

The Keck Geology Consortium

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The Keck Geology Consortium is a group of twelve small geoscience departments from predominantly undergraduate, liberal arts institutions that work together to improve student and faculty research opportunities and geoscience education. The primary activity of the consortium is to sponsor research projects where faculty and undergraduate students from throughout the consortium collaborate on earth science research. The results from research projects are presented in oral or poster presentations at the Keck Research Symposium in Geology and are summarized in this volume. The consortium also sponsors workshops for students and faculty that focus on research and educational topics of interest to people from all twelve schools, and participates in projects to enhance geoscience education nationwide.

The consortium was formed in 1987 with funds from the W.M. Keck Foundation of Los Angeles, to improve the quality of geologic education at all member schools. The W.M. Keck Foundation has been the principle supporter of the program, with contributions of 5.2 million dollars supporting the research of more than 600 students to date. Since 1991, funding from the National Science Foundation has ensured the participation of students and faculty from ethnic and minority groups underrepresented in the geosciences. This year for the first time, NSF funds also allowed students and faculty from schools beyond the consortium to participate in the program. National Science Foundation funds supported ten students and three faculty on sophomore projects and nine students and three faculty member on junior projects. Additional funding for the program came from the member institutions, ExxonMobile Foundation, and the American Association of Petroleum Geologists Foundation.

UNDERGRADUATE STUDENT-FACULTY RESEARCH PROGRAM

Consortium research projects are designed for students at two levels of experience. Senior-level projects are designed for advanced undergraduate students and require a year-long student commitment. Sophomore-level projects, which take place during five-weeks in the summer, are designed to give beginning students a taste of geologic research, and a sense of the challenge and enjoyment that comes from solving Earth systems problems. Research projects at both levels usually involve six to twelve students and two to four faculty. Students work cooperatively to address a research problem, or group of related problems, by integrating the results of individual or small-team projects.

This year, fifty-one students participated in senior projects located in California, Colorado, Florida, Greece, Ohio, and Wyoming. The projects spanned a large range of geologic disciplines, including studies of modern and ancient surficial processes and tectonic evolution of mountain ranges and rift basins. The 1999 projects showcase multidisciplinary approaches to solving geoscience problems. The research experience began in the spring with an introduction to the study area and problem via selections from the geologic literature. A major part of the research was completed in the summer during field or laboratory studies. During this time, each student identified and developed a research topic within the framework of the overall project goals. The research continued through the following academic year as students worked to finish independent studies or honors theses under the guidance of on-campus faculty sponsors. The research experience culminates with a presentation of results at the Keck Research Symposium in Geology and publication of the results in this volume and on line. In most cases, the research is documented more fully in a research paper or thesis evaluated for credit at the home institution. Many students may also present their research at regional or national professional conferences.

Twenty-two students participated in sophomore projects this year. Projects were located in Jamaica and Pennsylvania, and involved students in interesting archeological and environmental problems. The sophomore program is completed during five weeks in the summer. Participants form teams of two or three students that pursue small research projects for four weeks and spend the final week writing and illustrating reports on their team's research. Each team also writes a short paper published in this volume and presents its results in poster at the research symposium in April. Sophomore research projects are chosen to allow students with limited background to appreciate the importance of the overall problem, design a meaningful project, and produce results in five weeks.

Each student involved in a project has an on-campus faculty sponsor who oversees work done at their home institution. Experience shows that student research results are improved when sponsors are able to visit students in the field. This year, twenty sponsors spent several days with students during the summer phase of the projects.

SCIENTIFIC COLLABORATION

The Consortium research experience is strengthened by collaboration with professionals from all parts of the geoscience community who bring both scientific expertise and personal experiences to share with the students. This year, collaborating scientists came from state and federal agencies, the private sector, and universities in both domestic and international settings.

Three projects this year were made possible through close collaborations with other institutions. The Florida project was co-directed by Dr. Mike Savarese, Florida Gulf Coast University (FGCU), and took place at FGCU and the Rookery Bay National Estuarine Research Reserve (RBNERR). Dr. Lenore Tedesco, Indiana University and Purdue University at Indianapolis, an established researcher in this area, also served as a faculty member on the project. Scientists from the Florida Department of Environmental Protection and RBNERR staff and volunteers worked extensively with students throughout the summer.

The Wyoming project was made possible by collaboration with Dr. Peter Reiners and the California Institute of Technology. Students spent two weeks collecting data in laboratories at Caltech. Dr. Ken Farely (He isotope lab) and Dr. John Eiler (O isotope lab) graciously opened their labs to the students and assisted them in their research. The project provided a unique opportunity for students to experience life at a premiere research institute.

Students on the California project had the opportunity to join a team of U.S. Geological Survey and industry scientists working on the northern portion of the San Andreas fault. Dr. Carol Prentice at the USGS was essential in coordinating this effort which included USGS scientists Dr. Carl Wentworth, Dr. Mike Rymer, Dr. Rob Landgridge, Dr. Bob McLaughlin, and Dr. Jeff Hamilton, and William Lettis and Associates scientists, Dr. John Baldwin and Dr. Keith Knudsen.

Furthering the exposure of students to career paths beyond the liberal arts colleges, Dr. Carol Tang, Arizona State University, served as a faculty member on the Ohio Project. Steve Acheampong, Sierra Pacific Power Company, was a faculty member on the Pennsylvania Project.

The Greece Project and Jamaica Project provided students and faculty the opportunity to work with scientists from the international community. Dr. John Schumacher from Bristol University (U.K.) spent time in the field with students on the Greece Project. Students on the Jamaica Project worked with professionals of the Jamaican Heritage Trust, including Dr. Rosemarie Whitaker, archeologist. Trust director, Roderick Banks, and deputy director, Dorick Gray visited the study site for an overview of the project.

Scientists from the private sector provided insight into the world of private business. Students on the Jamaica Project enjoyed a tour of the Kirkeville bauxite mine, lead by Dr. Anthony Porta, Chief Geologist with Alcan Aluminum Limited. David Addison from the Conservancy of Southwest Florida, Matt Finn, private consultant, and José Leal of the Bailey-Matthews Shell Museum assisted on the Florida Project.

Many projects also benefited from visits, tours, lectures, technical assistance, and advice from other university scientists. Dr. Tom Anderson, Sonoma State University, provided local expertise, and Dr. Noah Snyder, MIT, worked with students on the California Project. Students on the Ohio Project visited the libraries and geological facilities at Ohio State University, hosted by Dr. Scott Bair, Chair of the Geology Department. Dr. Colin Sumrall, Curator of the Invertebrate Fossil Collection, gave a tour of the Cincinnati Museum of Natural History. Dr. Cathy Davis, University of Delaware, assisted students on the Pennsylvania Project. Dr. Rhonda Holtzclaw, Dr. Jerry Jackson, Dr. Mike Lucas, Dr. Mary Newman, of the Florida Gulf Coast University, and Dr. Larry Brand and Dr. Mica Suzuki from the University of Miami assisted students on the Florida project.

This year's projects also fostered collaboration with faculty from other disciplines. Dr. Jim Delle, Director of the Pen Archeological Program at Franklin & Marshall College worked as faculty on the Jamaica Project. A number of Franklin & Marshall faculty contributed to the Pennsylvania Project, including Dr. Joe Richardson (Biology), Dr. Steve Spadafore (Electronics Engineering, Physics, & Astronomy) and Dr. Sharon Moran (Environmental Studies).

WORKSHOPS

Workshops were developed by the Keck Geology Consortium to support the exchange of information and ideas among faculty and students during the academic year. This volume contains reports from three workshops that brought together students, faculty, and sponsors from senior-level projects to allow additional collection of data, data synthesis, and meetings with appropriate resource people. Two additional workshops are planned for this summer. In June consortium faculty will work with researchers at Lamont-Doherty Earth Observatory to identify collaborations on Earth system projects that can enhance either our classrooms or our research program. Dr. Jim Hays has been especially helpful in organizing this activity. In July, faculty involved in watershed studies will meet

at Carleton College in association with a sophomore research project to develop plans for upcoming projects and studies.

OTHER ACTIVITIES

One of the consortium's major achievements has been to create a community of students, faculty and alumni from the twelve college geology departments. We were very pleased to have more than forty members of this community come together for breakfast at the fall meeting of the Geological Society of America in Denver and more than thirty gather for lunch at the fall meeting of the American Geophysical Union in San Francisco. The fifth Keck Alumni Newsletter was distributed to alumni, faculty, and friends in February of this year. Our web site (www.carleton.edu/curricular/GEOL/resource/keck/keck.html) continues to be an important resource for communication both within the consortium community and beyond. New features for alumni are currently being planned under the direction of Dr. Rachel Beane, the alumni representative to the advisory board.

This year we have been asked to give a number of presentations on the lessons we've learned in setting up the consortium and in collaborating over the past thirteen years. Dr. Cathy Manduca presented a workshop on collaboration at the 1999 Council on Undergraduate Research (CUR) April Dialogue and will give similar talks at the Eighth National CUR Conference at the College of Wooster next June and at the spring AGU meeting. Dr. Bud Wobus (Williams) gave an invited talk on the history of the consortium in a symposium on undergraduate research at the fall GSA meeting, jointly sponsored by CUR, the National Association of Geoscience Teachers, and the consortium. (We will jointly sponsor a similar session next fall.) Jointly, Drs. Manduca and Wobus gave a talk on collaborations in a symposium on that topic at the fall AGU meeting, and Dr. Linda Reinen (Pomona) gave a similar talk at the Seismological Association meeting. Dr. Shelby Boardman (Carleton) and Keck student Christina Berglund (Carleton) collaborated on a panel discussing undergraduate research at the Sigma Xi forum, Reshaping Undergraduate Science Education—Tools for Better Learning, held in Minneapolis last fall.

In addition to a large array of student and faculty presentations on last summer's research results, other presentations this year included Dr. John Brady (Smith) speaking on collaborative undergraduate research at the spring AGU meeting, Dr. Tom Gardner (Trinity) presenting lessons learned running an overseas project in Costa Rica at the fall GSA meeting, Dr. Peter Crowley (Amherst) talking on using research in the petrology classroom at the fall AGU meeting.

This summer the consortium will jointly sponsor the Earth and Planetary Science program at the first annual Project Kaleidoscope Summer Institute. This program entitled "Bringing the Earth into the Classroom: Using Data, Images, Models and Problems" will feature Dr. Dorothy Merritts (Franklin & Marshall) as the keynote speaker.

The consortium has joined forces with several other large consortia in the Earth sciences to build a digital library for Earth System Education. The library is envisioned as a web resource that will greatly enhance geoscience education by making it easy for students to work directly with Earth data and for faculty to find materials to assist them in teaching. The library is being designed for learners and educators at all levels and will include a community center to foster the improvement of Earth science education. The consortium will serve as a test-bed of users and contributors for the initial prototype library.

The activities of the consortium are directed by a board containing one representative from each school and the consortium coordinator. The representatives met twice during the year: at the April 1999 symposium at Carleton College and at the October, 1999 Geological Society of America meeting in Denver. Business included a review of program evaluations from the previous year's program. A major focus of these meetings has been the development of consortium priorities for the next five years and a funding plan to support these activities. The result is a renewed commitment to collaborative research involving students and faculty from our institutions and beyond. Fostering collaborations with research universities, government agencies, and private industry is a major aspect of the funding plan.

The advisory board established in 1998 with members from graduate schools, government agencies, and industry continues to be a major resource for the consortium program. This board is charged with providing input to help maintain highest quality programs and in securing adequate funding for the program. The board met at the Carleton symposium last April and several times by phone during the year. Members include Rachel Beane, Bowdin College; Robert Brown, Chevron Petroleum Technology Company; Tom Casadevall, U.S. Geological Survey; Ben Cooper, Association of Oil Pipelines; George Davis, University of Arizona; Tom Doe, Golder Associates; Jerry Fine, Corning, Inc.; Bill Fox, Williams College; John Greene, consulting geologist, Kerry Inman, exploration consultant; Patricia Martin, Carleton College; Jim Taranik, Mackay School of Mines, University of Nevada Reno; Jan Tullis, Brown University; Sandra Glass, philanthropic advisor.

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The administration of the program has benefited from the cooperation of the Carleton College business office, particularly Beverlee DeCoux, Comptroller, Barb Fowler, Accounting Assistant, and Shirley Dulski, Accounts Payable Specialist. The coordinator has been aptly aided by Katrina Petersen and more recently Beth Palmer as administrative assistants. This year the symposium was organized by the Whitman College Geology Department, and the symposium proceedings were edited by Carol Mankiewicz and Carl Mendelson at Beloit College. We appreciate their hard work and the excellent job that they have done. One of the most pleasurable aspects of coordinating consortium activities is working with the consortium faculty, particularly the representatives and project directors. Thank you very much for your dedication to the consortium, your enthusiasm for each new opportunity, and your help in making things run smoothly.