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For Christ and His Kingdom

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The Alumni Newsletter of Wheaton College's Department of Geology

When I consider Your heavens, the work of Your fingers, The moon and the stars, which You have ordained; What is man that You take thought of him, And the son of man that You care for him?
—Psalm 8:3-4

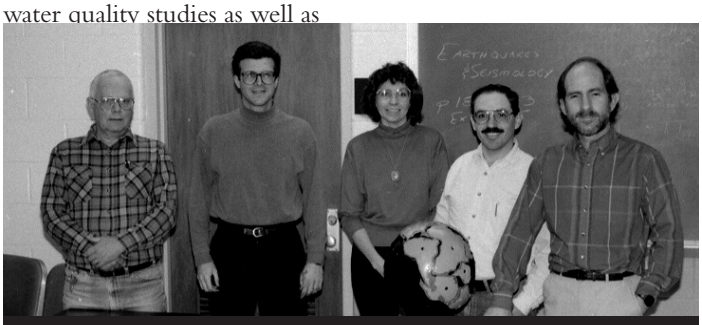
From the Chair....// by Stephen Moshier

One afternoon last week I walked into the Earth Materials lab to chat with a few students anguishing over their Structural Geology assignment (do you remember three-point problems?). This lab connects through a doorway to our Physical Geology lab/classroom. At that time of day the room might have been empty but it was packed with "intro" students, but including a few of our majors. I asked one of them what was up and learned that the Geology Club was holding review sessions for the upcoming midterm exams! This was a club initiative with no prodding from us professors. Earlier in the semester I saw one of our other geo majors in the Beamer Center paging through the Physical Geology textbook with a nervous student from the lab section she assists. Our geo majors seem to be on a mission to make Physical Geology, the department's most significant contribution to the college's General Education program, a positive experience. And, who knows? Perhaps encourage a few more students into the major!

The geology major is thriving as never before. As alumni, you all know that Geology has always been one of the best-kept secrets on campus. But with our new location in the Science Center and the largest number of majors ever, the secret is out!

An offspring of the Geology Department, Environmental Studies is also thriving. Over the past ten years, Dr. Fred Van Dyke has nurtured a community of ES majors who are motivated to be good stewards of creation. The geography of the new Science Center puts the Environmental Studies program in both physical and social continuity with Geology. With Dr. Van Dyke's departure to direct the Au Sable Institute, our incoming Environmental Studies director will make his office home and research space on the same floor as the geology faculty and will be a new member of our department! Dr. Chris Keil is no stranger to Wheaton College and environmental science education here. With a BS in Biology from Wheaton (1987) and PhD in Environmental Chemistry from University of Illinois-Chicago, Chris has been a Professor of Environmental Science at Bowling Green State University for many years. We have enjoyed having Chris and his family at the Science Station in South Dakota for many summers, with him contributing to both teaching and directing duties. It is a dream come true to have him join us in a permanent capacity. He brings expertise in air and water quality studies as well as science education pedagogy and assessment.

We have been blessed with many visits by alumni to our department this past year, as well as significant and much appreciated contributions to both the Donald Boardman Scholarship for the Black Hills and the Geology Department Scholarship. A significant contribution was made by a family to assist in geology faculty scholarship and faculty-student research collaboration (for travel, supplies, small equipment, etc.). Alumni may contribute to this spendable fund, as well. O



The Geology Department in the early 90's.
Gerald Haddock, Stephen Moshier, Kathy Smisher, Dennis Bebel, and Jeffrey Greenberg pictured.

Jeff's Journals

25 years at Wheaton College are now complete. There certainly won't be another 25. Somewhere between five and ten is more like it. Along with the not-far-enough-away retirement of Jim Clark, this really means that we need now to be preparing for huge change by recruiting our replacements. That might mean, you, alums with doctorates (or getting a PhD pretty soon).

This summer, we will have somewhere around 25 students in the Geology Majors' track at the Science Station. For the first time in eight years, I will again lead the western trip to Yellowstone, Tetons, etc. This time we should have good buddy, Chuck Carrigan, hard-rock geo-prof from Olivet Nazarene University going along. I hope my wife, Diane will also be able to join us and help keep the mob in line. With some help, an underground visit to the Stillwater platinum mine in Nye Montana may be possible.

My academic pursuits these days include a wide variety of student-oriented projects. Water and sanitation outreach with Water-For-Life in Kosova is temporarily (I hope) on hold, even though **Jonie Yates '12** and I presented on this initiative at the annual GSA meeting in Minneapolis. Right now, international projects focus on a student team going to Haiti in March sponsored by our Haiti Wheaton Partnership (I'm the faculty advisor). They will provide a concentrated survey of a small valley-bay in northwest Haiti in order to help plans for agriculture, irrigation and erosion control efforts. The HWP hopes to expand cooperative projects to include faculty development at a small Christian University, and to apply more of our academic advantages long term in support of the local folks. Geology students currently involved in the Haiti research-outreach include **Brandon Dykstra '15**, **Katelyn Kishkunas '12, Derek Meadows '12, and Toby Wright '12.**

It took a couple of decades, but I finally got some more-scholarly (?) research going in the amazing Black Hills. A confluence of relationships with other geologists that just happened made this possible. I already reported on the first phase of a comprehensive analysis done for the prominent exposure just south of the Pactola Dam along Highway 385. This macro-structure study has led to detailed petrography of lithology and key minerals by **Frances Griswold '13** and **Lissa Peterson '12**. We presented their investigation via poster at the Minneapolis GSA meeting. Attached to our little research group are Dr. Craig Schwandt of McCrone Associates (metamorphic petrologist, geochemical analyst), **Chris Gates '13, Kit Carson '12** and **Forrest Webb '10.** Webb is completing his research assistantship at the University of Kentucky and will help supervise Gates in analyzing carbonates from the Pactola exposure for carbon and oxygen isotopes. Carson will pick up where **Peter Brice '11** (now at Colorado School of Mines) finished and add microstructural data to the larger-scale study. Some very interesting and surprising possibilities remain interpreting the data. One or probably two journal articles should result from this project. This summer, Dr. Kent Ratajeski from the U of Kentucky and I will supervise a related study upon similar-aged (Proterozoic) basaltic rocks between Pactola and the Science Station. The student researcher is Environmental Studies major, **Chris Tulimiero '13.** He will map out the igneous body, in part aided by a magnetometer. He will then collect fresh samples for petrography and microprobe analysis. In addition, time should allow Chris to undertake a general interpretation of Precambrian granitic rocks in the northern Black Hills. We hope to see if these granite pegmatites are related to the large Harney Peak pluton to the south. Thanks to generous alumni (you know who you are) that enable the research with their donations to Wheaton College Geology.

I added a half-semester class designed primarily for newly decided Geology majors this semester. Eleven great people are engaged in researching topics they must construct into problems which then become the object of proposals for investigation. The class members serve each other as proposal critics. The ultimate course goal is attempting the challenge of project design. Very few students, including graduate students really experience this struggle to create a feasible program to test a thesis. Time in the class does not allow a full start to finish for the research agendas. However, in some cases, the topics will receive continued attention beyond the course schedule. Topics chosen by the students include investigation of ancient burial mounds close to campus (geoarcheology), thin section examination of dinosaur bones and enclosing matrix for taxonomic and paleoenvironmental determination, evaluation of scientific assertions made by opposing ideologies in debates concerning a) tar-sand mining (Canada), b) potential uranium mining (Virginia), and c) mine-water management (in the USA). I offered other topics including the stable-isotope studies in the Black Hills, the Haitian land-use survey, and experimentation on waste-water systems.

Sanitation Initiative // by Jeff Greenberg

College Trustee, Mac Airhart contacted the divisional dean and our department to consider the establishment of a new experimental facility. The concept follows the long-time philosophy of engineer Dr. Jack Shaeffer. One version of the "lagoon" or "pond" system for waste-water treatment is named after Shaeffer. These systems of his design are in action all over the world, exclusively in use for communities and industrial installations with substantial construction capitol. Our challenge from Airhart, Shaeffer, and Jack's colleague, Dr. Prakash Tata, is to extend the Shaeffer system model to include global regions with great sanitation and water-resource limitations. These new site objectives include millions of struggling, disadvantaged poor on every continent except Antarctica.

Jim Clark and I are hoping to cooperate in efforts to attract financial capitol and talented student researchers for the initiative. Old Armerding Hall may contribute space for the facility. Our current plans are for plenty of discussion and research to consider all possible human and environmental factors in design. Computer modeling ought to follow along with the first attempts to construct a small-scale version for experiments. A "best practices" model should integrate variables characteristic of many global communities. At some point, especially if funds allow, a larger-scale version will likely become the focus of experimentation. Our ultimate desire, even beyond the excellent student learning experiences, is to see these systems installed where so badly needed, with local people trained to manage all functions. The interdisciplinary potential in this endeavor is exciting. Students majoring in Pre-engineering, Physics, Biology, Chemistry, International Relations, Business-Economics, as well as Environmental Studies and Geology can become researcher-interns. This summer we begin the design for experiments with two student researchers.

Geology Majors and Jeffrey Greenberg in the Black Hills, 1992.

Wheaton College Geology Needs its Alumni! // by Jeff Greenberg

Every newsletter asks you good friends to send us news (see below), ideas, money, yourselves as visitors, etc. We are few, but with you our numbers are nicely increasing. The campus is unfortunately a rather competitive environment in that the larger programs tend to gather more support of all kinds along with greater popularity. We truly believe and hope you agree that Geology at Wheaton has been and is at present a very important component of the institutional mission. I am biased, but if there was a #1, we are it. It is us (we), and that includes you. PLEASE HELP! Here are a couple of wonderful ways to really join with the department in nurturing the global mission into the future.

The Geology majors would gain immensely from outside MENTORS. Three full-time faculty try to mentor the 40+ GEO majors and 30+ Enviro majors. These young protégés need more attention than we alone can give. If you are a consultant, work for an environmental-engineering firm, the energy or minerals industry, any governmental agency, are an instructor, or practitioner in any related field, how might that valuable background benefit the growing generation of pre-professionals? Some alums are already seeking majors as interns or apprentices. The mentoring need not be formal or greatly time consuming. For example, you could present lectures during your visits. We can also arrange for distant interaction, such as Skype sessions. For those close to campus, perhaps some type of job shadowing can be arranged so that students may see aspects of a career. Think and please pray about it.

Once upon a time, over twenty years ago, the much tinier, struggling WC Geology Program invited some of our own graduates and a few others to serve on an advisory board. People were asked, some agreed, but then there was no true interaction. That was mostly my fault. It is a very different time and situation for the world's best (per capita) undergraduate geology program today. We need you more now than ever. Therefore, if you are interested in being a member of the real live Wheaton College Geology Department Board of Advisors, please contact us. This commitment would last as long as you desire. We seek a few leaders who can help bring everyone together, even though we are physically apart. We will ask some of you specifically via e-mail invitation, but we look for all who are willing to serve. Actual involvement is totally up to you. There may be an official-looking certificate for members, or maybe not. There will be a more official acknowledgement of board membership but no other perks promised. Many of you already remain in contact with the department. Your advice and advocacy are highly coveted! O

Doc Mo's Memoirs

On this early morning I'm sitting in the upper deck of a Metra West commuter train between Wheaton College and the city; we are chasing a bright red-orange sun rising over villages and industrial parks as a full golden moon is setting over the tracks behind us. I have been spending two to three days each week at the Oriental Institute of the University of Chicago this semester during my second teaching sabbatical. The Center for Ancient Middle East Landscapes (CAMEL, of course) is a repository for maps and satellite imagery useful for conducting landscape archaeology studies across that region. Center Director and Wheaton Biblical Archaeology alumnus Scott Branting welcomed me in his lab and his graduate assistants are available to pull relevant data from their collection and provide technical advice for my project. I was almost fluent in arc-whatever v. 3 after my last sabbatical in 2001, but we are now in the era of arcMap v. 10! I have become too dependent on my ESRI-savvy students. To catch up, I completed many of the labs in Jim Clark's introductory GIS course during fall semester. At CAMEL, I am working through many of the GIS-based labs for Scott's graduate Ancient Landscape course. My goal is to become the arcMap user my students can be proud of.

One of my sabbatical projects is to gather as much geographic information as possible to trace the route of a defunct Pelusiac Branch of the Nile that flowed toward the northwest Sinai from the Bronze Age to Roman times. While the Pelusiac system is known from ancient history and modern geomorphology, I believe we have discovered the oldest and most easterly channel. Between 1999 and 2007 I was involved in the Trinity International University expedition to Tell el-Borg in the Northwest Sinai. We excavated and mapped a fluvial-estuarine channel that bisected the settlement at Tell el-Borg and I traced it south into a pear-shaped depression known from history as the Ballah Lakes. The modern Suez Canal runs right up through the center of the depression, which is most certainly related structurally to the Red Sea rift system (you can connect the lakes like dots from Port Suez to Port Said). We probed the subsurface of the Ballah area and found Nile sand in several locations. Maps from the CAMEL collection date back to the early 1900's at scales from 1:25,000 to 1:100,000 and declassified spy satellite images (CORONA) provide a high resolution picture of the ground back in the 1960s before intensive urban and agricultural development across the region of interest. I'm confident that the old Pelusiac channel can be traced west into the heart of the delta using this geographic information. Field-testing the channel course was planned for late spring, except for the current political situation in Egypt.

The past summer I found myself once again among the Philistines...and Byzantines and Crusaders... at Tel Ashkelon, Israel. The Wheaton College Summer Researcher program provided funding for two geology majors to join me in a study of geological and cultural strata along the beach cliff, freshly exposed by a 50-year storm in December 2010. We also continued the drilling program to define the upper surface of pre-cultural (geological) deposits beneath those thousands of years of human dirt. Our work over the past four years has resulted in the reconstruction of the site before humans found it a good place to build cities. See our GSA abstract in this CONTACT for the details. **David Wheatley '12** was already an Ashkelon veteran and **Jacob Lepori '12** made his first trip to Israel. We rented a car and traveled to the geological paradise of Makhtesh Ramon, a window into the subsurface of the Negev Desert, and up the coast to Haifa to study other beach cliff exposures. Thanks to our Dean and Provost for providing these opportunities for faculty-student collaborative research.

Fire tower, Israel

Senior Seminar was a highlight of my week during the fall semester. We met Monday evenings in the Physics seminar room. Essentially, the room is a glass box overlooking the atrium from the 3rd floor of the new Science Center. It takes on a special glow at night. We switched to fall because of my spring sabbatical, which turned out to be a good thing to be repeated in the future. Early fall senior year is a superior time to talk about the future (grad schools, jobs and life) and reflect on the past three years before contracting the inevitable affliction of HDSS...hyper-distractive spring senioritis. We all read, discussed and journaled from Ron Number's book *The Creationists*, with attention to the role of Wheaton scientists in the drama over origins. Then we read British geologist Richard Fortey's book *Earth, an Intimate History*. Students gave extended technical presentations on various topics in the book, from tectonics to paleontology and much in between.

This year I experimented with some new pedagogy in Geology of National Parks to motivate non-science majors. Two words: Play Dough.

Jeff's report for this Contact reminds me that his 25th year means that it is my 20th year.

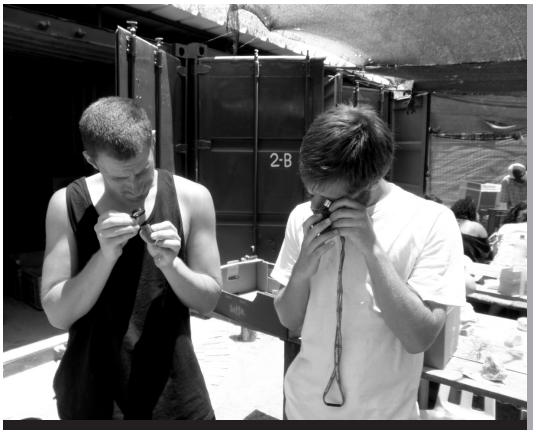
"The next stop, will be---- Ogilvie Transportation Center. Thank you for riding Metra." Time to save this .doc and shut down my laptop. One more train to Hyde Park. Blessings!

Clark's Capers

The geomorphology class in the Fall was the largest ever at Wheaton College with 37 students enrolled. It is great to have so many students interested in geology, but the down side is that Jim feels he cannot provide the individual time with students that is needed. Like all of our geology courses, this required course is only offered on an alternate year basis. With another faculty position in the department it would be possible to offer the course every year, easing student scheduling and providing better learning experience for everyone (add to your prayer list!). There were also 31 students in Hydrogeology last spring, another all time high. That course was benefited from the presence of Dr. Derek Chignell who attended the course and lectured on water needs and solutions in developing nations. Dr. Chignell is the director of Water for Life, a YWAM organization dedicated to bringing water and the gospel to underserved regions of the world. The class once again travelled to Taylor University to learn well-drilling methods with the LS-100 mud rotary drill rig. We also had a race with a hand auger drilling method, until our football players twisted the head of the auger into a pretzel at a depth of 18 feet. Jim also helped John Vendeland implement the new Introduction to Agronomy course which was a huge success (see article).

Jim was once again in California all summer enjoying his three grandchildren and helping to plant a huge (4000 ft^2) garden. The produce overwhelmed us with beets, beans, cucumbers and butternut squash totaling hundreds of pounds. It also required much weeding and distributing many pickup loads of manure. Another summer experience was helping an evangelistic tent meeting for three weeks in the Navajo Indian Reservation near Window Rock Arizona. The Native American culture is unique and interesting and not without its challenges.

Rick Page continues to help Jim develop inexpensive geophysical instruments for groundwater prospecting in developing nations. This hobby has become *bonafide* research with the publication of an article detailing the seismic refraction and resistivity methods in a free peer reviewed online journal, the *Journal of Water Resource and Protection*. You can view the article at http://www.scirp.org/journal/PaperInformation.aspx?paperID=8137. Rick and Jim are now trying to develop a cheap time-domain electromagnetic device which would provide the same information as resistivity but easier to implement in the field. O



Jacob Lepori '12 and David Wheatley '12 examine specimens in Israel.

Summer Research at Ashkelon // by Jacob Lepori '12

During summer of 2011 I had the privilege of doing research in Ashkelon, Israel – a national park that was once one of Israel's largest port cities in ancient times. Archeologists there are excavating several sites around the park, thereby reconstructing the past. As part of a team of geologists consisting of a fellow student David Wheatley and lead by Dr. Stephen Moshier, we studied the geoarcheology of the site. Our study included creating a stratigraphic section of the human and natural deposits along a sea-cliff recently exposed in a violent winter storm. This section was a slice though time on an unparalleled scale in the world of archeology. The paleo-landscape was reconstructed using a modern digital elevation model and the drill hole data. Determining what the ancient landscape was like allows for greater understanding of why the site of Ashkelon was chosen for settlement. Our study of the paleo-topography also included an analysis of the sand dunes on which Ashkelon was built. By studying the orientation of the cross-beds the dunes were determined to have been formed by dominantly northwestern winds creating a barchanoid dune complex that was used as a rough foundation for the ramparts that surrounded the ancient city. This fall we had the opportunity to present our work at the annual Geological Society of America meeting in Minneapolis. These were invaluable learning experiences that gave me a greater appreciation and understanding of geology and the how the professional geological community operates.

Abstracts from GSA

Widespread, Late-Stage Fluid Induced Metamorphism In A Buchan-Type Setting, South Dakota Black Hills

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Precambrian terranes, in the amphibolite facies of the Black Hills core, typically exhibit two stages of metamorphism. The earlier, moderately low-pressure event accompanied the development of pervasive structures, including two phases of folding. The later metamorphism produced a mostly thermal overprint of static porphyroblasts concentrated along lithologic boundaries, veins and shear zones. Latest tectonic and metamorphic features have been attributed to the final emplacement of the Harney Peak Granite (HPG) and its pegmatites at about 1715Ma (D_3). In a pattern around the HPG, the later metamorphism approximates a contact aureole and structures define a tectonic doming in the surrounding metasedimentary and metavolcanic units.

Recent study north of the HPG exposures and into regions of lower-grade regional metamorphism indicates that the latest metamorphism persists in hydrothermal character, associated primarily with steeply-dipping shear zones. In the vicinity of Pactola Dam in Pennington County, the shears developed at the brittle-ductile transition, and cut biotite-grade supracrustals. Selective growth of euhedral, randomly-oriented phases (biotite, amphibole, pyrite and more rarely, K-feldspar) took place along the shears and occur with or without accompanying quartz, carbonate and chlorite in veins. At Pactola, the dominant rock types are mafic metavolcanic flows (?), and volcanogenic metasedimentary units (greywacke and carbonaceous, sulfidic shales, originally). A great abundance of carbonate phases plus chlorite in all units may indicate the high activity of CO_2 as well as H_2O during the latest metamorphism.

Just north of HPG outcrops in the Keystone area, garnet-grade units compositionally equivalent to Pactola Dam, are also hosts to late, steeply-dipping mineralized veins. Even though no sign of granitic influence is obvious, static-growth tourmaline exists along chlorite-rich shears.

The HPG may only crop out in the southern Black Hills, but suspicions are that its regional influence may be more ubiquitous. Related metamorphism/metasomatism far beyond the dome, possibly occurs in the Lead area and even northwest to Tinton. Undated, granitic pegmatite similar to the HPG has been mined in Tinton.

Geological Foundations Of Ancient Seaport Ashkelon, Israel

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The ancient seaport city of Ashkelon just north of Gaza on the Mediterranean coast of Israel is the site of archaeological excavations since 1985. The cultural succession at Ashkelon from Early Bronze to Middle Ages includes most notably Canaanite, Philistine, Persian, Greek, Roman, Byzantine, and Islamic-Crusader. Canaanites were the first to shape the local topography into an imposing semi-circular rampart system that encloses an area of more than 150 acres against the coast. Recent geological investigations (2008-2011) have focused on site-formation and paleoenvironmental origins of Ashkelon. Late Pleistocene-Early Holocene eolian sandstones known in the region as kurkar are exposed in the scenic cliff along the coast, standing 6 to 18 m above sea level in front of a narrow beach. High waves during a severe storm in December 2010 produced fresh exposures of kurkar and tel stratigraphy along the beach cliff. Outcroppings along the cliff and sediments recovered from probes across the tel show that kurkar underlies all archaeological deposits. Kurkar typically occurs as unconsolidated sand as close as 20 m from the shoreline. Original kurkar (pre-cultural) topography was reconstructed from the subsurface probes and total-station surveys of the beach cliff. We interpret two sub-parallel kurkar ridges, remnants of a local dune complex: one along the coast and the other about 550 m inland, both merging in the north. Waves have pushed the beach cliff back at least 20 m in the past 2500 years. Local drainage created and maintained two wadis that dissected the coastal ridge. Erosion from storms/tsunami may have breached lower standing kurkar where the wadis formed. Paleosols known in the region as hamra are found in association with kurkar. Red and yellow paleosols developed upon weathered kurkar and are more thickly and laterally developed along the coast south of the tel where kurkar rarely stands higher than about 2 m above sealevel. A very thick deposit (8.5+m) of dark yellowish brown sandy clay loam was discovered in a limited area between the kurkar ridges within the tel. The original kurkar topography clearly influenced the position of the rampart system. The distribution of artifacts from excavation records and probes shows the timing of tel growth from original topography, illustrated and animated with GIS tools.

Geoscience Taking A Rightful Place, Leading The World To A More Equitable And Sustainable Future

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Signs-of-the-Times clearly indicate the central place of geology in global resource-economics, politics, disasters, environmental sustainability and the destiny of nations. Real practice indicates that geoscience still lags behind other disciplines in fulfilling our potential role in studying and solving complex problems. Ecological biologists are lead practitioners in most environmental challenges. Engineers in various specialties tend to lead the way in most international-development projects, and social scientists (anthropologists, policy analysts and legal professionals) dominate much government and foundational attention. The increasing involvement of geologists exploring throughout the world for water supplies is an encouragement, even though much more can be done.

A strong role model for professional geoscientists exists in the person of Dr. B.E. Vijayam, from southeastern India. He is a distinguished researcher and teacher with a great heart to serve his nation and its people. He established five different NGOs to improve the human-environment conditions among the poor. Most noteworthy is Vijayam's model of service, placing geological knowledge as the foundation for all development efforts. This emphasizes the interdisciplinary nature of geoscience and its fundamental importance in development planning. Artisanal mining is one example, where Indian village women collected very pure quartzite to sell for optical-quality glass. Vijayam was able to recognize the potential of the local bedrock in establishing microenterprise. Among many other actions, he applied some basic geomorphic design in helping to halt erosion of fragile farm soils.

A picture of the excavation of the fossilized turtle that will be placed in our museum. Collected in 1943 by George Mell '47, Eric Zetterberg '46, and Starkey.

In a more-perfect world, geologists would assume the position of project managers and supervisors. Our circumspect abilities, gained from interdisciplinary, academic breadth, should organize diversities of expertise to address and hopefully solve great problems of international significance.

Local Geology As Guide To Development Projects In Kosova

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Each case involving the improvement of human-environmental relationships bears its own geological challenges. Ongoing water and sanitation projects in Tushile village, Kosova must function under very difficult natural circumstances. The community of about 600 residents is distributed as households along the lower and upper slopes of a stream valley for almost three kilometers. Animal and human waste contaminate household wells. Direct influents from toilets also flow into the village stream. Solid waste in the form of plastic, paper, glass, metals and other materials thickly litter the stream and virtually all streams in Kosova. Planning to provide clean, adequate water supplies and sustainable waste management in Tushile requires both a cultural understanding and the realities dictated by the steep slopes, bedrock structure and soil characteristics.

Research conducted over the summers of 2010 and 2011 indicate that most household wells can be rehabilitated for significant increases in water quality. However, the specific nature of groundwater mobility is controlled by fractures in the folded turbidite bedrock. Even after rehab, all wells are therefore not capable of supplying adequate quantity of potable water. Catchment systems and water cisterns are required in these cases. Some houses are set upon larger, flatter sections of land with relatively thick soil. These units are candidate for conventional septic system installation. Many other households are on steeper slopes, close to the stream, or without adequate soil development. Plans for these situations involve innovations, such as mound-system septics.

Engineered landfills, recycling centers and waste-water facilities are not yet established in Kosova. The solid waste problems remain to be studied

Abstracts from GSA continued

further with geological knowledge. Problem solutions over the entire country should include the great potential for job creation amidst terrible unemployment.

Inexpensive Geophysical Instruments For Groundwater Exploration In Developing Countries

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Geophysical methods are often used to aid in exploration for safe and abundant groundwater. In particular resistivity and seismic refraction methods are helpful in determining depth to bedrock and zones of saturation in the subsurface. However the expense of these instruments ($5000 to $20,000) has resulted in their limited use in developing countries. This talk briefly describes how to construct these devices for less than $250 each. The instruments are small, light and robust and are as accurate as the commercial models for shallow aquifers (less than 35 m deep) where wells can be hand dug, augured or drilled with small portable drill rigs. Seismic sampling rates up to 40,000 samples/second with 16-bit accuracy are possible by using the sound card microphone input available on most laptop computers. A MEMS accelerometer chip serves as a tiny geophone and costs only $13 US. Data interpretation can be accomplished quickly in the field with free software implemented on a laptop computer. A laptop computer can also implement free GIS programs that aid in remote sensing exploration for groundwater sites. A suite of geophysical instruments and software can therefore be assembled for less than $850 US. The instruments have been tested in the field in Tanzania, Chad, Nigeria and Haiti where indigenous well-drillers have been trained to use them. It is hoped that these inexpensive geophysical instruments can be widely distributed among drillers and aid workers in developing countries improving the success rate of water wells.

A Great Opportunity For Globalized Science Via On-Site, Service Learning And Geology Students

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The industrialized or "developed" nations of the world graduate a great abundance of earth science students each year. A small proportion of these with undergraduate and graduate degrees have any real connection to the issues dominating the peoples and environments of the majority world. The irony is that studying the earth without practical application is not a truly global vocation.

Challenges to increasing the number of globally informed and globally motivated geoscientists come from the lure of industry (mostly financial) and academia (mostly prestige). Opportunities directly involving geology for the improvement of lives among the global poor are few and typically un(der) funded. Volunteerism is required and quite difficult for those already employed. Increasing global involvement among well-educated geology students however, offers many benefits. There is the strong sense of altruism among the young, such that they can be recruited in efforts to help fix the world's problems. They are also less encumbered by family and existing career commitments. Perhaps their only limitation is need for mentoring/supervision requiring professional geoscientists. Once given sufficient training, the younger workforce is very capable of learning in the service context of global outreach. This assertion is supported by various cases of partnership networking for global projects. As examples, Wheaton College undergrad geology majors have served as the heart of research in South Africa (community waste-management), in Tanzania (water and mineral resource studies), in Kosova (holistic community development, including the analysis of fold-fracturing that control groundwater resources), in Senegal (coastal land-use analysis for construction materials) and in Haiti (geophysical search for aquifers). In each instance, a local organization hosts the research and provides trainees to gain expertise unavailable in their own schools. The only factor restricting the effective growth of this service-research-training paradigm is relatively modest funding support.

Geophysical Predictions Of The Hydrologic History Of The Great Lakes

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Over the last century geological studies of the ancestral Great Lakes have confirmed that the large surface load of the Laurentide ice sheet deformed the region causing tilting of ancient lake shorelines. We developed a method, utilizing a numerical model of glacial isostatic adjustment combined with GIS and high resolution digital elevation models to predict the paleo-topography at 1000-year intervals. GIS was then used to recreate the 30,000-year paleohydrology of the Great Lakes. Predictions include the extent of late glacial, postglacial and Holocene lakes and their associated outlets and bathymetries. This predicted history of the Great Lakes is similar to that obtained from a century of detailed field studies but our method uses only the present digital elevation model, a prescribed ice sheet chronology and an assumed earth viscoelastic rheology. GPS data support

our conclusions that the Great Lakes, south of a "hinge line", has never been stable. The geometry of outlet channels and the predicted water level and lake volumes permits an estimation of the discharge that likely occurred during outburst floods. Ancient lake bathymetry predictions provide an estimate of water loads associated with each lake and these loads also impact the isostatic adjustment process. Using the predicted paleo-topographic surface it was possible to predict where river drainage changes were caused by the isostatic process. GIS hydrology modeling packages were used to predict the drainage patterns during the past 10,000 years and regions where the patterns alter through time were highlighted for further study in the field. Finally the thickness of the ice sheet over the Great Lakes region was estimated from comparison of the observed deformation to predictions and a relatively thin ice sheet is suggested by the predictions. O

GSA and Summer Research

// by Lissa Peterson '12 and Frances Griswold '13

This past fall, approximately 15 of us had the opportunity to attend the Geological Society of America annual meeting in Minneapolis, where we were able to present our research with professors (see abstracts). The GSA annual meeting allowed us to share our research with a variety of professional geologists whose years of experience were evident in the questions we were asked and in our discussions with them. We gained a wider appreciation for the field of geology from our time at the GSA meeting. Although we knew before this trip that geology is an important and expansive field, hearing lectures and presentations on everything from Mars to waste management allowed us to understand how many areas of study and work there are within the earth sciences. Through our own poster presentation and the many lectures and presentations we attended, we were able to see our own research in a wider context of geology. This, in turn, helped us to see where we could go in the future as students of geology. Presenting our own research at this meeting was a rewarding experience as we became part of a national geologic community.

During the past summer we were continuing work on an outcrop at Pactola Dam in the Black Hills of South Dakota. This region is a fascinating study in multiple stages of metamorphism. In order to look more deeply at this metamorphosis, our portion of the research was focused on a petrographic analysis of hand specimens, which were brought back to Wheaton from the Pactola outcrop by Wheaton graduate **Peter Brice '11**. In addition to our petrographic view of this region, we also partnered with Dr. Craig Schwandt, who was able to perform a chemical analysis of key minerals within the rocks. Through our research, we found evidence for two separate stages of metamorphosis; it was this research that we were able to present in Minneapolis this past October. O

Scholarship Awards

This academic year the department has had the privilege of awarding the Geology Scholarship and Donald C. Boardman Black Hills Award in the next few months. It is becoming more and more difficult to select recipients of these awards from our large group of devoted majors.

This year the merit based Geology Scholarship awarded a total of $2750 to three deserving majors, **Michael Davis '12**, **Sun Ho Hwang '13**, and **David Wheatley '12**. A passion for geology, involvement in the department, and academic achievement are considered when selecting recipients.

The Donald C. Boardman Black Hills Award is a need based scholarship given to defray the cost of attending the Science Station, as Geology majors are required to complete field courses in the Black Hills as part of the degree. A total of $2500 was awarded to **Brit Rustad '13**, **Jonathan Yates '12**, **Josiah Hulsey '13**, **Kit Carson '12**, and **Lissa Peterson '12**.

Thank you alumni for your continuing contributions to our scholarship funds—we are blessed to have scholarships to aid our students. Please remember that you must designate these scholarships when making a contribution to the college. O

An expert is brought in via teleconferencing during the fall Agronomy class.

Basic Agronomy Class Offered

//by James Clark

During fall semester a new course was offered, Introduction to Agronomy (Geology/En. Studies 420). Although this course has been in the catalog for many years it was never offered because no professor at the college was qualified. Fortunately John Vendeland, husband of Applied Health Sciences professor Dr. Susan Vendeland, agreed to provide the course as an adjunct professor. John is well qualified to do this with 25 years experience as an agricultural consultant. He has worked on hundreds of projects with leading companies on strategic and financial issues across a broad range of crop and agricultural markets. His experience includes all phases of the value chain from research and development to final retail. He has a strong background in crop protection, seeds and seed technology, fertilizers, cereals, produce marketing and tropical production systems. John received a B.S. in Biology from Stanford University, an M.S. in Agronomy from Cornell University, and an MBA from the University of California at Berkeley. Added to these qualifications, John assembled a truly impressive group of colleagues, each an expert in a different field of agricultural research, to give lectures in their respective expertise. The result was a truly one-of-a-kind course that would be life changing to students in the class. The course not only broke new ground in the curriculum but also used novel pedagogy. Each of the "expert" lecturers was beamed-in from their homes in Hawaii, California, Michigan, etc. to serve as cyber-speakers. Through video conferencing methods implemented by our computer services folks the experts could interact with the class as if they were in the room. The result was a truly unique experience. We owe John sincere thanks for providing this experience for our students – and he volunteered his time and effort as well! Topics included in this linear quad course included:

Weed Control, Cover Crops & Tillage
Agricultural Soils
Cacao
Sorghum
Cowpeas
Papaya & Virus Resistance
Plant Pathology
Plant Nutrition
Irrigation
Agricultural Entomology
Postharvest Losses
Tropical Forestry
Propagation Principles

Department Completes 10- Year Review

// by Stephen Moshier

The Department of Geology and Environmental Science completed a Ten-Year Review during the fall semester. The process starts with the preparation of a self-study report. A survey sent to alumni of the past decade provided significant feedback for assessment of our program (thanks to all of *you* who responded). A review team visited us for two days in late October: Dr. Jon Peterson (Hope College), Dr. Barbara Tewksbury (Hamilton College), Dr. Lynn Cooper (Wheaton College) and Dr. Jennifer Busch (Wheaton College). Dr. Peterson wrote the evaluation report, which was followed by a departmental response. Their report accurately reflects the current condition and culture of the department, affirms that our program is consistent with the mission of the college, finds that students and recent alumni were well served by the program, and illuminates specific concerns and deficiencies of the program that must be addressed to meet the demands of a growing major and to maintain the vibrancy of the program. The primary recommendation of the team to add a new tenure-track, full-time faculty line is justified by a number of factors that contribute to concerns and deficiencies of the program. These include curricular gaps and deficiencies, the department's contributions to General Education, impending retirements, and diversity. We will be working with the college administration to implement the recommendations of the reports.

Geology Club

// by Katy Foltz '13

The Geology Club has started to take root on campus… literally. This year has been about building up a solid base for future involvement, and thus, we took on a massive fundraising project of growing coffee plants. We partnered with A-Rocha, the environmental club on campus, to germinate, grow, and sell actual coffee plants around campus and the community. Through contacts from our project advisor, John Vendeland, *Arabica Coffee* seeds were donated from a research facility in Hawaii in April. Over the summer, we germinated and grew these plants in the Wheaton College Physical Plant Greenhouse, with great success. Though we expected to lose around 20-30% of the plants over the summer, we were shocked to discover that by the time we were ready to sell, we had only lost around 20 plants total, leaving over 1100 individual coffee plants. We are currently in the process of selling to students, faculty and staff, and the Wheaton community. We even have an advertisement up on Craig's List that has been met with a lot of interest. Revenue from this fundraiser has been over $400 per club, and we are expecting much more in the weeks to come. Although we have only been around for a year and a half, Geology Club has big ideas for the future and this will continue to foster our explorations of creation.

Environmental Studies Director

// by James Clark

The director of the Wheaton College Environmental Studies program, Dr. Fred VanDyke, announced in the fall that he will be leaving Wheaton College to accept a position as director of AuSable Environmental Institute. So a search was begun to fill that vacancy. Two excellent candidates were interviewed and Dr. Chris Keil '87 was selected to fill the position. His expertise is in environmental chemistry and will fill an important deficiency in the ES major. Some of you may recall that the Environmental Studies program began under the wings of the Geology Department and it is likely that with the new director the Environmental Studies program will once again be more closely affiliated with Geology. In the new science building the ES director has an office next to the geology offices and ES student lab and work space are also near Geology classrooms. We therefore look forward to an even closer relationship with Environmental Studies than we have had during the past few years.

Chris Keil at the Science Station

Chris comes to Wheaton College after eighteen years at Bowling Green State University's Environmental Health program. Chris graduated from Wheaton in 1987 with a BS in Biology and continued on to the University of Illinois at Chicago for a MS and PhD in Environmental and Occupational Health. Beginning in 1996, Chris has taught classes at the Wheaton College Science Station in summer.

Top row, from left: Jamie Selander '04, Layton Boeve '12, Christina Hegdahl '12, Amy Neilson '12, Jeffrey Greenberg, James Clark, Lisa Heidlauf, Benjamin Bader '12 Front row: Stephen Moshier, Peter Brice '12, and Sara Federschmidt '12

Class of 2011 Graduates

Seven majors graduated in 2011. **Cory Hart** graduated in December, and in May, **Benjamin Bader**, **Layton Boeve**, **Peter Brice**, **Sara Federschmidt**, **Christina Hegdahl**, and **Amy Neilson** completed their degrees. To celebrate, we took the graduates to Gino's East. Cory is working for Geosteerer for Chesapeake Energy Corp. and Benjamin is taking a year off before entering graduate school. Amy Neilson is working on water missions at Oregon State University. Peter Brice and Sara Federschmidt are working on master degrees at Colorado School of Mines and University of Kentucky (in Alaskan geomorphology), respectively. Christina Hegdahl has joined the work force as a secondary education teacher, and Layton is working on development missions in Africa. We are very proud of our graduates and hope they come back to visit us frequently.

Alumni News //by Jeff Greenberg

It seems that each year our cadre of graduates grows exponentially. That is an exaggeration but in a year with 21 majors graduating (all time record), it is a good impression.

We (Jim, Jeff and Steve) saw Wheaton Geology alums at the Minneapolis GSA, including the new University of Minnesota PhD, **Andrew Luhmann '06** and most recent Doctor **Lindsey Christiansen Henry '04.** Andrew and his wife Audrey recently welcomed child #3 and Lindsey and husband Chris have a pretty young one themselves. Lindsey presented on some of her University of Wisconsin-Milwaukee doctoral work in Tasmania at the meeting. **Glenn Sharman '08** was also there and presented a part of his Stanford University dissertation. **Gary LaVanchy '98** took a break from his University of Denver doctoral studies in geography in order to present his Masters thesis at the special session on *International Development and Geosciences* convened by former department colleague, **Michael Guebert** and myself. You already know that we took a healthy bunch of our current geology majors to the conference.

Visits: Rich Aram '76, Don Beaumont '49, Dean Dumais '95, Andrew Kulpecz '02, Cathy Webb Watts '73
Babies: Ana C. Meyer '04, Lacy N Smith '01, Katie L. O'Connor '04, Jamie Selander '04, Andrew Luhmann '06

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Clockwise from top:
Taking measurements during a local field trip in Geomorphology in fall. ❍ The Geomorphology Class on a field trip to the Indiana Dunes. The class had a record enrollment of 37 students. ❍ Geology majors in the 90s.