Assessment Self Study Report, 2003
GEOLOGY DEPARTMENT
NATURAL SCIENCES DIVISION
COLLEGE OF ARTS AND SCIENCES

The University of Hawai'i at Hilo

Prepared by the faculty of the Geology Department, UH Hilo

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Geology Program Self Study Report, 2003

ROLE AND MISSION OF THE UH HILO GEOLOGY DEPARTMENT

Role in the UH Hilo Mission and Strategic Plans

The Geology Department shares the mission of UH Hilo to provide an excellent undergraduate liberal arts education. We stress the importance of providing a personalized atmosphere that encourages student faculty interaction. We encourage a feeling of ohana and camaraderie between students and faculty and offer a number of unique hands on learning experiences. The presence of active volcanoes on our island makes UH Hilo a natural place to study geology and attracts students that are fascinated with volcanoes. We regularly take students on field trips to explore the island and actively support the Geology Club that organizes overnight camping trips. Many of our 100-200 level courses are very popular choices for students filling their general education degree. We stress the unique environment of Hawai'i and how human actions and political decisions affect that environment.

History and Degrees Offered

The UH-Hilo Geology program was created by funding from the Hawaii State Legislature in 1987-1988 largely through the efforts of Dr. Joe Halbig, the UHH administration, and our state representatives. The Geology building was completed in 1989 and the department consisted of four faculty at that time. The program was founded to take advantage of the unique opportunity to study the geology and the active volcanoes on the Island of Hawaii in keeping with UH Hilo's to use the island as a living laboratory. In 1989, the legislature created the Center for the Study of Active Volcanoes (CSAV) within the UH-Hilo Geology Department to further these goals and provide opportunities for hazard studies and professional training programs. In 1990, an APT position was added to the Geology Department and CSAV. In 1995, a faculty member was added with expertise in hydrology and environmental geology to replace Professor Dudley who started the Marine Science program. Currently, the Geology Department consists of three faculty with expertise in hydrology, structure and tectonics, volcanology and mineralogy. The fourth position is vacant due to the resignation of our geophysicist in 2002. We are in the process of advertising to fill this position.

The Geology Department has offered a Bachelor of Science Degree in Geology for many years. This degree has relatively rigorous requirements in physics, calculus, and chemistry and is intended for students that wish to pursue graduate degrees in Geology. However, these more stringent requirements are often an impediment for students wishing to major in Geology that either decide later in their undergraduate career or transfer from community colleges and lack the proper preparation. In response to this, the Geology Department began offering a Bachelor of Arts degree in Geology that was approved by the University of Hawai'i Board of Regents for the 2002–2003 academic year. This degree program has fewer and less stringent requirements in physics, chemistry, and mathematics as well as offering a broader range of interdisciplinary course requirements. This degree is intended for students who wish to pursue teaching or more generalized professions. The majority of geology majors (~80-90%) pursue the BS degree.

In the spring of 2003 the department took over management of the Natural Science Major, which had been leaderless for several years. This Natural Science BA is an interdisciplinary degree, and students take a variety of science courses from a wide range of science department. This new commitment will place demands on the Geology faculty in terms of advising and program management and assessment. For the most part this report addresses only the geology program, and not the natural science program.

Department Mission

The mission of the UH-Hilo Geology department is to provide students with a rigorous, high-quality foundation in geological science. The primary goal is to prepare students for graduate studies, work as professional geologists, or careers in secondary education, planning, or natural resource management. The geology department also supports the liberal arts mission of the University by providing general education students with a broader knowledge of their natural environment. Although delivery of quality undergraduate education is the focus of the department's efforts in keeping with the mission of UH Hilo, the department also supports and contributes to advancement of scientific knowledge, application of geologic knowledge, and community education and service.

Goals of the Academic Programs in Geology

The Geology Department offers both a Bachelor of Science and a Bachelor of Arts degree in Geology. The Bachelor of Science degree is intended to prepare students for graduate school or entry level positions in the Earth Sciences. The required courses are designed to develop the appropriate scientific and analytical skills necessary for the students to succeed. The Bachelor of Arts degree was approved in 2002 and is less rigorous in the required math, physics, and chemistry; but provides a broader range of courses in Earth Science and related fields. This degree is intended to prepare students for careers in resource management and K-12 science education that are less demanding in the technical application of science but require a wide range of knowledge.

General Goals

1. Acquisition of basic knowledge and skills that prepare students for one of the following:
2. graduate school;
3. entry-level positions as professional geologists or natural resource managers;
4. secondary education.
5. Development of a comprehensive understanding of Earth Systems through the integration of mathematics, chemistry, physics, and biology into geologic investigations.
6. Broad understanding of the role of geologic knowledge in society and the relationships of humans to their natural environment.

Educational Objectives: Content

Program graduates (both BS and BA) are expected to have mastered basic concepts and vocabulary in the following areas:

1. The major events in the history of Earth and how they relate to the geologic time scale and the origin and evolution of life;
2. The history of discoveries and ideas and application of the scientific method that have led to our current understanding of the Earth
3. The response of the Earth to internal and external forces, crustal deformation, plate tectonics, and the geophysical properties of the Earth;
4. The origin and nature of Earth materials, the classification of rocks and minerals including their physical and chemical characteristics, and the availability of natural resources;
5. Processes that shape the surface of the Earth and their associated hazards, interpretation of paleo-environments and paleo-climates and the implications for the future; and
6. The range of interactions of mankind with the solid Earth and the hydrosphere, especially environmental hazards and issues that affect society.

Skills for the Geology Bachelor of Science Degree

1. Students are expected to develop skills in observing, measuring, and recording geologic features and processes to test or develop theories.
2. Students are expected to develop competency in the interpretation of earth science data, including both qualitative and quantitative analyses. They should be capable of Recognizing, formulating, and applying the scientific methodology that is appropriate to geologic research.
3. Program graduates shall be competent in
4. Locating and interpreting scientific literature; reading and critically evaluating relevant geological literature
5. Using computers at a level consistent with current professional practice, applying tools from mathematics, chemistry, and physics to solve geological problems.
6. The methods used in the field to map and interpret the diverse variety of rock types and structures. The production and interpretation of geologic maps.
7. Graduates shall be able to express earth science concepts in writing and prepare professional written reports and oral presentations that convey the results of scientific research.
8. Graduates can function either independently or collaboratively in an ethical fashion with other professionals.

Skills for the Geology Bachelor of Arts Degree

1. Graduates can recognize, formulate, and interpret the scientific methodology that is appropriate to a broad, general, understanding of science and how it operates.
2. Graduates are expected to develop competency in the interpretation of earth science data, and will have the knowledge to obtain and use educational and other earth science resources that are available to teachers and resource managers.
3. Program graduates shall be competent in
4. Locating and interpreting scientific literature; reading and critically evaluating relevant geological literature
5. Using computers at a level consistent with current professional practice.
6. Understanding the ancillary scientific disciplines (math, chemistry, and physics) at a level commensurate with the earth science data or curricula.
7. Graduates will have oral and written communication skills necessary to convey current theories in geology and Earth science.
8. Graduates can function either independently or collaboratively in an ethical fashion with other professionals as colleagues and supervisors.

PROGRAM ORGANIZATION

Organization of the Department

Currently the Geology Department consists of 3 faculty, a vacant tenure track position that we are in the process of refilling, and an Education Specialist position. The department chair is assigned on a rotating basis by mutual agreement of the faculty. The term of the chair is usually a few years, thus allowing each member of the department to have an opportunity to guide the program. The department chair represents the faculty; the faculty forms policy by collaboration and consensus. We have weekly meetings to review current issues and are constantly adjusting our long term goals and plans. Communication between department members is excellent. We place a high value on collegial interaction and personal friendships within the department. These relationships are critical in identifying areas of the program that need strengthening the most. By developing a unified policy we are able to use our budget to effectively upgrade our teaching facilities and student resources. The greatest strengths of the Geology Department are the unified vision, sharing of common resources for the good of the students, and the close camaraderie between professors and students.

General Education Courses

The Geology Department provides a two courses specifically to fulfill General Education requirements: Environmental Geology (GEOL 100) and Geology of the Hawaiian Islands (GEOL 205), which also fills the Hawaiian-Asian-Pacific Requirement. In addition, many students also take Physical Geology (GEOL 111), which is a major requirement. Approximately 60-70% of our student semester hours are devoted to non-majors (Appendix 1). Geology classes are popular with many students because they provide a "big picture" of the Earth and its environment while

introducing many of the students to the scientific method. Because many of our liberal arts students will not pursue science past the required courses, we try to teach them what science is, how it is conducted, and what it can and cannot tell us about the world. We feel that it is important to teach students how scientific reasoning and discovery provide a crucial standard for rational knowledge and inquiry in modern society.

Majors

The Geology major program was originally modeled after geology programs at small, high quality, undergraduate, liberal arts institutions. The purpose is to provide a rigorous and well–rounded education in the geological sciences that would allow our graduates to get into graduate programs at high quality universities. In addition to the core Geology curriculum, we require our B.S. students to take a year of calculus, physics, and chemistry and encourage good students to take additional courses in these subjects as preparation for graduate school.
Each of our major courses is intended to address or achieve a portion of the academic goals and skills we have outlined for our majors. The expectation is that our students will acquire the knowledge necessary to succeed in either graduate school or in entry level professional positions upon completion of the course sequences.

Advantages and Disadvantages of Teaching Geology in Hawaii

Currently our degree program is structured to give students a very broad background in geology and to prepare them to enter graduate schools in a wide range of Earth Science disciplines. We have been very successful in getting our students into graduate schools. However, it is difficult to continue this broad training and still integrate the necessary technology related courses into our degree requirements.

It is also difficult for our department to compete for Geology majors with similar departments on the U.S. mainland. Geology is a very field intensive subject and many student's interest in the subject is awakened by seeing geological features in the field. While our location in the Hawaiian Islands gives us tremendous access to volcanoes and related features, we have virtually no access to the majority of geologic features that students are required to study during the course of a geology major. Dr. Jim Anderson has been very successful in raising funds for a 2 week trip to the mainland for students in Field Methods, but this is only one field trip to see non-volcanic rocks during the course of an undergraduate degree. Ideally we would like to take our students to the mainland every year or every other year, but funding does not permit it. We have also begun leading trips to the Grant Canyon, and hope to continue this every other year. Students must pay their own travel costs, which reduces the number of students that are able to participate. We are also participating in the NSF STEM grant at UH Hilo, which potentially can provide funding to take Native Hawaiian freshman to the mainland to experience a wide variety of geologic environments and hopefully excite them about the science.

Because of our proximity to active volcanoes, we do attract a large number of 1–2 semester exchange students from the mainland that wish to study volcanoes. However, the lack of diverse geologic environments make the UH Hilo Geology Department a less attractive destination for students interested in general geology program and also makes it more difficult

to recruit students attending UH Hilo. The Geology Department recognizes the need to place a greater emphasis on our specialties in order to attract more students.

Employment Outlook for Geology Graduates and Long- Term Trends

One of the principle reasons that nationwide geology enrollments have dropped is that nationwide employment opportunities have declined precipitously, especially in the petroleum and mining sectors that commonly fuel the large upswings in employment. Environmental consulting is still a viable alternative and one of our recent graduates has been employed by a California consulting firm for several years. A recent graduate has also been hired to work on the Koohalawe restoration project as a geologist. We have 3 students that have obtained highly competitive jobs with the U.S. Geological Survey, one in California, one in Honolulu, and one at the Hawaiian Volcano Observatory. Another current student is an intern at the Hawaiian Volcano Observatory and has a track for a permanent job. We also have a native Alaskan alumni that works doing resource management for the Native Alaskan Corporation and a native Hawaiian student that is teaching high school science in a Hawaiian immersion school. While many of our graduates do find employment, jobs in the geological sciences in Hawai'i are relatively rare. We are working with Dr. Peter Mills in the anthropology department to develop a joint geoarcheology program that would train students for work in archeological surveys, a field with some more employment opportunities here in Hawai'i. Distance is a barrier that makes it difficult for UH Hilo faculty to network with colleagues and potential employers on the mainland Nationwide, the long term trends in undergraduates majoring in geology has shown a sharp downtrend in recent years. Most of these departments are in larger universities with total enrollments 5-10 times greater than UH Hilo. This trend has also been mirrored by undergraduate majors at UH Manoa, whose enrollment now approximately matches that of UH Hilo even though their undergraduate body is 5 times larger. The enrollment in the UH Hilo Geology Department has stayed nearly level during this dramatic nationwide downturn suggesting that we have a fairly strong market but we need to do more active marketing and recruiting to increase our major numbers. We also expect to see an increase in majors due to the new Geology B.A. degree, which was just offered this year.

Curricular Changes to in Response to Current State of the Discipline

The geological sciences, like most other disciplines, have changed greatly over the past 2 decades due to the growth and availability of technology. Perhaps the most striking changes have come due to enhanced ability to collect spatial data using satellites and the ability to integrate this data using GIS program. We now have the capability to manipulate spatial data and imagery on inexpensive desktop computers that a decade ago could only be done on super computers. While much of the knowledge and conceptual material required to become a good earth scientist remains essentially unchanged, the skills required to collect and manipulate large global datasets have changed dramatically.

Two approaches are necessary to keep up with this change. First, we must make an effort to integrate these skills into all of our core courses. We need to begin introducing skills in

introductory geology laboratories and continue to improve skill levels in each course. We have begun the process of identifying skills that each of our core courses should focus on teaching and we need to work at integrating these specific skills into our learning matrix.

The second approach is to develop new courses specifically to teach these skills. In 1998, the Hawai'i State Legislature authorized UH Hilo to plan for a degree in Volcano Geotechnology and provided a new position to support the degree. The Geology Department responded to this by beginning to plan the courses for this new degree and get approval by the CAS faculty senate for the new courses and the degree program. The degree program was not approved by the CAS Dean due to concerns over small enrollments, but the new courses were added to the Geology Department curriculum in 2001. We now have several courses designed to specifically teach modern techniques in geodesy, satellite imagery, and geographical information systems.
One of the biggest impediments to integrating technology in the core courses is the lack of computers and appropriate software (often very expensive) within the Geology Department laboratories. While the Geography and Geology Departments have a joint GIS laboratory that is excellent for teaching dedicated courses, it is in high demand already making it difficult to schedule "drop-in" sessions for other courses. We have directed a fair amount of our departmental resources during the past several years to attempt to build up an internal computer capability for student use. We have been somewhat successful, but it is clear that additional resources will have to be pursued via grants.

Innovative Teaching

Teaching geology in Hawai'i is by definition innovative. While we are surrounded by incredible active volcanoes, the Hawaiian Islands have very few examples of many geological features. We are constantly trying to figure out new ways to get students, many of whom have never visited the mainland, to visualize geological landscapes and to understand the important contributions of earth resources to our society. We have developed several websites to deliver content for some of our courses. We are also constantly taking students out into the field to see features and to exercise their critical thinking in the field. Many of our classes incorporate active discussions and learning groups to facilitate student understanding. Faculty have obtained several undergraduate research grants for students and also placed them in cooperative work study positions at the USGS Hawaiian Volcano Observatory.

PROGRAM RESOURCES

Human Resources

Faculty and Lecturers

Existing faculty resources consist of three tenured professors and one visiting professor who is temporarily filling a vacant position. In the fall of 2004, Dr. Art Jolly, a seismologist, will be hired as an assistant professor. Lecturers are also used for instruction. The availability and quality of lecturers is variable, but currently a very high quality lecturer, Dr. Steven Lundblad is covering Ken Hon's courses while Dr. Hon is on sabbatical.

Existing faculty are generally sufficient to cover the teaching demand at the present time, particularly if lecturers can be procured to teach a few laboratory sections, fill in during sabbatical absences, or cover research-funded course buy-outs. If the program expands by acquiring new majors and teaching required courses on an annual basis, which is highly beneficial for pedagogical reasons, then it could be increasingly difficult to cover the teaching load. A related concern is the desire of one geology professor to teach occasional courses for the TCBES program. Because the geology department has not received any EPSCor positions, there will be a conflict between the needs of the geology program and the TCBES program. Resources available for faculty development mostly consist of opportunities for RCUH-funded grants to present papers at meetings and small seed-money grants to stimulate new research projects. Faculty sometimes use personal funds for research supplies, professional dues, conference fees, or professional travel.

APT (Educational Support Specialist)

An APT is assigned to the geology department. The APT job description focuses on supporting field work and field courses, assisting the Director of CSAV, and maintenance / management of equipment, vehicles, and library resources. In addition, the division chair has mandated that the APT process the department's purchase orders. Historically, the APT was attached to Center for the Study of Active Volcanoes (CSAV), but the position was re-assigned to the geology department when CSAV was nearly disbanded in 1995/1996. As clarified by a spring 2003 memo from the CAS dean, the APT is in fact assigned to geology, and the department chair has the discretion of determining what percentage of the APT's time is devoted to support of the Geology mission and what percentage is devoted to support of CSAV. It has generally been agreed that the APT's time is split 50/50 between Geology and CSAV. It is the perception of the geology faculty, however, that the person in the APT position strongly prefers to be affiliated with CSAV rather than Geology. Making more effective use of the APT resource, and balancing the needs of the Geology Program and the CSAV program is therefore one of the challenges facing the department. Revision of the job description, which is 14 years old, to reflect changing conditions would be helpful.

Other Support

Secretarial. The Geology department shares three secretaries with about 70 other faculty and staff. The level of support is therefore low. For example, several summers ago, geology faculty were not paid summer salary to which they were entitled (from a grant) because the division secretary was unable to process the paperwork before the grant expired.
Chair. The department chair does not receive release time. It is difficulty for the chair to run the department, manage the Natural Science major, teach nine credits, and maintain an active research program.
Student Workers. Student workers are used for teaching assistants for labs, providing support for field trips, maintaining the laboratories and computer equipment, and general office duties. We would like to also use student workers to develop extra-curricular support materials such as information about graduate school and summer jobs. In the opinion of the chair, the amount of available student support is inadequate, partly due to the limitations of the student workers themselves, and partly due to shrinking funding. One management issue is the balance between faculty, student workers, and the APT in providing needed support to the department.

Budget

University support for the Geology Department has historically been adequate for most immediate needs considering UH-Hilo's overall budget. The yearly budget has permitted the upkeep of equipment and vehicles, and also has provided sufficient funds to replace and add to our faculty and student computers. These funds have also been adequate for the acquisition of basic lab and office supplies. Our average discretionary budget over the past 5 years (1998-2002) has been $14,760 and this has been supplemented in the past 2 years by additional funding for maintenance of the electron microprobe facility. It is encouraging that the annual budget allocation has recently increased to $17,300, but this follows a long period of essentially frozen budgets. The 5-year average for the years 1993-1997, for example, was $14,100 compared to $14,760 for the next 5 years (1998-2002).

Student help money has averaged $3,600 per year over the past 5 years (1998-2002) compared to an average of $4,600 per year for the previous five years (1993-1997). This constitutes a decrease of 22%.

The following are considered to be weaknesses in the level of funding for the Geology program:

- The shrinking student help budget compromises the ability of the department to pursue creative endeavors that lead to extramural funding. This should be increased to at least $6,000 per year ($2,000 increase over funding level of 2002-2003).

- Budgetary cutbacks of library journal subscriptions severely hamper the teaching of research methods in all upper-level classes. The effort to secure E-journal access by the UH-Hilo library has failed to correct this problem. Key journals such as the Journal of

Geophysical Research (JGR Red), for example, are not available either in hard copy or via E-journal access. Although the key geological database "GEOREF" is still available to us, it has been repeatedly put on the block for elimination. A recent request for a specific issue of JGR (Red) took more than one month to fill. These conditions also hamper faculty research. A supplement of $3,000 to the Geology portion of the library journal budget would be a good start toward correcting this problem.

- Travel money for faculty development. Over the past 5-7 years, faculty members have been expected to self-fund travel to scientific meetings or to include money for such travel in grant proposals. This amounts to a "Catch 22" wherein faculty needs to interact with other researchers in order to develop grant ideas and smooth the way for funding. This, unfortunately, requires travel. Presumably the faculty member is expected to initially invest in this effort anticipating a later return. And this is expected to happen on salaries that are among the lowest in the United States. Faculty travel grants are available to those who are presenting papers resulting from completed research or research in progress, not to those in the developmental stages. Funding of support for 1 trip per year would cost approximately $2,000 per faculty member.

- Travel money for students. Typically, this would not be a large budget consideration for a mainland college as the necessary field trips could be conducted locally. In Hawaii, however, it is essential for students to get some exposure to the geology of continental areas if minimal national standards are to be met. There is currently no official venue for this. For this reason, the Geology program has self-funded this effort by raising the money outside of the academic arena. We have raised $22,500 for this purpose over the last 5 years (1998-2002). The University should support the efforts of the faculty member leading the trip by providing travel money and/or overload teaching compensation. Over the past 7 years we have conducted a mainland component of our Field Methods (Geol 370) on alternate years, with instruction performed on a volunteer basis. We have begun offering field trips to the Grand Canyon and would like to continue doing so during the years that the Geol 370 trip is not offered. These efforts should be officially supported which would cost about $1,000-2,000 annually.

- Electronic classroom development. The geology department has been modernizing the electronic equipment in our classrooms. All equipment has been purchased with department funds. Renovation efforts in our main lecture hall are still incomplete and there are two other classrooms that would benefit from some of these improvements. An additional $3,000 per year would helpful in pursuing the gradual upgrading of our teaching facilities.

The amounts suggested above would double the Geology program budget (e.g. a $15,000 increase). This level of funding would make it possible for the program to break out of the steady-state condition that currently exists and would revitalize many key factors that will stimulate growth and the pursuit of excellence in teaching/research.

Space, Equipment, and Library

Space. Space within the Geology Department is sufficient for our current needs and for the foreseeable future. Because of the electron microprobe facility, we are tied to this building and chose not to move into the newly planned Science and Technology Building. The close proximity of the Geology Department to Marine Sciences on campus is good. Our classrooms, offices, and labs were renovated 13 years ago and are still in good shape. Our classrooms could use more A/V equipment, particularly digital projectors so we can fully migrate to computer presentations. Currently we have funds from an NSF grant to upgrade one of the classrooms near the microprobe. Other upgrades will probably have to come from our operating budget and from additional grants.

Library. Library resources are continually eroding for all departments due to the cost of journals and the need for addition of new programs. The library resources for the Geological Sciences consist of Nature, Science, Bulletin of the Geological Society of America, Geology, Bulletin of Volcanology, Journal of Geology, American Mineralogist, Geotimes, Journal of Geological Education, and Journal of Sedimentology. The most important service the library provides is access to the GeoRef database, which makes it possible to find references for earth science research. Without GeoRef, it would be nearly impossible to conduct research in the Earth sciences from UH Hilo. Only the Bulletin of Volcanology and Nature are currently in electronic form, although we have temporary access to all of the Elsevier publications, which is a huge upgrade for the library. However, this access may expire when the free trial is over.
Lab Equipment. The available equipment for teaching laboratories is in pretty good shape. The most important resources are: petrographic microscopes, rock collection, and rock preparation equipment. Maintenance of the (very expensive) microscopes is a high priority in order to deliver high quality instruction.

Field Equipment. Much of the equipment that the Geology Department uses including our vans and expensive surveying equipment, is co-owned with the Center for the Study of Active Volcanoes (CSAV). In recent years the relationship with CSAV is not optimal and has been poorly defined. If CSAV is allowed to separate from the Geology Department as the director wishes, it will be a great loss of resources to the department. This will substantially hamper the development of the Geology Program. A positive development in this regard is a memo issued by the CAS Dean during spring 2003 that clarified that CSAV is assigned to, and is part of, the Geology Department. In theory this addresses concerns about access to CSAV equipment, but in practice, the situation is still shaky because the CSAV director does not wish to be under the geology department. We are actively trying to build a cooperative and mutually supportive relationship.

Vehicles. Our two vans shared with CSAV are approaching 15 years old and one (the 4WD) was recently retired from service as it was no longer safe to operate. The CSAV director was able to replace the defunct van with a used 2WD van purchased from the UH motor pool. Thus Geology now has access to two vans (one ancient and one relatively new) and we rely on them for frequently course-related field trips during the semester. We contribute to the cost of

maintenance. While CAS has a pair of Suburbans, they have been fraught with the problems of multiple use. We have recently submitted an NSF grant that requests funds for a new 4WD van, but the proposal was not funded. Because our academic programs rely heavily of field exercises, continued access to vans is a major concern for the future.

Faculty Computers. Computer equipment for Geology Department faculty is in relatively good condition. We all have adequate computers and try to purchase new ones every 3-5 years, depending on the need of the individuals. We also have adequate printing and the network services provided by ACS are good.

Student Computers. Computer equipment and programs for our students remains one of the biggest issues within the department. We have used and continue to budget part of the departmental operating budget to purchase computer equipment for our laboratories. Due to security concerns, the student computers are now maintained by academic computing services (ACS) and faculty do not have administrator privileges. This is a mixed blessing, as the support from ACS ranges from good to indifferent.

GIS Lab. In about 2000, the Geology and Geography Departments collaborated to obtain system funds to start up a Geographical Information System (GIS) Computer Laboratory, which is housed in the geography department. Barbara Gibson in the Geography department has been successful in obtaining funds to maintain and update the lab, which now has 20 seats. The GIS lab is available to geology faculty and students, and we can schedule GIS or remote sensing course in the lab.

PROGRAM PERFORMANCE

Faculty Creativity and Achievements

Research

The more junior members of the department are moderately productive with respect to publications and presentations, and one junior member currently has a NSF grant. The more senior members of the department have not been as productive in academic research over the last 7 years (but this is changing). It should be noted that [former] faculty member Carl Johnson was extremely active in applied research, but due to the commercial nature of the research did not publish.

Service to Community

From time to time the geology department participates in community outreach programs which educate the public about geologic hazards. One geology faculty member (Ken Hon) produces educational films about Hawaiian volcanism intended for the general public and provided technical assistance to the County when they were opening the Kalapana Lava Viewing Area. [Former] faculty member Carl Johnson served on the Hawaii State Earthquake advisory board, and faculty member Jene Michaud provides technical assistance to the Mauna Kea Soil and Water Conservation District. By helping to educate Natural Science majors, we are making a contribution to meeting the community's needs for secondary science teachers.

Student Learning

During the past 7 years, the Geology Department has been engaged in very informal assessment. We keep in contact with many of our majors and verbally discuss how their education has served them and changing needs in education that they may have observed. During this period we have reassessed much of our curriculum during the planning for 2 new degrees. The process of writing these degrees up for CAS senate and UH Hilo administrative approval has been a significant assessment process in itself. We did a lot of re-thinking about the importance of core courses during this process and have significantly added to our curriculum. We are still re-evaluating our departmental objective to turn out well-rounded earth scientists. Many small liberal arts universities have good geology departments and the competition is strong for qualified students. One possible alternative is to focus our Bachelor of Science degree on 2 more specific tracks, one in Volcanology that would produce students with high tech skills, and another in Environmental Geology that would produce employable students. The advantage of this approach would be to play to the departmental strengths and use our location more aggressively as a recruiting tool. The disadvantage is that it will require more students in our upper division courses.

In the course of our informal assessment activities, we have noticed that many of our majors come to us unprepared in the ancillary sciences, especially mathematics. This deficiency makes

it very difficult to incorporate math in many of our courses as students have widely variable backgrounds. Again increasing the major count to where we can offer courses yearly would eliminate some of the problem as we can then require students to take the classes they need to be prepared for major core courses.

Student Achievement: Graduate School

We have a number of UH Hilo graduates either working on or have obtained advanced degrees at a number of institutions. Several of our graduates have been admitted on full scholarship to pursue doctoral research at Stanford, Notre Dame, and UH Manoa. We are extremely proud that we have turned out exceptional students that can compete at the best schools in the nation.

Enrollment Trends and Required Assessment Data

Another healthy sign is that our upper division course enrollment (Table 1) has significantly increased in the past 6 years from an average of 7-8 students to 14-15 students per upper division course. Some of our upper division courses are filled to capacity and we have not had a course with less than 10 students for several years. . We also expect to see an increase in majors due to the new Geology B.A. degree, which was just offered this year. It will be several years before we can expect to see any result of this degree on numbers of graduating students. The number of graduating majors has not gone up significantly over the same time period. First, the recent increase in majors has not reached graduation, and second is that historically we have had a high number of National Student Exchange students in our department. While these students don't graduate from UH Hilo, they add to our major count. Oddly, some of the students actually stay to finish their studies here, but graduate from their original institutions due to the difficulty in transferring credits from one institution to another.

The data in Table 1 also show that a large proportion of the student semester hours delivered by the Geology faculty are for general education (about 60-70%). If we are successful in recruiting more majors, we would have to teach our upper division core classes every year instead of every other year. While this is a good situation for our majors (allowing them more flexibility in taking classes), the classes that would be cut back would probably be general education courses. We can probably absorb up to 40-50 majors before this would become necessary.

The funding numbers that we were provided and the resultant cost per student semester hour (Table 1) are very curious. The numbers for the Geology Department budget vary significantly from year to year, but are impossible to assess without detailed itemization. For the 95-96 year our budget was listed at over $400,000. Clearly we have not seen these widely fluctuating budgets and their must be some inherent problems in the data. Our discretionary budgets and number of faculty have remained fairly constant (interestingly, our lowest budget year is when we are listed with 6 FTE faculty). We suspect that non-instructional funds related to CSAV are being included in our department budgets. There are also problems with the breakdown of

Table 1. Assessment data for the UH-Hilo Geology Program.

												Date: **Oct 01, 2003**	
Year	**Level**	**No. Majors in fall**	**Fall SSH Taught**	**FTE Course Enrollment**	**Crossover % of SSH taken by own majors**	**Data % of SSH taken by Non-majors**	**# Classes**	**Avg Class Size**	**FTE Faculty**	**Student Faculty Ratio**	**Degrees Or Graduates**	**Expenditures**	**Cost Per SSH**
96-97	L											$366,649	$224
	U												
	T		897	60			16	21			2		
97-98	L		660	44	36%	64%	13	19				$233,727	$170
	U		94	6			4	9					
	T	22	754	50			17	17	6	8.38	3		
98-99	L		751	50	29%	71%	12	24				$355,473	$226
	U		58	4			4	6					
	T	17	809	54			16	19	4.89	11.03	3		
99-00	L		659	44	33%	67%	12	22				$351,104	$239
	U		29	2			1	9					
	T	19	688	46			13	21	4.11	11.16	4		
00-01	L		703	47	36%	64%	13	22				$242,943	$162
	U		93	6			2	16					
	T	17	796	53			15	21	4.56	11.64	0		
01-02	L		632	42	39%	61%	10	24				$244,976	$169
	U		42	3			1	13					
	T	23	674	45			11	23	3.67	12.24	6		
02-03	L				28%	72%	9	21			n/a	n/a	n/a
	U						5	16					
	T	33	712	47			14	19	4.25	11.17			

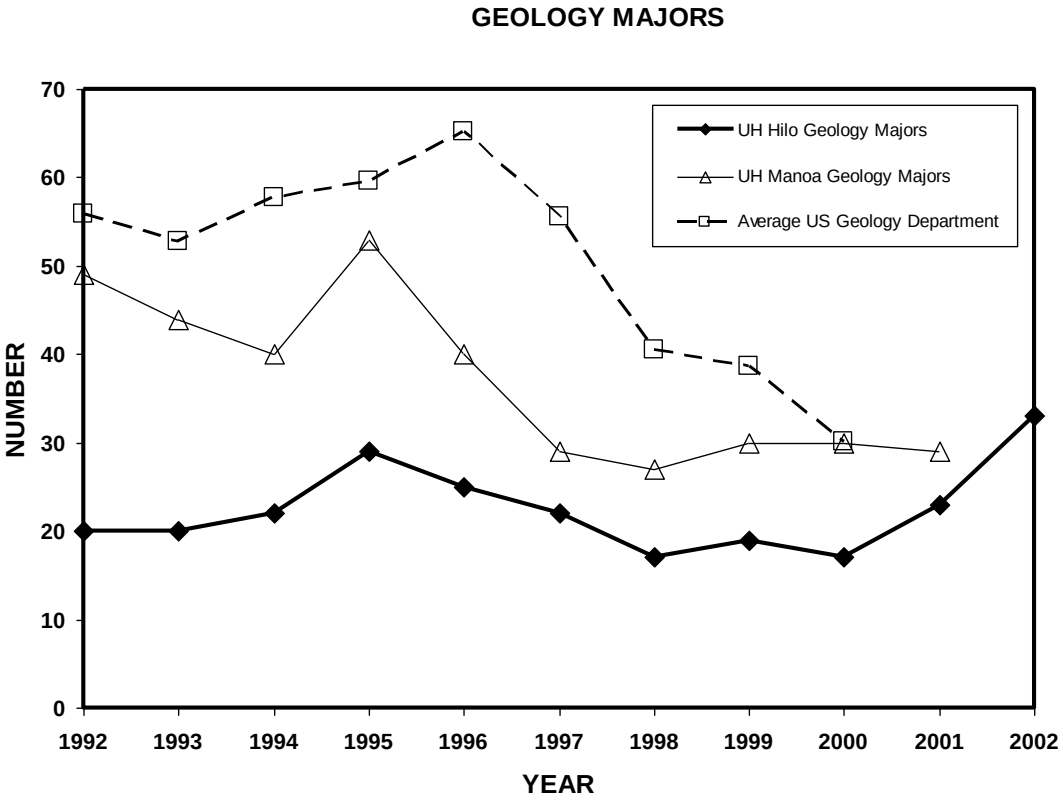

Figure 1. Comparison of enrollments between geology departments at large U.S. universities, UH Manoa, and UH Hilo for the past 10 years. Nationwide date is from the American Geological Institute report on the 2001 Status of Academic Geoscience Departments.

individual FTE for each faculty member. For example, one faculty member was shown having 10-12 hour loads every semester for the past five years and has never had an overload. Currently this data is impossible to assess and we will try to reconstruct the parts that we find useful to our assessment efforts. If we assume that the most current budget numbers are correct, then our per SSH costs are similar to many other departments in CAS ($160-$180). Our faculty to
student ratio has remained relatively constant at about 11:1. Overall our total number of SSH taught has fallen gradually over the past 5 years. The drop is roughly coincident with the decreasing number of FTE (largely instructors) and the reduction in the number of class sections offered. This year we have seen what may be a drop in the numbers of students enrolled in Geology courses for GE credit, but there is too little data to evaluate this trend at present.

EDUCATIONAL ASSESSMENT

Previous Assessment

During the period 1991-1995, the Educational Testing Service "Major Field Test" in geology was administered to graduating seniors. The results of the tests were helpful from the standpoint of comparing the geology program at UHH with other colleges. Also, subscores given made it possible to assess the relative strength or weakness of specific content areas. These tests suggest that none of the content areas were notably weak among graduating seniors. Moreover, the scaled total scores were actually quite high from the standpoint of an institutional average (1991-1994 data). UHH geology majors as a group graduating in 1994 and 1995, for example, ranked in the 99th percentile nationally. In 1991 and 1992 the institutional percentile rankings were 83 and 78 respectively (no tests given in 1993). These high scaled total score rankings are indicative of strength across the board relative to subject content in comparison to other colleges. Unfortunately, after 1995, ETS quit offering the test for the geological sciences.

Current Assessment Efforts

Student Learning (repeat of paragraphs under "Program Performance")

During the past 7 years, the Geology Department has been engaged in very informal assessment. We keep in contact with many of our majors and verbally discuss how their education has served them and changing needs in education that they may have observed. During this period we have reassessed much of our curriculum during the planning for 2 new degrees. The process of writing these degrees up for CAS senate and UH Hilo administrative approval has been a significant assessment process in itself. We did a lot of re-thinking about the importance of core courses during this process and have significantly added to our curriculum. We are still re-evaluating our departmental objective to turn out well-rounded earth scientists. Many small liberal arts universities have good geology departments and the competition is strong for qualified students. One possible alternative is to focus our Bachelor of Science degree on 2 more specific tracks, one in Volcanology that would produce students with high tech skills, and another in Environmental Geology that would produce employable students. The advantage of this approach would be to play to the departmental strengths and use our location more aggressively as a recruiting tool. The disadvantage is that it will require more students in our upper division courses.

We have also noticed over the years of engaging in informal assessment that many of our majors come to us unprepared in the ancillary sciences, especially mathematics. This deficiency makes it very difficult to incorporate math in many of our courses as students have widely variable backgrounds. Again increasing the major count to where we can offer courses yearly would eliminate some of the problem as we can then require students to take the classes they need to be prepared for major core courses.

Assessment Learning Matrices

We have examined the assessment programs used at a variety of other geology departments, mostly at bigger universities. By far the best set of goals, objectives, and criteria for assessing the geological sciences were put together by the geology department at Indiana University-Purdue University Indiana. We have "borrowed" the various learning matrices from their excellent work and are in the process of modifying them for the Geology Department at UH Hilo. The edited matrices are available in the appendices. We need to continue to modify these matrices and identify the specific goals, outcomes, and assessments with individual courses in the major sequence. We have also included a detailed assessment matrix for our field methods class. These matrices can be combined over several courses to synthesize a capstone assessment experience. We need to make similar assessments for all of our courses. The advantage of this type of assessment is that it can be filled out for the individual student to give them an idea of their progress or distributions of students from the entire class can be shown, which is a more effective way for the department to assess outcomes.

Examples of Course Objectives and Assessment

In addition to the learning matrices and course assessment matrices, it will be useful to develop short summaries of the learning objectives and assessment for each individual course. Below, an example of this type of summary is given for our Physical Geology Laboratory Course.

Learning Objectives

Factual Information The students are expected to learn the terminology necessary for the different exercises. They must know what the different types of mineral properties are. They must know the different size categories for sedimentary rocks. They must learn the different geologic principles, like superposition. They must know what contour lines are.

Concepts The students must understand how to identify minerals and rocks. They must understand how to use topographic maps to identify geologic features and processes. They must understand how P- and S-waves are used to determine the epicenter of an earthquake. They must understand how plate tectonics works.

Skills The students should learn how to read a topographic map and how to contour. They should be able to convert map scales for different uses. They should be able to draw a topographic profile. They should be able to use a stereoscope with stereopair picture.

Learning Assessment

Learning of factual information is assessed through pre-lab exercises and quizzes. Concepts and skills are assessed by use of these concepts and skills in different lab exercises.

Department Retreat

In October 2003, the Department held a faculty retreat on a Saturday afternoon. The major activity at the retreat was to map student learning objectives for majors into specific courses. In most cases a specific objective will be introduced in one course, developed in another, and applied in a third. While we did not finish this task in one afternoon, we made a good start, and plan to finish over the next year. We felt that the exercise was useful. For example, we discovered that we are not stressing professional ethics enough.

Future Assessment: Models Under Consideration

Standardized Tests

Standardized testing is a very familiar form of assessment and creates much more concrete numbers that any of the other methods. The Geology Department previously administered subject tests provided by ETS, these are no longer available. The GRE Geology specialty tests have been discontinued and are no longer an option.

We are currently evaluating the ACAT tests for Geology. It is unclear if these will actually be available. Furthermore, it is difficult to know if there is a sufficient pool of geology departments in the U.S. administering these tests to make our rankings statistically significant. The ACAT tests have a significant advantage over other tests in that they let the departments choose the specialty areas to be covered on the test.

We also noticed by looking at the numbers from the early 90's that many of the local students did significantly worse on the standardized tests than students from the mainland. We do not know if this reflects a real difference in performance or simply a poor response to the standardized tests. In some of the cases, the lower test scores correlated with lower grades in classes also. We again have a hard time differentiating between real differences in performance and responses to teaching techniques. Mainland students are more likely to have been exposed to a wide variety of geological environments and probably have a significantly easier time visualizing many of the geological processes. Because geology is a highly visual science, this effect is likely to be real. The NSF STEM grant financed field trips for Native Hawaiians will provide an excellent opportunity to assess if early exposure to a wide range of geologic features produces a change in interest and performance levels.

Standardized testing would be useful in that it does provide a measure of comparison with other schools that can be helpful both to the department and to the students. However, if the tests create a bias, they could also provide misleading results. While we intend to pursue reinstating a standardized test, the level of feedback information these tests provide is limited and we need a broader means of assessing our students and programs.

Individual Portfolios Model

Program goals and objectives are determined and faculty from each of the courses are asked to rate the degree to which their course addresses each of the program objectives. Each student is rated for how they met the goals and objectives of each course. Students learn about creating a portfolio, engage in a process of self-reflection about the level at which they have met the program goals and objectives, discuss methods for scoring the portfolios, and peer-review each other's portfolios. Students continue to build their portfolios throughout their academic career. The items in the portfolio include:

- Work selected by faculty from each course in the program
- Work selected by students
- Yearly self-reflections and faculty reviews that rate student's progress on each of the objectives and provides evidence of their progress
- At the end of their senior year, students could display and refine their work in the Natural Sciences Seminar where they refine their portfolios with an eye towards writing a statement for entrance in graduate Other possible contributions to the departmental portfolio could include:
- Faculty ratings of student's contributions to a group project
- Students' ratings of each other's contribution to a group project
- Copies of student's course notes
- Video tapes of student presentations
- Audio tapes of a class discussion or a copy of a course discussion using e-mail or a listserve
- Data gathered from faculty on the number of students for whom they wrote letters of recommendations for graduate school, or creating a portfolio to help them in applying for jobs.

For the department, faculty would review the portfolios. Depending on the number of portfolios, it is possible that a random sample of the portfolios is read. Scoring would help the department assess how each class is contributing to the learning objectives of the major.

Departmental Portfolio Model

Program goals and objectives are determined and faculty from each of the courses are asked to rate the degree to which their course addresses each of the program objectives. Program portfolios are created by selecting key courses in the geology program and selecting key works from those courses. Each year, a representative sample of students' work on the key assignments is selected. These random assignments are assembled into a generic portfolio that resembles the path that students might take through the program. We have assembled much of our geology curriculum into a departmental portfolio for external review with examples of student work from each of the classes. These include:

- Papers
- Exams
- Lab assignments

- Syllabi and some statements of the learning objectives and assessment addressed in the course
- Course schedules, giving a detailed outline of what was taught in the course.
- Creative works such as web-pages, PowerPoint presentations etc.

Input-Output Assessment Testing

Program goals and objectives are determined and faculty from each of the courses are asked to rate the degree to which their course addresses each of the program objectives.
A lower division course that is required before taking other upper division courses is chosen for "input" assessment. At the beginning of this course, all students are required to take an exam designed to measure the program learning objectives and their basic knowledge.
An upper division course that students are required to take in their last or second to last term is selected for "output" assessment. An exam similar to the one given for "input" assessment is given as part of the final.

A similar, but slightly different variant is to test students upon entering and leaving a single course. This type of testing could be useful, particularly for assessing what students learn in GE courses. We would have to devise the tests ourselves and keep revising them yearly, which is a considerable amount of work for a non-class test.

Senior Seminar and Capstone Courses

Currently, Geology majors must complete the Natural Sciences Seminar, which is a taught cooperatively with Geology, Physics, Chemistry, and Math. The seminar consists of 2 semester courses, each for 1 credit. This course is an important part of all of the disciplines in that it gives the students the opportunity to watch diverse styles of oral presentations. During the second semester, the students each develop oral skills during preparation and delivery of a presentation. While this course has served the respective departments well, it is probably time that all of the departments collectively assess this course and clearly define the learning objectives

It is very difficult for the Geology Department to have a single capstone course as we only offer core upper division courses every other year. We propose to use several courses as our capstone course. These senior-level courses already exist in department curricula and have traditionally been used to test students' ability regarding the ability to synthesize ideas and use the knowledge gained from a course of study. Some courses are centered around the practical application of major-relevant skills (e.g., Geologic Field Methods requires the students to produce maps) and in other cases (e.g., Natuaral Science Seminar where students are required to make an oral presentation) the course is taught in more of a seminar fashion.
Another capstone experience that we are considering either a senior thesis or practical experience. In fact, we proposed a thesis course, which would be optional for seniors, but the senate inexplicably voted against the proposal. Senior theses and practicals are done by some of the Marine Science students. The Geology Department is interested in discussing the

implementation of these programs with the Marine Science faculty and possibly doing a limited implementation of one or both. The advantage of the senior theses is that it would encourage faculty to develop collaborative research projects that involve students on a long term basis. A number of our students are also involved in practical job experiences, particularly at the Hawaiian Volcano Observatory. Both senior theses and practicals require advising time and also replace normal electives that the student would be taking.

Post-Graduation Surveys, Exit Interviews, and Alumni Surveys

Soliciting self-reports from students, alumni, and employers is another means of measuring outcomes in the majors. Surveys have the advantage of generating both quantitative and qualitative data regarding perceptions of achievement as well as obtaining fresh ideas for improvement within the majors. The major disadvantage is that the small sample size means that results are statistically unreliable. This is a problem with nearly all the assessment methods under consideration. There are three types of surveys we are interested in developing:

1) Oral exit interviews with the Geology Department Chair. This has the advantage of allowing us to poll all of our graduates and get feedback when their course work is still fresh in their minds. Once the students have graduated there is no pressure on them to hold back thoughts. Students may often say things orally that they would not put in writing, thus offering insights that might have been missed. The drawback is that students have little perspective on the quality of their education until they can measure it during employment or against students from other institutions in graduate school.
2) Alumni surveys should be an excellent way to get feedback from our graduates. These surveys tend to have a built in bias, in that we generally stay in better communication with our best students. Still the alumni surveys will be a good measure of how well we prepared the best students to succeed and should also provide fresh feedback and new ideas to implement in curriculum.
3) Surveying employers and graduate student advisors of our graduates should also provide very useful information. While we have had some limited contact with employers and advisors, it has been very small and we need to make a concerted effort to evaluate how our graduates are prepared.

RESPONSE TO OUTSIDE REVIEWER'S COMMENTS

The outside reviewer's report is found at the end of this report. The reviewer (Rick Hazlett) has identified a number of issues, which if addressed, would strengthen the Department. These issues can be divided into those that are within the power of the Department to address, and others which are not. Examples of the latter include the low level of secretarial support and fact that the library does not carry all the major journals in the field. As much as we agree with these comments, there seems to be little point in dwelling on them. This section of the report, therefore is confined to that portion of the reviewer's comments that can be addressed constructively by the Department.

The reviewer identified the strained relationship between the Department and CSAV as a major issue. The reviewer's perception was that the Department feared that a complete break between the two organizations. There have been some positive development in CSAV-Geology relations since the reviewer's visit that make this possibility less likely.
The reviewer recommended that we re-name our courses so that the course content is more clearly communicated to prospective and introductory students. We agree, and have prepared the course modification forms, which will be submitted in spring 2004. The proposed name changes are listed below:

Environmental Geology	Environmental Earth Science
Advanced Environmental Geology	Advanced Environmental Earth Science
Physical Geology	Understanding the Earth
Historical Geology	History of the Earth and Its Life
Mineralogy	Earth Materials I: Minerals
Petrology	Earth Materials II: Igneous/Metamorphic Rocks
Geomorphology	Earth Surface Processes
Structural Geology	Deformation of the Earth
Stratigraphy and Sedimentology	Sedimentary Processes

The reviewer noted several ways to provide extra-curricular support to geology majors. Our responses as of December 2003 are in italics.

1. Provide information about graduate schools, and how to prepare for and apply to graduate school. *We plan to develop materials that address this need within the next year, and place them on our webpage.*

2. Provide information about summer jobs, summer field camps at mainland universities, internships, and permanent job opportunities.
   We have already developed a library of sorts that holds information about internships, field camp, and summer jobs. This is located in the seminar room where geology majors study. In addition, we are developing a web page with career and job links. We have a prototype already placed on the web page, and plan to improve it in the future. In the future this website could also include links to information about summer field camps.

3) Improve computer availability for students.
   Students can either use computer at the large campus-wide computer labs, or the six computers available in the geology department classrooms and seminar room. Problems at the large campus-wide computer labs are beyond the Department's ability to fix. The computers in the geology department are maintained by ACS and the geology faculty lack administrator privileges, so must rely on ACS for repairs. There has been a problem with ACS response times (six months), but the situation has improved recently, and all computers and printers are now working. We do need to re-institute a procedure for identifying and addressing problems on the student computers.

4) Invite visiting geologists to give talks.
   If this can be arranged at minimal cost this is an excellent suggestion. Possibilities may include speakers already scheduled to speak at Manoa and geologists vacationing on the big island.

The reviewer also noted that the Department could benefit from a stronger network of alumni, and by advertising in the American Geological Institute AGI directory. We are already in the AGI printed directory, and are deciding if we should join as an associate to get advertising on the AGI web page. Although we maintain informal contact with many of our alumni, we need to develop a stronger network of alumni and put a survey or note on our web page, develop a database, and re-establish the alumni newsletter.

The lack of spare faculty time is an impediment to accomplishing many of the reviewer's suggestions. Student workers could do much of the work, but their availability is limited.

CHAIR'S EVALUATION

Current Status and Future Directions

The Geology Department is doing a good job of delivering a high quality education in the Earth sciences and preparing students for graduate school and other occupations. While lacking in any quantitative assessment data, we do follow our graduates and send them alumni news letters. Our students have gone on as Ph.D. candidates at highly competitive schools such as Stanford and Notre Dame, clearly an indication of the broad background we have provided them in the geological sciences.

The use of technology within the Geological Sciences has changed dramatically within the last decade. We have added several courses in GIS and Remote Sensing to our curriculum to address these needs. The addition of these courses came out of our evaluation of what new technology courses were needed for the proposed degree in Volcano Geotechnology. While the degree did not come to pass, the courses were approved and added to our curriculum. There is always a constant need to evaluate the balance between teaching new technological skills, subject knowledge, and analytical thinking. Over the past several years we have constantly discussed what the balance between subject matter and technology should be in our core

curriculum. One path would involve replacing some traditional discipline courses with those that are more skill oriented such as remote sensing and geographical information systems. While there is justification for this in job market demands, many of these skills become dated rapidly and reduce the value of the degree. Another direction is to attempt to incorporate or integrate some of these technological skills into existing courses.

Assessment Activities

We do need to be more systematic in tracking the outcomes of students and also in incorporating their feedback into planning for the Geology Department. Developing a good assessment program will be a departmental priority over the next several years. We can take some steps immediately, such as trying to list and track all of our majors rather than just our graduates. We can also conduct exit interviews with recent graduates and do alumni surveys. Instituting assessment testing will require a great deal of care to craft tests and questionnaires that will yield reliable information. We plan to begin working on these areas immediately, develop a plan and have it fully implemented in 2-3 years.
The geological sciences have no widely used assessment test and in fact the only test that could be found that offers geology testing is the ACAT. This test doesn't seem to be widely used by geology departments around the country, but this could change with the new emphasis on assessment. We will investigate this and determine if we can use this as an assessment test or if we need to develop our own "in-house" tests.

Department Management

The tracking of budgets and faculty course loads appears problematic. The Geology Department should keep its own numbers for faculty teaching loads and instructor assignments, something we haven't been rigorously doing to date. The faculty routinely teach overloads because they do not receive extra compensation for the three-hour long labs embedded in the majors courses. While we could reconstruct these figures out of back records, it would take time. It becomes clear when looking at the itemized records for faculty teaching loads they are high in many instances, making it appear that a number of the faculty have been consistently teaching large overloads, which has not been the case. These numbers are difficult to evaluate and do not appear to be required, so we are uncertain as to whether there is a need to track them for the administration.

Likewise, the total budget numbers assigned to the Geology Department are also difficult to interpret as was mentioned previously. The large fluctuations in the year to year budget numbers are not reflected in any real changes that can be identified by the Geology Department faculty. There are potential complications, because some of the expenses for the Center for Study of Active Volcanoes may be included within the academic budget. It is very difficult to accurately interpret these numbers without some detailed itemization. The Geology Department doesn't have access to the information necessary to make these calculations, so they will need to be provided by the administration for future calculations.

DEPARTMENT GOALS

Vision for the Future

The primary goal of the Geology Department faculty is to grow the program in prestige, stature, and size. We need to capitalize on the strengths of the department in volcanology and environmental science, particularly in recruiting students. We are also working to make our program more culturally relevant to students from Hawai'i, particularly native Hawaiian students. Our long-term goal is to roughly double our number of majors, so that we can offer core geology courses more frequently. This will reduce the bottle neck that majors encounter when trying to get all of their courses done within a 4 year course of study.

The addition of seismologist Dr. Art Jolly to our faculty is welcomed as an opportunity to invigorate and strengthen our program.

In order to make our graduates more competitive in the 21st century, we intend to continue integrating technology into courses.

Another important goal is continued improvement in the relationship between the Department and CSAV. Our goal is a relationship of mutual respect and support, in which the success of CSAV enhances the reputation of the Department and visa versa.

Student Learning Assessment

Continue with the development of more specific learning objectives for each course, and mapping of program objectives into specific courses.
Have students compile a portfolio of work as they progress
Develop an assessment plan for tracking general science learning in general education courses.
Develop assessment grids for each of our major courses that track the students' accomplishments and level of proficiency in courses
Suggest that we add a few assessment questions on every course evaluation and that course evaluation data be returned to professors in computer form so it can be tabulated.

Curriculum Development

General Education
The goals of general education courses should be re-evaluated in light of assessments. Other university geology programs have had some success with greater incorporation of classroom exercises, relevance to society, incorporate reading and discussion of current events, and emphasis on connections to accomplishments of specific men and women in science.

We feel that adding several new General Education courses covering topics of current public interest would attract more potential majors to the Geology Department. Examples of courses that are highly successful at other Universities are "Earthquakes and Volcanoes" (commonly referred to as Shake n Bake), a course in climate change, for example "Past and Future Climates of Our Planet", and a course in the evolution of life on our planet such as "Dinosaurs and the History of Life on Earth". All three of these classes would use subjects that interest students to draw them in, but present a much broader view of the geological sciences and could serve as foundation courses for more advanced coursework.

Integration of New Technologies in Existing Courses

The nature of the Earth Sciences has changed dramatically in the past 10 years as technology has advanced. The challenge for any geology department is to integrate new technologies into course work while continuing to provide a strong foundation and background in fundamental science. Currently we offer a very wide range of courses that include the standard courses in geology—Physical Geology, Historical Geology, Mineralogy, Petrology, Structural Geology, Stratigraphy and Sedimentation, etc. and have recently added courses with specific technology applications such as Geographic Information Systems and Remote Sensing.

While we have added courses in new technologies to our curriculum, most students are not introduced to these subjects until their junior and senior year and have little opportunity to apply them to specific topics in geology. We recognize the need to integrate these technologies within the Geology curriculum at all levels. Most of these new technologies are both equipment and computer intensive. The Geology Department does own a substantial amount of the equipment, but is lacking a computer laboratory facility that could be used in conjunction with normal laboratory exercises. The Geology Department does share a GIS classroom and lab facility with the Geography Department, but the lab is located in a different building and requires scheduling dedicated courses. Currently the GIS laboratory is nearly fully used for upper division technology courses and could not accommodate scheduling of intermittent use by other courses. Most Geology laboratory courses require a substantial amount of special material (such as rocks, maps, equipment, etc.) that make it infeasible to run these courses in general university computer laboratories. In order to effectively implement new technologies in current courses, the department would require a dedicated computer facility setup with 10–15 computers in one of our teaching laboratories. While we have attempted to fund such a facility with our current budget, we can generally afford only a few student computers each fiscal year. Generally, we find ourselves mostly replacing outdated or broken computers and have had difficulty in supporting more than about 5 machines for student use dispersed throughout the department.

Development of Specialized Tracks within the Bachelor of Science Degree

Our future plans are to concentrate our courses on 2 tracks, which will allow development of more specific requirements. The two proposed tracks would be Volcanology and Environmental Earth Sciences. The Volcanology track would play to our strength as the only U.S. campus located near an active volcano. We also have faculty with extensive experience in volcanology. Dr. Ken Hon was formerly with the U.S. Geological Survey Volcano Hazards Team and spent 3 years as staff volcanologist at the Hawaiian Volcano Observatory. Dr. James Anderson has

worked on large volcanic fields and has extensive experience in geodetic monitoring of active volcanoes. Dr. Anderson also started the Center for the Study of Active Volcanoes and was its director for many years. We have also hired a new assistant professor Dr. Arthur Jolly, who will begin in fall 2004. Dr. Jolly has extensive experience doing seismic monitoring of volcanoes in Alaska and as seismologist at the Montserrat Volcano Observatory. The presence of two faculty with experience at volcano observatories makes our program unique among undergraduate universities in the United States. Our close association with the Center for the Study of Active Volcanoes makes additional research and learning opportunities available to our students. This track would focus students more on the chemistry and physics of the solid Earth.

The second track would focus on Environmental Earth Science due to the continued importance of this field. Dr. Jene Michaud is a specialist in surface and groundwater resources, and earth surface processes including weathering, erosion, and soil formation. Dr. James Anderson also has significant experience in the environmental consulting profession where he has worked on slope stability and mass wasting problems. Dr. Hon has extensive experience with rock alteration and ore deposits that are often the sources of natural and man–made pollution. Dr. Jolly could introduce students to geophysical methods used to detect groundwater pollutants and determine subsurface structure and water table location. Students specializing in this track would get additional training in water chemistry, waste disposal problems, development of water resources, soil erosion, near coastal marine environments. The Environmental Earth Science Track would be strengthened by collaborations with the Chemistry Department and the College of Agriculture and Natural Resources.

One course that could easily be added to the curriculum would be an upper division course in coastal processes. This course would be consistent with the strategic goal of using the island as a living laboratory and would be popular, particularly if cross-listed with marine science and geography. Dr. Jene Michaud is willing to develop and teach this course, but there are scheduling issues as she already teaches a large number of other courses, and is also needed to teach introductory courses.

By breaking the Geology major into two tracks, we hope to make the major more relevant and marketable to students while capitalizing on the strengths of our faculty and our location in Hawai`i. Currently, the relatively low number of Geology majors inhibits the institution of a dual track system. Establishing our dual tracks will increase the number of required courses, a number of which will not overlap between tracks. This will require additional students majoring in Geology so that we will be able to meet the 10 student minimum to run any additional required courses.

Capstone course
The Natural Science seminar should be re-evaluated to determine if a different kind of course would better serve the function of a capstone course.

Additional Teaching Resources
Additional teaching resources for both tracks are also available locally. Dr. Steven Lundblad has nearly a decade of teaching Environmental Earth Science and Chemistry and recently relocated to Hilo. Dr. Lundblad has extensive experience analyzing both water and rocks using an ICP instrument similar to the one that the EPSCOR project is proposing to buy and site on the Hilo campus. Dr. Gillian Norton, the spouse of Dr. Jolly, will be relocating to Hilo in fall 2004. Dr. Norton is an expert on magma rheology and has also served several terms as director of the Montserrat Volcano Observatory. She could add significantly to the Volcanology track if the student demand materializes. Dr. Cheryl Gansecki, the spouse of Dr. Ken Hon, is an expert on radiometric dating and large explosive eruptions and also makes educational scientific films though her production company, Volcano Video Productions.

Pedagogical Benefits of Increasing the Number of Geology Majors
There would be several distinct benefits if we could increase the number of Geology majors from the present 20–25 to about 40–50. First, the additional number of majors would allow us to teach required courses on a yearly basis, rather than alternate years as we do now to meet the 10 student minimum for these courses. Teaching these courses yearly is important to make it easier for students to complete their majors at UH Hilo in a timely manner and make it easier for students to transfer to UH Hilo. Perhaps more importantly, it would better enable instructors to integrate material from other geology courses and ancillary natural science courses such as physics, calculus, and chemistry. The current alternate year system produces courses that have entry level and advanced students in the same course. This situation commonly prevents us from teaching to the upper division students to keep the lower level students from getting left behind. Teaching all of our required major courses each year would allow us to require and enforce pre–requisites for upper division courses. This would create a system much more conducive to integration of knowledge in higher level courses. Additional instructors would be needed, however, to staff sufficient sections of introductory and service courses.

An increase in the number of Geology majors would also enable us to enact the Volcanology and Environmental Earth Science tracks, which we feel would lead to focusing on core areas more appropriate to Hawai‘i. A major issue is what curriculum modifications can be made recruit Geology majors from the general student body and/or develop a reputation that attracts more students interested our disciplinary strengths.

Other Teaching Issues
To better prepare students for professional careers we should implement more mathematics and quantitative problem solving in courses. There are several difficulties in doing so including uneven preparation of students and a tendency to drive away certain students. Finally, it is likely that many of our courses would be improved by more active learning and class discussions, and by more critical analysis of the literature.

Miscellaneous Goals

Natural Science Major. Support and invigorate the Natural Science program, which once had the highest number of majors in the division (it now has 24). Ideas for doing this include developing stronger personal relationships between advisors and students, and development of an environmental sciences track within the degree.

Department Retreat. The first department retreat was a success and should be repeated.

APT Support. Improve the supervision of the APT in order to improve the maintenance and tracking of equipment and improved tracking of equipment, and improved support for courses. Revision of the APT job description to include a statement regarding support of the geology educational mission is priority. The current plan of monthly priority-setting meetings between the CSAV Director, the Geology Chair, and the APT is likely to be productive, and should have the added benefit of improving communication between the Director and the Chair.

Faculty Development.
Continuing faculty development is essential to maintaining competency in the classroom and maintaining the ability to conduct research. The entire geology faculty should be encouraged to attend professional conferences on a regular basis and to interact with their peers. In instances where RCUH funding is unavailable to fund professional travel, department funds could conceivably be used if costs are modest. It should noted that some of the research equipment purchased under EPSCoR (chemical analyses, differential GPS) may stimulate new research initiatives.

Change in Department Name
It is our feeling that the term Earth Science conveys more relevance than the term Geology. Many people have only a vague idea what geology is or what a geologist does. The term Earth Science is easily understood by most people and quickly conveys the idea that the discipline is involved in the scientific study of our planet. Many Geology Departments at other Universities are called the Department of Earth Science or the Department of Earth and Environmental Sciences. We are also considering changing the name of our degree from Geology to Earth Sciences.

We realize that this change moves us farther from the course names and requirements used by the Department of Geology and Geophysics at the University of Hawai'i at Manoa. The UH-Hilo faculty feel that it is important for us to have the ability to restructure our degree and degree requirements to keep up with changes in the field and not have follow the lead of another campus for the sake of institutional homogeneity. The Department of Geology and Geophysics at UH Manoa has a very different mission and is primarily involved in graduate student education and research. The Geology Department at UH Hilo is focused solely on education of undergraduates and has a different set of needs and requirements. Most graduate students chose their discipline long before arriving at a choice of schools and are also familiar with a large degree of geologic nomenclature. In contrast, at UH Hilo, the Geology Department is faced with

recruiting high school students, many of whom have been exposed to little or no geology. It is very important to us that we clarify our message in order to find students that are interested in the Earth Sciences.

EXTERNAL REVIEWER'S REPORT

Refer to the following pages or accompanying document.