Atlanta Geological Society Newsletter

Next meeting of the Atlanta Geological Society is
May 29, 2012
Fernbank Museum of Natural History (Clifton Road)
Social begins at 6:30 pm – Meeting begins at 7:00 pm

May 2012

ODDS AND ENDS

Ben Bentkowski, Newsletter Editor

Did you ever think that extracting groundwater would make a difference in sea level? Well, I never had until my son sent me the link to the articles on pages 4-6. I'm aware of the mechanism of thermal expansion of the oceans' water causing a rise in sea level but hadn't considered *all* that pumping, world-wide. Nor had I considered that dams could make a significant contribution to recharge but there's the corresponding article by the same author. If you follow the comments you'll find the solution is, in one man's opinion, solar powered desalinization.

Sedimentary diagenesis – there's a topic I had not covered much since graduate school. There is a new theory that diagenesis propagates through rock in response to geological (geochemical?) stress. It's an interesting idea that's explored on Page 2 and the more technical abstract is on Page 9. (go to Pg 3)

MAY MEETING

Join us Tuesday, May 29, 2012 at the Fernbank Museum of Natural History, 760 Clifton Road NE, Atlanta GA. The pre-meeting social starts at 6:30 pm and the meeting will start at 7 p.m.

This month is our annual poster session meeting. Usually these meetings are held upstairs in one of the class rooms in order to give plenty of room for poster display. This meeting is a departure from our usual speaker format and more like an 'open mic night'. So, search your files, both electronic and mental, and see if there is a poster or a cross section or a map that tells an interesting story with a geologic angle. One never knows but you might be our local expert in that subject and your colleagues would benefit from you sharing your knowledge.

Please come and enjoy the social time and the interesting presentations on Tuesday, May 29, 2012.

New Model of Geological Strata May Aid Oil Extraction, Water Recovery and Earth History Studies

ScienceDaily (May 24, 2012) — A Sandia modeling study contradicts a long-held belief of geologists that pore sizes and chemical compositions are uniform throughout a given strata, which are horizontal slices of sedimentary rock. By understanding the variety of pore sizes and spatial patterns in strata, geologists can help achieve more production from underground oil reservoirs and water aquifers. Better understanding also means more efficient use of potential underground carbon storage sites, and better evaluations of the possible movement of radionuclides in nuclear waste depositories to determine how well the waste will be isolated.

"I think our paper for the first time provides a reasonable explanation for the origin of patterns," said lead researcher Yifeng Wang. "We found we could predict the variations in pores as well as the heterogeneity of a reservoir."

The analysis, published Feb. 21 in *Nature Communications*, was able to match the field observations published in 2006 by second author David Budd, professor of geological sciences at the University of Colorado at Boulder. Budd said Wang put together a session at the 2010 annual meeting of the Geochemical Society at which Budd presented field studies of porosity and chemical composition. "He recognized that the data I showed could be explained by stress-induced chemical waves. He subsequently developed the numerical model to test his idea. Then we used the 2006 data set to demonstrate the correspondence between his model's outcomes and the field data."

A chemical wave in this context relies upon mineral dissolution and precipitation, powered by geologic stress, to penetrate surrounding material, just as an ocean wave powered by the moon's gravitational pull rides up on a beach. Ocean waves shift sand; Wang found that chemical waves modify the spatial distribution of rock porosity.
As Wang puts it, a chemical wave is "like water rippling. The concentration of a chemical species varies periodically in space (a standing wave) or sometime such variations propagate through space (a travelling wave).

"The one we revealed in dolomite (a type of sedimentary rock) may be the largest chemical wave ever known, because no one has thought to look for chemical waves in strata. It occurred on the scale of meters to tens of meters and propagated between a hundred to a thousand years." Chemical waves are usually observed on much smaller scales in laboratories.

Sandia National Laboratories (2012, May 24). New model of geological strata may aid oil extraction, water recovery and earth history studies. *ScienceDaily*. Retrieved May 26, 2012, from http://www.sciencedaily.com/releases/2012/05/120524092042.htm

AGS Members… Geology Enthusiasts Needed!!

If you are an AGS member and would like to contribute to the Professional Registration Committee by leading a lecture on one of the subjects listed below, then please contact me either by e-mail or at the monthly AGS meetings. The lecture should be for one hour followed by a Q&A session. We need different speakers for each workshop. Your volunteering to teach on one of these subjects is essential to the success of the Professional Registration Committee – we need more widespread participation by the AGS membership. Speakers can be compensated for expenses and will receive certificates to acknowledge their participation.

The following content domains are covered in the Georgia Professional Geologist exams:

A. General Geology
B. Mineralogy, Petrology, & Petrography
C. Sedimentology, Stratigraphy, & Paleontology
D. Economic Geology & Energy Resources
E. Structure, Tectonics, & Seismology
F. Hydrology & Environmental Geochemistry
G. Engineering Geology
H. Quaternary Geology, Geomorphology, & Surficial Processes

We do not "teach the test" our aim is to review fundamental concepts of the earth sciences and acquaint candidates with industry specific information not easily obtainable from the literature. Please inform anyone who might be interested in becoming a professional geologist of our workshop. Please consider joining us even if you are not a P.G. candidate. The workshops are interesting and informative.

Ken Simonton, P.G., Chair
Professional Registration Committee

www.atlantageologicalsociety.org

ODDS AND ENDS continued

In the news, a geologist has been nominated to be the new head of the Nuclear Regulatory Commission http://news.sciencemag.org/scienceinsider/2012/05/radioactive-waste-expert-nominated.html?ref=hp As Dr. Macfarlane steps into the spotlight, I wish her patience and clarity of thought. See a bit of her C.V. on Page 9.

There is a short geologic side trip to report. While in Oklahoma recently, I revisited the Wichita Mts in southwest Oklahoma. These Cambrian-aged intrusives include granite and some very interesting red rhyolite. You can drive right up to the top of Mt. Scott, some 1,200 feet above the surrounding plain, for a fantastic view. Apparently these structures continue WNW towards Amarillo but mostly underground. (Are they still mountains if they are underground?) In the village of Medicine Park, folk have included uniformly spherical granite boulders as a building material for their houses. Most interesting. Pictures next time.
B. B. Keep on Rockin'

Can pumping too much groundwater raise sea level?

by **Scott K. Johnson** - Sept 16 2011, 10:25am EDT

A hydrogeologist at the United States Geological Survey has compiled the most rigorous accounting of global groundwater depletion to date, which was published recently in *Geophysical Research Letters*. Since much of the water pumped out of the ground eventually ends up in surface water bodies, it ultimately makes its way to the ocean where it could potentially contribute to rising sea level. To evaluate this, the researcher used historical water level observations, measurements of aquifer characteristics, pumping data, groundwater flow models, and even some data from the Gravity Recovery and Climate Experiment (GRACE) satellites.

The total amount of groundwater lost between 1900 and 2008 was estimated at 4,500 km^3—enough to raise global sea level by about 12.6 mm. That's a little more than 6 percent of the total sea level rise seen in that time period. It's interesting to note, however, that the retention of surface water in reservoirs behind dams has had the opposite effect—counteracting sea level rise. A related paper in press (also in *Geophysical Research Letters*) shows that between 1972 and 2008, when groundwater depletion contributed an average of 0.3 mm/yr to sea level rise, surface water retention *decreased* sea level rise by 0.4 mm/yr.

Perhaps the most remarkable thing about the groundwater analysis is that 25 percent of the total 1900-2008 depletion occurred between 2000 and 2008. During those final eight years, the volume of groundwater lost is equal to 13 percent of global sea level rise. In the US, this acceleration is largely due to increasing use of the Ogallala Aquifer and aquifers along the Gulf Coast. In fact, over-pumping of the Ogallala is responsible for nearly half of the total US depletion during that period despite conservation efforts and changes in farming practices.

Geophysical Research Letters, 2011. DOI: 10.1029/2011GL048604; *Geophysical Research Letters*, 2011. DOI: 10.1029/2011GL048794

http://arstechnica.com/science/2011/09/can-pumping-too-much-groundwater-raise-sea-level/

Damned if you don't (dam): Groundwater use outpacing dam building

by **Scott K. Johnson** - May 17 2012, 10:00am EDT

Last year, we had covered a study on the non-trivial contribution of groundwater depletion to sea level rise. It concluded that humans have pumped enough water from underground sources to account for up to 13 percent of the rise in ocean levels that occurred between 2000 and 2008.

A caveat, from a related paper, was that this might be offset by an increased retention of surface water in large reservoirs behind new dams. That would make the net effect of these human activities a wash. In fact, the 2007 IPCC report left out groundwater depletion when projecting sea level rise because of the uncertainty of existing estimates and the presumed balance with reservoir impoundment.

A new estimate, published recently in *Geophysical Research Letters*, takes a closer look at dam building and projects current trends into the future. While groundwater depletion continues, dam construction is on the decline. The result should be an increasing contribution to sea level rise.

For the new estimate of global groundwater depletion, the researchers used data on groundwater use and "recharge"—water that refills groundwater aquifers. This additions-and-subtractions water budget approach is less reliable than actual measurements of falling water levels, but solid data is much easier to come by, allowing for country-by-country estimates instead of extrapolations from those areas where there's detailed monitoring.

These detailed water budgets were tallied by country for the year 2000, which was used as a benchmark. To extend the estimate back to 1900, each country's benchmark value was scaled to changes in water demand. The numbers compare reasonably well to earlier estimates, including those that used measurements of groundwater levels. The researchers did find that their method overestimated groundwater depletion in some wetter regions, so a correction factor was used to bring them into line.

They then projected these processes into the future, using three of the familiar IPCC scenarios. These scenarios include things like trends in land use, development, and population, as well as the magnitude of climate-altering emissions. Socio-economic patterns controlled changes in groundwater use, and a climate model was used to simulate meteorological conditions and calculate groundwater recharge.

This estimate puts the past contribution of groundwater depletion to sea level rise higher than the last study we covered. Where that study calculated a rate of 0.35 ±0.07 mm per year for the period 1993-2008, this new one estimates 0.54 ±0.09 mm per year—nearly 20 percent of the total sea level rise. Of course, newer does not always mean better, and it's hard to say which of these is closer to reality.

(continued on next page)

Damned if you don't (cont.)

Dam building has offset much of the contribution from groundwater depletion, wetland draining, and deforestation. In the early 1900s, the net contribution from these other activities was positive—raising sea level. When dam construction really kicked up in the 1950s, it held back more water than we were losing. Between 1970 and 1990, the net contribution from continents was -0.15 ±0.09 mm per year, partially counteracting those other contributions to sea level rise.

The number of new dams being built has dropped off markedly since 1990, though, and once a reservoir fills, it no longer affects the amount of water that makes it to the ocean. Because of that, the net contribution of these human activities between 1990 and 2000 was 0.25 ±0.09 mm per year, meaning that dam construction no longer offsets groundwater depletion.

If you look at the total impact on sea level since 1900, we're on track to break even in 2015. Since dam construction continues to decline while groundwater depletion continues to increase, the researchers estimate that these terrestrial sources will have accounted for 3.1 ±0.03 cm of sea level rise by 2050.

The researchers say that, while increasing groundwater depletion in the past was primarily caused by growing demand, future growth in groundwater use looks to have more to do with climate change. Yoshihide Wada, a researcher at Utrecht University in the Netherlands and the lead author of this study, told Ars that, in 1900, the area of irrigated land globally was about the size of France. Today it's about the size of India.

That expansion has limits, and the growth has slowed. In the future, Wada explained, "Our results also indicate changes in precipitation patterns such that the available water becomes less during cropping periods. In many regions, the amount of irrigation water that needs to be supplied over irrigated areas will also increase due to enhanced evaporation as a result of increased temperature under global warming."

That means more depletion for places that rely heavily on groundwater, like the western United States, northern China, western India, and Iran. "About 600 cubic kilometers of water was used for irrigation in India for the year 2000," Wada wrote, "Irrigation water withdrawal for India is nearly [one] quarter of the global total." That leads to the loss of some 50 cubic kilometers of groundwater each year in India. "Groundwater use is especially intensive [in] northern Iran," Wada added, "where some local studies report that the groundwater table has dropped [at a] rate of 0.5 to 1 meter per year for the last decade." Iran is losing an astounding 20 cubic kilometers of groundwater every year.

Since new dams are no longer making up for it, that water adds to the sea level rise. It's a small addition but gets combined with the usual suspects—melting glaciers and thermal expansion of ocean water—to drive long-term trends.

Geophysical Research Letters, 2012. DOI: 10.1029/2012GL051230

http://arstechnica.com/science/2012/05/damned-if-you-dont-dam-groundwater-use-outpacing-dam-building/

FERNBANK MUSEUM of NATURAL HISTORY

Fernbank Museum of Natural History

Upcoming Public Programs and Events

(All programs require reservations, including free programs)

UPCOMING EVENTS:

97 Days of Play

Join us May 29 through September 2 for **97 Days of Play**, a summer-long celebration of great activities, events and ways to keep families entertained and inspired while school's out.
See the full scheudle of unique events and activities.
Unless noted, all all **97 Days of Play** offerings are included with Museum admission and **are free for members**. So join today and soak up the summer fun for free!
Support for Fernbank's **97 Days of Play** provided in part by AT&T Real Yellow Pages, The Official Yellow Pages of Fernbank Museum.

Now Showing in the Fernbank IMAX movie theater: (Check our website for special screenings)

Last Few Days for Born to be Wild

Greece: Secrets of the Past Opens May 29, 2012
Journey to the birthplace of democracy and embark on a quest to uncover the buried secrets of one of the world's most enlightened societies. Set against the breathtaking, azure vistas of the Greek Isles, Greece is both a modern detective story and a sweeping journey to the distant past, complete with digitally recreated scenes that restore centuries-old spectacles such as the original Parthenon and the volcanic eruption that buried Santorini in 1646 BC.

Fernbank Museum of Natural History

767 Clifton Rd, NE, Atlanta, GA 404-929-6400

Special Exhibits On View: http://www.fernbankmuseum.org/explore-exhibits/special-exhibitions

The Scoop on Poop Open May 26- -September 3, 2012

It's the #1 exhibit about #2.

Fish do it, frogs do it, pythons, eagles, and elephants do it, yet poop is one of those subjects we find difficult to talk about with a straight face.

Listen in on a bear's digestive system, learn the language of poop in countries around the world, examine fecal samples in a veterinarian's lab, compete in dung beetle races, track wild animals by clues left in scat, see how long it takes an elephant to poop their body weight, and meet a dinosaur dung detective in this fascinating exhibition that reveals what we can learn about animals by examining what they leave behind.

For tickets and details on exhibits, films, and events, please visit the website at www.fernbankmuseum.org Follow us on Facebook or Twitter for the latest news and updates! Please see the website for details about Martinis and IMAX on Friday nights.

ABSTRACT:
Stress-induced chemical waves in sediment burial diagenesis

Yifeng Wang & David A. Budd *Nature Communications* **3**, Article number:685
doi:10.1038/ncomms1684 Received 05 September 2011 Accepted 13 January 2012 Published 21 February 2012

Lateral metre-scale periodic variations in porosity and composition are found in many dolomite strata. Such variations may embed important information about dolomite formation and transformation. Here we show that these variations could be fossilized chemical waves emerging from stress-mediated mineral-water interaction during sediment burial diagenesis. Under the overlying loading, crystals in higher porosity domains are subjected to a higher effective stress, causing pressure solution. The dissolved species diffuse to and precipitate in neighbouring lower porosity domains, further reducing the porosity. This positive feedback leads to lateral porosity and compositional patterning in dolomite. The pattern geometry depends on fluid flow regimes. In a diffusion-dominated case, the low- and high-porosity domains alternate spatially with no directional preference, while, in the presence of an advective flow, this alternation occurs only along the flow direction, propagating like a chemical wave. Our work provides a new perspective for interpreting diagenetic signatures in sedimentary rocks.

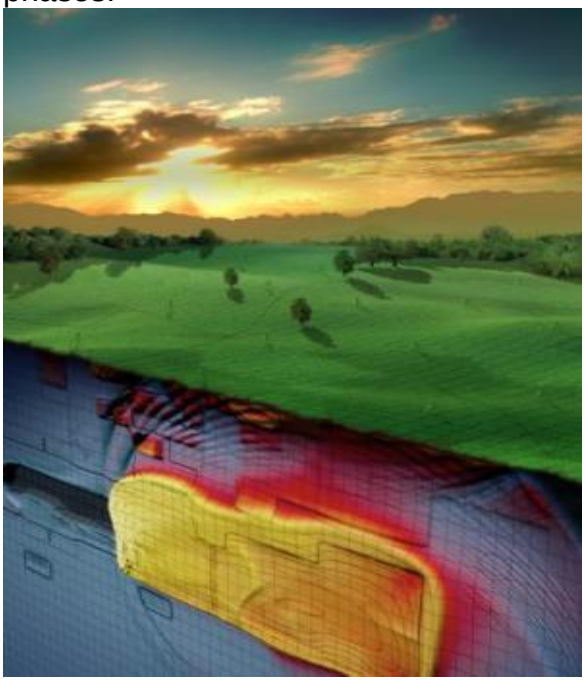
Geologist nominated to head Nuclear Regulatory Commission
Allison M. Macfarlane

Allison Macfarlane is currently an Associate Professor of Environmental Science and Policy at George Mason University in Fairfax, VA. She received her PhD in geology from the Massachusetts Institute of Technology in 1992. She has held fellowships at the Bunting Institute at Radcliffe College, the Center for International Security and Arms Control at Stanford University, and the Belfer Center for Science and International Affairs at Harvard University. From 1998-2000 she was a Social Science Research Council-MacArthur Foundation fellow in International Peace and Security. She has served on National Academy of Sciences panels on nuclear energy and nuclear weapons issues. She is currently a member of the White House's Blue Ribbon Commission on America's Nuclear Future. She is also presently chair of the Science and Security Board of the *Bulletin of the Atomic Scientists* and serves on the Keystone Center's Energy Board. Her research focuses on environmental policy and international security issues associated with nuclear energy, especially the back-end of the nuclear fuel cycle. In 2006 MIT Press published her book, *Uncertainty Underground: Yucca Mountain and the Nation's High-Level Nuclear Waste*, which explores the unresolved technical issues for nuclear waste disposal at Yucca Mountain, Nevada.

Greater Insight Into Earthquake Cycles

ScienceDaily (May 10, 2012) — For those who study earthquakes, one major challenge has been trying to understand all the physics of a fault -- both during an earthquake and at times of "rest" -- in order to know more about how a particular region may behave in the future. Now, researchers at the California Institute of Technology (Caltech) have developed the first computer model of an earthquake-producing fault segment that reproduces, in a single physical framework, the available observations of both the fault's seismic (fast) and aseismic (slow) behavior.

"Our study describes a methodology to assimilate geologic, seismologic, and geodetic data surrounding a seismic fault to form a physical model of the cycle of earthquakes that has predictive power," says Sylvain Barbot, a postdoctoral scholar in geology at Caltech and lead author of the study. "Previous research has mostly either concentrated on the dynamic rupture that produces ground shaking or on the long periods between earthquakes, which are characterized by slow tectonic loading and associated slow motions -- but not on both at the same time," explains study coauthor Nadia Lapusta, professor of mechanical engineering and geophysics at Caltech. Her research group developed the numerical methods used in making the new model. "In our study, we model the entire history of an earthquake-producing fault and the interaction between the fast and slow deformation phases."



. *The yellow colors indicate the highest speeds of slippage between plates along the San Andreas Fault. The reddish colors represent slower seismic speeds and the bluish colors indicate slippage at velocity close to the long-term advance of the San Andreas Fault. The dark color indicates a portion of the fault where the velocity is so small that it appears completely locked. (Credit: Sylvain Barbot / Caltech)*

Using previous observations and laboratory findings, the team -- which also included coauthor Jean-Philippe Avouac, director of the TO -- modeled an active region of the San Andreas Fault called the Parkfield segment. Located in central California, Parkfield produces magnitude-6 earthquakes every 20 years on average. They successfully created a series of earthquakes (ranging from magnitude 2 to 6) within the computer model, producing fault slip before, during, and after the earthquakes that closely matched the behavior observed in the past fifty years.

"Our model explains some aspects of the seismic cycle at Parkfield that had eluded us, such as what causes changes in the amount of time between significant earthquakes and the jump in location where earthquakes nucleate, or begin," says Barbot. The paper also demonstrates that a physical model of fault-slip evolution, based on laboratory experiments that measure how rock materials deform in the fault core, can explain many aspects of the earthquake cycle -- and does so on a range of time scales.

The paper also demonstrates that a physical model of fault-slip evolution, based on laboratory experiments that measure how rock materials deform in the fault core, can explain many aspects of the earthquake cycle -- and does so on a range of time scales. "Earthquake science is on the verge of building models that are based on the actual response of the rock materials as measured in the lab -- models that can be tailored to reproduce a broad range of available observations for a given region," says Lapusta. "This implies we are getting closer to understanding the physical laws that govern how earthquakes nucleate, propagate, and arrest."

California Institute of Technology (2012, May 10). Greater insight into earthquake cycles. *ScienceDaily*. Retrieved May 26, 2012, from http://www.sciencedaily.com/releases/2012/05/120510142003.htm

AGS Officers

President: Nils Thompson
nils.thompson@erm.com
Phone (678) 486-2766

Vice-President: Cassidy Evans
Phone (770) 492-8230
ceevans@golder.com

Secretary: Rob White
Phone (404) 463-0679
robeth@bellsouth.net

Treasurer: Stacey Durden-Phillips
stacy.durden@gmail.com

AGS 2012 Meeting Dates

Listed below are the planned meeting dates for 2012. Please mark your calendar and make plans to attend.

May 29 AGS Poster Session

June 26 AGS Annual Social

June 30 Dr. Julian Grey, Mineralogy Note this session will be at the Tellus Science Museum where Dr. Grey will use the Museum's collection for his lecture.

AGS Committees

AGS Publications: Allison Keefer
Phone (404) 657-8642
allison_keefer@dnr.state.ga.us

Career Networking/Advertising: Todd Roach
Phone (770) 242-9040, Fax (770) 242-8388
tdr@piedmontdrilling.com

Continuing Education: Currently Open

Fernbank Liaison: Chris Bean
Phone (404) 929-6313
Chris.bean@fernbankmuseum.org

Field Trips: Josh Jenkins
Phone (770) 421-3412
jljenkins@mactec.com

Georgia PG Registration: Ken Simonton
Phone: 404-825-3439
kws876@gmail.com

Teacher Grants: Bill Waggener
Phone (404)355-7377
wgwaggenerii@bellsouth.net

Hospitality: Tom Watson
Phone (678) 358-6943
twwatson@mindspring.com

Newsletter Editor and Membership
Ben Bentkowski
Phone (404) 562-8507
bentkowski.ben@epa.gov

Web Master : Kathaleen Bentkowski
kathaleen770@gmail.com

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STUDENT $10 ☐

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CORPORATE MEMBERSHIP $100 ☐
(Includes 4 professional members, please list names and emails below)

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For further details, contact the AGS Treasurer: stacy.durden@gmail.com.

Please make checks payable to the "Atlanta Geological Society" and remit with the completed form to:
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