Ironing out a longstanding geological puzzle

Why massive formations of banded iron began precipitating on Earth's surface billions of years ago

By Neal Singer

The physicist's concept that the Earth coalesced from the stuff of stars doesn't generally raise the issue of why massive formations of banded iron — some hundreds of kilometers long — began precipitating on Earth's surface about 3.5 billion years ago and then ceased relatively suddenly, approximately 1.7 billion years ago.

Because these deposits provide much of industry's iron resources and also carry information about Earth's early surface conditions and climate changes, interested researchers have cast a wide net in trying to explain why the formations exist. But attempts to pin the rap on seasonal variations, surface temperature changes, and episodic seawater mixing all have foundered on assumptions requiring the unexplained oscillations of

(Continued on page 5)

IRON MAN — Yifeng Wang (6772) holds a piece of banded iron during a visit to the Albuquerque Aquarium. Yifeng and colleagues have proposed an explanation — published recently in *Nature Geoscience* — for the precipitation of banded iron deposits in the planet's oceans billions of years ago. (Photo by Randy Montoya)

TWO WHO SERVED — Sandians have served in uniform in all of America's armed conflicts in recent decades. *Lab News* writer Iris Aboytes tells the stories of two of them on pages **6 and 7.**

Sandia LabNews

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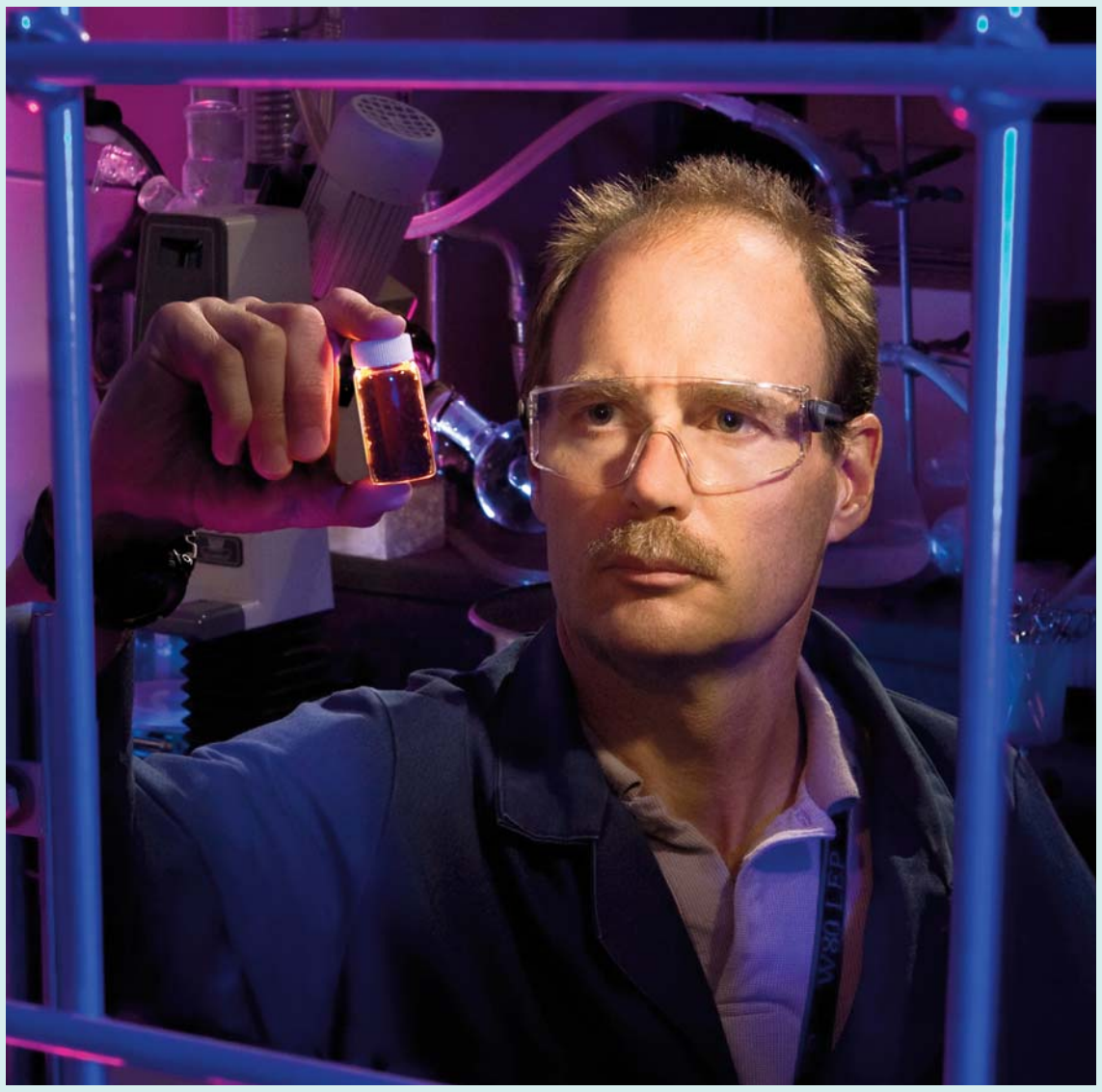
Sandia National Laboratories

Sandia getter technology a textbook case for technology transfer



MORE THAN MEETS THE EYE — Tim Shepodd (8223) describes Sandia's hydrogen getters program as a "sweet story of technology transfer." Originally developed to scavenge hydrogen from nuclear weapons nearly 20 years ago, Sandia's getters were licensed to Vacuum Energy Inc. for use in vacuum-insulated refrigerator panels, waterproof flashlights, flares, and most recently, plutonium transport. Read more about Sandia's getter technology on **page 3.** (Photo by Randy Wong)

Inside . . .

Graham Yelton, a chemical engineer in Sandia's energy and weapon programs, has been an avid beekeeper for more than 10 years. His hobby has taken him all over New Mexico, as far north as Las Vegas and as far south as Truth or Consequences, in pursuit of seasonal pollen and nectar for his hives. Read more on **page 12.**

That's that

November 11 is Veterans Day and to take note of it, we're running a couple of very compelling stories on pages 6 and 7 about two Sandians who served in Vietnam. Their stories are unique, but also representative of the sacrifices our veterans and their families have made and continue to make on our behalf every day. The least we owe them is our gratitude.

And while I'm on the subject, I got an email the other day from Ruth Smelser, who recently took her aged father, retired Sandian and World War II vet John Smelser, to Washington for a visit to the World War II Memorial there. The visit was hosted by an organization called Honor Flight. "The only thing they asked in return," Ruth's note said, "was for us to get the word out to other WWII veterans so they can visit 'their' memorial before it's too late. I was wondering if you might be interested in doing an article on this outstanding organization in hopes other Sandia retirees might enjoy the same opportunity my father experienced." Sounds very worthy to me. For more information, go to Honor Flight's website at www.honorflight.org.

* * *

Did you happen to see the story and photos we ran a couple of weeks ago about our LAZAP facility and the cool and important work the folks are doing over there? Randy Montoya's photo of the laser shooting out of the facility's telescope dome, leaving a vivid green slash right out to the edge of the atmosphere, was so astonishing and unlikely looking that we felt compelled to add a note in the caption that the image was unretouched.

What brings this up? Well, last summer, my wife and I spent 10 days at Heron Lake State Park (and I could rhapsodize about Heron Lake all day, but that's a subject for another time). One night, we went to a star party/campfire talk that sounded interesting. The speaker (an astronomer from Los Alamos National Laboratory, by the way) started explaining interesting facts about the nighttime sky, using a laser pen to point out specific stars and constellations. Thing is, it was a green laser; you could see its beam in the dark night sky and see *exactly* what he was talking about. (With red laser pointers you usually can't see the beam, just the point of light where it strikes something.) Having that visual frame of reference really enhanced the experience, so much so that as soon as we got home from our camping trip, I ordered two green laser pointers on eBay — one for myself and one for my wife. We've really started getting into stargazing. We love pointing stuff out to each other using our personal green lasers and are, bit by bit, really learning about the nighttime sky.

* * *

Just as we were preparing to go to press, my colleague Iris Aboytes gave me some good news, which I'm happy to pass along here: This year's Spirit of Giving Employing Caring Program (ECP) campaign in New Mexico appears to have been a great success. Although it's a bit early to totally close the books on the campaign, preliminary numbers indicate a 77.3 percent participation rate, the highest since 1994. More than $3.7 million has been pledged this year by Sandia employees, retirees, and the Lockheed Martin corporate contribution. Because some folks pledge a percentage of their income, and because we won't be getting raises until January 2010, final numbers will be announced in February.

* * *

Can you believe it? It was 20 years ago this month that the Berlin Wall came down is a spontaneous, collective outburst of unconfined joy. Remember the kids bashing the Wall with sledgehammers? Never thought I'd see it in my lifetime, and I bet most of you didn't, either. One noted historian even called the fall of the Wall "the end of history." Well. History is still with us. And Sandia still has a vital mission helping the nation address any surprises history may throw at us.

See you next time.

— Bill Murphy (505-845-0845, MS0165, wtmurph@sandia.gov)

Exploring next-generation technologies, opportunities in biodetection and diagnostics

Sandia researchers invited to Labs-wide workshop

By Mike Janes

Sandia scientists and researchers at every level are invited to a workshop, "Next-Generation Technologies for Biodetection and Diagnostics," taking place Dec. 10-11 in San Ramon, Calif. (roughly 20 minutes from Sandia's California site).

"We've never really had a forum where scientists from both of Sandia's main sites can talk freely about the future of our biological research and its support of our homeland security and defense mission," says Anup Singh (8621), one of the workshop organizers. "This workshop will allow us to do just that, in a facilitated and open fashion."

Anticipated outcomes of the workshop will include a greater awareness by Sandia researchers of the varied biodefense and emerging infectious diseases work taking place at the lab, improved networking, development of new ideas, and dissemination of a post-workshop report to a broad set of program managers, staff, and other stakeholders.

Research has taken off

The workshop, says Anup, will explore the current research landscape and bioresearch challenges facing the nation, the complex problems that Sandia is best equipped to tackle, the customers the Labs should be engaging, and the most effective tactics to use in directing these efforts.

Sandia's work in the area of biodefense and emerging infectious diseases has taken off in recent years, with a diverse customer set that includes the National Institutes of Health, the Department of Homeland Security's Office of Health Affairs, and others. Partnerships with institutions such as the University of New Mexico (UNM), the University of Texas Medical Branch (UTMB), and others have helped solidify Sandia's standing in the bioresearch arena.

Sandia's bioresearch activities and projects are spread throughout the Labs, in both New Mexico and California. So, about a year ago, Anup and others decided that a Labs-wide workshop was in order to bring together all the scientists and researchers engaged in such work, with the purpose of exploring ways in which Sandia can and should be focusing its bioresearch efforts in the coming years.

Sandia's Bioscience Research Foundation, Partnerships group, and Homeland Security & Defense Strategic Management Unit are sponsoring the workshop.

Though the final agenda is still in development, multiple "big name" external speakers are expected to be featured on day one in an effort to motivate and excite participants about the future of bioscience. Day Two will likely involve breakout sessions that look at specific focus areas.

Sandia staff interested in learning more about the workshop can visit http://info.sandia.gov/centers/8600/bioresearch_workshop or contact Laura Santos (8529), Beth Richter (8620), or Anup Singh (8621).

Retiree deaths

Philip H. Dailey (age 88) . . . . . Sept. 15
Watson D. Rinks (93) . . . . . Sept. 18
Charles L. Hines (84) . . . . . Sept. 23
Lewis Butler (83) . . . . . Sept. 27
Kelly S. Davis (91) . . . . . Sept. 27
Frank Thomas Dellamura (71) . . . . . Sept. 29
Paul S. Hamilton (90) . . . . . Sept. 29
Richard P. Demmel (86) . . . . . Sept. 29
Bernard E. Shea (84) . . . . . Oct. 7
Haddon C. Redding (92) . . . . . Oct. 12
Charles E. Cockelreas (81) . . . . . Oct. 13
Gertrude E. Hall (91) . . . . . Oct. 16
Bernice D. Dumond (96) . . . . . Oct. 20
Jack R. Kidd (77) . . . . . Oct. 22

Sandia 60th anniversary brochures

Sunday, Nov. 1, marked Sandia's 60th birthday. In honor of the date when Sandia was first established 60 years ago, commemorative brochures describing the first 60 years are being distributed to all mail stop areas and can be picked up by employees on a first-come, first-served basis. The brochures are a reprint of the publication that was available during the recent Sandia Family Day.

Sandia LabNews

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Sandia, others funded to sequence microbial genes for potential biofuels use

By Mike Janes

Sandia researchers and others at the University of New Mexico (UNM), the Joint BioEnergy Institute (JBEI), Novozymes, and North Carolina State University's Center for Integrated Fungal Research (NCSU-CIFR) have received a DNA sequencing award from the DOE Joint Genome Institute (JGI) to study microbial genes in arid grasslands. The research combines interests in fundamental microbial ecology with DOE goals to exploit microbes in the production of biofuels.

"This award positions a very talented team to collaboratively apply DOE's unique facilities in genomics and systems biology to the important challenge of sustainable bioenergy production," says Grant Heffelfinger (8630), manager of molecular and computational biology. "We normally think of biofuels-relevant ecosystems as those where substantial amounts of biomass are produced and broken down, but this is an excellent example of the relevance of biodiversity across ecosystems — both for the advancement of systems biology as well as biofuels production."

High-efficiency recycling systems

Microorganisms in arid land ecosystems have evolved high-efficiency recycling systems to cope with severe nutrient scarcity, extreme temperatures, and low water availability. Genes underlying these adaptations offer great potential in industrial-scale processes designed to convert plant material cheaply and efficiently into biofuels.

The project's sequencing effort will focus on microorganisms associated with the roots of a common grass species, blue grama, and will interface with ongoing environmental change experiments at UNM's Sevilleta Long Term Ecological Research site in central New Mexico.

"This award will enable us to better understand the metabolic potential of microbial communities native to extreme environments," says Don Natvig, professor of biology at UNM. "This understanding can in turn be applied to real-world problems, such as biofuels production inefficiencies and greenhouse gas management technologies."

Biofuels research and environmental change studies are united by the urgent need to develop sustainable energy sources, and to understand and mitigate the environmental effects of spiraling greenhouse gas emissions. In terms of renewable energy, the study will drive the commercial development of new products useful in the breakdown of lignocellulosic biomass, the starting material for production of biofuels.

From an environmental sciences perspective, the award will enable researchers to study and monitor the effects of altered patterns of fire, precipitation, increasing temperatures, and atmospheric pollution on ecosystem structure and function.

MORE THAN 400 genome sequencing instruments (some shown here at the Joint Genome Institute's Walnut Creek, Calif., headquarters) are among the platforms to be used in the grasslands project.
(Photo courtesy of Roy Kaltschmidt, Lawrence Berkeley National Laboratory)

The scientific team includes Amy Powell and Bryce Ricken (both 8622) from Sandia; Don Natvig, Scott Collins, Robert Sinsabaugh, Andrea Porras-Alfaro, and Diego Martinez from the UNM Department of Biology; Blake Simmons (8625) of Sandia and JBEI; Ralph Dean of NCSU-CIFR; and Randy Berka of Novozymes.

Advancing green technology innovation

"It is tremendously exciting for us to establish a genomics-based research program at Sandia to study the value of microbes endemic to extreme environments for the development of biofuels and in understanding carbon cycling and sequestration. Climate and energy eclipse all other science and engineering issues now, and will for the foreseeable future. Our studies are timely and will advance green technology innovation," says Amy.

Sandia CaliforniaNews

The total sequencing resources allocated to the project by DOE will be the equivalent of that required to analyze several microbial genomes or a significant fraction of the human genome, which contains approximately three billion base pairs of DNA.

Established in 2005, the JGI's Community Sequencing Program (CSP) provides the scientific community at large with free access to high-throughput sequencing at DOE JGI for projects of relevance to DOE missions. Sequencing projects are chosen based on scientific merit — judged through independent peer review — and relevance to issues in bioenergy, global carbon cycling, and biogeochemistry. For more information, see www.jgi.doe.gov/CSP/index.html.

Sandia's getter technology comes full circle

By Patti Koning

Hydrogen getters are not sexy, but they are reliable. Sandia has been in the getter business for nearly 20 years through a flourishing partnership with Vacuum Energy Inc., which has the exclusive license to the technology.

"This is really the textbook case of how technology transfer should work," says Tim Shepodd, manager of Materials Chemistry Dept. 8223. "We developed our hydrogen getters for applications in nuclear weapons. Then they were commercialized, which kept the program going at Sandia, and they have come back to us for plutonium transport."

About 15 years ago, Brad Phillip of Vacuum Energy approached Sandia for help removing gases from vacuum-insulated refrigerator panels to extend the product life, improve efficiency, and decrease size. Seeing the potential for hydrogen removal applications, Vacuum Energy licensed Sandia's getter technology.

If you've used a waterproof flashlight, there's a good chance you've encountered one of Sandia's getters. Each year, Vacuum Energy sells millions of Sandia's getters to flashlight manufacturers. The getters, which are about the size of a pencil eraser, scavenge the hydrogen that accumulates in the sealed compartment to prevent an explosion.

Hydrogen is ubiquitous because moisture is always present, despite efforts to remove it. Water reacts with metals, making metal oxides and hydrogen gas. Hydrogen is also dangerous, especially when it builds up in sealed compartments, because it is chemically reactive and has a large explosive range with air and high thermal conductivity.

"Have you ever opened your TV remote to change the batteries and noticed that the old batteries are bulging slightly? That's hydrogen pressure," explains Tim. "A typical AA battery is semihermitically sealed, so when it fails, it fails suddenly." That released hydrogen can be ignited with static electricity, such as static generated from sliding across a synthetic bed comforter or carpet.

The getters contain unsaturated organic compounds that react directly with the hydrogen and remove it from the atmosphere, a process called "gettering." If oxygen is present, the getter enables the hydrogen to react with the oxygen to form water in a controlled catalytic reaction. Tim describes getters as being like ice cream, with many different flavors designed to work in high or low temperature, radioactive, or noxious gas environments. While the flashlight getters are pellets, getters are also used in powder, spray coating, and sheet form.

Easy to get rid of

"It's easy to get rid of hydrogen," says Tim. "The challenge is to move an explosive atmosphere below an explosive concentration in a controlled fashion. That's what our technology does extremely effectively without igniting anything — it moderates the reaction by never letting the temperature get to the ignition point."

About five years ago, Vacuum Energy expanded the getter application space into flares. Flares are sealed to enable a chemical reaction when they are exposed to oxygen. That sealed compartment, like a waterproof flashlight, can become explosive if too much hydrogen builds up inside.

Tim says he receives several calls each year about new uses for hydrogen getters. "The common theme is often water. I've been contacted repeatedly by submarine and buoy operators, even water-themed Las Vegas shows," he explains. "We are always looking for new applications."

In many of those calls, Tim says, people tell him they have a hydrogen problem but they have no idea how much hydrogen they are dealing with. Sandia's getters can be used to determine the extent of hydrogen build-up, as you can count the number of hydrogen atoms absorbed by a getter over a set period of time.

Last year Sandia's getter passed rigorous DOE testing for use in plutonium transport. Tim says that without getter commercialization, Sandia never would have been able to develop the technology for this application. Vacuum Energy is now supplying getters to DOE's Savannah River Site.

"The biggest hurdle was that the plutonium shipping container contains a mixture of carbon dioxide

(Continued on next page)

Truman Fellows boost Sandia's mission work

By Rachel Kolb

The President Harry S. Truman Fellowship in National Security Science and Engineering started in 2004 as an effort to enrich Sandia's environment with fresh expertise and innovative ideas. In the five years since, the program has done exactly that.

"At the postdoctoral level, the opportunity to spearhead a research program of one's choosing is very rare and enormously valuable for career development."

— Bryan Kaehr

"I believe the Truman Fellowship program is one of the best things we've done to bring in young PhDs who impact the Labs and conduct research that ties in to our needs," says Charles Barbour, senior manager of ST&E Strategic Initiatives Center 1010.

The Truman Fellowship program seeks to attract the best nationally recognized, new PhD scientists and engineers to Sandia. The three-year fellowship enables recipients to pursue independent research of their own choosing that supports Sandia's national security mission.

"Many Truman Fellows come in to advance Sandia's understanding of a key area, as well as their own capabilities. The fellowship is a benefit to both," says Charles.

Bryan Kaehr (1815), a current Truman Fellow who earned his PhD in biochemistry from the University of Texas at Austin in 2007, praises his fellowship as a great learning experience.

"At the postdoctoral level, the opportunity to spearhead a research program of one's choosing is very rare and enormously valuable for career development," he says.

Bryan says his Sandia experience has taught him more about the practical matters of scientific research than he knew from his previous experiences, such as setting up a laboratory from scratch and managing a research budget. His research, on "Development and Characterization of 3-D, Nano-Confined Multicellular Constructs for Advanced Biohybrid Devices," is intended to provide Sandia with a new technology for building almost any structure with proteins.

President Harry S. Truman Fellowship in National Security Science and Engineering

Another current Truman Fellow, Anatole von Lilienfeld-Toal (1435), says that the best aspect of the program is the fellows' independence to pursue cutting-edge research over a long-term timeframe.

"The program works at the frontier of science," he says. "The ideal of the program is pure science. If a small fraction of the work is successful, then it's already worth it."

Anatole received his PhD from the Swiss Federal Institute of Technology in 2005. His research proposal, "Multiscale Schemes for the Predictive Description and Virtual Engineering of Materials," as well as his expertise in the field of theoretical chemistry, will enhance computational material studies conducted at Sandia.

Current Truman Fellow Whitney Colella (6339), who received her PhD from Oxford University, is pursuing research in computer simulations of low-carbon energy systems to describe their thermodynamics, economics, and environmental impacts.

"The Truman Fellowship has enabled me to build up an excellent technical track record with external customers. In FY09, DOE's Energy Efficiency and Renewable Energy Program funded $225,000 in related research projects to cross-pollinate my Truman Fellow research to research areas of interest to them."

— Whitney Colella

"The Truman Fellowship has enabled me to build up an excellent technical track record with external customers," says Whitney. "In FY09, DOE's Energy Efficiency and Renewable Energy Program funded $225,000 in related research projects to cross-pollinate my Truman Fellow Research to research areas of interest to them."

Other current Truman Fellows include Patrick Hopkins (1513) and Darin Desilets (6312).

Bryan, Anatole, and Whitney represent a sample of the talent brought to Sandia by the Truman program, but the true question remains: Can Sandia succeed in retaining that talent? These current fellows seem confident that it can.

"I would anticipate staying at the Labs after the fellowship if I can continue to work on interesting problems that are, hopefully, of value to Sandia's mission," says Bryan.

A few Truman Fellows have pursued academic faculty positions at top universities after the culmination of their fellowships, including Youssef Marzouk at the Massachusetts Institute of Technology (MIT) and Ilke Arslan at the University of California at Davis, but several other fellows have found long-term employment at Sandia.

"The program works at the frontier of science. The ideal of the program is pure science. If a small fraction of the work is successful, then it's already worth it."

— Anatole von Lilienfeld-Toal

Former Truman Fellow David Scrymgeour, who now works in Photonic Microsystems Technology Dept. 1725 after pursuing research in nanomaterials for his fellowship, calls his experience in the program a "fantastic boon" to his career. He says that Sandia's technical diversity first attracted him to the fellowship and continues to make his current research feel fresh, interesting, and satisfying.

"The culture here at Sandia was a very good fit for me," says David. "I enjoyed the collaborative environment of the research, where you can in theory pick up the phone and talk to a fellow Sandian who is an expert in their field, and they would be more than happy to talk with you about a problem that you are having. Also, the mix of both basic and applied science is something I really enjoy."

Greg Nielson (17492), another former Truman Fellow who works in microelectromechanical systems (MEMS) research, says two major factors influenced his decision to remain at Sandia.

"First, Sandia has a remarkable micro/nano fabrication facility. There are things that I have designed and manufactured here that I don't think can be done anywhere else in the world. Being able to use this facility to create new and unique devices was very exciting to me," Greg says. "Second, Sandia is a place where there is the freedom to pursue new ideas. One of the most exciting things for me in my work is finding creative solutions to difficult problems."

Jacques Loui (5345) is another former Truman Fellow who also converted to regular staff at the end of his fellowship.

Sandia management is also pleased with the progress of the fellowship. David Sandison (1110), Greg's manager during his fellowship, praises the new ideas and research direction that Greg brought to Sandia's MEMS group. The Truman program, he says, "brings smart, creative, dedicated people to the lab," something which Sandia needs to succeed technically. In addition, he says, the program provides Sandia with new connections to the outside world.

So where is the Truman Fellowship headed? According to Charles, outside awareness of the program has increased over the years. "It's on an upward trajectory," Charles says. "We hope that we can continue to get an increase in high-quality applicants, and that we can align the research with the corporate strategic thrust."

Getter technology

(Continued from preceding page)

and air, and getters had never been used in that environment before," says April Nissen (8223), who oversaw the testing for Sandia. "We had to ensure that the getters would perform perfectly in those conditions. Failure is not an option."

An important component of the testing was how the getters performed as they aged in the radioactive environment. Recently, April ran tests on a getter that had been in service for two years and found that they performed better than the laboratory-aged samples, which were subjected to worst-case conditions. "The getters sailed through a very rigorous set of tests," says April. "We knew the technology would perform, but you never expect this sort of thing to come off without a hitch."

Another potential getter application is in radar sources, which can degrade and malfunction when exposed to hydrogen. "A lot of people have an issue with hydrogen-sensitive devices that are placed with or in microchips and sealed," says Tim. "Existing technology used for radar sources deactivates very quickly when exposed to room air, making this technology very difficult to work with."

Tim presented Sandia's getter solution at the Advanced Technology Workshop on RF and Microwave Packaging, sponsored by the International Microelectronics and Packaging Society last month in San Diego, Calif. An advantage of Sandia's technology is that it can be worked on in air for several hours before it needs to be sealed. "Our technology also has orders of magnitude less equilibrium water vapor over the surface of the material, minimizing the chance of corrosion, and it passes low ionic content test," says Tim. "Our presentation was very well received. We are definitely expanding this line of business.

Sandia's getter work has taken Tim and other researchers in some unusual directions. About a year and a half ago, a salmon supplier asked Sandia for help in maintaining a specific environment in shipping containers that were cooled using a technology that leaked a little hydrogen.

"If the supplier could keep the fish at a certain pressure and temperature consistently, they could change their shipping method and save a lot of money," he says. "So for a few months we had refrigerators out in the lab with trays full of salmon and getters as we worked on the environment."

Another aspect of the project was quantifying the odor emitted by the salmon to determine what factors might be changed to keep the fish fresher. "That's the beauty of working at Sandia," says Tim. "You never know what kind of project you'll be working on next — salmon or radar sources or something else totally unexpected."

Banded iron

(Continued from page 1)

external forces.

None of these theories could satisfactorily explain all the observations made by geologists, particularly the existence of structural bands in these deposits that alternate silica-rich layers with iron-rich layers.

A new solution proposed in an October issue of *Nature Geoscience* by principal investigator Yifeng Wang (6772) and colleagues may have the answer.

A key component of the process, Yifeng and his colleagues found in computer simulations, may have been the absence of aluminum in early oceanic rocks, an absence that chemically favored the formation of banded iron formations. The continual enrichment of oceanic crust by aluminum as Earth evolved ultimately ended the era of iron band formation.

"Luckily, I came across a very recent publication on silicic acid interactions with metals. With these new data, I did thermodynamic calculations. I looked at the results and talked to both Huifang and Enrique. The whole banded-iron-formation puzzle started to fit together nicely."

— Researcher Yifeng Wang

A complete thermodynamic explanation by the researchers suggests that iron- and silicon-rich fluids were generated by hydrothermal action on the seafloor. Their calculations show that the formation of bands was generated by internal interactions of the chemical system, rather than from external forcing by unexplained changes such as ocean surface temperature variations.

"This concept of the self-organizational origin of banded iron formations is very important," says Yifeng. "It allows us to explain a lot of things about them, like their occurrence and band thickness.

"My PhD advisor Enrique Merino [at Indiana University] was probably the first to consider banded iron formations as formed through self-organization," says Yifeng. "We started to work on the issue about 15 years ago." But difficulties in pinning down an actual mechanism persisted.

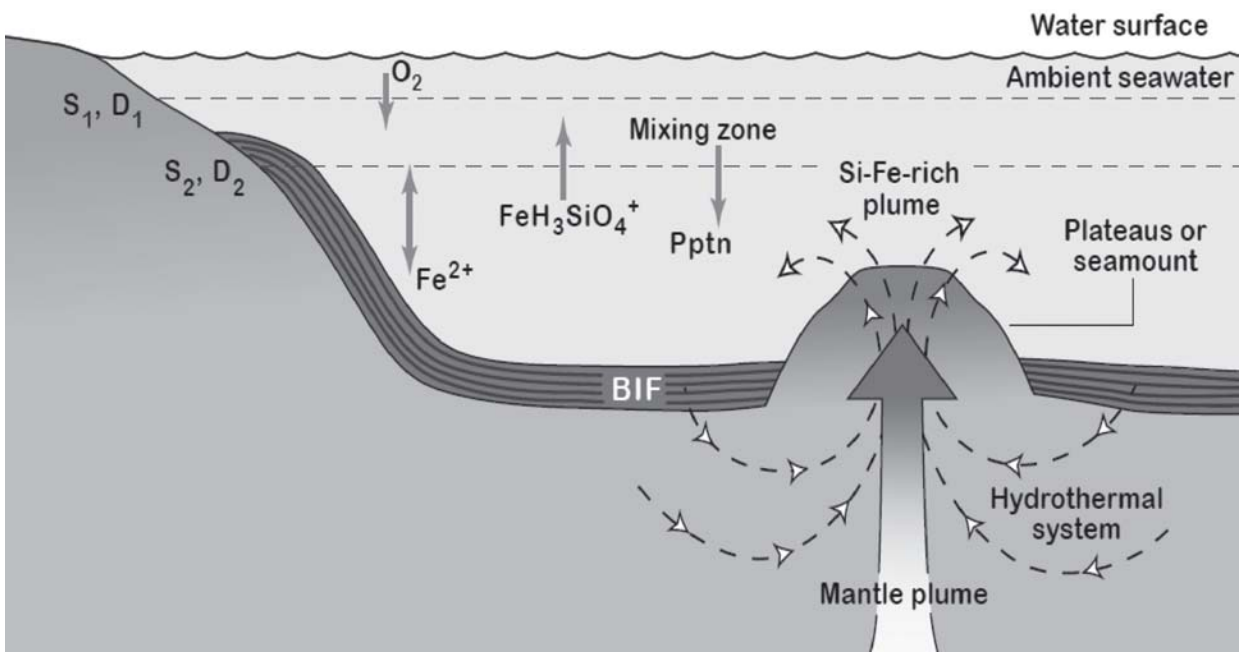
"Last year, Huifang Xu [at the University of Wisconsin at Madison] and I happened to talk about his work on astrobiology and then we talked about banded iron formations," says Yifeng. "After that, I got interested again in the topic. Luckily, I came across a very recent publication on silicic acid interactions with metals. With these new data, I did thermodynamic calculations. I looked at the results and talked to both Huifang and Enrique. The whole banded-iron-formation puzzle started to fit together nicely."

Merino and Xu coauthored the paper with Yifeng, along with Hironomi Konishi, also at the University of Wisconsin at Madison.

"Our work has two interesting implications," says Yifeng. "The Earth's surface can be divided into four interrelated parts: atmosphere, hydrosphere, biosphere, and lithosphere. Our work shows that the lithosphere, that is, the solid rock part, plays a very important role in regulating the surface evolution of the Earth.

"This may have an implication to the studies of other planets such as Mars. Our work also shows that to understand such evolution requires a careful consideration of nonlinear interactions among different components in the system. Such consideration is important for prediction of modern climatic cycles.

"After all," he says, "Earth's system is inherently complex and the involved processes couple with each other in nonlinear fashion."



PRECIPITATION OF BANDED IRON FORMATIONS (BIFs) from a hydrothermal system. The ambient seawater could be either oxic or anoxic (only the former is shown here). Komatiitic rocks formed as a part of plateaus or seamounts above a deep mantle plume. Periodic precipitation of iron oxide and silica was induced through a self-organization mechanism. Pptn — mineral precipitation; S1, D1 — the area of the upper surface of the mixing zone and the corresponding mass exchange coefficient for mixing, respectively; S2, D2 — the area of the lower surface of the mixing zone and the corresponding mass exchange coefficient for mixing, respectively.

Sandia upper management gathers for Fall Leadership Forum

SANDIA EXECUTIVE VP and Deputy Labs Director for Nuclear Weapons Paul Hommert makes a point during a panel discussion at the annual Fall Leadership Forum. The panel discussion was a follow-up to a presentation by Elizabeth Turpen (photo at right), an associate with Booz Allen Hamilton, who spoke about nuclear security challenges in the coming decade. With Paul on the panel are Turpen (to Paul's right), Executive VP and Deputy Labs Director for National Security Technologies and Systems Joan Woodard, and Victor Utgoff, deputy director of the Strategy, Forces, and Resources Division of the Institute for Defense Analysis. Utgoff had spoken earlier in the day about America's current strategic posture. The 2009 Fall Leadership Forum was based around the theme "The Next Generation of National Service." In addition to presentations about nuclear security, other sessions focused on energy security, nuclear proliferation and terrorism, and defining a new national laboratory. The purpose of the Fall Leadership Forum is not to make decisions or develop action/implementation plans, but to stimulate discussion, brainstorm ideas, and learn from successful national leaders. Thoughts and ideas from these discussions will then be used in the annual strategic planning process. (Photos by Randy Montoya)

HONORING OUR VETERANS

'Many times I felt like I was in a glass shield,' says Lt. Harold Clay

Stories by Iris Aboytes

The text in italics is taken directly from Lt. Harold Clay's personal log written during his first few months in combat in Vietnam.

May 15, 1967 — We were resupplied today and continued on our night operations. Mike was on point. My platoon, November, was on the right. Lima was on the left. We only got about 200 meters before Mike hit a booby trap. Seven soldiers were hit. Our recon was ahead of the action and some of Mike's were already passed, so it must have been command detonators. White had both legs blown off. The lieutenant had one blown off, the other in bad condition. Another soldier was hit in the head, taking his ear off and some of his brain. They don't expect him to live.

HAROLD CLAY

Lt. Harold Clay (4211) enlisted in the Army after high school. "Instead of waiting to be drafted," says soft-spoken Harold, "I wanted to get it over with." Harold was in the 173rd Airborne Brigade (separate) 2nd Battalion, 503rd Infantry. He was a squad leader in November platoon, Charlie Company.

Bien Hoa/Dak To

After a year of training, Harold was shipped to Vietnam. As the plane landed and the door dropped open at Bien Hoa, the heat was almost overpowering. "It was as though the heat engulfed us," says Harold. "It wrapped around us, making it hard to breath.

"The landscape was similar to the Manzanos but the hills were not jagged. They were smooth and covered with lush green grass. It was very humid."

From Bien Hoa, his group took a C-130 to Dak To, their home base. As they began to drag their equipment and gear off the plane, someone shouted 'get down, get down." There were incoming mortar rounds. "It was disturbing. I had not known what to expect," says Harold.

"Dak To has big tall trees, beautiful green country, a constant mist, and fog similar to Oregon," says Harold. "That area gets rain six months out of the year, so we wore our ponchos. We were in a rain forest."

HAROLD CLAY on patrol in Vietnam in 1967.

Rolling Thunder (Air Force B-52s)

Their search and rescue patrols extended to Kontum, Bong Son, Pleiku, Ankhe, Qui Nhon, Ban Me Thuot, Tuy Hoa, and Cam Ranh.

Battles occurred about two days of every week. Booby traps covered all the areas. Craters about 35 feet wide and 20-25 feet deep with splintered trees over about a quarter-mile radius identified the impact of the bombs dropped by the B-52s.

"When we would go in for the night, we would set up a perimeter and dig fox holes for shelter," says Harold. "When Rolling Thunder dropped their bombs, the Earth would shake and vibrate. We would get a good rest. We knew there would be no firefights that night. The quiet we did not like. On one occasion, when in position for the night, I heard Viet Cong coming toward my location. I immediately launched a couple of grenades at them."

A HELICOPTER races above the forest canopy in Vietnam. Helicopters, which saw limited deployment in Korea, were a vital component of America's military presence in Vietnam.

May 19, 1967 — We moved out of our position by Chinook choppers. On the way to the landing zone Wilcher's team hit a booby trap. When I heard the explosion, I turned around, I saw Nasau on the ground. I ran to him. Are you hurt, I asked, knowing he was. He was calm, not saying a word. He was holding his jaw. He had a hole in his chin. I called for the medic to hurry up and come. I went back a little further and saw Wilcher. He was hit in the upper left leg and left trunk. He was saying "Oh Lord, Oh Lord." The medic gave him some morphine. After we got them out, we made a combat assault to our new location where it was believed that a battalion was operating.

Hill 875

"I remember when two bombs were dropped on our position," says Harold. "A whole platoon [50] was lost at Hill 875. It was a major battle that lasted about seven hours into the night. The explosions made it seem like daylight. There was a lot of screaming. 'Help me.' 'I am hit,' says Harold. "The soldier next to me was hit. He grabbed his stomach. He said it felt like hot molten lead.

"The medics always took the heavy tolls. They would run to the front lines to care for the wounded. After one of our fire fights we started moving out and noticed the medic. As we turned back we saw he was not coming. We called out, 'Come on, let's go,' but there was no response. When we went back, we realized he had been killed. He was still in a kneeling position like he was tending to a soldier. We brought him along with us. The wounded were put on basket-type stretchers and taken by the medevac helicopters.

"My belief in God, in Jesus Christ, gave me strength," says Harold. "It gave me stamina and endurance. From day one we did not believe we were going to make it back home. Were we?"

Common purpose

All the soldiers carried 70-pound rucksacks or Alice Packs, full of supplies. "Initially I could not keep up with the hill climbing," says Harold. "My legs would get sore. It all subsided. After about a week or two, my legs were in good shape. Eventually I became team leader. I learned to appreciate those 70-pound rucksacks. We carried everything we needed. Iodine pills for the water, malaria pills, food, etc. In the metal cases attached to the sacks, we carried M-60 machine gun ammo. We had grenades readily available in our belts. We were resupplied by helicopters when they could make it in, and if we could cut a landing zone.

"We were all scared. If we heard a noise, none of us wanted to go out and check it out. Nobody wanted to get ambushed. I would volunteer and pretty soon we would all go. Many nights we did not want to do it, but we were a team. We learned to control the fact that we were scared."

May 23, 1967 — We are operating in the flat land again. This time we went through a large village. It was a very hot day. The packs were heavy. What do you think happened? Some Vietnamese girls brought out some Cokes. The boys couldn't believe it, they sold for 50 cents a can.

"We patrolled many villages with real friendly kids, but you could not trust them," says Harold. "Some of the villagers had Cokes that they would try to sell to us."

Harold says being in Vietnam taught him patience and strengthened his faith. He also learned how to work better in harmony with comrades for a better relationship. After all, they all had a common purpose — do their job and get home safe.

His colleagues all used reverse psychology, according to Harold. They did not think they were coming back so they did not worry.

"If we got to return home, that was the most gracious prize," he says. "Many times I felt like I was in a glass shield because I had nothing bad happen to me, no booby traps or sniper rounds. Maybe it just wasn't my time."

May 24, 1967 — We received some fire today from the left, so we called in an air strike and Big 6 sent our platoon to check the ridge line. We didn't have any question. The only thing we saw was B Company in a fire fight in the valley from the top of the ridge. After that we got word to check the village and move to the landing zone to be resupplied with the rest of the company. On the way there my point team hit another booby trap. This is just too many for one platoon to be hitting. The boys just don't know what to think. This is the first time we hit this many since I have been here. Spencer was the only one hit bad in the legs and arms.

Harold kept a short-timer calendar and came home safe on a commercial plane. It wasn't until then that he actually realized that he was coming home alive. "I was

A PURPLE SMOKE GRENADE identifies a location for a helicopter pickup.

more than overjoyed to see the United States," says Harold. "One of the hardest things to get used to was sleeping. It was hard to sleep in a bed in the quiet. I was used to sleeping on rocks with the ground reverberating."

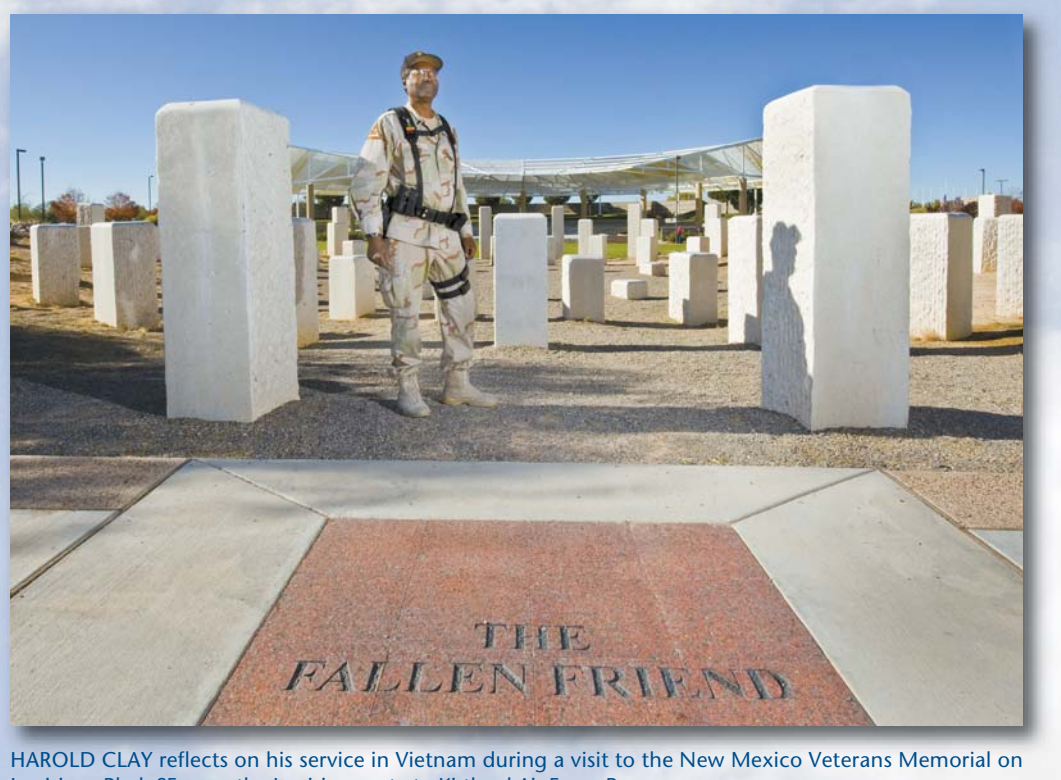
Harold still has shrapnel in his hip sustained from mortar rounds while on patrol.

"It was not a big deal," says Harold. "I just got bandaged. I did not realize metal was still in me until I was returning home and had my Army exit medical review." Harold also sustained an injury to his left leg from punji sticks (Punji sticks were placed by the enemy as booby traps).

Harold completed his tour of duty and went to flight school. For eight years he was a pilot for Air Midwest Airlines. He was transferred to Albuquerque and Air Midwest disbanded because of the 1970s fuel prices and load factors.

He was told that if he wanted to remain in Albuquerque, the best place to work was Sandia National Laboratories. "It is," says Harold. "I have been here 24 years."

U.S. PROPAGANDA FLYERS distributed in Vietnamese villages during the war.



HAROLD CLAY reflects on his service in Vietnam during a visit to the New Mexico Veterans Memorial on Louisiana Blvd. SE, near the Louisiana gate to Kirtland Air Force Base.

'I left Vietnam, but the bond remains', says Joe Polito

Div. 9000 VP Joe Polito was a pilot in Vietnam with the 361st and 362nd Tactical Electronic Warfare Squadrons. He flew EC-47 aircraft from 1971 to 1972. The EC-47 was a modification of the World War II-era C-47 Skytrain, a military version of the venerable Douglas DC-3.

During the Vietnam war, some C-47s were taken out of mothballs and refitted with electronic surveillance equipment and became EC-47s.

JOE POLITO

"Our mission was to detect enemy transmitters," says Joe. "Once the transmitters were located, airstrikes, artillery, or Special Forces teams were called in.

"Known as a 'slow-mover,' the EC-47 cruised at about 150 miles per hour at 10,000 feet," says Joe. "Our mission required the aircraft to fly in a straight line for extended periods of time. A slow-mover flying straight and level is easy pickings for antiaircraft guns. We always had intelligence regarding the latest positions of the enemy's antiaircraft guns. This made flying relatively safe, although the airplanes had some reliability issues."

On one occasion Joe lost an engine over western Vietnam. He flew back to Da Nang and informed the tower of his emergency.

"Normally an emergency gets you to the front of the line for landing," says Joe. "On this day, however, it was foggy over the South China Sea, and all the Navy carrier fighters were recovering at Da Nang. I was advised to stand by. There were six emergencies ahead of me."

Joe was stationed at both Phu Cat and Da Nang. Enemy activity occurred near these bases, and on many evenings machine gun fire could be heard from the perimeters. There were also rocket attacks on the bases at night. "On those occasions, I would listen to the explosions wearing a flak jacket and metal helmet under my bed," says Joe.

"There were also other hazards that you might not think of. Repair parts were in short supply. We had a van whose brakes did not work, so it was not allowed on the flight line because it might damage an airplane. That, however, did not prevent it from being driven on the rest of the base where it might damage people!"

"Every war has its incongruities that seem humorous in hindsight," says Joe, "but Vietnam was serious business. My main memories of Vietnam are about the mission. Our 'customers' were hungry for the information we provided. My squadron was dedicated to getting the job done. We flew long hours in all kinds of weather, and we responded on short notice when the need was acute, because we knew that others were depending on us."

AN EC-47 on the runway at an airfield in Vietnam. The aircraft was equipped to detect enemy transmitters for targeting by artillery, air strikes or Special Forces attacks.

A VIEW OF THE COCKPIT of an EC-47, the kind of aircraft flown by Joe Polito during his tour of duty in Vietnam.

JOE POLITO stands by the nose of an EC-47 aircraft. The EC-47 was the electronic surveillance version of the venerable C-47, which was, in turn the military version of the legendary DC-3.

Joe had mixed emotions when he left Vietnam.

"I was more fortunate than many others. Because of my role, I was not often in harm's way," he says. "I certainly was relieved to be getting out of a warzone. On the other hand, I had a feeling of leaving unfinished business to others.

"Our men and women who serve in the military have an unwavering sense of national service and a strong sense of responsibility to one another. Doing important things for the country is their profession. I was part of that, and I still believe in it. Even today, when our military deploys to conflicts in far-off places, I feel a sense of loss at not being able to contribute more directly."

Working at Sandia is Joe's way of continuing that service. "Our corporate principle that states, 'We always place national interests above Sandia's interests, Sandia's interests above organizational interests, and organizational interests above our personal interests' speaks very personally to me," says Joe. "I know that not everyone can share my experiences, but I hope that everyone sees themselves as a part of the Sandia community with a common and integrated commitment to national service."

American Indian Outreach Committee Veterans Day tribute

As part of American Indian Heritage Month, Sandia's American Indian Outreach Committee will sponsor a Veterans Day tribute to honor and recognize Sandia veterans. The event at Hardin Field Wednesday, Nov. 11, 11:30 a.m.-1 p.m., will feature various traditional Native American foods. If you're a veteran and wish to bring a memento to share, there will be a short time of remembrance at the end of the veterans tribute program.

As part of its commitment to the safety and education of employees regarding the current flu season, Sandia is working with the state of New Mexico and providing this Flu Decision Chart created by the New Mexico Department of Health. Sandia's H1N1 situational awareness team continues to monitor current seasonal flu conditions.

Flu Decision Chart

Protecting Yourself, Protecting Others

IF YOU HAVE FLU SYMPTOMS

Use the guidelines in this table to help make the best decision for you and your loved ones. Also, remember to wash your hands often and to cover coughs and sneezes with a tissue or the inside of your sleeve. It is not important to know if you have seasonal flu or H1N1, the recommendations are the same.

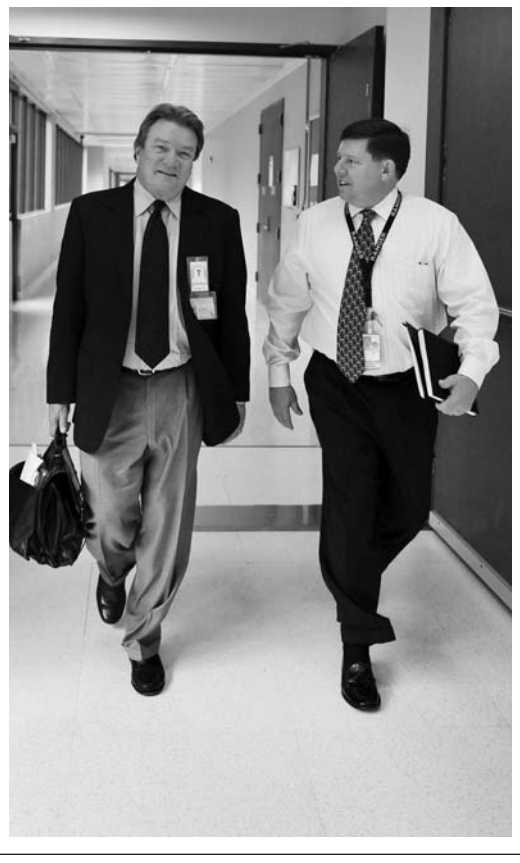
SITUATION FOR AN ADULT OR CHILD	DECISION
The person does not have a fever (temperature is less than 38°C or 100.4°F), but does have these symptoms: > Sore throat > Stuffy nose > Runny nose > Cough	**Probably a cold.** **Rest is indicated.**
The person has a fever over 38°C (100.4°F) that is accompanied by these symptoms: > Cough > Sore throat > Significant fatigue > Headache > Muscle aches **AND** The person does not belong to a group at higher risk of developing flu-related complications (see next box.)	**Probably the flu.** **Rest at home** until 24 hours after the fever is gone (without the use of fever-reducing medication.) Drink plenty of liquids and take fever reducers such as ibuprofen and acetaminophen. Children with fever should not take aspirin or aspirin-containing products such as Pepto-Bismol. Children younger than 4 years of age should not be given over-the-counter cold medications without first speaking with a health care provider.
The person has a fever over 38°C (100.4°F) that is accompanied by these symptoms: > Cough > Sore throat > Significant fatigue > Headache > Muscle aches **AND** The person belongs to a group at higher risk for flu-related complications (children under 2 years of age; adults age 65 and older; pregnant women; persons under 19 years of age on long-term aspirin treatment; and people of any age who have a chronic lung disease such as asthma or COPD, diabetes, heart disease, cancer, kidney or liver disorders, blood disorders such as sickle cell disease, weakened immune systems from medications or AIDS, brain or spinal cord injuries, or neuromuscular disorders such as muscular dystrophy and multiple sclerosis.)	**Probably the flu.** **Contact a doctor today** for possible treatment with anti-viral medications that might decrease the risk for severe flu complications (most effective when started within 48 hours of symptoms onset.) **ALSO** Rest at home until 24 hours after the fever is gone (without the use of fever-reducing medication.) Drink plenty of liquids. Take fever reducers such as ibuprofen and acetaminophen as directed by your doctor. Children with fever should not take aspirin or aspirin-containing products such as Pepto-Bismol. Children younger than 4 years of age should not be given over-the-counter cold medications without first speaking with a health care provider.
The person has a fever and one of these symptoms: > Shortness of breath > Difficulty breathing > Painful breathing > Vomiting for more than four hours > Fever in a child who is too quiet and less active than normally or who refuses to play or is agitated	**See a doctor today.**
The person has a fever over 38°C (100.4°F) **AND any one of the following:** > Difficulty breathing that persists or worsens > Blue lips > Difficulty moving > Severe neck stiffness > Drowsiness, confusion, disorientation, or difficulty being roused > Convulsions > No urination for 12 hours > Fever in an infant under 3 months old	**Go to the emergency room immediately.** **Call 9-1-1, if necessary.**

NEW MEXICO DEPARTMENT OF HEALTH

This publication was supported by Grant # 1H75TP000364-01 from the CDC.

60 Minutes, Steve Kroft come to Sandia

Program on cyber security expected to air this month



A FILM CREW with CBS' *60 Minutes* spent the better part of two days at Sandia last week gathering video footage and conducting interviews for an upcoming segment on cyber security. The *60 Minutes* producers and reporter Steve Kroft have been working on the story for six months and they said it probably will air sometime this month. Above, camera operator Bill Hitchcock (left) talks to Sandia Fellow Jim Gosler (12003), senior producer Graham Messick, and Kroft before Kroft's interview with Jim. At right, Sandia Communications Director George Rhynedance accompanies Kroft in the hallway of Bldg. 858 where Sandia's cleanrooms are located. Kroft also interviewed John Mulder (5628) with the Labs' SCADA security team. (Photos by Randy Montoya)

Sandia/New Mexico sets new marks in recycling

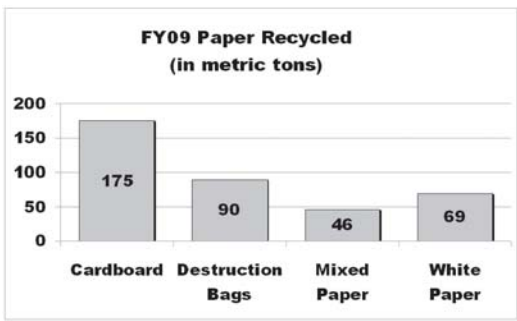
The annual America Recycles Day focuses national attention on recycling issues and — closer to home — highlights Sandia/New Mexico's accomplishments with recycling in FY09.

634 POUNDS of shrink wrap in a sea of cardboard.

With increased participation from individuals and organizations across the Labs, Sandia exceeded the corporate Environmental Management System annual goal of recycling 55 percent of solid waste, setting a site record by achieving 56.85 percent. Sandia/California has been above 50 percent of solid waste recycled and has been continuously improving that mark since FY04, often reaching between 70 percent and 80 percent. The DOE complex average is approximately 44 percent.

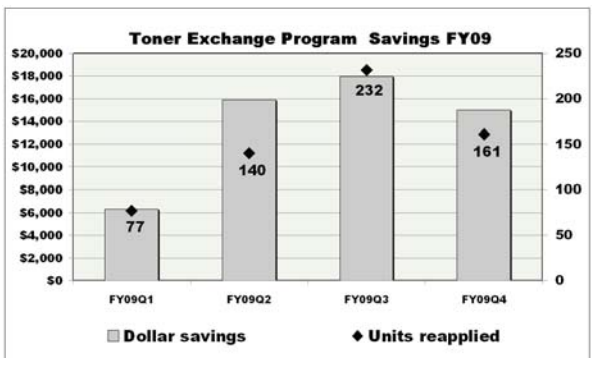
Throughout Recycling Awareness Month, Sandia's Pollution Prevention group (4131) will be hosting a table at the Thunderbird Cafe for national America Recycles Day on Monday, Nov. 16. Experts will be on hand to answer questions about both solid waste and hazardous waste recycling at work and at home. Informational brochures and recycle bins will be available as well. Sandians will be challenged to make a personal pledge to increase recycling efforts at www.americarecyclesday.org.

A major component of Sandia/New Mexico's recycling portfolio is paper. One-third of the Labs' recycled solid waste is cardboard, paper in destruction bags, mixed paper, and white paper. Launched as a pilot effort in FY07, and still largely dependent on volunteers, is mixed paper recycling. About 500 collection points have been established in Labs buildings, and collection weights have almost quadrupled in three years. Ongoing attention to placing each paper type in its correct container and keeping inappropriate materials out is contributing to the success of the mixed paper effort.



FY09 saw the introduction of several new recycle streams at Sandia, including alkaline batteries, Styrofoam blocks, shrink wrap, and other plastics.

The toner exchange program has continued strong for its fourth year, and the new binder exchange program was launched at the end of FY09.



To meet packing foam and mixed paper goals in FY10, Sandia plans to begin recycling packing foams #4 and #5, and continues to investigate potentially recycling polyurethane foam, shredded paper, and fiber optic cable. If you have questions about recycling or are interested in recycling more materials from your department, contact Pollution Prevention by searching the Techweb for "Recycle." Further recycling and disposal instructions can be found there and on the Get Rid of It website.

THESE VOLUNTEERS at Sandia Base Elementary School were among the more than 275 Sandians who participated in Make a Difference Day activities.

Make a Difference Day brings out record number of Sandia volunteers

"We had an outstanding response to Make a Difference Day," says Patty Zamora, (3652), Sandia's volunteer coordinator. "We had more than 275 volunteers, including employees, contractors, retirees, and family members."

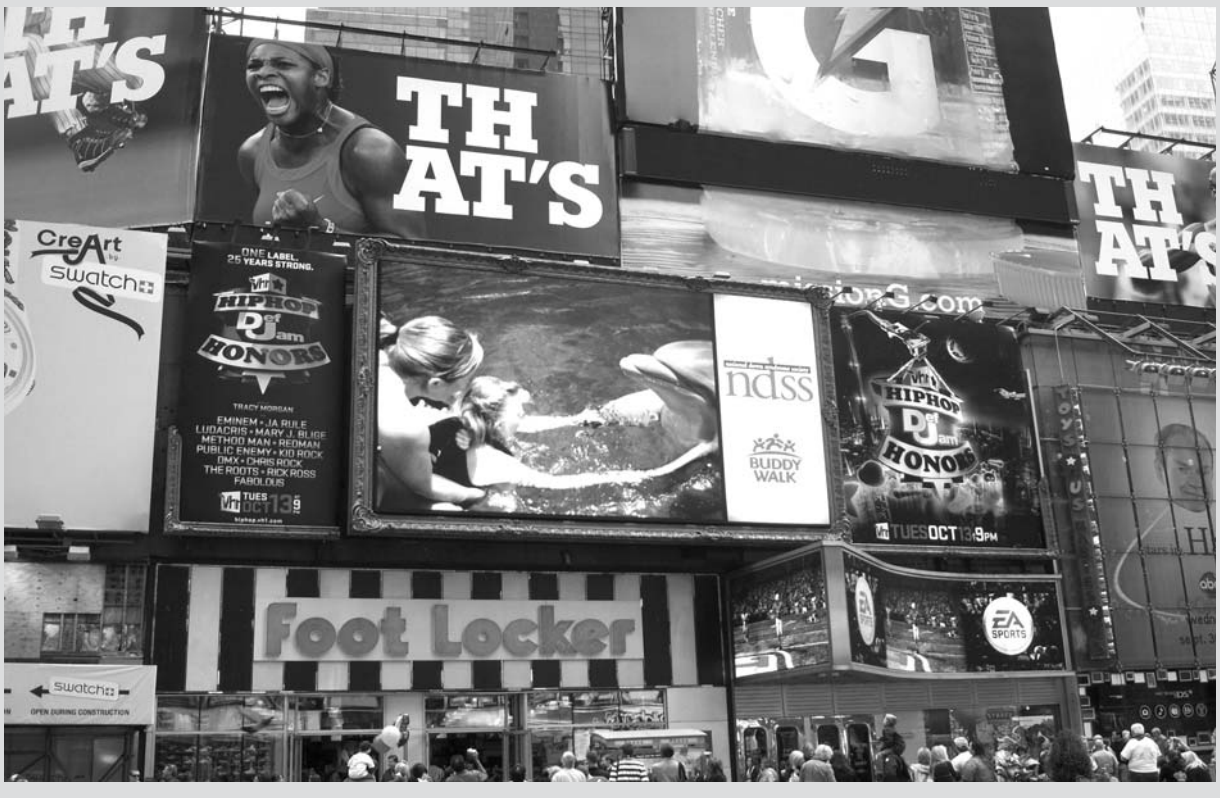
The volunteers completed the following projects:

- Baked 3,360 cookies for Community Health Charities of New Mexico. The cookies will be sold at the Holiday Cookie Walk fundraiser.
- Assembled and donated 40 quilts to KAFB Quilts. Quilts will be donated to infants of military families.
- Painted a multicolored United States map and interior wall at Sandia Base Elementary playground.
- Helped out at the Albuquerque Bernalillo County Children's Water Festival. Teaching 4th-grade students about water through fun, hands-on activities.
- Constructed a food preparation area for the Albuquerque Opportunity Center for the Homeless.
- Prepared food boxes for individual emergency assistance programs with the Economic Council Helping Others Food Bank.
- Labeled children's books at Erna Fergusson Library.
- Supported the Rio Grande Community Farm event.
- Cleaned and organized storage space for Susan's Legacy.
- Supported the APS Education Foundation Boo Ball.
- Gardened at the Albuquerque Rose Garden.
- Installed trim around air conditioner units at Casa Esperanza.
- Prepared 10,000 senior-helping boxes for distribution to low-income seniors at Roadrunner Food Bank.

VOLUNTEERS PAINT A MAP of the US at Sandia Base Elementary School on Kirtland Air Force Base as part of Make a Difference Day.

GREEN-THUMBED Sandians prepare soil at the Albuquerque Rose Garden.

SANDIANS PITCH IN to assemble quilts that will be donated to infants of military families.



BRIGHT LIGHT IN TIMES SQUARE

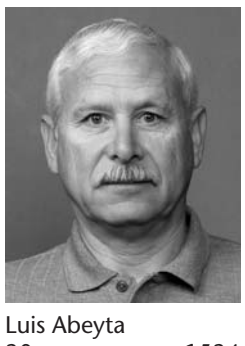
Angelina Minton's video appeared on Broadway on Sept. 26 as part of the National Down Syndrome Society video production to demonstrate that people with Down syndrome can be successfully included in community activities, education, and employment.

Angelina is the daughter of Sandian Miriam Minton (6414). Angelina is pictured swimming with Squirt, a dolphin in Key Largo, Fla. Her photo was selected from more than 2,500 entries.

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong

David Gartling
35 1500



Luis Abeyta
30 1534

Recent Retirees

Jim Buttz
35 6472

Molly Minana
15 6325

Mike Kanouff
30 8365

Evelyn Baca
25 8500

Frank Bielecki
25 8517

Carol Bonney
25 4136

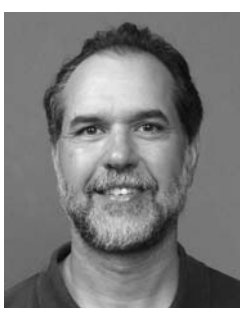
Robert Clevenger
25 8513

Alice Johnson
25 8248

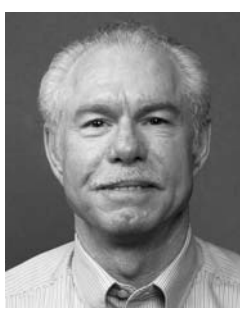
Clifford Loucks
25 6471

Todd Owen
25 245

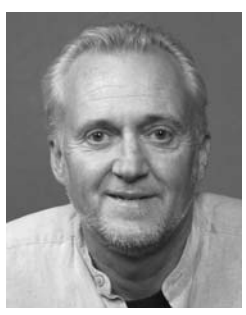
Lorenzo Salgado
25 6753



Steve Conrad
20 6322



Bob Dana
20 5099



Raivo Leeto
20 1735

Doug Vrieling
20 8512

Ellis Errett
15 1746

Iris Gorshen
15 8945

Linda Groves
15 8112

William Kitsos
15 4853

Cindy Kuffner
15 8100

Mary Roehrig
15 212

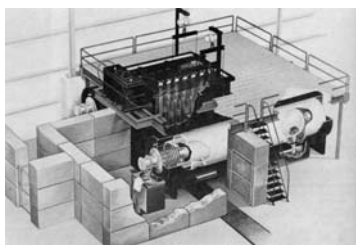
Judy Sesma
15 6432

Dennis Youchison
15 1658

50 years ago . . . Construction at Sandia is booming. The face of Sandia Laboratory changes daily. In the lobby of Bldg. 800 a new reception area is completed and refurnished. In Area III a two-story reactor vessel waits to be installed. A Radiant Heat Facility, Complex Wave Facility, Acoustical Test Facility and Vibration Facility are under construction. In Tech Area I a new three story environmental laboratory, Bldg. 861, is ready for partitions and installation of equipment. Bldg 841, a new specialties building for the Development Shops, grows with steel girders daily. New sidewalks and paving run throughout the area. In Coyote Test Area a new field headquarters building is almost ready for occupancy. Dozens of other projects are underway. A reclamation facility, Bldg. 870, is almost complete. Additions are being made to the Van de Graaff facility, Industrial Hygiene Bldg. 868 and to Medical Bldg. 831. A new metal cutting facility in Bldg. 851 is being built.

REACTOR PRESSURE VESSEL stands in Area III undergoing inspection prior to installation.

40 years ago . . . A new test facility that incorporates **a new machine called REBA** (Relativistic Electron Beam Accelerator) is now undergoing operational testing in Area V. REBA produces a beam of electrons about four inches in diameter traveling at almost the speed of light. Energy output of the machine — 3.25 megavolts at 50,000 amperes — is released in a pulse of about 70 nanoseconds duration. REBA complements existing facilities in Sandia's radiation effects program and provides an additional tool for materials properties studies and for research in electron beam propagation. REBA replaces the old Hermes I flash x-ray machine which was first built to prove the principles now incorporated into the giant Hermes II facility. After initial design testing of Hermes I, the machine saw considerable use in laboratory experiments.



REBA (Relativistic Electron Beam Accelerator) facility is now undergoing operational testing in Area V.

30 years ago . . . Sandia Laboratories has begun development of a neutron generator for use in cancer treatment. The two-year program will be supported by an $800,000 grant from the National Cancer Institute.

DON COWGILL AND FRANK BACON, both of Applied Technology Division 2352, examine target element of neutron generator designed for application to cancerous tissue.

The new project follows two years of research at the Labs to determine if technology used in nuclear weapon neutron generators could be adapted for use in cancer treatment. The generators have long been used in weapons to produce an intense burst of neutrons to initiate an explosion, but it wasn't known whether devices could be adapted to produce continuous beams of intense radiation for cancer therapy. The Sandia research indicates that the generators can be so adapted. **Sandia and Diamond Oil Well Drilling Company have developed and successfully tested an advanced pressure coring system** using a drill bit equipped with synthetic diamond cutters and a special fluid that blocks invasion of the core by drilling mud. A problem with current pressure coring techniques is that while cores can be reliably sealed to maintain down hole pressure, the slow drilling rate permits the drilling mud to wash away a number of residual fluids (oil, salt water, natural gas, etc.) that are important in the analysis of the sample.

20 years ago . . . Sandians celebrated the 40th anniversary of Sandia Corporation, when Sandians officially became employees of the Sandia Corporation, then a subsidiary of Western Electric.

LEONARD BAKER of Drilling Technology Division 4741 holds Sandia's pressure coring drill bit.

10 years ago . . . Sandia-developed geothermal drilling technology played a key role in helping "kill" a wildcat natural gas well in California that blew out and remained out of control for six months. As all attempts above ground to cap the well failed, a relief well designed to intercept the first well's bore was started a quarter-mile away. Concerned that the same conditions that led to the first blowout were likely with the second, engineers and drill operators wanted a way to quickly detect gas kicks. (A kick is an influx of gas in an oil or gas well or stream in a geothermal well.) A device developed at Sandia, called a rolling float meter, that monitors drilling fluid, returns to rapidly detect loss of circulation during geothermal drilling was employed. Cement was pumped into the well on May 26, and the well was finally killed.

FLAMES BILLOW more than 200 feet high at a gas well fire near Bakersfield, Calif. (Photo courtesty of Epoch Wellsite Services, Inc.)

Bees fascinate, motivate, inspire Sandian Graham Yelton

Bees are 'real industrialists, real survivors,' says Sandia beekeeper

Story by Rachel Kolb
Photos by Randy Montoya

When entering the office of Graham Yelton (1725), at first glance everything seems rather ordinary. There is a desktop monitor, a bookcase, and a window opening to a view of the New Mexico desert. But hidden in one corner is something that reveals a side of Graham unrelated to his work: a bee swarm trap.

GRAHAM YELTON

Graham, a chemical engineer in Sandia's energy and weapon programs, has been an avid beekeeper for more than 10 years. His hobby has taken him all over New Mexico, as far north as Las Vegas and as far south as Truth or Consequences, in pursuit of seasonal pollen and nectar for his hives.

The swarm trap, he explains, is something he keeps on hand, just in case. Swarms are colonies of bees that divide and seek a new home due to impending overpopulation. Even while at Sandia, Graham is always prepared to give a group of hapless bees a place to stay. This enthusiasm for bees is typical for Graham, who first became interested in beekeeping in the 1970s, when he decided to start a hive to support his hobby of gardening. "I had no idea how to raise bees then," he says. "I probably killed more than I raised. I got disappointed and frustrated."

COLLECTING POLLEN from a hive.

In 1995, Graham returned to beekeeping when he let a commercial beekeeper place some hives on his property in the East Mountains. "He brought 14 hives over, and I started working. I learned a lot," says Graham. Soon those 14 hives had ballooned to 60. Graham began getting some hives of his own and expanding his operation to other sites in New Mexico.

Since he works full-time, Graham now limits his hives to less than 50. This includes nucs, a beekeeping term for starter colonies, and productive hives, which are hives that produce an excess amount of honey beyond what is needed to get the colony through the next winter.

GRAHAM YELTON examines one of many bee hives he keeps in locations around the state.

"Beekeepers only take the surplus," Graham says. "We leave enough for the bees to survive the winter. Our goal is to give the bees enough food."

A weak productive hive will produce roughly 45 pounds of honey per year, but Graham has seen strong hives produce more than 300 pounds in a good year, when rain is abundant and flowers prolific.

Graham currently supplies honey to a few coffee shops. He also sells directly to locals year-round. "Most years we produce five varieties of honey, starting with mesquite in the spring and finishing the honey flow with fall wildflowers," he says.

Gathering honey is one aspect that makes beekeeping worthwhile. "People don't realize that honey is like wine: there are many different flavors, colors, textures, depending on the colony of bees and the flowers they pollinate," Graham says.

His beekeeping operation does not filter its honey, keeping the pollen in for its reputed salubrious effects on the human immune system. He also says the honey is good for facial and hand lotion.

Even the sweetest honey, however, does not compare to what Graham says is the best part of beekeeping: the bees themselves. "They're incredible to watch," he says. "They're real industrialists, real survivors. The colony will work together, there's no one individual, they think like one — that fascinates me."

A PRODUCTIVE HIVE can produce more than 300 pounds of honey in a good year.

THESE HIVES produce five varieties of honey each year.

HONEY IS LIKE WINE; there are many different flavors, colors, and textures.

Colony collapse disorder and Africanized bees pose challenges to apiarists

According to beekeeper Graham Yelton (1725), beekeeping involves the complex task of maintaining hive health while looking out for the good of the environment and of humans. Two recent problems faced by beekeepers, colony collapse disorder (CCD) and the spread of hybrid Africanized honeybees, epitomize this challenge.

TWO BEEs OR NOT TWO BEEs — More like hundreds of bees in a typical hive.

CCD is a syndrome where adult honeybees go out to forage and never return. The colony loses its adult workforce to the point that only nurse bees remain alongside the queen, and soon the colony collapses to the point of failure. This disorder is wiping out large numbers of bee colonies and — because of their vital role in plant pollenization — threatening agricultural production around the world.

"At present, there is not one cause linked to CCD, but it is believed that bee decline is related to numerous factors including pathology, immunology, toxicology, genetics, nutrition, and hive management practices," says Graham.

Africanized honeybees, first introduced from Africa to the Sao Paulo area of Brazil in 1956 in an attempt to improve productivity, have spread throughout much of the southern US since 1990. These feral bees are superior foragers and have a remarkable resistance to diseases and parasites that commonly threaten European honeybees, but are extremely mobile and aggressive. In an attempt to mitigate their spread and aggression, Graham says that beekeepers are presently replacing queens with hybridized European honeybees, but ultimately will need to shape more desirable genetic traits from the Africanized bees.