Annual Report Executive Summary, 2009-10
Department of Geosciences

Learning: Undergraduate

The Department of Geosciences **awarded $9,300 in undergraduate** academic and research **scholarships and excellence awards**.

The Department had **94 undergraduate majors** this past year; 17 graduated with degrees in one of four degree options (Geology, Geochemistry, Geophysics, Earth Science Education). Forty students participated in research activities with faculty members.

Barbara Bekken received two university awards—the 2010 Edward S. Diggs Teaching Scholars Award and the 2010 Alumni Award for Excellence in Teaching.

The **Senior Seminar** (GEOS 4024), a communications-intensive (both written and oral presentations) course, **provides the opportunity for graduating seniors to develop their ability to communicate scientific information** to diverse audiences. Each student is required to write an NSF-style proposal (10 pages minimum) and also prepare and deliver a professional-style oral presentation using Powerpoint media. This class has proven to be an excellent "hands on" tool for students who are completing their undergraduate course of study.

The **Curriculum Committee** (CC), headed by Rick Law, undertook an **analysis of** the **math skills** currently employed in the 3000 level GEOS core courses. With the exception of 3104 Elementary Geophysics, 3000 level courses did not require any significant math skills beyond algebra, a minor amount of linear algebra, basic statistics and trigonometry. Nonetheless, the CC recommended that no changes be made to our current "Engineering Math" requirement as these courses may be particularly useful for students going on to Graduate School. The CC continued to examine and discuss course content and skill development throughout the undergraduate curriculum preparatory to determining whether curriculum restructuring is needed.

Learning: Graduate

The Department of Geosciences continues to maintain a **strong graduate program** with an **enrollment of 57 students** at the beginning of spring semester 2010.

Graduate student mentoring, activities, awards, and admissions are coordinated by the Graduate Student Affairs Committee (GSAC), which is led by the Graduate Program Director, Madeline Schreiber. The department administration is aided by a graduate liaison committee that consists of six graduate students, which meets with the Graduate Program Director each semester and is a line of open communication for feedback and concerns of graduate students.

The **GSAC modified procedures for evaluation of graduate student progress** in 2009-10. Each graduate student meets routinely with their major advisor, and has one mandatory committee meeting each year. The GSAC also monitors the progress of all graduate students, and provides advice and arbitration as needed. Each student completes an annual report of their research progress, which is evaluated by the advisor, advisory committee, graduate program director and reviewed by the department head. Additionally, the **GSAC has worked to improve the structure of the Ph.D. preliminary exam format** by requiring each research group to have written guidelines on the format of the preliminary exam which is provided to students as they prepare for the exam.

The 15th Annual Geosciences Student Research Symposium (GSRS) was held March 4-5, 2010. GSRS is produced and organized by the graduate students. The **symposium is designed to allow students the opportunity to prepare and present talks in their current research areas** for both professional growth and public awareness. Forty-four students presented talks.

In Spring 2010, the **department held an open competition for research funding** for graduate students. Students wrote proposals that were evaluated by the Graduate Student Affairs Committee. A total of 36 proposals were received and evaluated. Research support, summer stipends (for Summer 2010), and one RA (Fall 2010) were awarded to graduate students. Further details can be found in the Graduate Learning section of the Annual Report.

Discovery

The 22 teaching and research Faculty members in the Department of Geosciences have been awarded 19 new research grants to go along with 52 continuing research grants totaling $15,737,720, which comes out to approximately $750,000 per faculty member. **Total research expenditures for fiscal year 2009-10 are $2.9 million.**

Seventy-three research papers and approximately 153 abstracts were published by the Department's faculty from June 2009-May 2010.

Ross Angel will be awarded the **Dana Medal** from the Mineralogical Society of America in 2011.

Robert Bodnar was inducted as **Fellow of the Geological Society of America**; named **Virginia's Outstanding Scientist 2010** by the Governor of Virginia; received **Honorary Doctorate** in Geological Sciences from the **University of Napoli Federico II, Naples, Italy**.

Thomas Burbey spent summer 2009 as a **visiting scholar** in the Department of Geosciences, **University of Rennes, Rennes France**.

Patricia Dove was inducted as **Fellow of the Geochemical Society and European Association of Geochemistry**.

Scott King received the **Alexander von Humboldt Fellowship** (Preistraeger).

Madeline Schreiber was elected **Fellow of the Geological Society of America**, 2009.

Shuhai Xiao received the 2010 **Alumni Award for Excellence in Research**. Additionally, he has been **named a Guggenheim Fellow**.

Engagement

The Department of Geosciences has a **commitment to engagement and outreach** to increase public understanding of the value and relevance of the geoscienes through publications, presentations, exhibits, and formal and informal science education programs.

The department has highlighted the role of engagement and public outreach in the broader impacts of funding proposals, making them more competitive as a result. External funding for engagement activities provided for ~25% of a staff position during 2009-10.

Llyn Sharp provides leadership to the department's outreach and continues as a coordinator for VT-STEM, the University's K-12 Outreach Initiative in Science, Technology, Engineering, and Math, sponsored by the Division of Outreach and International Affairs. In Fall 2009, Llyn worked closely with VT-STEM on the statewide **Governor's Conference on STEM Education in Virginia**, attended by 230 educators and decision-makers. [www.stem.vt.edu]

In addition to engagement of faculty as part of their professional activities, the Department of Geosciences further demonstrated its commitment to outreach by housing the Museum of Geosciences programs, tours, exhibits, and collections. This staffed program includes management of Museum functions as well as **support for K-12 field science studies and in-class experiences**, mentoring students in projects, Education Resource Center (ERC) kit and material loans, earth and environmental education training workshops and teacher institutes, facilitation of community partnerships.

Over **8000 visitors visited the Museum of Geosciences** during 2009-10. Programs served almost **1500 K-12 students and teachers**. Visitors included individuals and families, K-12 school tours, youth groups, VT course uses, teacher workshops, meetings, and receptions for various events. There were 43 loans of teaching materials and equipment from the ERC, used by educators mostly from the local area. The Museum also served as the site for the College of Science promotional video interviews.

Diversity

The Department of Geosciences has been **active in improving diversity** within our student and faculty populations. We currently have four female tenured/tenure track faculty (2 Full Professors, 1 Associate Professor and 1 Assistant Professor out of 18 tenure-track faculty) and one non-tenure track female faculty member. As of fall 2009, we had 24 female graduate students (out of 55).

Although we are **closing the gender gap in Geosciences**, we have yet to significantly improve the participation of ethnic minorities in our field. This past year we successfully recruited two black African students to our department, which has improved the multicultural environment in the department. We also successfully recruited a Cuban-American female to our department; she will be arriving this fall. As this is a national trend, our struggles to maintain a multicultural balance of our graduate students and faculty are not unusual, but we hope to increase underrepresented students in our field in the coming years through more active recruiting of graduate students from minority-serving institutions, in conjunction with efforts that the College of Science Diversity Committee is initiating. Our 2009 diversity activities for the reporting period include the following:

Educational Programs and Workshops: Ross Angel with Chemistry colleague Carla Slebodnick organized and taught a week-long Crystallography Workshop for undergraduate and high school students. Over the 7-year period of the workshop, approximately 45% of the attendees have been women. Several of our faculty have attended AdvanceVT workshops, including Ken Eriksson, Madeline Schreiber, and Ying Zhou.

Teaching and Mentoring: Barbara Bekken, working with Dr. Shelli Fowler, has designed, incorporated, and is working to assess a progressive diversity awareness curriculum into the Earth Sustainability series.

Recruiting and Retention: As a member of the College of Science (COS) Diversity Committee, faculty member Madeline Schreiber has been involved in developing programs to enhance diversity of undergraduate, graduate and faculty in COS. In 2009, the committee gave awards to minority COS undergraduates, and has discussed organizing fall recruiting trips to historically black colleges and universities in Virginia for all COS departments.

Leadership: Mike Hochella heads up the NSF IGERT grant/program (called EIGER), for which he is PI and current Director. During five years of operation, five of the 27 Ph.D. students that have been supported under EIGER are underrepresented minority (URM) Ph.D. candidates. Patricia Dove is on the AdvanceVT advisory committee.

Goals for 2010-11

The department finalized its strategic plan for 2010-2014 in Fall, 2009 and has started evaluating the Action Items identified in the plan. Work has already started under the leadership of Ross Angel to identify a group of benchmark institutions and to establish metrics against which department achievements can be measured. Following multiple retirements in the past 3 years, including those of Don Rimstidt and Fred Read in June, 2010, coupled with the departures of Jake Sewall and Erin Kraal in 2009, our strategic plan contained a hiring plan to rebuild the department starting with two hires in Fall, 2010. This plan was developed within the framework of existing and new clusters and, in particular, the ISES cluster. Hiring has been delayed, however, we anticipate searching for two new faculty members starting in Fall, 2011.

Other goals for 2010-2011 are curriculum revision, to continue to actively encourage companies (oil and minerals) to interview in this department, to recruit top-quality undergraduate students, and to recruit top-quality graduate students at professional meetings and via personal contacts. The department is committed to increasing our undergraduate numbers and, towards this end, we will be identifying an individual to present guest lectures in all Intro Geology classes on career opportunities in Geosciences and giving consideration to establishing a new option in hydrogeosciences and environmental geosciences.

In addition, the department will pursue some immediate development goals to enhance the department's endowment situation starting with the establishment of endowments for Fred Read and Don Rimstidt. Planning for the new building is on hold pending news on private donations.

Discussions will continue on developing an administrative structure for the department in view of the anticipated retirements of three administrative staff within the next few years.

Statistical Information

Department of Geosciences
June 2009-May 2010

Academics:

Present Enrollment:	Undergraduate majors	94
	Graduate majors	57
No. of Courses:	Undergraduate	60.33 (161.33 sections)
	Graduate	41 (42 sections)
Student Credit Hours:	Undergraduate	16,205.5
	Graduate	1,900.5
Degrees:	B.S.	17
	M.S.	8
	Ph.D.	5

Full-time Faculty and Staff:

Professors (includes 2 University Distinguished Professors)	12
Associate Professors	5
Assistant Professors	2
Research Professor	2
Research Assistant Professor	1
Instructors	2
AP Faculty	2
Classified Staff	11

Other Affiliates:

Emeritus Faculty	13
Research Associates/Postdoctoral Associates	12
Adjunct and Cooperating Faculty	13

Publications:

Newsletters	1
Research Papers/Special Publications	73
Abstracts	~153

Grants:

Externally funded	$15,737,720.00
Proposals pending	$8,819,793.00

Gifts:

Industry support	$46,000.00
Scholarships and Endowments	$129,076.00

Note, all numerical entries are based on statistics as of May 31, 2010.

Current Faculty and Staff:

Professors:

Robert Bodnar (UDP), Patricia Dove, Kenneth Eriksson, Michael F. Hochella, Jr. (UDP), Scott King, Michal Kowalewski, Richard Law, J. Fred Read, J. Donald Rimstidt, Nancy Ross, Robert Tracy, Shuhai Xiao

Associate Professors:

Thomas Burbey, John Hole, Madeline Schreiber, James Spotila, Chester Weiss,

Assistant Professors:

Barbara Bekken, Ying Zhou

Research Professors:

Ross Angel, Robert Lowell

Research Assistant Professor:

Martin Chapman

Instructors:

Neil Johnson, Kimball Knight

AP Faculty:

Miles Gentry, Richard Godbee

Research Associates/Postdoctoral Associates:

Matteo Alvaro, Deborah Aruguete, Jacob Beale, Takuya Echigo, Luca Fedele, Nizhou Han, Bojeong Kim, James Schiffbauer, Elinor Spencer, Michael Tappa, Yonggang Yu, Jing Zhao

Adjunct/Cooperating Faculty:

James Beard, John Chermak, Benedetto De Vivo, Alton Dooley, Nicholas Fraser, William Henika, David Houseknecht, Jerry Hunter, Richard Koepnick, Matthew Mikulich, Csaba Szabo, Lauck Ward, Chester Watts

Classified Staff:

Linda Bland, Charles Farley, Mark Fortney, James Langridge, Mark Lemon, Connie Lowe, Ellen Mathena, Mary McMurray, S. Llyn Sharp, Daniel Smith, Carolyn Williams

Emeritus Faculty:

Richard Bambach, Donald Bloss, Gil Bollinger, Cahit Çoruh, John Costain, James Craig, Gerald Gibbs, David Hewitt, Gordon Grender, Wallace Lowry, Dewey McLean, Edwin Robinson, Paul Ribbe, A. Krishna Sinha, J. Arthur Snoke

Undergraduate Learning

Geosciences has approximately 94 undergraduate majors distributed over four options—geology, geophysics, geochemistry and earth science education.

Undergraduate Courses			
Courses	No. Sections	No. Students	Credit Hours
1st Summer 2009	1	22	66
2nd Summer 2009	2	24	70
Fall 2009	84	2636	7929.5
Spring 2010	116.33	2675	8140

GEOS Undergraduate Mission Statement: The primary goal of the Department of Geosciences in the education of its undergraduate students is to prepare them for productive careers either by directly entering the job market or competing successfully for admission to a graduate program. These goals are formally reflected in a new mission statement summarized below:

To provide undergraduate majors with a well-rounded education of the Earth's systems and the tools used to study them through four degree options: 1) geology, 2) geophysics, 3) geochemistry, and 4) earth science education. VT Geosciences graduates should be able to compete successfully for jobs or for entry to graduate studies in the Earth Sciences and related sciences.

This mission is supported by five learning outcomes updated during 2009/10 that will be assessed annually.

GEOS Undergraduate Learning Outcomes: Upon completion of a Bachelor's Degree, graduates from the Department of Geosciences should be able to:

(1) Propose a means for studying a typical earth science-related problem, select and apply appropriate scientific methods and tools to generate data, analyze and interpret data, and describe findings according to the conventions appropriate to the problem.

(2) Use the conventions for communication and information-seeking common to the geosciences to: search for and evaluate geoscientific and related information, write a geoscientific proposal and report, write a geoscientific abstract and give a companion oral presentation, and design a geoscientific poster.

(3) Use appropriate tools to identify geological materials and features, describe their properties and characteristics, and record information about them using conventions common to the geosciences.

(4) Identify and describe the dynamic processes that shape the Earth, recognize and describe the tools that geoscientists use to inform our knowledge of these processes, and explain how these processes interact within the Earth's systems.

(5) Use qualitative and quantitative evidence from geological, physical, chemical, and/or biological observations of Earth's materials and processes to constrain models of the Earth through space and time.

Academic Assessment Plan: Evaluation of student learning according to these five criteria is based on three performance-based measures of student learning: 1) written materials produced by students in four required courses (Geoscience Fundamentals, Structural Geology, Sedimentology/Stratigraphy, and Senior Seminar), 2) a repeated 'methods of science' questionnaire, and 3) a professional geosciences exit exam. The first two measures will assess the first two outcomes listed above, while the exit exam will assess the last three outcomes. The Geosciences exit exam will be written during the 2010/11 academic year.

ViEWS: The ViEWS assessment has been embedded into the Learning Outcomes Assessment that is now reported using WEAVE ONLINE. Learning Outcomes #1 and #2 directly evaluate the departments' ViEWS program. The department submitted materials for the SACS reaccreditation and these were considered as acceptable.

Written reports and oral presentations in writing and research intensive courses will continue to be used to demonstrate students' ability to pursue scientific inquiry (objective #1) and communicate that inquiry according to the conventions of the geosciences (objective #2). Courses identified for this purpose are Geoscience Fundamentals (GEOS 1005 and 1006) as well as Senior Seminar (GEOS 4024). In addition, writing and research assignments are incorporated into Structure (GEOS 3014, Fall 2009) and Sedimentology/Stratigraphy (GEOS 3204, Fall, 2009).

Educational Research: In Spring 2010, Barbara Bekken together with a team of ten diverse faculty and post-docs from four different colleges, concluded the fourth cohort of 72 students in the experimental Earth Sustainability (ES) integrated Liberal Education project. These students will receive credit for six of the seven areas of the Curriculum for Liberal Education (CLE). While the curriculum in Earth Sustainability also meets the content requirements for writing and discourse, we have applied for area credit for the series.

The ES program is a teaching and learning laboratory that is designed in accord with a well-established curricular/developmental model that supports student development along three key domains: cognitive/epistemological, interpersonal, and intrapersonal. The series is augmented by a six-year long NSF-supported longitudinal study to evaluate student gains in learning and development along these three domains relative to a control group of students who are enrolled in the CLE.

Curriculum Committee Report: The Curriculum Committee (CC), headed by Rick Law, undertook an analysis of the math skills currently employed in the 3000 level GEOS core courses. With the exception of 3104 Elementary Geophysics, 3000 level courses did not require any significant math skills beyond basic algebra, a minor amount of linear algebra, basic statistics and trigonometry. Nonetheless, the CC recommended that no changes be made to our current "Engineering Math" requirement as these courses may be particularly useful for those students going on to Graduate School. The CC continued to examine and discuss course content and skill development throughout the undergraduate curriculum preparatory to determining

whether curriculum restructuring is needed. The CC noted the need to address the developing problem of insufficient availability of appropriate graduate courses – at least for some research areas such as hard rock / mineral physics, soft rock, etc. This problem is linked to, and compounded, by upcoming retirements, faculty replacements etc.

Academic Advising: The Department strives to provide superior academic and career counseling for undergraduate students. Every undergraduate is interviewed at the time he or she enters the Department as a new undergraduate or as a transfer and is given information on academic expectations, course requirements, departmental activities, employment opportunities and other professional opportunities. Each student is assigned an academic advisor who oversees the student until graduation. Students are required to meet regularly before pre-registration each Fall and Spring semester to ensure that progress is being made towards their degrees. These meetings consist of two stages: first a meeting with Mrs. Connie Lowe (Student Coordinator) to check the technical details of their plan of studies and registration for the up-coming semester, and second a meeting with their academic advisor to discuss such broader issues as designing and maintaining a plan of study to achieve long term career goals. In combination with student course evaluations, these meetings have also proved to be an important (although un-quantified) source of student feedback on the curriculum.

Undergraduate Awards per 2010 Graduation Program:

—Geosciences Outstanding Senior Award: William Nachlas
—Geosciences Outstanding Service Recognition Award: Keith DePew

—Geosciences Excellence Awards: Kerry Douglas, Anthony Frayne, Rebecca Horne, Amanda Isbell, Matthew Kadilak, Rachel Raines, Obai Shaikh, John Smith, Iliya Smithka

—W. D. Lowry Field Camp Scholarships: Anthony Frayne, Joshua Seay, Alexandra Vallowe

—Geosciences Undergraduate Research Award: Joshua Hoover

College and Other Undergraduate Awards:
- —Sigma Gamma Epsilon W. A. Tarr Award: Keith DePew
- —ACC Undergraduate Research Scholar: William Nachlas
- —GSA/Subaru of America Minority Student Scholarship: Keith DePew
- —Anadarko Petroleum/SEG Fellowship Scholarship: Joshua Hoover

Undergraduate scholarships activity using Foundation endowed accounts for 2009-2010 totaled $9,300.

Graduate Learning

Mentoring: The Department of Geosciences maintains a strong graduate program with a large number of students given the size of the faculty. Although graduate students work with a primary advisor, there is considerable interaction among individual research programs, as collaboration is fundamental in the diverse field of geosciences. The responsibility of mentoring graduate research falls first on the primary advisor, but significant support is provided by a student's thesis committee as well as other faculty within and outside of the department.

Graduate student mentoring, activities, awards, and admissions are coordinated by the Graduate Student Affairs Committee (GSAC), which is lead by the Graduate Program Director (M. Schreiber). The department administration is aided by a graduate liaison committee that consists of 6 graduate students, which meets with the Graduate Program Director each semester and is a line of open communication for feedback and concerns of graduate students.

The department also offers several programs to facilitate the overall mentoring of graduate students as a collective. Activities during the 2009-2010 academic year include an annual orientation and field trip for new students (August, 2009), a faculty introduction seminar and student-faculty reception (August, 2009), the two-day Graduate Student Research Symposium (GSRS) (March, 2010), and several dinners, picnics, and socials throughout the academic year.

The new graduate student orientation in August now includes a presentation of expectations of graduate students, scientific culture and ethics, and graduate career paths. The departmental seminar program is also largely geared to expanding the scholarly horizons of graduate students, nearly all of whom attend on a weekly basis. (See listing of Departmental Seminars.) This year, we initiated a Geosciences International Potluck, which was organized by a group of graduate students, and held on May 6, 2010. Based on feedback from students and faculty, we plan to continue this potluck annually.

As a result of these activities in graduate mentoring, the Department of Geosciences maintains not just a graduate student body, but a cohesive community of students that interact and help each other, thereby enriching their graduate experience at Virginia Tech.

Recruiting: At the beginning of Fall semester 2010, Geosciences will have 10 M.S. and 47 Ph.D. students (57 total). This includes 14 new graduate students (5 M.S. and 9 Ph.D.). The following summarizes graduate applications and admissions for the 2009-2010 academic year:

Graduate students successfully completed: 7 M.S., 3 Ph.D.
New graduate applications: 75
New graduate applications accepted for admissions: 28
Graduate students offered support: 25
New graduate students accepting offer for admission for Fall 2010: 14

Special student recruiting and information booths to promote the Department of Geosciences were set up and tended by faculty and graduate students at the following professional meetings: Geological Society of America, Southeast Section of Geological Society of America, Society of Exploration Geophysicists and the American Geophysical Union. In addition, the departmental website continues to be updated and modified on a regular basis. The department also continues

to use a web-based pre-application form to reach potential applicants and to match their research interests with potential faculty advisors.

Academic Assessment: Each graduate student meets routinely with their major advisor, and has one mandatory committee meeting each year. The GSAC also monitors the progress of all graduate students, and provides advice and arbitration as needed. Each student completes an annual report of their research progress, which is evaluated by the advisor, advisory committee, graduate program director and reviewed by the department head. Each graduate student also generally gives a research seminar at the annual Graduate Student Research Symposium in March, which further provides an opportunity for faculty to assess their progress.

The GSAC modified procedures for evaluating graduate student progress in 2009-2010. The annual report template was modified to streamline the entry of information and we again modified the evaluation page to include ratings (satisfactory and unsatisfactory) for both coursework and teaching. The GSAC has worked to improve the structure of the Ph.D. preliminary exam format by requiring each research group to have written guidelines on the format of the preliminary exam which is provided to students as they prepare for the exam.

We also now require PhD students to take their preliminary exam by the end of the 5th semester of the program. We have also discussed other future improvements to the graduate program, including the possibility of developing an electronic database for admissions and academic progress, similar to the program recently implemented in the Department of Chemistry.

GEOS Graduate Learning Outcomes: The Department of Geosciences has the following goals and learning outcomes for our M.S. and Ph.D. candidates.

Goals for M.S. Candidates:

1. Conduct research in the field that is relevant to the thesis topic, including demonstrating fundamental knowledge of relevant areas of geoscience and other fields (physics, chemistry, biology, mathematics), adequate observational or experimental skills (laboratory, field, computational), and ability to organize, analyze, and interpret data.
2. Communicate the research comprehensively in both written and oral formats.
3. Design an investigation of the scientific problem, including development of testable hypotheses, a rigorous experimental approach, and/or a set of descriptive or exploratory observations that bear on the research question.
4. Develop a relevant scientific problem into a research question and thesis topic, based on thorough analysis of appropriate literature and related sources of information.
5. Demonstrate effective participation in broader areas of geoscience, including science education, professional development, understanding of ethical standards, outreach and service, and teamwork.

Goals for Ph.D. Candidates:

1. Demonstrate a comprehensive understanding of their specific discipline, the earth systems as a whole, and other basic sciences as appropriate, all towards the goal of being an independent, creative scholar.
2. Engage in the relevant scientific community via presentations at professional meetings, publishing research results in relevant journals, obtaining funding for projects, and developing connections to scientists beyond the home research program.
3. Effectively teach and mentor both undergraduate and graduate students in the classroom and in a research environment (i.e. become self-replicating).
4. Demonstrate effective participation in broader areas of geoscience, including professional development, understanding of ethical standards, outreach and service, and teamwork.
5. Independently develop relevant research projects, based on the current state of knowledge and need for discovery in a specific discipline.
6. Effectively conduct meaningful investigations of relevant geoscience problems, including developing testable hypotheses and experimental approaches, obtaining the necessary expertise to conduct research, and carrying out the research to production of meaningful, publishable results.

Industry Recruiting: The Department continues to maintain strong ties with industry as nine companies visited and conducted interviews with our students. As a result of these interviews several of our students were offered internships and/or employment.

Scholarship Activity: Foundation funds were used effectively to support graduate students in the past academic year. Four graduate students were funded by full GRAs (i.e. stipend and tuition) using Foundation funds as follows:

Kui Liu – BP Graduate Fellowship
Justin Warren – M.J. Mikulich and J. Costain Geophysics Scholarship
Joyce Carbough - Conoco-Phillips Corporation Fellowship
Eric Kazlauskas- Chevron Corporation Geophysics Fellowship

In Spring 2010, the department held an open competition for research funding for graduate students. Students wrote proposals that were evaluated by the Graduate Student Affairs Committee. A total of 36 proposals were received and evaluated. Awards for research funding, summer stipends (for Summer 2010), and one RA (Fall 2010) were awarded as follows:

<u>Research Awards</u>
T.T. Jeffries Award: Denise Levitan, Christina Blue
W.D. Lowry Awards: Kristi Dorfler, Jeanne Roningen
C.J. Gose, Jr. Award: Carrie Tyler, Jackie Wittmer, Michael Meyer
H. Robinson-R.J. Holden Award: Adeola Oyewumi, Oluyinka Oyewumi, Joyce Carbough

Endowed Scholarships

J. Costain Scholarship in Geophysics: Kiu Liu
L.P. and M.L. Harris Scholarships: Michael Meyer, Philip Prince, Benjamin Roth
A.E. Orange Scholarship in Geophysics: Sharmin Shamsalsadati
H. Robinson- R.J. Holden Scholarships: Kristin Dorfler, Denise Levitan, Adeola Oyewumi, Benjamin Roth
C.E. and F.P. Sears Scholarships: Jeanne Roningen, Amy Smith, Carrie Tyler
C.G. "Jake" Tillman Scholarship: Ryan Grimm
D.R. Wones Scholarships: Elizabeth Diesel, Ryan Grimm, Lisa Tranel

Semester RA Award

Youyi Ruan – Geoscience Graduate Scholar and J. Costain Fellowship

The Department also awarded other graduate fellowships throughout the 2009-2010 Academic Year, including:

M.J. Mikulich Graduate Scholarship: Justin Warren
Chevron Geophysics Graduate Fellowship: Eric Kaslauskas
Conoco-Phillips Graduate Fellowships: Joyce Carbaugh (full year), Carrie Tyler
BP Graduate Fellowship: Kiu Liu

The Department also presented several other awards to graduate students at graduation, including teaching and service awards:

Elizabeth Diesel and Lisa Tranel Outstanding Service Recognition Award
Anthony Guiffre - Tillman Teaching Award (introductory)
Kristen Dorfler - Tillman Teaching Award (combined)
Ryan Grimm, Benjamin Roth, Philip Prince: Career Awards for Sustained Excellence as Graduate Teaching Assistants

The total support awarded by the Department as graduate scholarships in 2009-2010 was $129,076. *(Note that this total includes $11,662 for a Petroleum Research Fellowship to Craft that was paid out in Fall 2009, but listed as an award made in the 2008-2009 Annual Report. This total does not include $12,675 to be awarded as the J. Costain Fellowship to Ruan in Fall 2010).*

Additionally, the Department created an assistantship program for offsetting graduate student fees. For all students at the base pay rate, whose fees were not covered using other scholarship monies, the Department used Foundation funds to pay for $150 of the student fees for both Fall 2009 and Spring 2010. The total support offered through this program using Foundation funds was $11,700.

Other university funding sources also supported graduate students in this academic year, including the Graduate School's PhD 2010 program, the Multicultural Academic Opportunities program, the NSF IGERT program, and the ICTAS fellowship program. Geosciences graduate students also received other important external awards, including within and outside of the university.

Graduate Degrees Completed (or near completion):
Note: These are students listed in the 2009-2010 commencement program; some of them will not actually finish until Summer or Fall 2010.

Masters

Evan Pelzner Anderson –*Chuaria, Vendotaenia*, and the Taphonomy of the Carbonaceous Compression

Summer Jasmine Brown – Integrating apatite (U-Th)/He and fission-track dating for a comprehensive thermochronological analysis: refining the uplift history of the Teton Range

Jesse Conrad Buckner - Investigation of Crustal Structure in a Mesozoic Extensional Terrane: The South Georgia Rift and the Epicentral Area of the 1886 Charleston, South Carolina Earthquake

Jonathan Daniel Gerst -Epikarst controls on karst aquifer recharge, James Cave, VA

Eric Michael Kazlauskas – Multi-fold, TDEM Induction Profiling in Sedimentary Environments

Benjamin Louis Roth - Strain and vorticity within mylonites of the northern Assynt region, Moine thrust zone, NW Scotland

Majken Krista Schimmel - Traces of predation and parasitism recorded in Eocene brachiopods from the Castle Hayne Limestone, North Carolina, USA

John Guthrie Wyatt - The Relationship Between Structural and Tectonic Evolution and Mineralization at the Coles Hill Uranium Deposit, Pittsylvania County, Virginia

Doctorate

Elizabeth Ann Diesel - Bioavailability of arsenic to *E. coli* and *C. fluminea*: insights into ecological impacts of arsenic in natural waters

Ryan Paul Grimm - Insights into the Stratigraphic Evolution of the Early Pennsylvanian Pocahontas Basin, Virginia.

Changyeol Lee - Compressible Convection and Subduction: Kinematic and Dynamic Modeling

Lisa Marie Tranel - Evaluation of Coupled Erosional Processes and Landscape Evolution in the Teton Range, Wyoming

Dongbo Wang – Calcification by amorphous carbonate precursors: Towards a new paradigm for sedimentary and skeletal mineralization

Discovery

Faculty and Staff Honors and Awards 2009-10:

Ross Angel was awarded the **Dana Medal** of the Mineralogical Society of America for "sustained outstanding contributions through original research in the mineralogical sciences." Award announced in October 2009, medal will be presented in 2011.

Robert Bodnar was inducted as **Fellow of the Geological Society of America**; named **Virginia's Outstanding Scientist 2010** by the Governor of Virginia; received **Honorary Doctorate** in Geological Sciences **from the University of Napoli Federico II, Naples, Italy**.

Thomas Burbey spent the summer 2009 as a **visiting scholar** in the Department of Geosciences, **University of Rennes, Rennes France**.

Martin Chapman was **promoted to Research Associate Professor**.

Patricia Dove was inducted as **Fellow of the Geochemical Society and European Association of Geochemistry**.

Mike Hochella was invited and gave the **William Smith Annual Lecture at The Geological Society in London, England,** in September 2009. This lecture commemorates William Smith, one of the founders of the geological sciences. Additionally, he was invited to give the **Adrian Smith Annual Lecture at the University of Waterloo, Ontario, Canada**. This lecture is in honor of highly esteemed geochemist Adrian Smith, and is only given once each year.

Scott King received the **Alexander von Humboldt Fellowship** (Preistraeger).

Michal Kowalewski was an invited **Keynote Speaker for the 2010 German Paleontological Congress,** Münich, Germany.

Fred Read was the recipient of the **Grover Murray Distinguished Educator Award**, American Association of Petroleum Geologists, Denver, June 2009.

Nancy Ross was an **invited speaker** for the **2010 Gordon Research Conference**, "Electronic Density and Chemical Bonding." She also served as the **2009 President** of the **Mineralogical Society of America.**

Madeline Schreiber was elected **Fellow of the Geological Society of America**, 2009.

Shuhai Xiao received the 2010 **Alumni Award for Excellence in Research**. This award is presented annually by the Virginia Tech Alumni Association to a faculty member(s) who has made outstanding research contributions. Additionally, he has been **named a Guggenheim Fellow**. The Guggenheim Fellowship will augment his research in South China to better understand the co-evolution of the environment and early animals 600 million years ago.

Scholarly Articles:

Angel, R.J., Jackson, J.M., Reichmann, H.J., and Speziale, S. (2009) Elasticity measurements on minerals: a review. *European Journal of Mineralogy,* 21:525-550. (Major review paper).

Camara, F., Nestola, F., **Angel, R.J.**, and Ohashi, H. (2009) Spontaneous strain variations through the low temperature displacive phase transition of $LiGaSi_2O_6$ clinopyroxene. *European Journal of Mineralogy,* 21:599-614.

Spencer, E.C., **Angel, R.J.**, **Ross, N.L.,** Hanson, B.E., and Howard, J.A.K. (2009) Pressure-induced cooperative bond rearrangement in a zinc imidazolate framework: a high-pressure single-crystal X-ray diffraction study. *Journal of the American Chemical Society,* 131:4022–4026.

Welsch, A.M., Maier, B.J., Engel, J.M., Mihailova, B., **Angel, R.J.**, Paulmann, C., Gospodinov, M., Friedrich, A., Stosch, R., Güttler, B., Petrova, D., and Bismayer, U. (2009) Effect of Ba-incorporation on pressure-induced structural changes in the relaxor ferroelectric $PbSc_{0.5}Ta_{0.5}O_3$. *Physical Review, B* 80:104118/1-7.

Comodi, P., Nestola, F., and **Angel, R.J.** (2009) HP-HT mineral physics: implications for geosciences. Preface *European Journal of Mineralogy,* 21:523-524.

Mahapatra, M.K., Lu, K. and **Bodnar, R.J.** (2009) Network structure and thermal property of a novel high temperature seal glass. Applied Physics A: Materials Science & Processing, **95**, 493-500 http://doi.org/10.1007/s00339-008-4926-z **[1].**

Lüders, V., Romer, R.L., Gilg, H.A., **Bodnar, R.J.**, Pettke, T., Misantoni, D. (2009) A geochemical study of the Sweet Home Mine, Alma, Colorado, USA: hydrothermal fluid evolution above a hypothesized cupola. Mineralium Deposita, **44**(4), 415-434 http://dx.doi.org/10.1007/s00126-008-0221-3 .

Severs, M.J., Beard, J.S., Fedele, L., Hanchar, J.M., Mutchler, S.R., and **Bodnar, R.J.** (2009) Distribution of trace elements between dacitic melt and plagioclase, orthopyroxene, and clinopyroxene: Evidence from laser ablation ICPMS analysis of silicate melt inclusions. Geochimica et Cosmochimica Acta, **73**(7), 2123-2141. http://doi:10.1016/j.gca.2009.01.009.

De Vivo, B., Lima, A., **Bodnar, R.J.,** Milia, A., and Spera, F.J. (2009) Il rischio eruzione nei Campi Flegrei. [The risk of an eruption at the Phlegrian Fields]. LE SCIENZE, December 2009, no. 496, pp.96-103[inItalian]. http://lescienze.espresso.repubblica.it/articolo/Il_rischio_eruzione_nei_Campi_Flegrei/1341143

Berkesi, M., Hidas, K., Guzmics, T., Dubessy, J., **Bodnar, R.J.,** Szabó, Cs., Vajna, B., and Tsunogae, T. (2009) Detection of small amounts of H_2O in CO_2-rich fluid inclusions using Raman spectroscopy. Journal of Raman Spectroscopy, **40**, 1461-1463; http://10.1002/jrs.2440.

Lima, A., De Vivo, B., Spera, F.J., **Bodnar, R.J.,** Milia, A., Nunziata, C., Belkin, H.E., and Cannatelli, C. (2009) Thermodynamic model for uplift and deflation episodes (bradyseism) associated with magmatic-hydrothermal activity at the Campi Flegrei active volcanic center (Italy). Earth-Science Reviews, **97**, 44-58 doi:10.1016/j.earscirev.2009.10.001.

Rhim, Y.R., Zhang, D., Fairbrother, D.H., Wepasnick, K., Livi, K.J., **Bodnar, R.J.,** and Nagle, D.C. (2010) Changes in electrical properties of microcrystalline cellulose as a function of carbonization temperature. Carbon, **48**, no. 4, 1012-1024 doi:10.1016/j.carbon.2009.11.020.

Becker, S.P., Eichhubl, P., Laubach, S.E., Reed, R.M., Lander, R.H., and **Bodnar, R.J.** (2010) A 48 m.y. history of fracture opening, temperature and fluid pressure: Cretaceous Travis Peak Formation, East Texas basin. Bulletin of the Geological Society of America, **122**, no. 7/8, 1081-1093. doi:10.1130/B30067.1.

Fedortchouk, Y., LeBarge, W., Barkov, A.Y., Fedele, L., and **Bodnar, R.J.** (2010) Major- and trace-element composition of platinum group minerals and their inclusions from several Yukon placers. *In:* Yukon Exploration and Geology 2009, K.E. MacFarlane, L.H. Weston and L.R. Blackburn (eds.), Yukon Geological Survey, p. 185-196.

Lin, F., and **Bodnar, R.J.** (2010) Synthetic Fluid Inclusions XVIII: Experimental determination of the PVTX properties of H_2O-CH_4 to 500°C, 3 kbars and $X_{CH4} \leq 4$ mol%. Geochimica et Cosmochimica Acta, **74**, 3260-3273. doi:10.1016/j.gca.2010.03.009.

Hidas, K., Guzmics, T., Szabó, Cs., Kovács, I., **Bodnar, R.J.,** Zajacz, Z., Nédli, Zs., Vaccari, L., and Perucchi, A. (2010) Coexisting silicate melt and H_2O-bearing, CO_2-rich fluid inclusions in mantle peridotite xenoliths from the Carpathian-Pannonian region (central Hungary). Chemical Geology, **274**, 1-18. doi:10.1016/j.chemgeo.2010.03.004.

Burbey, T.J. (2009) Fracture characterization using earth tide analysis. *Journal of Hydrology,* doi:10.1016/jjhydrol.2009.10.037.

Hernandez-Marin, M., and **Burbey, T.J.** (2009) The role of faulting on surface deformation patterns from pumping induced ground-water flow. *Hydrogeology Journal*, 10.1007/s10040-009-0501-8, v. 17, no. 8, p. 1859-1875.

Chapman, M.C. (2009) A comparison of short-period and broadband seismograph systems in the context of the seismology of the eastern United States. *Seismological Research Letters*, 80, no. 6, 936-952.

Wang, D., De Yoreo, J.J., and **Dove, P.M.** (2009) Systematic control of biomolecules on magnesium contents in amorphous calcium carbonate: Insights for calcification. *Proceedings of National Academy of Sciences,* 106: 21511-21516.

Wallace, A.F., De Yoreo, J.J., and **Dove, P.M.** (2009) Kinetics of silica nucleation on carboxyl and amine-terminated surfaces: Insights for biomineralization. *Journal of American Chemical Society*, **131**, 5244-5250.

De Yoreo, J.J., Zepeda-Ruiz, L., Wasylenki, L.E., Qiu, S-P., Gilmer, G., Chernov, A., and **Dove, P.M.** (2009) Revisiting BCF theory through molecular scale insights: Consequences of kink-limited kinetics for growth and inhibition of sparingly soluble crystals.

Gibbs, G.V., Wallace, A.F., Cox, D.F., **Dove, P.M.**, Downs, R.T., **Ross, N.L.,** and Rosso, K.M. (2009) Role of Directed van der Waals Bonded Interactions in the Determination of the Structures of Molecular Arsenate Solids. *Journal of Physical Chemistry A.*, **113**, 736-749.

Gibbs, G.V., Wallace, A.F., Cox, D.F., Downs, R.T., **Ross, N.L.**, Rosso, K.M. (2009) Bonded Interactions in silica polymorphs, silicates and siloxane molecules. American Mineralogist, 94: 1085-1102.

Wallace, A.F., **Gibbs, G.V.,** and **Dove, P.M.** (2010) Influence of Ion-Associated Water on the Hydrolysis of Si-O Bonded Interactions. *Journal of Physical Chemistry A*, **114**, 2534-2542.

Weisner, M.R., Lowry, G.V., Jones, K.L., **Hochella, M.F. Jr.,** Di Giulio, R.T., Casman, E., and Bernhardt, E.S. (2009) Decreasing uncertainties in assessing environmental exposure, risk and ecological implications of nanomaterials. Environmental Science and Technology 43, 6458-6462.

Liu, J., Aruguete, D.M., Murayama, M., and **Hochella, M.F. Jr.** (2009) Influence of size and aggregation on the reactivity of an environmentally and industrially relevant nanomaterial (PbS). Environmental Science and Technology 43, 8178-8183.

Aruguete, D.M., Guest, J.S., Yu, W.W., Love, N. G., and **Hochella, M.F. Jr.** (2010) Interaction of CdSe/CdS core-shell quantum dots and *Pseudomonas aeruginosa*. Journal of Environmental Chemistry 7, 28-35.

Aruguete, D.M. and **Hochella, M.F. Jr.** (2010) Bacteria-nanoparticle interractions and their environmental implications. Journal of Environmental Chemistry 7, 3-9.

Plathe, K.L., von der Kammer, F., Hassellöv, M., Moore, J., Muruyama, M., Hofmann, T., and **Hochella, M.F., Jr.** (2010) Using FlFFF and aTEM to determine trace metal – nanoparticle associations in riverbed sediment. Journal of Environmental Chemistry 7, 82-93.

Cerrato, J.M., **Hochella, M.F., Jr.,** Knocke, W.R., Dietrich, A.M., and Cromer, F. (2010) Use of XPS to identify the oxidation state of Mn in solid surfaces of filtration media oxide samples from drinking water treatment plants. Environmental Science and Technology, in press.

Aruguete, D., **Hochella, M.F. Jr.,** Liu, J. (2009) Synthetic colloidal nanoparticles in environmental systems. In: Environmental and Human Health Effects of Nanoparticles. J.F. Lead and E. Smith, Editors. Blackwell Publishers. (this is a book chapter)

Brancato, A., **Hole, J. A.,** Gresta, S., and Beale, J. N. (2009) Determination of seismogenic structures in southeastern Sicily (Italy) by high-precision relative location of microearthquakes. *Bull. Seismol. Soc. Amer.*, **99**, 1921-1936.

Bleibinhaus, F., Lester, W. R., and **Hole, J. A.** (2009) Applying waveform inversion to wide-angle seismic surveys. *Tectonophysics*, **472**, 238-248.

Wu, J., **Hole, J.A**., and **Snoke, J.A**., Early View, Date: April 2010. Fault zone structure at depth from differential dispersion of seismic guided waves: evidence for a deep waveguide on the San Andreas Fault. *Geophys. J. International*, doi:10.1111/j.1365-246X.2010.04612.x.

Lee, C., and **King, S.D.** (2009) The effect of mantle compressibility on the thermal and flow structures of the subduction zone. *Geochem. Geophys. Geosyst.,* 10, Q1006, doi:10.1029/2008GC002151.

King, S. D. (2009) On topography and geoid from 2D stagnant-lid convection calculations. *Geochem. Geophys. Geosyst.,* 10, Q3002, doi:10.1029/2008GC002250.

Simões, M.G., Rodrigues, S.C., and **Kowalewski, M.** (2009) *Bouchardia rosea*, a vanishing brachiopod species of the Brazilian platform: taphonomy, historical ecology and conservation paleobiology. *Historical Biology*, 21, 123-137.

Kowalewski, M. (2009) The youngest fossil record and conservation biology: Holocene shells as eco environmental recorders. *Conservation Paleobiology* (G. Dietl and K. W. Flessa, eds.), *Paleontological Society Special Papers*, 15, 1-23.

Dexter, T., **Kowalewski, M.**, and **Read, J.F.** (2009) Distinguishing Milankovitch-driven processes in the rock record from stochasticity using computer-simulated stratigraphy. *Journal of Geology*, 117, 349-361.

Payne, J.L., Boyer, A.G., Brown, J.H., Finnegan, S., **Kowalewski, M.**, Krause, R.A., Jr., Lyons, S.K., Mcclain, C.R., Mcshea, D.W., Novack-Gottshall, P.M., Smith, F.A., Stempien, J.A., and Wang, S.C. (2009) Two-phase increase in the maximum size of life over 3.5 billion years reflects biological innovation and environmental opportunity. *Proceedings of the National Academy of Sciences U.S.A.*, 106, 24-27.

Frasi, C., Carosi, R., Montomoli, C., and **Law, R.D.** (2009) Kinematics and vorticity of flow associated with post-collisional oblique transpression in the Variscan Axial Zone of northern Sardinia (Italy). *Journal of Structural Geology*, **31**, 1458-1471.

Craft, K., and **Lowell, R.P.** (2009) A boundary layer model for submarine hydrothermal flows at on-axis and near axis locations. *Geochem. Geophys. Geosyst.*, *10*(*12*) Q12012, doi:10.1029/2009GC002707.

Lewis, K.C., and **Lowell, R.P.** (2009b) Numerical modeling of two-phase flow in the NaCl-H_2O system II: Examples. *J. Geophys. Res*., *114*, B08204, doi:10.1029/2008JB006030.

Lewis, K.C., and **Lowell, R.P.** (2009a) Numerical modeling of two-phase flow in the NaCl-H_2O system: Introduction of a numerical method and benchmarking. *J. Geophys. Res.*, *114*, B05202, doi:10.1029/2008JB006029.

Liu, L., and **Lowell, R.P.** (2009) Models of hydrothermal heat output from a convecting, crystallizing, replenished magma chamber beneath an oceanic spreading center. *J. Geophys. Res*., *114*, B02102, doi:10.1029/2008JB005846.

Betzner, J., and **Read, J.F.** (2009) Evidence for Early Cambrian greenhouse climate in peritidal Shady Dolomite, Virginia. *Southeastern Geology*, **46**, 109-119.

Spengler, A., and **Read, J.F.** (2010) Sequence development on a sediment-starved, low accommodation epeiric carbonate ramp: Silurian Wabash Platform, USA midcontinent during icehouse to greenhouse transition. *Sedimentary Geology*, **224**, 84-115.

Scheetz, C. D., and **Rimstidt, J. D.** (2009) Dissolution, transport, and fate of lead on shooting ranges. *Environmental Geology*, **58**, 655-665.

Mitra, A., and **Rimstidt, J. D.** (2009) Solubility and dissolution rate of silica in acid fluoride solutions. *Geochimica et Cosmochimica Acta*, **73**, 7045-7059.

Huminicki, D. M. C., and **Rimstidt, J. D.** (2009) Iron oxyhydroxide coating of pyrite for acid mine drainage control. *Applied Geochemistry*, **24**, 1626-1634.

Fall, A., **Rimstidt, J. D.**, and **Bodnar, R. J.** (2009) An assessment of the precision of thermal history reconstruction based on fluid inclusions: The effect of inclusion size. *Economic Geology*, **94**, 1569-1579.

Fall, A., **Rimstidt, J.D.,** and **Bodnar, R.J.** (2009) The effect of fluid inclusion size on determination of homogenization temperature and density of liquid-rich aqueous inclusions. American Mineralogist, **94**, 1569-1579. http://doi:10.2138/am.2009.3186.

Elwood Madden, M. E., Madden, A. S., and **Rimstidt, J. D.** (2009) How long was Meridani Planum wet? Applying a jarosite stopwatch to constrain the duration of diagenesis. *Geology*, **37**, 635-638.

Ross, N.L., Spencer, E.C., Levchenko , A.A., Kolesnikov, A.I., Wesolowski, D.J., Cole, D.R., Mamontov, E., Vlcek, K. (2009) "Neutron Scattering Studies of Surface Water on Metal Oxide Nanoparticles" in Neutron applications in Earth, Energy, and Environmental Sciences, Liang L., Rinaldi R., Schober H., eds., pp. 235-256,Springer Science + Business Media, LLC.,.

Detrie, T., **Ross, N.L.**, **Angel, R.J.**, Gatta D. (2009) Equation of state and structure of prehnite to 9.8 GPa. European Journal of Mineralogy, 21: 561-570.

Spencer, E.C., Levchenko , A.A., **Ross, N.L.**, Kolesnikov, A.I.,Boerio-Goates, J., Woodfiled, B.F., Navrotsky, A., Li, G.S. (2009) Inelastic neutron scattering study of confined surface water on rutile nanoparticles. Journal of Physical Chemistry A, 113: 2796-2800.

Zhao, J., **Ross, N.L.**, **Angel, R.J.,** Carpenter, M.A., Howard, C.J., Pawlak, D.A., Lukasiewicz, T. (2009) High-pressure crystallography of rhombohedral $PrAlO_3$ perovskite. Journal of Physics-Condensed Matter, 21, article 24503.

Ross, N.L. (2010) Presentation of the 2009 Roebling Medal of the Mineralogical Society of America to Alexandra Navrotsky. American Mineralogist, 95: 659-660.

Yu, Y., **Ross, N.L.** (2010) Prediction of high-pressure polymorphism in NiS_2 at megabar pressures. Journal of Physics-Condensed Matter, 21, article 235401.

Pollitz, F.F., and **Snoke, J.A.** (2010) Rayleigh-wave phase-velocity maps and three-dimensional shear velocity structure of the western US from local non-plane surface wave tomography. *Geophys. J. Int.*, **180 (3)**, 1153–1169, doi:10.1111/j.1365-246X.2009.04441.x.

Beghein, C., **Snoke, J.A.**, and Fouch, .M.J. (2010) Depth constraints on azimuthal anisotropy in the Great Basin from Rayleigh-wave phase velocity maps. *Earth and Planetary Science Letters*, **289**, 467–478, doi:10.1016/j.epsl.2009.11.036.

McAleer, R.J., **Spotila, J.A.**, Enkelmann, E., and Berger, A.L. (2009) Exhumation along the Fairweather fault, southeast Alaska, based on low-temperature thermochronometry. *Tectonics*, 28, TC1007,17 p.

Adams, B., Dietsch, C., Owen, L.A., Caffee, M., **Spotila, J.A.**, and Haneberg, W.C. (2009) Exhumation and incision history of the Lahul Himalaya, northern India, based on (U-Th)/Hethermochronometry and terrestrial cosmogenic nuclide dating techniques. *Geomorphology*, 107, 285-299.

Laflamme, M.,**Xiao, S.,** and **Kowalewski, M.** (2009) Osmotrophy in modular Ediacara organisms. *Proceedings of the National Academy of Sciences, USA*., 106: 14438-14443.

Schiffbauer, J. D., and **Xiao, S.** (2009) Novel application of focused ion beam electron microscopy (FIB EM) in the preparation and analysis of microfossil ultrastructures. *Palaios*, 24: 616-626.

Shen, B., **Xiao, S.**, Zhou, C., and Yuan, X. (2009) *Yangtziramulus zhangi* new genus and species, a carbonate-hosted macrofossil from the Ediacaran Dengying Formation in the Yangtze Gorges area, South China. *Journal of Paleontology*, 83: 575-587.

McFadden, K. A., **Xiao, S.**, Zhou, C., and **Kowalewski, M.** (2009) Quantitative evaluation of the biostratigraphic distribution of acanthomorphic acritarchs in the Ediacaran Doushantuo Formation in the Yangtze Gorges area, South China. *Precambrian Research*, 173: 170-190.

Liu, P., **Xiao, S.**, Yin, C., Tang, F., and Gao, L. (2009) Silicified tubular microfossils from the upperDoushantuo Formation (Ediacaran) in the Yangtze Gorges area, South China. *Journal of Paleontology*, 83, 630-633.

Zhang, X., Yao, J., and **Xiao, S.** (2009) SEM observation of the polychaete *Lepidonotus* helotypus Grube, 1877 and its comparison with the Cambrian animal fossil *Wiwaxia*. *Acta Palaeontologica Sinica*, 48: 45-55.

Yuan, X., Wang, D., and **Xiao, S.** (2009) Animals in the Neoproterozoic Doushantuo epoch. *Acta Palaeontologica Sinica*, 48: 375-389.

Xiao, S., **Kowalewski, M.,** Shen, B., Dong, L., and Laflamme, M. (2009) The rise of bilaterians: A reply. *Historical Biology*, 21: 239–246.

Zhou, Y. (2009) Surface-wave sensitivity to 3-D anelasticity (Q). *Geophysical Journal International*, **178**, 1403-1410.

Ruan,Y., and **Zhou, Y.** (2010) The effects of 3-D anelasticity (Q) structure on surface-wave phasedelays. *Geophysical Journal International*, doi: 10.1111/j.1365-246X.2010.04514.x.

Research Grants:

DEPARTMENTAL ACTIVE RESEARCH GRANTS
2009-10

Angel, R	Oxford Diffraction	9/1/02 - 8/31/12	$50,000.00
Bekken, B	NSF	3/15/05 - 2/29/10	$115,650.00
Bodnar, R	PRF	9/1/07 - 8/31/09	$45,000.00
Bodnar, R	NSF	7/1/07 - 12/31/10	$378,110.00
Bodnar, R	Virginia Uranium, Inc.	6/1/08 - 6/15/10	$194,110.00
Bodnar, R	USGS	3/25/09 - 4/1/11	$60,000.00
Bodnar, R	*URS	1/15/10 - 4/30/10	$31,227.00
Bodnar, R	*NSF	9/1/09 - 8/31/11	$215,671.00
Burbey, T	NSF	8/1/07 - 7/31/10	$151,902.00
Chapman, M	Consol Corporation	7/1/08 - 6/30/11	$220,124.00
Chapman, M	Univ. of Utah	6/5/08 - 9/4/09	$12,500.00
Chapman, M	US/NRC	9/29/08 - 10/1/09	$60,000.00
Chapman, M	USGS	6/1/09 - 5/31/10	$67,755.00
Chapman, M	*BP America	1/1/10 - 6/30/10	$30,000.00
Dove, P	DOE	8/10/00 - 10/31/10	$1,802,489.00
Dove, P	NSF	9/15/06 - 8/31/10	$219,767.00
Dove, P	NSF	2/1/08 - 1/31/11	$300,056.00
Hochella, M	DOE	5/15/06 - 9/14/10	$540,891.00
Hochella, M	NSF	7/1/05 - 6/30/10	$3,398,801.00
Hochella, M	Duke University	10/1/08 - 8/31/10	$700,000.00
Hole, J	NSF	8/1/03 - 8/31/10	$511,126.00
Hole, J	NSF	5/15/08 - 4/30/13	$932,235.00
Hole, J	*NSF	7/1/09 - 6/30/14	$755,207.00
King, S	NASA	11/9/07 - 11/8/11	$247,264.00
King, S	NSF	1/1/09 - 12/31/10	$161,897.00
King, S	*NSF	10/1/09 - 9/30/12	$253,720.00
Kowalewski, M	NSF	5/1/06 - 6/30/10	$219,290.00
Kowalewski, M	*NSF	7/1/09 - 7/31/12	$227,555.00
Law, R	NSF	1/1/06 - 12/31/09	$229,996.00
Law, R	NSF	8/15/07 - 7/31/10	$340,480.00
Lowell, R	NSF	2/1/08 - 10/31/11	$172,265.00
Lowell, R	*NSF- CMMI	8/15/09 - 7/31/10	$30,994.00
Lowell, R	*NSF	9/1/09 - 8/31/12	$288,581.00
Lowell, R	*NSF	12/1/09 - 8/31/12	$288,581.00
Read, J	NSF	4/1/07 - 3/31/11	$182,139.00
Read, J	*Aramco Services Company	10/19/09 - 10/24/10	$15,000.00
Ross, N	DOE	5/15/05 - 5/14/10	$379,000.00
Ross, N	NSF	7/1/06 - 6/30/10	$245,832.00
Ross, N	NSF	1/1/08 - 12/31/10	$349,094.00
Schreiber, M	NSF	9/1/07 - 8/31/10	$126,479.00
Schreiber, M	DEQ	6/11/07 - 2/28/10	$2,550.00

Schreiber, M	Cave Conservancy of VA	11/1/07 - 10/31/09	$13,386.00
Sinha, A	NCAR	6/1/06 - 9/30/09	$139,997.00
Spotila, J	NSF	9/15/04 - 8/31/09	$164,727.00
Spotila, J	*NSF	1/15/10 - 12/31/10	$109,524.00
Tracy, R.	*Atlantic Coast Conference	8/16/09 - 5/15/10	$2,000.00
Weiss	*NSF	3/15/10 - 2/28/11	$91,512.00
Xiao, S	NASA	9/15/05 - 9/14/09	$209,720.00
Xiao, S	*NASA	7/1/09 - 6/30/10	$113,516.00
Xiao, S	NSF	8/1/08 - 7/31/10	$90,000.00
Xiao, S	NSF	3/5/09 - 5/31/11	$70,001.00
Zhou, Y	NSF	7/1/08 - 6/30/11	$179,999.00
	TOTAL		**$15,737,720.00**

*Awarded in 2009-10 reporting period.

Engagement

The Department of Geosciences has a commitment to engagement and outreach: increasing public understanding of the value and relevance of the geosciences through publications, presentations, exhibits, and formal and informal science education programs.

The department has highlighted the role of engagement and public outreach in the **broader impacts of funding proposals**, making them more competitive as a result. External funding for engagement activities has provided for ~45% of a staff position during 2009-10.

In this position, Llyn Sharp provided leadership to the department's outreach and continued as a coordinator for VT-STEM, the University's K-12 Outreach Initiative in Science, Technology, Engineering, and Math, sponsored by the Division of Outreach and International Affairs. In Fall 2009, Llyn worked closely with VT-STEM on the statewide **Governor's Conference on STEM Education in Virginia**, attended by 230 educators and decision-makers. [www.stem.vt.edu]

In addition to engagement of faculty as part of their professional activities, the Department of Geosciences further demonstrates its commitment to outreach by housing the Museum of Geosciences programs, tours, exhibits, and collections. This staffed program includes management of Museum functions as well as support for K-12 field science studies and in-class experiences, mentoring students in projects, Education Resource Center (ERC) kit and material loans, earth and environmental education training workshops and teacher institutes, facilitation of community partnerships.

There were over **8000 visitors** to the Museum of Geosciences during 2009-10. Programs served almost **1500 K-12 students and teachers**. Visitors include individuals and families, K-12 school tours, youth groups, VT course uses, teacher workshops, meetings, and receptions for various events. There were 43 loans of teaching materials and equipment from the ERC, used by educators mostly from the local area. The Museum also served as the site for the College of Science promotional video interviews.

Seminars: Fall 2009/Spring 2010

Richard Bambach, Professor Emeritus, Department of Geosciences, Virginia Tech and Research Associate of the Smithsonian Institution, "Possible Reality in the Periodic Fluctuation in Diversity Game"

Barbara Bekken, Virginia Tech Geosciences, "The Earth Sustainability Project: A New Paradigm for Liberal Education"

Emily Brodsky, University of California-Santa Cruz, Earthscope National Speaker, "Earthquakes Triggered by Seismic Waves"

Eric Calais, Purdue University, "From Rifting to Spreading: Geodetic Constraints from the East African Rift"

John Cottle, University of California, Santa Barbara, "Developing New Strategies in Laser Ablation U(-Th)-Pb Geochronology to Unravel the Tempo of Orogenic Processes"

Rosa Domanech, University of Barcelona, "The Harsh Life on the Rocky Shores: Holes that Tell Stories"

Josepf Dufek, Georgia Institute of Technology, "Multi-scale Dynamics in Explosive Volcanic Eruptions"

Diego Gatta, University of Milan, "Natural Zoelites: Occurrence, Crystal-Chemistry, Behavior at Non-Ambient Conditions and Technological Applications"

Stephen T. Hasiotis, Coeditor PALAIOS, University of Kansas, "Traces of Life on Land: Using Ichnology to Understand the Diversity, Abundance, and Distribution of Organisms in Continental Strata"

William Klein, Boston University, "A Physicist's View of Earthquakes"

Michal Kowalewski, Virginia Tech Geosciences, "Eclectic Research Adventures of a Statistical Paleobiologist"

Paul Marinos, Jahns Distinguished Lecturer, National Technical University of Athens, "Geology of Athens, Greece. A Case of Urban Geology for Land Use, Construction of Major Engineering Structures, Hazard Assessment and Sustainable Development"

Jordi Martinell, University of Barcelona, "Taphonomy and Bioerosion versus Bioerosion and Taphonomy"

Brent Owens, The College of William and Mary, "Mineralogical and Geochemical Constraints on the Origin of Kyanite Quartzites in the Piedmont Province of Virginia"

Raymond Rogers, Macalester College, "Expedition to the Late Cretaceous of Madagascar: Geology and Taphonomy of a Stressed Terrestrial Ecosystem"

Robert Runkel, U.S. Geological Survey, Denver, "Mountains, Methods, & Models: Characterizing Reactive Transport in Streams Affected by Acid Mine Drainage"

Katherine Scharer, Appalachian State University, "Recurrence Behavior of the San Andreas Fault"

Timothy Scheibe, 2010 Darcy Lecturer, Pacific Northwest National Laboratory, "Beyond the Black Box: Integrating Advanced Characterization of Microbial Processes with Subsurface Reactive Transport Models"

Robert Seal, U.S. Geological Survey, Reston, "Abandoned Mines and the Sulfur Cycle: Examples from Superfund Sites in the Eastern United States"

David Spears, Virginia State Geologist, "The Past, Present and Future of Virginia's Geological Survey"

Jim Spotila, Virginia Tech Geosciences, "Understanding Erosion at Topographic and Tectonic Scales"

Robert Tracy, Virginia Tech Geosciences, "An Example of the Effect of Tectonics on Short-Term P-T Evolution: Overprint of Silurian Contact Metamorphism on Ordovician Regional Metamorphism in the Northern Appalachians"

Steve Whitmeyer, James Madison University, "Modern Methods of Field Geology: From the Outcrop to 4-D Visualization"

International Education/Research: The following will serve to highlight faculty involvement with various international programs in research and education. GEOS faculty also serve as editors and associate editors for prestigious international journals.

Ross Angel

- Gave a series of four 1-hour lectures on mineral physics to graduate students and faculty from the University of Padua and neighboring Universities, **Padua, Italy**, 7th and 14th September
- Gave an invited talk, "Equilibrium phase diagrams and the atomic scale compression mechanisms of framework minerals" at Geoitalia 2009 (National Geosciences meeting of Italy), **Rimini, Italy**, 9-11 Sept.
- Presented a seminar, "Current research at VTX," Copenhagen Mineral Torturers Meeting, **Copenhagen, Denmark**, 3-5 June
- Taught a 1 day workshop on data analysis for single-crystal high-pressure X-ray diffraction at the meeting of European mineralogical crystallographers, **Copenhagen, Denmark**.

Robert Bodnar

- Presented a two-day short course on *Fluid Inclusions in Ore Deposits, with Applications to Exploration* in **Granada, Spain**, on September 21-22, 2009. The course was attended by 24 students from Spain, Turkey, Tunisia, Switzerland, France, Canada, Brazil, Germany, Russia, Hungary and Poland (see pgs 30-31)
- Chaired sessions on "Experimental studies of melt inclusions" at the European Conference on Research on Fluid Inclusions, **Granada, Spain**, September 23, 2009
- Chaired session entitled "C-O-H-S fluids in the subduction zone and mantle" at The 2nd Deep Carbon Cycle International Conference, **Beijing, China**, April 23, 2010
- Hosted two pre-doctoral students (Paula Valenti and Valentina Cantarelli) for short-term visits from **Potsdam, Germany** and **Camerino, Italy**.

Thomas Burbey gave the following invited lecture:

- "Fracture characterization using Earth tides" at the University of Rennes, **Rennes, France**, July 2, 2009

Kenneth Eriksson

- Gave an invited seminar at the University of **Pretoria, South Africa**
- Served as host for an international student, Florian Heimann, from **Munich, Germany** for 6 weeks during summer 2009
- Presently hosting a PhD student, Dong Wei, from **Beijing, China** for 1 year

Mike Hochella gave the following invited lectures:

- William Smith Annual Lecture at The Geological Society in **London, England**, in September 2009
- Adrian Smith Annual Lecture at the University of Waterloo, **Ontario, Canada**, March 29, 2010
- Bharathidasan University, Department of Marine Science, **Tamil Nadu, India**

Scott King

- Gave three presentations at the 11th International Workshop on Modeling of Mantle Convection and Lithospheric Dynamics in **Brunwald, Switzerland**, July 2, 2009

  "Tharsis Rise and the Hemispheric Dichotomy on Mars: Numerical Results"
  "Relationship between variations in spreading rate of the Pacific plate and time-dependent subducting slab dynamics"
  "The Influence of Evolving Plate Boundaries in 3D Mantle Convection Simulations"

Michal Kowalewski

- Hosted an international student intern, Carolina Zabini, from **Brazil** for a six month period (December 2009-May 2010)
- Invited Keynote Speaker for the 2010 German Paleontological Congress, **Munich, Germany**

Richard Law gave the following invited seminars:

- "Internal flow, thermal structure and extrusion of the Greater Himalayan Slab, Mount Everest Massif," Department of Earth Sciences, University of **Birmingham, England**, January 13 2009

- "Internal flow, thermal structure and extrusion of the Greater Himalayan Slab, Mount Everest Massif," Department of Earth and Environmental Sciences, University of **Portsmouth, England**, January 15 2009

- "Internal flow, thermal structure and extrusion of the Greater Himalayan Slab, Mount Everest Massif." Department of Geology, University of Delhi, **Delhi, India**, June 15 2009

Fred Read continues collaboration with Saudi Aramco on Mesozoic cores and reservoirs and traveled to **Saudi, Arabia** in 2009.

Shuhai Xiao was an invited lecturer at the following:

- International Workshop on P-C & P-T Transitions, Nanjing Institute of Geology and Paleontology, **Nanjing, China**, 11/15/2009
- School of Earth & Planetary Sciences, Peking University, **Peking, China**, 10/28/2009
- Darwin China 200 Conference, School of Life Sciences, Peking University, **Peking, China**, 10/26/2009
- 2nd World Summit on Evolution, Galapagos, Universidad San Francisco de Quito, **Ecuador**, 8/21-28/2009

Ying Zhou was an invited lecturer at the following:

- Geosciences Azur, **Nice, France**, 2009
- University of Science and Technology of China, **He Fei, China**, 2009

Alumni Interaction: The annual alumni/faculty dinner held on November 7, 2009 was attended by approximately 65 people. The program after dinner celebrated four decades (1950s through the 1980s) in the department. Speakers were Bill Presley, Jeff Jeffries, Michael Hochella and Kay Johnson. The fall dinner provides an excellent opportunity for former graduates of the department to converse with faculty and learn how the department is progressing.

The Spring 2010 **Geosciences Magazine** came out in April 2010. Approximately 1,400 were mailed to our alumni base. The cover story featured alumni Jason Hinkle who was awarded a special Presidential Citation from the Association of Environmental & Engineering Geologists for predicting debris flow near Wooden, Oregon. Other features of this full color, 14-page issue included the 2009 spring graduation, a description of a number of faculty and alumni honors and awards, the retirements of Professors Fred Read and Donald Rimstidt, and the alumni dinner in November.

The Geosciences Spring Banquet was held on April 22, 2010 at Owens Banquet Room. This annual event is held each year to honor our graduating seniors and completing graduate students. Dr. Christina Lopano, Postdoctoral Research Associate with DOE National Energy Technology Laboratory and former undergraduate of the Department, was the guest speaker. This event also serves as an opportunity to emphasize the importance of "giving back" to higher education when careers are established.

Diversity

The Department of Geosciences has been active in improving diversity within our student and faculty populations. We currently have four female tenured/tenure track faculty (2 Full Professors, 1 Associate Professor and 1 Assistant Professor out of 18 tenure-track faculty) and one non-tenure track female faculty member. As of fall 2009, we had 24 female graduate students (out of 55).

Although we are closing the gender gap in Geosciences, we have yet to significantly improve the participation of ethnic minorities in our field. This past year, we successfully recruited two black African students to our department, which has improved the multicultural environment in the department. We also successfully recruited a Cuban-American female to our department; she will be arriving this fall. As this is a national trend, our struggles to maintain a multicultural balance of our graduate students and faculty are not unusual, but we hope to increase underrepresented students in our field in the coming years through more active recruiting of graduate students from minority-serving institutions, in conjunction with efforts that the College of Science Diversity Committee is initiating. Our 2009 diversity activities for the reporting period include the following:

Educational Programs and Workshops: Ross Angel with Chemistry colleague Carla Slebodnick organized and taught a week-long Crystallography Workshop for undergraduate and high school students. Over the 7-year period of the workshop, approximately 45% of the attendees have been women. Several of our faculty have attended AdvanceVT workshops, including Ken Eriksson, Madeline Schreiber, and Ying Zhou.

Teaching and Mentoring: Barbara Bekken, working with Dr. Shelli Fowler, has designed, incorporated, and is working to assess a progressive diversity awareness curriculum into the Earth Sustainability series.

Recruiting and Retention: Our NSF IGERT grant/program (called EIGER), for which Michael Hochella is PI and current Director, is entering its last full year. During the five years of operation, five of the 27 Ph.D. students that were supported under EIGER are underrepresented minority (URM) Ph.D. candidates. These students are (in alphabetical order) José Cerrato (Hispanic, civil and environmental engineering), Adam DeOliveria (Hispanic, education), Kevin Sevilla (Hispanic, engineering education), Lauren Thomas (Black, engineering education), Nicole Thompson (Black, psychology). Adam DeOliveria has left his Ph.D. program, taking a job offer from industry that he felt he could not refuse. José Cerrato successfully definded his Ph.D. this past May, and is currently a post-doc at Washington University in St. Louis. The other three students are currently working successfully in their Ph.D. programs.

As a member of the College of Science (COS) Diversity Committee, faculty member Madeline Schreiber has been involved in developing programs to enhance diversity of undergraduate, graduate and faculty in COS. In 2009, the committee gave awards to minority COS undergraduates, and have discussed organizing fall recruiting trips to historically black colleges and universities in Virginia for all COS departments.

Leadership: Patricia Dove is on the AdvanceVT Advisory Committee. Madeline Schreiber is on the COS Diversity Committee.

Goals for 2009-10

The department finalized its strategic plan for 2010-2014 in Fall, 2009 and has started evaluating the Action Items identified in the plan. Work has already started under the leadership of Ross Angel to identify a group of benchmark institutions and to establish metrics against which department achievements can be measured. Following multiple retirements in the past 3 years, including those of Don Rimstidt and Fred Read in June, 2010, coupled with the departures of Jake Sewall and Erin Kraal in 2009, our strategic plan contained a hiring plan to rebuild the department starting with two hires in Fall, 2010. This plan was developed within the framework of existing and new clusters and, in particular, the ISES cluster. Hiring has been delayed but we anticipate searching for two new faculty members starting in Fall, 2010.

Other goals for 2010-2011 are curriculum revision, to continue to actively encourage companies (oil and minerals) to interview in this department, to recruit top-quality undergraduate students, and to recruit top-quality graduate students at professional meetings and via personal contacts. The department is committed to increasing our undergraduate numbers and, towards this end, we will be identifying an individual to present guest lectures in all Intro Geology classes on career opportunities in Geosciences and giving consideration to establishing a new option in hydrogeosciences.

In addition, the department will pursue some immediate development goals to enhance the department's endowment situation starting with the establishment of endowments for Fred Read and Don Rimstidt. Planning for the new building is on hold pending news on private donations.

Discussions will commence on developing an administrative structure for the department in view of the anticipated retirements of three administrative staff within the next few years.

Keep Scrolling ↓

In September, 2009, **R. J. Bodnar** and 4 students and one post-doc from the Fluids Research Laboratory in the Department of Geosciences traveled to Granada, Spain, to participate in the European Conference on Research on Fluid Inclusions. The Virginia Tech group made 10 presentations at the conference, and Professor Bodnar presented a two-day (16 hours) pre-meeting short course on *Fluid Inclusions in Ore Deposits, with Applications to Exploration* on September 21-22, 2009. The course was attended by 24 students from Spain, Turkey, Tunisia, Switzerland, France, Canada, Brazil, Germany, Russia, Hungary and Poland. A photo of course participants, with the world-famous Alhambra in the background, is included below.

Bodnar presented the first two-days (16 hours) of a five day short course on *Fluids in the Earth* in Naples, Italy, on November 9-10, 2009. The course was attended by 11 students from Italy and the United Kingdom. Below is a photo of course participants and lecturers, taken during a mid-course field trip to visit the volcanic island of Procida, and with the Vesuvius volcano in the background.