges, referred to as the Tule Springs Hills, rising up from this desert record episodes from the entire life history of these rocks.

It was a fairly quiet few hundred million years before the Sevier thrusting began to push up rocky, snow-capped peaks two miles skyward. At this time, the rocks that I am looking at were still buried deep below the mountains. But over a hundred million years gravity can wear a mountain range down. And so these rocks—the core of an ancient range—found themselves near the surface again, as ridges far above them eroded away.

Then, 16 million years ago, in a tectonic shift, a striking role reversal occurred: a continent, under compression for tens of millions of years due to its collision with another tectonic plate, began to pull itself apart in a process called extension. Exactly why this happened is not completely understood. Yet the topography we now see is a result of extension, not compression. In a different style of mountain building, the crust broke into distinct blocks of ranges and valleys. When the forces of extension caused the ranges to move away from each other, the blocks of valley began to drop. In a sense, these mountains were not so much thrust upward, but rather the valleys dropped down, stranding the ranges high above their flat floors.


Chris Walker


Chris Walker

What clues do I see that might help shape our understanding of this history? The dolomites, limestone, and sandstones here are extensively faulted and gently tilted, pulverized in some places and folded in others. Two weeks of kicking around these rocks, measuring fault surfaces and kinematic indicators (signs of how these rocks have moved relative to each other), and I hope to extract a clue that will provide insight into the mystery of the Basin and Range. Which faults are related to thrusting? Which to extension? And could there be another, as yet undiscovered, chapter in the history of these hills—perhaps a massive landslide?

The rocks know, but they aren't talking. Not yet, at least. Time to pull out the rock hammer and hand lens.

From Underwater Vents to Oil Spills: Measuring Fluid Flow at the Ocean Bottom

By Mohi Kumar

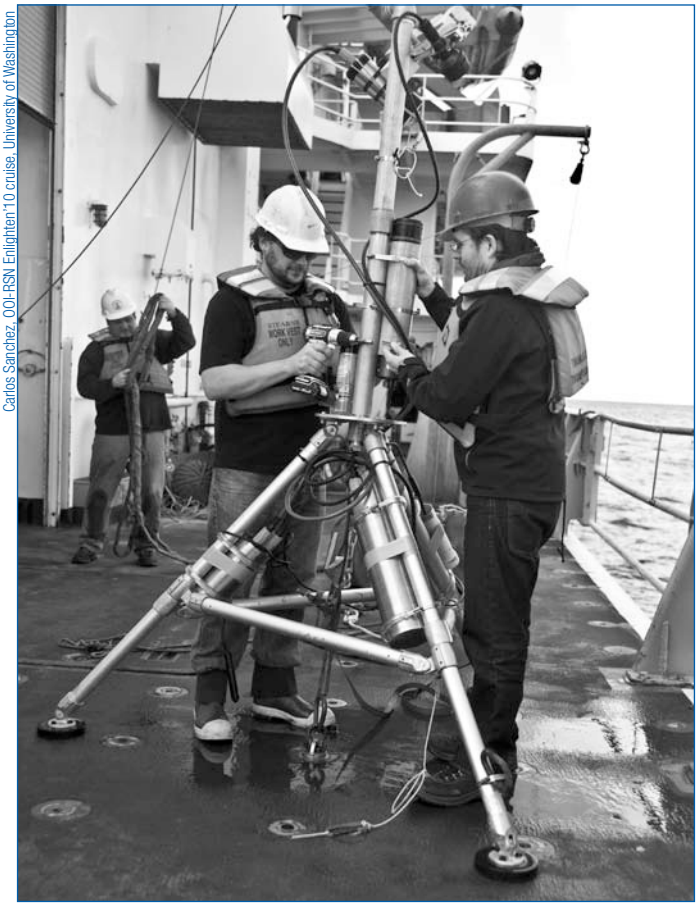
Imagine an underwater landscape where mats of microbial ooze drape around clusters of giant protruding tubes from which red worms wriggle. Crabs, colored white from the lack of sunlight, creep over large clams while octopuses swim with translucent, eyeless shrimp. Ghostly fish dart around limpet-covered giant mussels, searching for a stray crustacean to eat. Amid this scene of teeming life, tall chimneys of rock spurt hot, mineral-rich water, which rises in plumes like dark clouds of ink.

This isn't a scene from the pages of Dr. Seuss. It's life at a mid-ocean ridge, nearly 2.5 kilometers beneath the ocean's surface, where heat from the earth and chemicals from the crust support diverse biological communities.

Mid-ocean ridges encircle the globe like the seams on a baseball. They are located where oceanic plates are slowly moving apart, exposing fresh magma and building new seafloor. There, where Earth's crust is the thinnest, a network of cracks allows seawater to seep into the ground, where it is heated by the magma below. The water—which can reach temperatures greater than 400°C—escapes from the crust through hydrothermal vents, which are similar in some ways to the geysers and hot springs found on land.

Using energy derived from chemicals in the hydrothermal fluids, rock-eating bacteria thrive in these extreme environments, forming the lowest link in this ecosystem's food chain. Timothy Crone, a marine geophysicist at the Lamont-Doherty Earth Observatory, has spent the last ten years studying hydrothermal vents. "Even after years of study, there are still numerous questions about these systems we have yet to answer," Crone says. "How deep within the earth do hydrothermal waters circulate, and how hot do they get? How far away from the ridge and how far into the cooler oceanic crust can hydrothermal waters flow? How are vents connected, how often do vents turn on and shut off, and what triggers this?"

Answering these basic physical questions will give scientists the foundation they need to explore the role of underwater vents in the broader context of oceanography. Hydrothermal flow is the primary way in which new oceanic crust cools, and these vent systems transfer significant quantities of chemicals between the crust, the upper mantle, and the overlying ocean. Further, bacteria in these systems are some of the most genetically primitive organisms known. Thus, they may be the key to understanding how life on Earth first began. And since they survive without the direct input of the Sun's energy, they may hold secrets regarding the way life might survive elsewhere in the solar system.



Carlos Sanchez, OOI-RSN Enlighten10 cruise, University of Washington

Crone and University of Washington graduate student Hugo Solis prepare the VentCam tripod for deployment at Axial Seamount on the Juan de Fuca Ridge.

But studying seafloor hydrothermal vents is a challenging endeavor. "First of all, it is hard to do any kind of science at the bottom of the ocean," says Crone, who notes that throwing an instrument into 2,200 meters of water and expecting to retrieve it is often a tall order. Further, the devices used in these environments must endure harsh conditions. The vent fluids are filled with metals and minerals, which, in addition to being toxic, can coat instruments and clog pathways and moving parts. And vent waters are often very acidic, so they can corrode susceptible materials.

Surmounting these barriers is one focus of Crone's research. He has been working to develop new ways to image and analyze the properties of hydrothermal vents, and extract information that he can use to understand some of the most basic processes occurring deep below the surface of the ocean. "It is a difficult place to work, and a difficult place to get data," he says. "I think the sheer challenge of it is partly what draws people to the field."

MEASURING FLOW RATES IN HYDROTHERMAL VENTS

In 1977, scientists used DSV *Alvin*, a human-operated submersible research vessel, to study the Galapagos rift, a seafloor spreading center in the eastern Pacific Ocean. Plunging to a depth of 2.5 kilometers, *Alvin* allowed humans to observe directly what they had previously hypothesized—that hot springs dotted the crests of these mid-ocean ridges. But they were also surprised to find seafloor oases teeming with unusual life. This first discovery soon led to more, and in 1979 scientists discovered "black smokers"—the huge chimneys of hydrothermal vents.

Four of Crone's trips have included dives in the *Alvin*—two to the Juan de Fuca Ridge off the coast of Washington State in 2000 and 2005, and

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two to the East Pacific Rise in 2009. "Traveling to the seafloor and being directly under towering chimneys can provide an unparalleled sense of the scale of these systems, as well as the relationship between their components. *Alvin* is a wonderful tool for such exploration." However, Crone adds, "trips to the bottom of the ocean are expensive and rare. To better understand these systems, we need to observe them and measure them continuously over long time periods."

Even though multiple temperature and chemical measurements had been made at these vents, one critical area of research requiring long-term observation involved quantifying fluid flow rates. Without flow measurements, it is difficult to estimate the amount of heat and mass exchanged between the crust and ocean. "We really need to know how much fluid is being released—and how quickly—because this would allow us to estimate the amount of chemicals and heat the vents release over time," Crone explains.

To solve this problem, Crone began researching ways to measure flows using optical image analysis. In 2006, while a graduate student at the University of Washington, Crone examined several videos from black smokers taken in the 1980s and 1990s at the Juan de Fuca Ridge. "I noticed that when looking at the flows, I could see billows coming out and moving upward," Crone said. "By eye, I could make a fairly educated guess about how fast the fluid was coming out. The trick would be to teach a computer to do this same thing, in an automated way and with more accuracy than a human could ever achieve."

US Coast Guard

The Deepwater Horizon offshore drilling platform in flames

Based on that idea, Crone wondered if he could employ a computer to analyze such footage and track the swirls and whorls—pixel by pixel—as they rotate and deform, and then convert the resulting data into a measure of the flow rate of liquid exiting the vent.

"The fundamentals of this method sound quite simple," Crone explains. But in practice they are quite complex. "We trace the speed of moving objects with our eyes all the time, but teaching a computer how to do this? It is incredibly difficult. How our brain processes sight is very involved, and getting a computer to mimic this is no easy task."

In the laboratory, after building a computer program, Crone constructed a model of a black smoker with known flow rates. Once the computer program was tuned to accurately detect the flow rates of the simulated vents, Crone applied his method to the video data taken from actual black smokers when he joined Lamont-Doherty for a postdoctoral research fellowship in 2007.

CAUSE AND EFFECT: THE INTERSECTION OF LARGE-SCALE PHYSICAL PROCESSES

At Lamont-Doherty, Crone analyzed six weeks' worth of video taken for a few seconds every hour from a cluster of vents. The idea behind this study was to pinpoint the factors that affected the mechanics of vent systems. Cross-referencing the collected flow rates with the timings of known earthquakes along the ridge axis, which are typically very shallow and very weak—less than 1.0 in magnitude—Crone found that changes in flow rates matched episodes of earthquake activity. Further, as suspected, the rise and fall of oceanic tides changed the fluid pressures inside the vents.

"Basically, earthquakes that were imminent because of seafloor spreading are pushed over the edge by tides, which, in turn, can shift the flow of hydrothermal fluid," explains Maya Tolstoy, a marine geophysicist at Lamont-Doherty who is working with Crone on the ties between vent flow and microearthquakes on a section of the East Pacific Rise. This can reveal the vent system's permeability—the ease at which fluid flows through the crust.

In essence, "tectonic processes can completely rearrange the fluid flow pathways in and out of vents," explains Crone. "This may even divert hydrothermal fluid and energy from one place to another, or set up new pathways that serve to partially flush the system of some of the organisms that live inside the crust. So large-scale geophysical processes could have very strong effects, not just on vent systems, but on the underwater ecosystems that need hydrothermal flow to survive."

UNEXPECTED APPLICATIONS: THE DEEPWATER HORIZON OIL SPILL

On April 20, 2010, the offshore oil drilling rig Deepwater Horizon, leased by British Petroleum, caught fire, severing it from its well in the Gulf of Mexico. Immediately, the well began to jet oil into the sea.

"As soon as news stations released the first video on the oil gushing into the sea, it became clear that these flows were very similar to black smokers, only bigger," Crone remembers. As he watched, Crone suspected that his technique to measure flow rates could be utilized to estimate the rate of the gushing oil. Crone applied his method first to the TV images and then to higher-quality images. "The technique worked quite well! But it became clear immediately that my estimates were quite a bit higher than the early estimates discussed in the media."

First news estimates claimed that 1,000 barrels of oil were leaking from the well each day (BP later upped this to 5,000.) "That number persisted for over a month," Crone recalls. "Even just a very quick cursory look at the video data would have indicated that the number should have been higher." Based on his analysis, Crone estimates that in early June more than 60,000 barrels were being dumped into the Gulf daily.

As one of the first to recognize that the leaking oil could be independently measured, his work was featured on National Public Radio, Reuters, CBS News, and other media sources. Crone also co-authored an op-ed piece in *The New York Times* urging for the release of higher-resolution video so that scientists could better calculate flow rates and variability over time.

Crone's research on black smokers had revealed there were fundamental problems with early estimates of the emission rates. "He's custom-made his own method, and he's probably one of the best-positioned persons in the world to be studying the video data from the leak," says Tolstoy, who is collaborating with Crone to write up their analysis of the oil spill.

"This is a great example of basic research having an applied use," explains W. Roger Buck,

the associate director of the marine geology and geophysics division at Lamont-Doherty. Tolstoy adds, "Who would have thought that this somewhat esoteric research would be so useful for something with enormous societal implications?"

THE FUTURE: IMAGING VENT SYSTEMS IN REAL TIME

Armed with his successes in estimating the flow rate of the Deepwater Horizon spill and in showing how earthquake swarms along the ridge influence hydrothermal flow rates, Crone is ready for the next step: building a camera specifically designed to collect optical properties required for accurate video analysis.

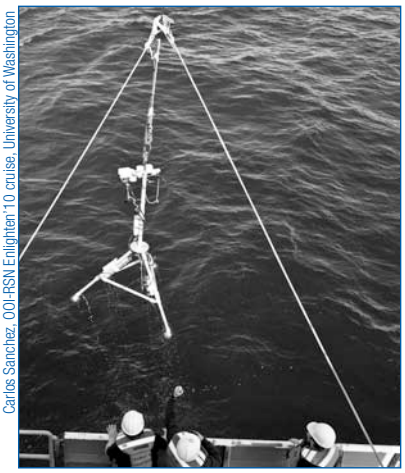
"The goal is to develop a high-resolution camera that can quickly process data for faster, more accurate measurements," says Crone. Several of these would need to be deployed on the seafloor to collect data for long stretches of time before any concrete inferences could be made about the plumbing mechanisms of hydrothermal vents.

Crone tested a prototype of his camera during an expedition to the Juan de Fuca Ridge this summer, as part of the National Science Foundation's Ocean Observatories Initiative (OOI). A component of this project, called the Regional Scale Nodes (RSN), aims to radically change the way scientists monitor the oceans. To move beyond ship expeditions, where scientists go and collect data for short periods of time, researchers who study hydrothermal vent systems are developing technologies for remote, long-term monitoring using fiber-optic cabled observatories.

The RSN involves the creation of an ocean observatory at the Juan de Fuca Ridge webbed with fiber-optic cables that would provide continuous streams of data to scientists onshore. Spearheaded by researchers at the University of Washington, scientists from around the country and in Canada are installing nodes, cables, and sensors along this active volcanic zone.

"This is several years away, but eventually I'd like to be able to connect my cameras to this network," Crone says. "Then we'd be able to study vent systems in real time."

From theoretical problems of how heat and fluid flow affect the structure of the crust, or how life on Earth first evolved, to applied problems like the potential mining of mid-ocean ridge systems, Buck stresses there is real hope that scientific problems will be illuminated through this research. We are an observatory," he says of Lamont-Doherty. "Scientists rely on new observations, and it is great to see us spearheading some of these new technologies."



Carlos Sanchez, OOI-RSN Enlighten'10 cruise, University of Washington

Crone lowers the VentCam into the water.

Carlos Sanchez, OOI-RSN Enlighten'10 cruise, University of Washington

View in the ROV *Jason* control room

Researchers who study hydrothermal vent systems are developing technologies for remote, long-term monitoring using fiber-optic cabled observatories.

Carlos Sanchez, OOI-RSN Enlighten'10 cruise

Crone aboard the R/V *Thomas G. Thompson*

David Rencher

Leaked oil in the Gulf of Mexico

Carlos Sanchez, OOI-RSN Enlighten'10 cruise, University of Washington

Crone inspecting his VentCam

Letter from Steven Cande, Alumni Board President

Dear Alumni and Friends of Lamont,

Greetings from La Jolla! I'd like to take this opportunity to report on a few events that speak to the bedrock of the Observatory.

Like many of his generation, John Diebold was drawn to the Observatory by the seductive thought of going to sea. Doc Ewing saw to it that John got his fill: the founding director sent John on a globe-circling twenty-month science odyssey aboard the R/V *Conrad*. Hooked, John went on to receive a PhD here at Lamont. I last saw John two years ago when the R/V *Langseth* stopped in San Diego. John gave me a tour of the ship, and we reminisced about how far technology had come since the "good old days" on the *Conrad*. Despite his love for the sea, John enjoyed what life on land had to offer too. He will be deeply missed.

On a lighter note, there was a wonderful celebration in April to mark Wally Broecker's fifty years as a Columbia professor. Wally has been, of course, one of Lamont's more illustrious scientists for most of those fifty years, making major contributions across a broad swath of geochemistry. I never took Wally's course when I was a student—something I later regretted—but listening to him grill speakers at Friday afternoon seminars in Lamont Hall was always enlightening and entertaining. If you were not able to make the event, you can watch much of the day's program at the video library on the Lamont-Doherty website.

I cannot close without acknowledging an old colleague, Arnold Finck, who is retiring from the Alumni board. Arnold was responsible for so many aspects of Lamont operations when I was there. For 30 years, he plotted a steady course for the Observatory, supervising all nonscientific staff. In retirement, he has co-chaired Lamont's historic preservation campaign. Please join me in saluting Arnold for his dedication.

I hope to catch up with many of you at December's alumni reception in San Francisco during the American Geophysical Union conference. Until then, have a very pleasant fall.

Warm regards,

Steven C. Cande, PhD '77
Alumni Board President

SAVE THE DATE
Tuesday, December 14, 2010

AGU Alumni Reception
6:30–8:30 p.m.

Join us beforehand for the General Alumni Meeting
5:30–6:30 p.m.

Alumni Association Board of Directors

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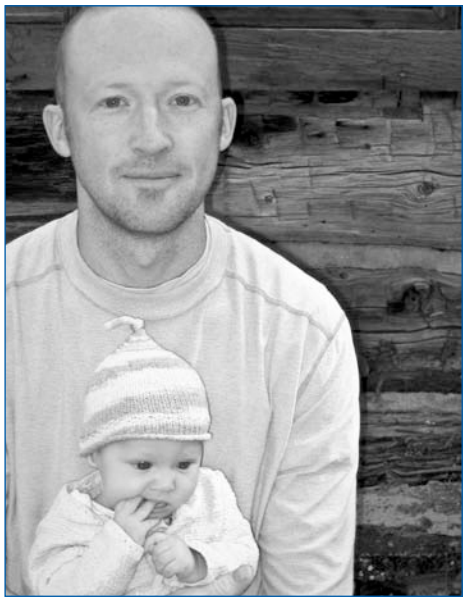
Q & A with Kevin Vranes, PhD '03



Growing up adjacent to where the San Andreas Fault intersects the peninsula of San Francisco, Kevin Vranes was made aware of nature's sometimes fickle state from an early age. As a graduate student at Lamont-Doherty, Vranes studied the air-sea interactions involved in major climatic events such as El Niño and the Asian monsoons. After receiving his PhD in physical oceanography, he served as a science adviser for Senator Ron Wyden of Oregon, as part of an American Geophysical Union Congressional Science Fellowship. In 2006 Vranes co-founded Point380*, a consulting firm that helps business leaders respond to volatile energy prices, climate change, and impending greenhouse gas emissions regulations. The firm gets its name from the approximate carbon dioxide concentration in the atmosphere at the time of its founding: 380 parts per million.*

Editor: Just living in California likely made you sensitive to water/energy policy issues. At what point in your graduate education did you consider the move into policy?

Before I even started. I studied geology as an undergrad at UC Davis, and the intersection of policy and science was brought out on a number of issues there—water use, historical geology/mining issues, land use. So I've been very interested in those issues for a while. As a graduate student I started really thinking of a policy career sometime in my third or fourth year, although it was probably always in the back of my mind. Once I heard about the Congressional Science Fellowship, I knew that was exactly what I wanted to do once I completed my PhD.

Editor: In your year on Capital Hill as a congressional fellow did you find politicians receptive to honest consultation regarding environmental science?

Operating in politics is almost never about facts. That's not bad, it's just the nature of politics. There is almost never a black-and-white solution when it involves governing a country of 300 million people with our geographic spread and demographic diversity. So scientific "facts" can be used in an argument to try to convince a certain group of people to agree with you, but whatever the "fact" may be, the policy implications of that "fact" are going to mean ten different things to ten different constituencies. Take climate change: the *science* says nothing about the proper political and policy response. The response is a values choice. Carbon tax, cap-and-trade, adaptation, geoengineering, no response? All of those are legitimate policy responses to the risk presented. Our society—through our policymaking apparatus—might decide that the costs of addressing climate change outweigh the costs of not addressing it. Personally, I would think that a seriously misguided choice, but I don't speak for the system.

Editor: So as a PhD scientist, what assistance did you provide to Congress?

Staffers are the ones who pull together all sorts of different factual and political considerations in crafting major legislation. How they get that info ranges from briefings (asking scientists to brief staffers on an issue), direct phone calls from a staffer to a scientist, online research and reading papers, and even reading scientists' blogs.

I would also say a key role for a scientist in Congress is as a fact checker. There is a trove of people (internally and externally) trying to put something over on members of Congress and/or their staffs. Having reliable scientists around can be a very valuable thing.

Editor: Could you give a brief sketch of what a typical day for you at Point380 looks like? What kind of help are you providing to clients?

Well, there is no typical day. One day can be spent doing billable work on a project, the next can be business development, writing a proposal, or working on one of our cleantech ventures.

Over the past six months most of my time has been spent trying to get an alternative fuel venture funded. This venture will supply recovered hydrocarbon fuel to iron-making blast furnaces (the first step in making steel). I can's say much more about that at the moment because of nondisclosures. I also recently helped write a proposal on behalf of the Colorado Cleantech Industry Association to the Department of Energy (DOE) to fund a cleantech incubator that will accelerate the commercialization of university lab innovations. If the DOE funds it, we will pipeline the three major Colorado research universities with the National Renewable Energy Laboratory and the robust Colorado venture capitalist and cleantech entrepreneur network to provide university innovators with business mentoring, plus the technical and market

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validation of their ideas. There is a very wide gap between public funding of basic research and the commercial products that research helps to generate. To actually bring a product to market requires a lot more money, and the government does not pay for product development. Yet venture capitalists don't usually put their money in at this early stage. Our proposed initiative seeks to help innovations see the light of day.

Editor: Climate science has taken a beating this year in the media. Climategate, talk of IPCC inaccuracies. For some time, major companies appeared to want to convince consumers they care deeply about the environment. Are those days over?

The train has left the station on what really matters here, which is clean energy. I sense that climate concern as a driver is losing some steam, but what has replaced it are two realizations about clean energy. The first from companies: they realize they can get a triple win in energy efficiency, process/operational efficiency and publicity if they pursue clean energy projects aggressively. The second is from the public: they realize there is no excuse for companies to stay in the dark ages on energy use, and they are demanding tangible changes in how companies operate. I think this is an irreversible trend and will continue regardless of whether we get a real climate bill any time soon.

That said, heavy legislation is needed for the decarbonization of the electricity supply. The smart ones on the Hill realized a couple of years ago that we can get climate addressed, as much as it will ever be addressed by the U.S. Congress, in the form of an energy bill. I think they've been using cap-and-trade as a smoke screen to get a serious energy bill passed.

The smart ones on the Hill realized a couple of years ago that we can get climate addressed, as much as it will ever be addressed by the U.S. Congress, in the form of an energy bill.

Editor: Do your clients for the most part support a climate bill? Do you think they will benefit economically from a new federal energy strategy?

If you are a cleantech entrepreneur, you absolutely support a climate bill. If you are a manufacturer with on-site process energy use, you should support it because you can make out handsomely if you play your cards right. But the cost-benefit equation has come around to cleantech even without a carbon price buoyed by a regulated market. We are on the tip of an explosion in cleantech product growth, and we will see a boom (and a bust, of course) in cleantech in the next five to ten years, just like we did for IT in the early 2000s. It will happen without a federal carbon price, but will happen sooner with one.

Editor: How do you stay informed about the science? Do you maintain trusted sources in academia?

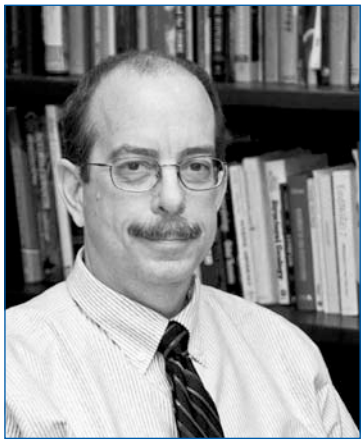
I'm based in Boulder, home to the University of Colorado, NCAR, NREL, and major NOAA and NIST facilities. This is probably the single richest place for climate-related and cleantech research in the U.S. So I have no problem getting information. I also keep in close touch with a few of my Lamont-Doherty classmates still in academia. That said, keeping on top of actual climate science hasn't been something my clients are demanding.

Editor: Would you encourage other science PhDs to join the policy discussion? Are there ways they can participate in the conversation from the ivory tower?

Yes, with caveats. I think all PhDs should be educated about policy, how it really works—the different levels of policy and the different places people can have influence—and how they might insert themselves into the game. But part of that education needs to be a very realistic guide to what will work, what won't, and why. There are many places scientists can be influential (from the national to the local level), but they need to be prepared so as not to become discouraged when they realize they won't get what they want directly. No scientist is going to run to the Hill, testify before a committee, and change the course of a major bill. It just doesn't work that way. But scientists can absolutely influence the talking points, which probably makes more difference than most would think.

Editor: Are you optimistic enough to think your company will need a name change? Point360, perhaps?

Ha! I'm a realistic optimist, so no.



Alumni Profile: Brad Clement, PhD ’85

By Mary Tobin

Early on, Brad Clement enjoyed geology and amassing his own rock collection, but he credits his undergraduate professors for nurturing this interest into both a passion and lifelong career. He became fascinated with the geology of the Appalachian Mountain chain and its elongated bands of marine sedimentary rocks, volcanic rocks, and remnants of ancient ocean floor. Clement had hiked in these mountains as a boy and wondered about the processes that had shaped this meandering landscape. At the time of his graduation from college, Lamont-Doherty’s Neil Opdyke and Dennis Kent were conducting groundbreaking research on the tectonics of the northern extension of this 480-million-year-old mountain chain. Eager to work with them, Clement joined the Observatory in 1979 as a PhD student.

At Lamont-Doherty, Clement’s research evolved from Appalachian tectonics to examining changes in Earth’s magnetic field as recorded in the sediment cores housed in the Observatory’s vast Deep-Sea Sample Repository. His doctoral research, conducted under Dennis Kent’s supervision, examined changes in the direction and intensity of the Earth’s magnetic field as it reverses polarity, which it has done frequently throughout its history.

Today, Clement is a professor in the Department of Geology and Geophysics at Texas A&M University and serves as director of science services for the U.S. Implementing Organization of the Integrated Ocean Drilling Program (IODP). The IODP is perhaps the most successful international scientific collaboration of researchers ever established, with roots dating back to 1961. It is funded by the U.S. National Science Foundation and Japan’s Ministry of Education, Culture, Sports, Science and Technology, along with support from additional member organizations.

IODP provides the deep-sea drilling platforms from which researchers obtain samples of subterranean seafloor environments. These cylindrical cores of sediment and rocks hold the signature of our planet’s structure and history. The oldest marine rocks collected date back 220 million years. Samples are taken from locations in all of the world’s oceans and seas and are largely unchanged from their original state, unlike samples taken from land, where erosion can wash away valuable information. The deep-sea cores contain a wealth of data that over the years have allowed researchers to make leaps in their understanding of planet Earth. Proof of such theories as continental drift and plate tectonics are just some examples of the breakthroughs these samples have facilitated.

“Just as astronomers need telescopes to peer deep into the history of the cosmos, we geologists need a drill ship in order to see into our own planet’s history,” says Clement.

The complexities involved in drilling beneath the ocean basin through a mile or more of Earth’s crust are difficult to fathom. Drill time on research vessels is expensive; it is crucial to know exactly when one has achieved one’s research goals in a drill hole in order to move on to drill in another. Clement was well versed in a great many aspects of the job, having served as a staff scientist at the Ocean Drilling Program (ODP) in the early 1980s. The ODP was the United State’s predecessor program to IODP. During this time, Clement installed a superconducting rock magnetometer aboard the *JOIDES Resolution*, a vessel that was just being converted into a research drilling ship. The instrument was able to take immediate measurements of the magnetization of cores, providing rapid information on the age of the cored material and ultimately maximizing the efficiency of drill time.

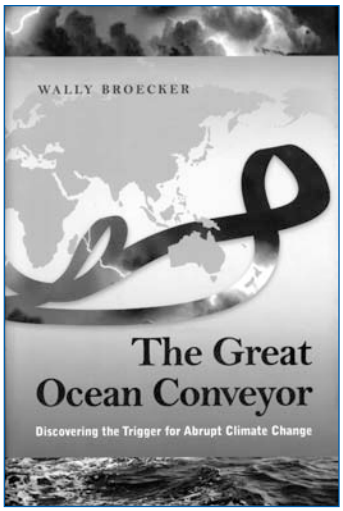
Clement’s successful installation of this magnetometer—which many doubted could function effectively on a moving ship—was a personal achievement of which Clement is proud, and rightly so. It was exactly this kind of optimization of time and tools that made him a perfect candidate to be a director at IODP. One of his first missions as director was to reorganize the management structure of the organization in order to maximize the science that comes off the *JOIDES Resolution*, one of three drilling platforms now operated by IODP. To date, the *JOIDES Resolution* has traveled a total of 422,440 nautical miles and extracted nearly 40,000 cores representing 150 million years of Earth’s history.

When he is not engaged in his administrator role at IODP, where he has served since August of 2009, Clement continues to publish studies on paleomagnetism. His most recent work has examined the effects of wildfires on magnetic properties of soils in the Everglades, one of three wetland areas to be designated of global importance by UNESCO. The study Clement led indicates that fire-induced heating makes minerals in the surface soils more magnetic. Since wildfires are a frequent occurrence in the Everglades, Clement’s findings could have important implications for phosphorus cycling in this fragile ecosystem.

> “Beneath the oceans, the past 150 million years of our planet’s history remain largely intact. That history is critical: Only by understanding the natural variability of our planet can we come to understand how human actions may affect it.”

Because his life’s work was inspired by dynamic teachers, Clement has a similar desire to stimulate young students. He took great satisfaction in teaching upper-level science courses developed for non-science majors at Florida International University. Clement has received multiple outstanding teaching awards and looks forward to teaching again in the future.

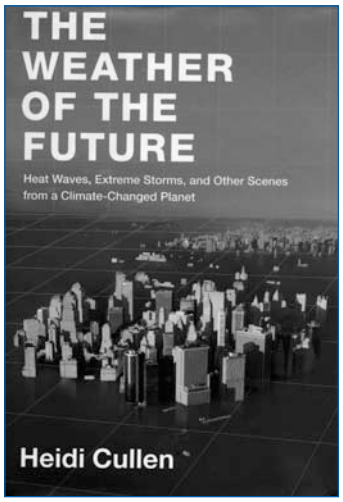
On Our Bookshelf



The Great Ocean Conveyor: Discovering the Trigger for Abrupt Climate Change

By Wally Broecker
Princeton University Press
Publication date: January 2010

In his latest book, Lamont-Doherty climate scientist Wally Broecker shows how scientists study ancient ice cores and marine sediments to probe Earth's distant past, and how they blend scientific detective work with the latest technological advances to try to predict future climates. He traces how the science has evolved over the years, from the blind alleys and wrong turns to the breathtaking discoveries. Broecker describes the men and women behind the science, and reveals how his own thinking about abrupt climate change has transformed as new evidence has emerged.



The Weather of the Future: Heat Waves, Extreme Storms, and Other Scenes from a Climate-Changed Planet

By Heidi Cullen
Harper
Publication date: August 2010

Lamont-Doherty alumna Heidi Cullen illustrates how, if left unabated, climate change will transform every corner of the world by midcentury. What emerges is a mosaic of changing weather patterns that collectively spell out the range of risks posed by global warming—whether it's New York City, whose infrastructure is extremely vulnerable to even a relatively weak Category 3 hurricane, or Bangladesh, a country so low-lying that millions of people could become climate refugees due to rising sea levels. Cullen walks readers through what could play out in seven of the most at-risk locations across the globe.

Alumni Mike and Martine Rawson hosted LDEO friends at their Miami home last April when Art Lerner-Lam, associate director of seismology, geology, and tectonophysics, and Barbara Charbonnet, director for development, visited Florida. While in Florida, Lerner-Lam also made presentations to Columbia alumni chapters in Sarasota and Tampa. His talk, "Predicting the Inevitable—What Have We Learned from the Haitian Earthquake?" addressed how nations, international organizations, and local communities can prepare and respond to geologic events that develop into human calamities.

Tribute to the Director—10 Years at the Observatory

On June 4, senior research staff organized a surprise party for Mike Purdy to honor his tenth anniversary as director. Under the guise of a colloquium with Sean Solomon, director of terrestrial magnetism at Carnegie Institution of Washington, the Monell Auditorium was filled to capacity on a hot Friday afternoon, which in and of itself could have made one wonder what was "really" going on.

As the colloquium moved to Q&A, a carefully staged question posed by a member of the audience led Solomon to arrive at his final slide of the day—a caricature of the director riding the good ship *Lamont* into the twenty-first century. A series of humorous and heartfelt tributes ensued, with the organizing committee joining the stage to read a proclamation highlighting Purdy's many achievements over the years. Most notable among them are the launch of the R/V *Marcus G. Langseth*; the construction of the Gary C. Comer Geochemistry Building; and the creation of a new title within the University, the Lamont Research Professor.

Faculty, staff, and friends of the Observatory raised more than $200,000 to initiate a future endowment fund to name a **G. Michael Purdy Lamont Research Professorship** upon his retirement (which we hope is a long way off!). Until this time, and until the fund is fully endowed for its formal purpose, proceeds will be used to support initiatives at the director's discretion. Gifts to support the growth of this fund are always welcome.

If you would like to contribute or would like more information about the fund, contact Barbara Charbonnet, director for development, at 845-365-8585 or bcharb@LDEO.columbia.edu.

Illustration by Nancy Brandwein

Your Support Is Needed

Your support is essential to funding important outreach and research initiatives at Lamont-Doherty. To make a tax-deductible contribution, please visit our website (www.LDEO.columbia.edu) and click on the "support LDEO" icon.

To send a gift by check, make it out to "Trustees of Columbia University," with "LDEO" in the memo line, and mail it to: Development Office, LDEO, 61 Route 9W, Palisades, NY 10964. If you would like to make a restricted gift, planned gift, or a gift of stock, please contact the director for development, Barbara Charbonnet, at 845-365-8585.

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P.O. Box 1000, 61 Route 9W
Palisades, NY 10964-8000

www.ldeo.columbia.edu

FROM THE ARCHIVE

Taylor Babb

John Diebold, Peter Buhl, and Howard Santamore aboard the R/V *Conrad* in 1968

INSIDE