

THE ARIZONA HYDROLOGICAL SOCIETY

NEWSLETTER

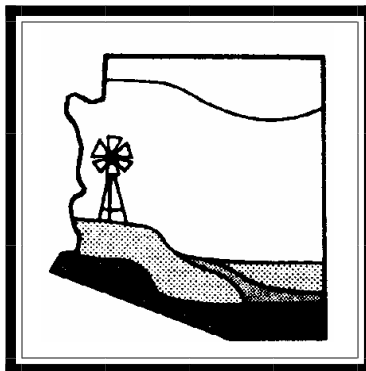


HERMAN BOUWER – IN THE INTERNATIONAL SPOTLIGHT

-by Dennis Shirley
Errol L. Montgomery & Associates, Inc.

We at AHS have always known how fortunate we are to count Dr. Herman Bouwer as one of us. Herman is widely recognized as one of the foremost groundwater hydrologists and experts in the field of artificial recharge in this country. Yet Herman is much more than that. Those that know Dr. Bouwer as colleagues, students, and water resource professionals understand that Herman has selflessly dedicated his life to learning, serving, and helping others. We also realize the world is a better place in return.

So what better person to receive the prestigious International Prize for Water in the field of Artificial Groundwater Recharge? Over a year ago, AHS with support from the Arizona Society of Civil Engineers, nominated Herman for the inaugural International Prize for Water, established through the patronage of Prince Sultan bin Abdulaziz and the Kingdom of Saudi Arabia. The Water Prize recognizes outstanding contributions by innovative scholars and scientists as well as applied water resource organizations worldwide. The Prize aims to advance research dedicated to solve the problems associated with the provision as well as the preservation of adequate and



sustainable water resources, particularly in arid regions.

On November 2, 2004, Herman was notified that he won the International Water Prize for his lifetime work in artificial groundwater recharge. The Prize includes a monetary award of 500,000 Saudi Riyals (about \$133,000) and a gold medallion celebrating his accomplishments. Herman is regrettably unable to travel to King Saud University in Riyadh to receive the award on December 5.

continued on page 2



PLEASE SEND ME A CHRISTMAS CARD

-by Leilani Bew
Errol L. Montgomery & Associates, Inc.

Actually, please send AHS a Christmas card...In the flurry of December activities, it is hard to remember to take care of little chores, so that's what I'm here for. It is time for all AHS members to renew their memberships for 2005. Because we operate on a calendar year, all dues are due by January 1.

There are three categories of members who do not have to send in their 2005 dues. The first is our elite group of lifetime achievement award winners. The second group of lucky folks are those who paid registration fees for the 2004 Annual Symposium; your dues for 2005 were included in your fees. Finally, for those of you who

continued on page 2

CONTENTS

HERMAN BOUWER – IN THE INTERNATIONAL SPOTLIGHT	1
PLEASE SEND ME A CHRISTMAS CARD	1
USDA PROVIDES \$19.5 MILLION FOR SALINITY CONTROL IN THE COLORADO RIVER BASIN	2
OVERVIEW OF THE 85 TH ARIZONA TOWN HALL	3
CHAPTER NEWS	4
ISOTOPES FROM FEATHERS REVEAL BIRD MIGRATIONS	6
CASSINI'S RADAR SHOWS TITAN'S YOUNG ACTIVE SURFACE	8
MEMBERS ON THE MOVE	9
EMPLOYMENT OPPORTUNITES	9



USDA PROVIDES \$19.5 MILLION FOR SALINITY CONTROL IN THE COLORADO RIVER BASIN

The following is a Nov. 1, 2004, U.S. Department of Agriculture news release. It can be found at http://www.usda.gov/wps/portal/ut/p/_s.7_0_A/7_0_10B?contentidonly=true&contentid=2004/11/0489.xml. LKB

The U.S. Department of Agriculture today announced that Colorado, Utah and Wyoming will receive \$19.5 million in Environmental Quality Incentives Program (EQIP) funding to control salinity in the Colorado River Basin. The Natural Resources Conservation Service (NRCS) will provide \$9.7 million to both Colorado and Utah and \$90,000 to Wyoming. Only these three states have USDA-approved salinity control projects in the basin.

The Colorado River Basin is the primary domestic water supply source for 27 million residents in seven states (portions of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) and a source of irrigation water for more than 3.5 million acres of farmland.

"These funds will help farmers and ranchers control salinity on their lands and improve water quality in the basin so that millions of people can have a cleaner, safer domestic water supply," Agriculture Secretary Ann M. Veneman said.

Through EQIP, NRCS works with eligible agricultural producers in the basin who voluntarily implement land management and irrigation improvement practices that reduce salinity by preventing salts from dissolving and mixing with the river's flow.

Improved irrigation systems reduce leaching in the soil which, in turn, reduces the amount of salt that moves through the soil into the water table. The end result is that less salt ends up in the Colorado River that flows more than 1,400 miles from its headwaters in Wyoming and Colorado to the Gulf of California in the Republic of Mexico. USDA partners with the U.S. Department of Interior's Bureau of Reclamation (BR) and Bureau of Land Management to carry out Colorado River Basin salinity control activities. The Colorado River Basin Salinity Control Forum, established in 1973 by the basin states, provides interstate and interagency coordination and guidance for the combined state and federal salinity control efforts.

For every dollar of EQIP funds allocated to salinity control in the authorized project areas, 43 cents is made available from accounts in BR's basin states for on-farm financial and technical assistance.

USDA aims to reduce the salt loading by 705,000 tons by the year 2020. So far, agricultural producers have reduced over 404,000 tons of salt or nearly 57 percent of the USDA goal. The overall goal for the federal partners is to reduce 1.8 million tons of salt annually by the year 2020.

Additional information on USDA's Colorado River Basin salinity control activities is on the web at <http://www.nrcs.usda.gov/programs/salinity/index.html>. Additional information on EQIP is at <http://www.nrcs.usda.gov/programs/eqip>.



HERMAN BOUWER CONTINUED FROM PAGE 1

AHS heartily congratulates Herman for this distinguished honor! We are delighted to see international fame and fortune bestowed on our trusted friend and mentor. In recognition of this prestigious award, AHS will be hosting a fun and festive celebration in January to honor Herman and Jesse Bouwer. Stay tuned for more details in our January newsletter or visit our website at www.AzHydroSoc.org.



CARDS CONTINUED FROM PAGE 1

joined AHS during the months of October, November, or December of 2004, you will be current through December 2005.

Everyone else needs to pay their dues to continue uninterrupted newsletter delivery. If you have not already done so, you will be receiving a postcard to help you remember to take care of business. The fee for regular membership is \$40.00 for the calendar year; student rate is \$15.00 with a valid student ID. You may send a check made out to AHS (and a Christmas card?) to:

Leilani Bew
Errol L. Montgomery &
Associates, Inc.
1550 E. Prince Rd.
Tucson, AZ 85719

or visit the AHS website at www.AzHydroSoc.org to renew online.

All of us wish all of you a very happy holiday season and a peaceful and healthy 2005.



OVERVIEW OF THE 85TH ARIZONA TOWN HALL

-by Marvin Glotfelty
Clear Creek Associates

*This item was also published in the Arizona Water Well Association's newsletter **Well Said**. LKB*

The 85th Arizona Town Hall involved a gathering of 177 invited participants at the South Rim of the Grand Canyon for the three days between October 31 and November 3, to debate the issue of "Arizona's Water Future: Challenges and Opportunities." The goal of the Arizona Town Hall is to seek consensus of its participants on important issues, with a resulting report of their conclusions and recommendations. While not all of the Town Hall participants will agree with each of the conclusions and recommendations that are generated, the Town Hall report reflects a significant degree of their collective views and opinions.

The attendees at the 85th Town Hall had some very impressive titles, such as Chairman of the Board; Chief Executive Officer; President; Mayor; Town Manager; etc. The Town Hall organizers asked us all to leave our titles at the front gate (which was pretty easy, in my case), and maintain an open but focused dialogue on the issue of Arizona's water. The Town Hall included participants from no less than 40 different Towns and Cities across the State (from Kingman to Yuma to Morenci, and many communities in between). Our educational institutions were represented by our three Arizona universities (ASU, NAU, and U of A) and numerous community colleges, and several state agencies (including

ADWR, ADEQ, and the Arizona State Land Department) were also represented. There were participants from Indian Tribes (such as the Gila River Indian Community), and federal agencies (such as the U.S. Forest Service, National Park Service, U.S. Army Corps of Engineers, and U.S. Bureau of Land Management). Environmental and lobbying groups (such as the Nature Conservancy and the Arizona Municipal Water Users Association) were also represented, along with industrial, development, and agricultural entities (such as real estate companies, land developers, Phelps Dodge Corporation, Intel Corporation, and farmers from various areas). Large water providers and irrigation districts (such as the Salt River Project, Maricopa Water District, Central Arizona Water Conservation District, and Arizona Water Company) were represented, along with water lawyers, and water policy experts, and a few hydrogeologists.

The Town Hall was divided into five discussion panels, with an equal blend of the various entities (municipal, industrial, agricultural, regulatory, technical, etc.) on each panel. For the next 2½ days, we had many excellent discussions on such topics as balancing expectations and realities for Arizona's water future; drought planning; watershed management; conservation alternatives; and options for water resource development and funding. On the final ½ day of the Town Hall, all five panels came together to gain consensus and vote on the wording for our final report. Here are some of the Town Hall recommendations (paraphrased in my general wording and comments):

- Water management and planning efforts for Arizona's future will require reliable and current information. There must be improved and expanded information gathering regarding the water resources of the State, especially in rural areas. This may include increased regulation and metering requirements on exempt wells, which is a controversial topic in many rural areas. It is a reality, however, that with our arid climate, limited water resources, and explosive population growth, we can no longer fail to obtain and analyze data on all our aquifers and water systems.

- The Arizona Department of Water Resources must be adequately funded to meet its mandate of managing the State's water. Budget cuts have reduced this agency's staff and capabilities during that past few years, while population growth and water demands have increased enormously in most areas of Arizona. The legislature must provide for this funding, which will ultimately benefit all Arizona water users. Funding of proper water management and planning by ADWR may require impact fees or implementation of a pump tax in some areas. Those funding mechanisms will not be popular, but the consensus of the Town Hall is that those who benefit from water use should be responsible to pay for the true long-term cost of that water. We cannot put the burden of today's population growth and water consumption on future generations.

- The report of the 4th Arizona Town Hall in 1964 provided a recommendation against failing to use our full allotment of surface water, "which would result

continued on page 6

CHAPTER NEWS



FLAGSTAFF

-by Nancy Riccio
Plateau TechComm / Plateau
MediaWorks

RECAP OF NOVEMBER SYMPOSIUM PLANNING MEETING

Flagstaff Chapter members met again on November 3 to continue planning for the 2005 symposium. We narrowed down choices for possible venues, themes, and formats, and discussed hiring an event coordinator. Three members (Don Bills, Richard Brose, and Jim Janacek) also volunteered for the "Executive Committee," which will assume the duties of the Symposium Chairperson.

DECEMBER MEETING

Thursday, December 9, 2004

We're combining the next symposium planning meeting with our annual Christmas dinner on December 9, starting at 5:30 PM. This event will tentatively be held at the Weatherford Hotel. Details will be announced via email and posted on the AHS website. ❄️



PHOENIX

-by Lee-Anna Walker
Archaeological Consulting Services, Ltd.

NOVEMBER MEETING SUMMARY

Marvin Glotfelty (Clear Creek Associates) and Basil Boyd (City of Tempe) presented the Phoenix Chapter with a tale of two wells (Well-15 and Well-12).

Both wells were drilled in the same parcel in Tempe for back-up municipal water supplies. Based upon their close proximity to one another, similar geophysical logs and similar cuttings, the geology does not appear to differ significantly between the two wells. Well-12 was drilled to an approximate depth of 1,200 feet and had a pumping capacity of 2,500 gallons per minute. No unusual issues were encountered during Well-12's construction and development. On the other hand, numerous attempts to straighten out the boring for Well-15 were required, resulting in a very large diameter boring. During the initial pump test, Well-15 had a disappointing pumping capacity of 150 gallons per minute, unlike the 2,500 gallons per minute in Well-12. Well designs alone could not explain the difference in the pumping capacities, since both had similar designs, construction materials, and initial well development efforts. It appears that the main difference between them was Well-15's large annulus and skin damage that resulted from the multiple attempts to straighten out the boring.

Numerous attempts were made to improve the water production from Well-15. First, a dispersant was added to help mobilized the finer particles trapped in formation and filter pack sand outside the well screen. Unfortunately, this was unsuccessful. A cable tool rig was then mobilized to the well, and a Mills knife perforation tool was used to cut slots in the louvered well screen. This allowed the filter pack sand to flow into the well

casing, creating an open annular void outside the casing. Once the filter pack sand was removed by bailing and air lifting techniques, the well was again developed by swabbing and pumping. After the additional development, pumping tests indicated that the production of Well-15 had improved to approximately 2,000 gallons per minute with 240 feet of draw-down, much closer to the 2,500 gallons per minute seen in Well-12.

The lessons learned from the two City of Tempe wells may provide insight for design and development standards of similar wells in the future. For example, in similar geologic settings, development of a natural gravel pack or a well design with a relatively thin filter pack envelope may be appropriate options.

Thanks to our speakers for an interesting and informative presentation.

DECEMBER MEETING

Tuesday, December 14, 2004

Time:
5:30 PM Social Hour
6:30 PM Dinner
7:15 PM Meeting

Location:
Macayo's Depot Cantina
300 S. Ash, Tempe

Topic: "Do we need to learn to live with drought?" presented by Mark Raming of SWCA

CHAPTER NEWS

PHOENIX NEWS
CONTINUED FROM PAGE 4

Cost: \$12 members, \$17 non-members, \$5 students

Please RSVP by Friday, December 10 to Beth Proffitt by phone at (602) 437-0330 or by email at: eproffitt@transgeo.com.

Abstract: Are annual precipitation and temperature averages realistic or are current "drought" conditions the norm? The interpretation of climatic averages based upon archeological tree ring data and ice cap cores paint a complex and very dynamic image of long-term regional and continental weather conditions. Findings indicate that contemporary settlement of the Western U.S. likely occurred during a wetter than normal period over the last 600 years. Is that a trend we can count on? Will we ever know for sure? Come hear some of the facts and draw your own conclusions.

LOOKING AHEAD...

Dr. Phil Christensen with ASU will be discussing the Mars program in March.

February, April, and beyond are open for presentations. Please contact a Phoenix Chapter officer if you are interested in sharing your work and ideas. ❄️



TUCSON

-by Phil Bredfeldt
Clear Creek Associates

NOVEMBER MEETING

Kerry Schwartz, the Education Program Coordinator at the University of Arizona's Water Resources Research Center and the State Coordinator for Project WET International, spoke to the Tucson Chapter on November 9. Her presentation was entitled "An Overview of Project WET (Water Education for Teachers)".

Established in 1957, Arizona Water Resources Research Center (WRRRC) was created to provide statewide outreach and education focused on critical water issues affecting Arizona. In addition, the WRRRC provides the public with expertise on state and regional water management and policy. The WRRRC works with public and private organizations and with individuals to provide information and services through outreach, conferences and symposia, and a publications program that includes two newsletters. As part of this public outreach mission, the WRRRC is directly involved with the Arizona branch of Project WET.

Project WET is an international, interdisciplinary, water education program for formal and non-formal educators and students ages 5 to 18, as well as a basis for adult learning. The program provides numerous curriculum guides, activity ideas, and teaching aids to help educate the public of the importance of

water resources, and to promote responsibility and community participation. The curriculum covers all aspects of water and its uses, including the properties of water, the water cycle, watersheds, groundwater, water quality, water rights, as well as an understanding of the importance of water to all water users. Arizona's Project WET also hosts learning workshops and local water festivals, which occur each year on the National Water Education Day in September.

Through participation in Project WET studies, students learn to identify a question, formulate a hypothesis, control and manipulate variables, devise experiments, predict outcomes, compare and analyze results, and defend conclusions in activities like *H2Olympics*. In *Just Passing Through*, *Incredible Journey* and dozens more activities, students use their own bodies as models for simulating processes. Students learn to organize and present data gathered from their own experiences using mathematical and graphical representations in activities like *Back to the Future* and *Get the Groundwater Picture*. Students are asked to analyze data, scientific reports, and finally come to consensus with people that hold different opinions in *A Grave Mistake* and *Water Bill of Rights*.

At the chapter meeting, Kerry presented a visual aid tool she often uses to simulate a groundwater aquifer, complete with stratified beds, observation wells, pumping wells, and surface recharge points. By using a hand-operated pump and food



**TUCSON NEWS
CONTINUED FROM PAGE 5**

coloring, the model can display the nature of groundwater flow characteristics in cross section. The WRRC owns several of these models, which can be checked out for free for use in the classroom.

Additional information about Project WET and the WRRC can be found at www.ag.arizona.edu/AZWATER/, and www.ag.arizona.edu/AZWATER/wet/.

The Tucson Chapter would like to thank Kerry for both an informative presentation, and for her water resources public education efforts in the local community and throughout Arizona.

DECEMBER MEETING

Tuesday, December 14, 2004

Time:

**7:00 PM Social Half Hour
7:30 PM Presentation**

Location:

Errol L. Montgomery & Associates, Inc.

Topic: Current water issues and policy in the San Pedro Watershed presented by Dr. Tom Maddock, Department Head, Hydrology and Water Resources Department, University of Arizona

On Tuesday evening, December 14, Dr. Tom Maddock, Department Head and Professor at the Hydrology and Water Resources Department at the University of Arizona, will be speaking on current water issues and policy in the San Pedro Watershed. Dr. Maddock has worked

in the San Pedro watershed for many years, and has been instrumental in the development of groundwater flow models, including a fine-grid multilayer flow simulation model of the Middle San Pedro River Basin. Dr. Maddock has also long been involved with water policy in the Upper San Pedro Basin, and will be speaking about current and upcoming changes in the water use and/or policy in the basin, and with time permitting, some of his current work in the Rio Grande.

LOOKING AHEAD...

Dr. Frank D'Agnese, a Consultant and Senior Partner at Earth Knowledge, LLC, will be speaking at our January 11 meeting. Dr. D'Agnese's presentation will discuss Earth Knowledge's current efforts to build stronger and more-informed multi-stakeholder involvement in water sustainability projects in the southwest-



**TOWN HALL CONTINUED
FROM PAGE 3**

in any water in the Colorado River entering Mexico which is not chargeable to Mexico's treaty allocation." But now, 40 years later, we are allowing 100,000 acre-feet per year of Arizona's entitled water to flow into Mexico. That situation can be addressed by starting up and operating the Yuma Desalting Plant, which has been mothballed for the past decade. Operation of the desalting plant would allow use of our full surface water allotment, while maintaining river flow into Mexico in accordance with our treaty obligations.

- Education programs for all Arizonans are critical to create a statewide conservation ethic

and encourage participation in conservation activities. Financial incentives for conservation should be offered, and policy-makers should evaluate existing water subsidies and not reward wasteful practices. The Town Hall commended Governor Napolitano's establishment of the "virtual water university" that brings together the resources of the three Arizona Universities for scientific water research. However, the Town Hall also encouraged further development of a conservation curriculum for grades K-12, which would require a meaningful public education campaign "beyond slogans and sound bites."

The full text of the 85th Arizona Town Hall will hopefully be available soon, at which time I would be glad to share the full text with anyone who is inter-



**ISOTOPES FROM
FEATHERS REVEAL
BIRD MIGRATIONS**

The following is a press release from the Geological Society of America. It and others can be viewed at <http://www.geosociety.org/news/pr/03-39.htm>. LKB

Using naturally occurring patterns of stable-isotopes created by weather and plants, Jason Duxbury of the University of Alberta and his colleagues are tracking the migration routes of birds of prey. Their work on the summer origins of migrating and wintering Peregrine Falcons and Burrowing Owls has shed new light on what has previously been the secret, non-breeding half of the birds' lives.

By analyzing stable isotopes of hydrogen, carbon, and nitrogen in bird feathers, Duxbury has been able to trace Burrowing


**ISOTOPES CONTINUED
FROM PAGE 6**

Owls wintering grounds in southern Texas and central Mexico, as well as migrating Peregrine Falcons caught on the gulf coast of Texas, back to their breeding grounds in Canada.

The principle behind the work is simple: birds are what they eat. And what birds eat while growing feathers on the breeding grounds contains isotopes of hydrogen, carbon, and nitrogen. These vary in predictable patterns across North America.

Duxbury will be presenting a paper on his work on Wednesday, November 5, at the annual meeting of the Geological Society of America in Seattle, WA. Scientists there are exploring the evolving interface between isotope geochemistry and ecology.

Hydrogen and its heavier version, the isotope deuterium, are both naturally found in molecules of rain water. But as the cycle of evaporation and precipitation repeats across North America and over mountainous regions, the heavier deuterium isotopes get left behind. That creates well-mapped hydrogen/deuterium trends across the continent, Duxbury explains.

"There is a well known gradient of depleting deuterium/hydrogen ratios from the Gulf of Mexico and the Atlantic Ocean across the eastern part of North America," said Duxbury. As you get near mountains there is also a noticeable elevation effect that reflects how changes in elevation also cause precipitation cycles.

The hydrogen isotope signature of animals is essentially the isotope signature found in the water and food they eat. Furthermore, the isotope signature found at the bottom of the food chains can be passed up to the top of food chains. The result is that isotopic signatures in the feathers of the top predators reflect the area where the food was consumed while the feathers were grown.

Carbon isotopes, also found in feathers, vary with latitude due to different growing conditions for plants across the continent. Even nitrogen isotopes can help track birds, though nitrogen isotopes variations are not found in predictable patterns. The application of nitrogen-rich fertilizers in agricultural areas can also alter nitrogen isotope ratios, Duxbury explains.

To collect the feathers for analysis, Duxbury and his colleagues rely on other researchers across North America. "Since 1995 I've had other researchers who were banding birds gather feathers all across North America," Duxbury said.

In order to get a local isotope baseline for a bird population the researchers first gather feathers from nestlings at their nest sites. Then they gather feathers from birds on migration or on their wintering grounds to trace them back to the isotope baseline based on the nestlings. In the case of Burrowing Owls, the stable isotope technique has traced unbanded owls wintering in central Mexico back to Canadian breeding populations, said Duxbury. Subsequent analyses have also revealed that Burrowing Owls disperse more widely between breeding seasons than

previously thought. That discovery, in turn, can be applied to population models used in the conservation of Burrowing Owls.

This relatively new technique will not replace banding, says Duxbury, since it cannot trace a bird to an exact location. However, the recovery of a banded bird is very rare event, and so it takes decades to accumulate data. Stable-isotope analysis is providing similar dispersal and migration data, but at a far greater rate. In essence, every bird that is captured for a feather sample is equivalent to a band recovery, Duxbury says.

"Essentially, it's not as good as getting a band return, which gives you A to B," says Duxbury. "You can't say exactly where a bird's origin was, but you can narrow it down to a region. For instance, with an isotope signature we can get it back to southern Alberta, whereas a band can get it to an exact nest location."

Satellite telemetry is by far the most accurate method of tracking birds. However, it comes with a hefty price. In addition, technology has not developed satellite transmitters small enough for Burrowing Owls, says Duxbury.

*The abstract for **Stable Isotopes and Solving Migratory Mysteries of Birds of Prey** may be viewed at:*
gsa.confex.com/gsa/2005AM/finalprogram/abstract_48.htm


2005 MEMBERSHIP DUES

Dues, payable to AHS (\$40.00, \$15.00 for students) should be sent to:

Leilani Bew, AHS Newsletter Editor
Errol L. Montgomery & Associates, Inc.
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Tucson, Arizona 85719
Phone: (520) 881-4912



CASSINI'S RADAR SHOWS TITAN'S YOUNG ACTIVE SURFACE

The following is an October 29, 2004, NASA press release. For more information on Cassini's mission and to view images, visit http://www.nasa.gov/mission_pages/cassini/media/cassini-102904.html. LKB

The first radar images of Saturn's moon Titan show a very complex geological surface that may be relatively young. Previously, Titan's surface was hidden behind a veil of thick haze.

"Unveiling Titan is like reading a mystery novel," said Dr. Charles Elachi, director of NASA's Jet Propulsion Laboratory, Pasadena, California, and team leader for the radar instrument on Cassini. "Each time you flip the page you learn something new, but you don't know the whole story until you've read the whole book. The story of Titan is unfolding right before our eyes, and what we are seeing is intriguing."

The October 26 flyby marked the first time Cassini's imaging radar was used to observe Titan. The radar instrument works by bouncing radio signals off Titan's surface and timing their return. This is similar to timing the returning echo of your voice across a canyon to tell how wide the canyon is. Radio waves can penetrate the thick veil of haze surrounding Titan.

Approximately 1 percent of Titan's surface was mapped during the October 26 flyby. Radar images from Titan's northern hemisphere, a region that has not yet been imaged optically, show great detail and features down to 300 meters (984 feet)

across. A wide variety of geologic terrain types can be seen. There are bright areas that correspond to rougher terrains and darker areas that are thought to be smoother.

"In the two days since this flyby, our understanding of Titan has grown tremendously," said Dr. Jonathan Lunine, Cassini interdisciplinary scientist, University of Arizona, Tucson. "Titan is a dynamic place with complex geologic processes that may be shaping its surface. Its surface may well be covered with organic materials, but we still don't know how much of the surface is liquid or solid. The fact that we have seen few craters tells us that Titan's surface is young."

The radar images show a world brimming with features that are dark and white, indicating sharp contrast. One area dubbed "Si-Si" or the "Halloween cat" because it is shaped like a cat's head is very dark and relatively smooth. That leads scientists to speculate that it might be a lake of some sort, but they caution that it is too soon to know for sure.

"With the radar in its active mode, it is like shouting at Titan and listening for the echoes," said Dr. Ralph Lorenz, Cassini radar team member, University of Arizona, Tucson. "But we can also just listen with the sensitive radar receiver, the radiometry. The radiometry data shows early indications of the composition of the surface materials. One interpretation of what it is telling us is that Titan is a place covered with organics."

The optical imaging cameras on Cassini show streaks on the surface. The streaking may be

caused by movement of a material over the surface by wind, flowing hydrocarbon liquids, or a moving ice sheet like a glacier. Imaging scientists are also seeing multiple haze layers in Titan's atmosphere that extend some 500 kilometers (310 miles) above the surface. At the surface Titan's atmosphere is about four times denser than Earth's.

With a remarkable flyby and complicated set of spacecraft gymnastics, Cassini will try its luck with Titan again on December 13, 2004. The European Space Agency's Huygens probe will detach from Cassini on Christmas Eve and descend through Titan's dense atmosphere on January 14, 2005.

"It's as if we were building a puzzle without the top of the box," said Lunine. "It will be necessary to piece together the clues provided by Cassini and Huygens over the next few years. Sometimes we'll be wrong and we'll need to take the pieces apart and reassemble them again until finally, a complete picture of the nature and evolution of Titan pops into view," said Lunine.

More information on the Cassini-Huygens mission is available at <http://saturn.jpl.nasa.gov> and <http://www.nasa.gov/cassini>.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington, D.C.





MEMBERS ON THE MOVE

Three AHS Members are New Employees at Water Management Consultants

Kenneth (KC) Carroll joins WMCI as a Geochemist/Hydrogeologist. His specialized skill areas include mine tailings and pit-lake geochemical analysis, mine closure design, heap leach dynamics, environmental hydrogeology, and water resource development. KC will focus on developing numerical models of hydrologic and geochemical processes and implementation of field activities including collection, management and interpretation of chemical and hydrogeologic data. His training includes an undergraduate and a master's degree in geology with a specialization in geochemistry, and he is currently finishing a doctoral degree in hydrology.

Michael Geddis re-joins WMCI after a 7-year hiatus as a Senior Hydrogeologist/Project Manager. He will provide senior technical support to existing and future projects related to mine dewatering, mine closure, heap leach dynamics, environmental hydrogeology, and water resource development. In addition to technical work, his responsibilities include further developing and marketing WMCI's capabilities in environmental hydrogeology and water resources. He will also play an important role in marketing and developing WMCI's soil and flow dynamics laboratory. Michael has a master's degree in hydrology and is a registered professional geologist in Arizona, Wyoming, and Utah.

Michael McGlone joins WMCI as a Numerical Modeler/Hydrogeologist. He will support projects related to mine dewatering, mine closure, heap leach dynamics, environmental hydrogeology and water resource development. Mike will assist in the continued development and application of numerical techniques for variable saturated flow and transport modeling and air flow modeling. He will also design and execute multi-disciplinary field programs. He has an undergraduate degree in geology, and is in the process of completing a master's degree in hydrology.

All three may be reached at:

Water Management Consultants, Inc.
3845 N. Business Center Dr., #115
Tucson, Arizona 85705

(520) 319 - 0725
(520) 319 - 0724 (fax)
www.watermc.com

or
kcarroll@watermc.com,
mgeddis@watermc.com, or
mmcglone@watermc.com,
 respectively.



EMPLOYMENT OPPORTUNITIES

MACTEC is looking for an Environmental Scientist for it's Phoenix office.

Description/Responsibilities: Performs routine field and office assignments with some to little supervision and performs more complex assignments and analysis under closer supervision; directs routine field and office activities depending on experience. Will be involved in Phase I ESA, regulatory compliance, and water resources projects.

1. Performs field exploration, inspection, analysis; provides technical support with supervision.
2. Acts as a data gatherer; prepares maps, charts; runs computer programs.
3. Performs field testing; uses equipment and instrumentation. Interprets data and test results.
4. Evaluates, selects, and applies standard techniques, procedures, and criteria to perform technical tasks, field tasks, studies, and analysis with ongoing review from project team management.
5. Prepares field reports, internal correspondence, sections of formal reports.
6. Contacts vendors; researches literature and regulatory requirements; prepares draft designs.
7. With experience, calculates and manages simple, small fee, non-complex project budgets.

Required Skills

1. Skilled at basic or standard field procedures and techniques.
2. Demonstrated professional judgment, consistency, and attention to detail; track record of quality work products.
3. Demonstrated organizational skills.
4. Strong oral and written communication skills.
5. Demonstrated experience working successfully in a team environment.
6. Experience preparing reports that demonstrate technical knowledge.

Education: B.S. or M.S. Engineering, Scientific Discipline, or related technical field.

Experience: 2+ years

Physical Requirements
 Must be able to lift 25-50 lbs.
 Must pass drug test, background check and MVR check.

For more information, please contact Shelley Santillo at (602) 437-0250 ext. 222 or msantill@mactec.com.



ARIZONA HYDROLOGICAL SOCIETY
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AHS NEWSLETTER SUBMITTALS

Submittals and comments should be addressed and faxed to Leilani Bew at Errol L. Montgomery & Associates, Inc. by the **15th** of each month. If you learn of something timely after the deadline has passed, call me, and we can discuss it.

Phone : (520) 881-4912
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Thanks are extended to Errol L. Montgomery & Associates, Inc. for their donation of phones, fax, computers, and staff to support publication of this newsletter.

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MANY THANKS EVERYONE



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