1993-1999 ACADEMIC PROGRAM REVIEW

Department of Geology & Geophysics
University of Hawaii

Prepared by David Bercovici, Chairman

Preface

This program review follows the "Self-Study Outline for Program Review" (January 2000 revision) with some modifications based on the WASC report. Included in the supplemental information requested are: Form A, quantitative indicators of the Geology & Geophysics undergraduate and graduate degree programs, and curriculum vita for all graduate faculty. The review was completed during Spring 2000 by Chair David Bercovici.

Section I. Program Information

A. The Department.

History:

The subject of Geology has been taught at the University of Hawaii since its inception in 1920. In 1955, the Department of Geology was formed within the College of Arts and Sciences with a single faculty member. By 1959, the Department had grown to four faculty members. In that year it was renamed 'Geology and Geophysics' and the first undergraduate majors were graduated. The program continued to grow throughout the 1960's and a graduate program (M.S. and Ph.D) was initiated in 1962. The name of the program changed to 'Geological Sciences' when the meteorologists elected to form a separate department. Similarly, Geological Sciences faculty formed the Oceanography Department in 1964. In 1965, the non-oceanographic earth sciences were combined by the Dean of Arts and Sciences into an undergraduate Department of Geosciences. Two years later, the graduate fields of Geological Sciences and Meteorology recombined. Finally, in 1971, Meteorology separated and the Department acquired its current name of 'Geology and Geophysics' (G&G) for both the undergraduate and graduate programs.

Degrees offered:

- BS in Geology & Geophysics (for students planning to be professionals)
- BA in Geology (for students not planning to become professional geoscientists)
- M.S. in Geology and Geophysics
- Ph.D. in Geology and Geophysics
- The Department offers no certificate programs

Research Areas of Emphasis:

Emphases in undergraduate and graduate study are presently listed as

- High-Pressure Geophysics and Geochemistry;
- Hydrogeology and Engineering Geology;
- Marine Geology and Geophysics;
- Planetary Science and Remote Sensing;
- Seismology and Solid Earth Geophysics;
- Volcanology, Geochemistry and Petrology.

However, the Department is in the process of reorganizing these areas of emphasis to reflect the present composition of the faculty. The reorganization is expected to be completed as of Fall 2000 and will include the following four areas of emphasis:

- Geophysics and Tectonics: Plate tectonics, marine geophysics, geodynamics, geodesy, seismology,mineral physics
- Volcanology, Geochemistry, Petrology: Physical volcanology, igneous and metamorphic petrology,isotope geochemistry (high-temperature and environmental)
- Marine and Environmental Geology: Engineering geology, hydrogeology, coastal geology, paleontology and paleoclimatology, marine sedimentology, geobiology and geochemistry.
- Planetary Science: Meteorite geochemistry, remote sensing, geomorphology, planetology. (This last field is primarily covered by graduate faculty from the Hawaii Institute of Geophysics and Planetology.)

B. Program Objectives.

- To develop and maintain high quality undergraduate and graduate degree programs;
- To provide general survey and core curriculum courses in the Earth sciences;
- To conduct high-quality nationally and internationally recognized research in all fields of Earth science that are appropriate to the needs of the State of Hawaii, the Pacific Basin and national interests;
- To assist and advise the public within areas of our competence.

The earth is a dynamic planet, and is constantly changing. It continually undergoes natural processes that profoundly impact mankind such as volcanic eruptions, earthquakes, landslides, and coastal erosion, among others. Furthermore, man's activities, including land, air, and water pollution, are having drastic effects on the Earth, and appear to be causing global climatic changes and sea level rise. Thus it is an exciting time to be a geoscientist. Fundamental contributions in Earth sciences are still being made. To meet our objective of quality degree programs, we expect our faculty to be active researchers and to involve students in their research (both graduate and undergraduate students) and instruction and research are integrated throughout the

curriculum. Faculty from many different areas of Earth sciences are involved in teaching our general survey and core classes. We have faculty from all ranks, including some of the University's top, internationally recognized researchers (e.g. three faculty who are recipients of the Regents Medal for Excellence in Research) involved in teaching these courses.

The G&G major must complete support sciences through two semester of calculus, 2 of physics and Chemistry 171 and 171L. Completion of the major requires 25 credits of prescribed courses as well as 15 credits of electives in physical and mathematical sciences. The major is inherently interdisciplinary and provides preparation for professional geological careers in government services, advanced study, or industry.

The faculty of G&G maintain vigorous programs of research (see attached curriculum vita). This spans the range from people-oriented studies like volcanic hazards, earthquakes and coastal erosion to theoretical and experimental studies on the nature of Earth's interior. We are regularly called upon by various state and county agencies to give expert advice on a variety of geological and geophysical problems. We also receive numerous requests from the community for advice and to give talks. Many of the G&G faculty go to schools and civic functions to give talks to educate the community about the Earth. We continuously participate in outreach efforts (e.g., SOEST Open-House, Bows Night, etc) to maintain community contact and encourage more local students to attend the University. Our "Ask-An-Earth-Scientist" web site (http://www.soest.hawaii.edu/GG/ASK/) received a 5-star ranking from Schoolzone's panel of expert teachers, plus a StudyWeb Excellence Award and designation as an "Editor's Choice Supersite" for kids.

C. Major Curriculum Changes in the Past 5 Years.

Although the department is nationally recognized for its research and graduate education, it is also highly dedicated to its undergraduate program. The department continuously exerts great effort to review its programs and keep both the undergraduate and graduate curricula modern and rigorous, to continue to provide state-of-the-art research experiences for our graduate students, and to offer exciting research opportunities for undergraduates. Indeed, in the last 8 years the undergraduate curriculum has gone through two complete reviews and revisions.

From 1989 to 1995 the undergraduate curriculum provided an essential education in geology. Required classes included courses in 1) introductory geology (GG101); 2) mineralogy (GG301); 3) petrology (GG302); 4) historical geology (GG308); 5)

sedimentology and stratigraphy (GG309); 6) structural geology (GG303); 7) geophysics (GG360 or GG304); and 8) geological field methods (GG305). Electives such as hydrgeology, volcanology, engineering geology, plate tectonics, marine geology and summer field camp were consistently offered and encouraged.

In 1995, the department introduced a very different curriculum (after 3 years of review and work) that was designed to increase curricular flexibility and give students the opportunity to sample, in depth, the very wide (and ever increasing) range of fields in Earth science. The required core was reduced from the 8 listed above to 5: 1) introductory geology (GG101); mineralology-petrology synthesis (GG201); historical geology-sedimentology-stratigraphy synthesis (GG202); structural geology-geophysics synthesis (GG203); field methods (GG305). After taking this core, students were then advised to follow one of 5 pre-designed tracks in 1) Geology; 2) Volcanology, Geochemistry, Petrology; 3) Environmental Geoscience; 4) Earth Mechanics and Dynamics; and 5) Teaching Geology. The number of electives was increased considerably, as was the total number of courses as a whole. This new curriculum initially achieved some success. However, in the 5 years it has been employed some tracks flourished and others faired less well. Coincident with the increased undergraduate offerings, faculty positions were lost (due to budget cuts) and the undergraduate enrollment decreased (due to tuition increases coincident with budget cuts). Thus, the average number of students per undergraduate class continued to decline while the undergraduate teaching loads had increased. The overall effect was deleterious to our graduate program (e.g., many faculty were unavailable to teach graduate courses for several years on end), all for the sake of a diminishing clientele (and this was tracked over 4 or 5 years). In 1999, after yet another curricular review (involving a two-day retreat and many follow up curriculum committee meetings), the department will once change the undergraduate program, this time toward a more focussed curriculum.

In Fall 2000 will begin a curriculum that is somewhat reminiscent of the program from 1989 to 1995, yet more rigorous, providing a bridge between freshman and junior level courses, and making a clearer distinction between the BS and BA degrees. The BS in Geology and Geophysics will require classes in 1) introductory geology (GG101); 2) geological and scientific inquiry (GG200); 3) mineralogy (GG301); 4) petrology (GG302); 5) historical geology (GG308); 6) sedimentology-stratigraphy (GG309); structural geology (GG303); geophysics (GG304); geological field methods (GG305); geological data analysis (GG313); and geochemistry (GG325). The BA in Geology (for students not planning on becoming professional geoscientists) will require one less semester of calculus than the BS, and will require all the above courses except geophysics (GG304), geological data analysis (GG313) and geochemistry (GG325). Both

the BS and BA degrees will require a 1-credit research seminar (GG410).

One of the unique offerings of the Geology and Geophysics undergraduate program has always been its field classes and field trips. Several courses involve numerous field excursions to areas both around Oahu and the other islands. However, students need to see other types of rocks and geological structures in addition to what is available in Hawaii. Both the students and the department continue to struggle to find the resources to get students to the mainland for 1-week for the required field course (GG305), as well as for 4-6-week field-camps that are highly desirable for proper training as professional geologists. Almost all other schools require a 6-week field camp for their geology majors; most are outside of their state. Students in our department raise money from club activities, and the department subsidizes as many students as possible from its ever-shrinking budget.

D. Last Complete Study of Curricula and Resulting Action.

As discussed above in Section C, the department has undergone intensive reviews and revisions of its undergraduate program. The last review of all programs was made in the period of 1998-1999, culminating in a two-day department retreat in the early Summer of 1999; the curriculum was revised in Fall 1999 and the new curriculum will begin in Fall 2000.

The graduate subdisciplines within our program make periodic reviews of their curricula. Each year we publish a handbook that contains information for our graduate students. The subdisciplines modify their sections of the handbook according to their needs. In summary, we are annually adjusting our curricula to meet the needs of our students, delete classes that are too infrequently taught, and to be in sync with both changes in the profession as well as the strengths of our faculty.

E. Relationship of Program to Strategic Planning Documents.

The overall University of Hawaii strategic plan, *Focus on Quality: The University of Hawaii Strategic Plan, 1997-2007*, includes many goals to which G&G has contributed in the past and will continue to contribute in the future. Areas in which G&G excel include:

- **Access to quality education and service to the state**: The department continues to provide access to quality educational experiences by offering both rigorous undergraduate and graduate programs from a nationally ranked research

faculty. Numerous research opportunities and fellowships for undergraduates are offered, mixing education and research extremely effectively. Service to the state is provided by educational outreach in Earth sciences to the community, through, for example, speakers to secondary schools, SOEST Open House, and the highly-utilized Ask-an-Earth-Scientist Web Site. Service is also provided professionally through geological consultation on problems such as earthquake and volcanic hazards, landslides and slope stability, groundwater flow and contamination, and beach erosion and coastal management.

- **Campus missions:** The G&G department fits well into the Manoa campus' role as a premier research institution. The department has a nationally highly ranked graduate and research programs and its priorities are well-placed with UHM's mission to emphasize quality and rigorous undergraduate and graduate education and perform internationally recognized research.

- **Diversity:** The G&G department has a diverse student population: from 1995-1999 there have been between 15 and 20 women graduate students (approximately 1/3 of the graduate student population) and between 11 and 24 women undergraduates (typically over half); in the same period, we have had between 5 and 13 minority graduate students (Black/African-American, Asian, Hispanic) and between 6 and 14 minority undergraduates (Asian, Native Hawaiian/Pacific Islander). While the department strives to maintain a diverse faculty, its demographics invariably reflect those of the national and international applicant pool in Earth science, which is not overly rich with women and minorities. Moreover, because of budget cuts, the department has not hired a junior faculty member in 7 years, even though we have lost a total of 4 positions through retirements or mortality (in fact 5 positions were vacated, but one was a prestigious chair in volcanology and was thus recently replaced). Thus opportunities for improving faculty diversity have been infrequent at best. Presently, however, the regular graduate faculty has 4 women (2 tenure track) and 4 minorities (2 Hispanic, 1 east-African [Egyptian citizen], and 1 Asian); the cooperating graduate faculty has 6 women (4 tenure track), and 2 minorities (Asian); the affiliate faculty has 1 woman and 2 minorities (Asian and Hawaiian).

- **Hawaiian/Asian/Pacific resource and international leadership:** The G&G department is well-placed to take advantage of a combined volcanic and marine environment, surrounded by the most seismically active zone on Earth (the Pacific Ring of Fire). The department provides international leadership in its research programs in volcanology, petrology, and geochemistry; in marine geophysics, tectonics and geodynamics; and in marine, environmental and coastal geology. The

majority of these programs focus on geological, geophysical, environmental and natural-hazard problems unique to Hawaii, the Pacific Polynesian islands, the Pacific seafloor, and Asia and the Pacific rim (i.e., from New Zealand through Indonesia, Micronesia and Melanesia, Japan, China, Phillipines, Kuriles, Kamchatka and the Aleutians). Our faculty maintain many active programs of study in these areas, collaborating with Pacific-rim and Asian scientists, and providing their expertise in these areas through invited lectures and extended visits.

- **Managing resources:** The Department's finances are divided into educational (UOH-101) and research (UOH-102) categories. Additional research overhead return funds are efficiently utilized by individual PI's, and to a lesser extent by the department to support fellowships and increase contact with other institutions (e.g., via seminar programs). Educational funds are highly leveraged as they are generally insufficient to cover the entire educational program. In terms of human resources the department has an outstanding faculty that is both recognized for its research accomplishments as well as the quality of its instruction and service. While budgetary constraints apparently preclude merit or equity adjustments necessary to keep excellent faculty, the department continually strives to make the atmosphere and working conditions of the faculty and students a highly desirable place to live and work. That we succeed at this is evident in the extremely high-quality applicants we continue to get for new faculty positions (which have not happened in the review period), post-doctoral positions and graduate students.

The 8 major objectives of the Manoa planning document, *Manoa at 100: The University of Hawaii at Manoa Strategic Plan, 1998-2007* (pages 5-9) are commensurate with G&G goals:

- **Undergraduate experience:** The G&G department continually strives to provide a rigorous undergraduate curriculum. Geoscience is perhaps one of the most cross-disciplinary applications of physics, mathematics, computer science, chemistry and biology; the undergraduate curriculum emphasizes skills in these fields, as well as geological skills (e.g., mapping and surveying, mineralogical/petrological analysis, oil and mineral exploration techniques). We traditionally offer a good sample of writing intensive classes, and clearly emphasize in all classes quantitative and analytic skills and computer technology. The vast majority of our courses are taught by research faculty (we have 1 instructor who teaches a section of introductory geology, and 5 graduate student teaching assistants who teach introductory labs under the supervision of a faculty member); our faculty continually and uniformly receive high marks on student evaluations. We have a rigorous system of undergraduate advising (with a cadre of faculty advisors overseen by a lead advisor and a full-time

educational specialist) in order to graduate students in a timely manner. Finally, we maintain several programs to involve undergraduates in research. We have 4 fellowships to foster undergraduate research; we also maintain an Undergraduate Research Thesis 3-credit senior level elective (GG499), and will in the upcoming new curriculum require a research seminar course for all undergraduates (BA and BS alike) that is similar to the one required of our graduate students every year (which involves scientific-meeting style presentations on their research). Moreover, many undergraduate students are employed by faculty to work on research grants which often result in undergraduate theses. Undergraduates are also provided with leadership and teaching opportunities in our freshman seminar series wherein GG majors teach introductory geology (GG101) and receive credit (GG491 Teaching Geology). The department also creates an undergraduate community for our majors with their own lounge and support of a very active Geology Club through a departmental committee that is dedicated full-time to undergraduate activities (the Department Student Committee). Contact with outside institutions and universities is fostered both through research programs, as well as through participation in mainland geology summer field camp. While we have not provided explicit distance learning, our internet web site has won numerous awards and kudos (see http://www.soest.hawaii.edu/AWARDS) and provides a very heavily utilized information service called ”Ask an Earth Scientist” (see http://www.soest.hawaii.edu/GG/ASK/). Moreover, all course offerings and information for students is given on the web, as are many course lectures and assignments themselves. As part of our perpetual self-review, we are presently undertaking a major upgrade of our web site.

- **Graduate and professional education:** The department of Geology and Geophysics was one of only 3 graduate programs that was nationally ranked (top quartile) in the last (1995) National Research Council/National Academy of Sciences Survey, and was ranked highest in effectiveness. Although the US News and World Report Rankings are fickle, the department was ranked in 1998 as one of the top graduate programs (top 30 overall; top 17 in geophysics). The graduate program undergoes continual review (at least annually) by our Curriculum, Graduate Admissions and Graduate Studies committees and courses and programs are periodically revised or eliminated. Earth science is by nature interdisciplinary and our faculty collaborate with scientists from many other universities and disciplines. Although lack of new hires makes it difficult to stay current with emerging academic trends, the department continues to contribute to highly current and relevant problems of environmental issues, including, for example, climate change, water quality and coastal erosion and management. As one of the premier units of SOEST, which itself

brings in the majority of extramural funds to the university, the G&G department maintains a healthy level of research funding by its faculty. All graduate students are only admitted with either fellowship, teaching-assistantship or research-assistantship support, and we maintain a large graduate population averaging around 60 graduate students at any given time. Clearly the G&G department has maintained a high national stature for several years and thus complies with the planning goals of UH Manoa; however, faculty attrition and budget cuts threaten this high standing and the ranking of one of the Universities top graduate programs.

- **Research:** As stated above, the G&G department has a nationally ranked graduate and research program. Faculty members maintain active independent research projects, publishing and presenting their work at high levels of productivity. Our graduate faculty include 3 recipients of the Regents Medal for Excellence in Research, 5 Fellows of the American Geophysical Union and one recipient of the James B. Macelwane Medal from the American Geophysical Union (one of only two Union-wide medals chosen from over 10 different disciplinary sections; the membership of AGU is over 35,000 from 115 countries), and 4 Fellows of the Geological Society of America. Also, as stated above, undergraduates are strongly encouraged and recruited to participate in research. The G&G department obviously fits into one of the universities target areas of research excellence (to achieve international prominence) which included (as stated in the planning report) Ocean and Earth science.

- **Societal and state needs:** Students in both our undergraduate and graduate program are not only trained to be scientists and taught to think analytically, but they are educated to understand the Earth and the environment on a local and global scale and through events spanning many time scales (from daily and yearly, to millennial and epochal). There is no field that can provide a broader view of the Earth through space and time (save, perhaps, Astronomy which, however, does not concentrate on the Earth) and thus our students have every opportunity to leave with great objectivism and balanced perspective. On a more pragmatic note, students are also trained in a variety of valuable skills of value to the state and national economy, including geological mapping and surveying, geophysical exploration techniques (seismology and gravity/magnetic surveys), chemical and mineral analysis, formal data analysis, and computer programming. The department is also active in community outreach through visitation programs, internet-based information and programs; the department also willingly adjusts the scheduling of classes to accommodate continuing education students and especially secondary and high-school science teachers. Several of our faculty consult with local and state

government agencies regarding relevant geological and environmental issues such as slope stability, coastal management, volcanic hazards and water quality.

- **Distance learning and information technologies:** The department has not yet entered any electronic distance learning activities. While theoretical courses can conceivably be taught electronically, much of what the department does involves field work and examination of mineral samples which is not amenable to distance learning. However, many of student services (e.g., course offerings) and information programs (interactive "Ask-An-Earth-Scientist" web page) are being spearheaded by the department on its internet web page. Moreover, some of our accelerated Geoscience courses (GG611/612) are frequently offered in the evenings to accommodate nontraditional students and science teachers.

- **International leadership**: G&G provides expertise and leadership in geosciences in the Pacific Basin; many Pacific and Asian institutes draw on faculty expertise and students from the area frequently apply and attend our program.

- **Diversity and respect for differences:** See statement above under the overall UH strategic plan under Diversity.

- **Resource management:** See statement above under the overall UH strategic plan under Resource management.

F. Methods of Interaction with Community Groups.

Currently, we have a modest but growing program for interaction with the community. One faculty member devotes about 25% of her time to the University and community outreach and informational programs. She coordinates G&G participation in various community informational and counseling programs such as open houses, UH college days, high school counselor visits, etc. Her efforts often are augmented by those of many of our full-time faculty. In addition, we maintain a Speakers' Bureau and publicize it to the community. Most of our faculty regularly give invited talks for community groups, judge science fairs, participate in radio and TV programs and give interviews to the newspapers. Our faculty are also primarily responsible for organizing and running the SOEST Open House which brings in thousands of students and community members in its 2 day period. Finally, GG has established a formidable inter-net presence with an award-winning web page and the highly utilized "Ask-an-Earth-Scientist" web page (http://www.soest.hawaii.edu/GG/ASK). The Department also offers a weekly seminar series open to the public at which faculty, student s and visiting colleagues present research results.

G. Fundraising

SOEST has a full-time development officer who coordinates the efforts of the School. The Department maintains several fund raising programs within the department. We have 5 awards for students that are financed by private contributions. The Abbott Award is an annual award made to the outstanding undergraduate student each year. The Macdonald Awards are to support research by students working on Hawaiian and Pacific problems. There are several each year. The Harold Stearns Awards also support student research. The Honolulu Chapter of the ARCS Foundation, Inc. (Achievement Rewards for College Students) has given our students substantial awards in recognition of their scholarship. An award from the Watumull Foundation is given each year. A UH Foundation account for general Department needs (to which faculty and alumni contribute) is used to help support various programs such as the GG/HIGP Visiting Scholar program. We maintain an annual newsletter to our alumni to keep them informed about the Department and other alumni; this is also used to solicit funds and this effort has been reasonably successful at bearing fruit.

Section II. Students.

A. GPA's and GRE Scores.

Average GPA		**Average GRE**		
At Admission	Current	Verbal	Quantitative	Analytical
Undergraduates				
3.1	3.1	-	-	-
Graduate Students				
3.4	3.6	67.9	78.6	70.1

There were ## undergraduate majors registered for Fall 1999. Of these:

entered as Freshmen
#transferred from community colleges
#transferred from within UHM
#transferred from other college

Overall Quality of Students:

The undergraduates constitute a good group of hard working students. Usually we have two or three outstanding students who would be among the best students at any university. These students usually continue their education for advanced degrees at institutions on the mainland (we strongly encourage them to do so). Among the others, we usually have a bimodal distribution. We typically have a group with GPA's > 3:0 and another group between 21.-2.7. Our current group contains more of the better students.

The Graduate Students are a very good group of professionally oriented students. Most are from the mainland (73%), some are from Hawaii (16%) and a few are from foreign countries (11%). Our Ph.D. students generally are excellent and would be accepted at any major research university. By the time they graduate, many have presented talks at national or international meetings and some have published papers in refereed journals.

Graduate admissions information for the past several years shows gradually decreasing numbers in what has been recognized as a nationwide trend in the geosciences by the American Geological Institute.

Geology & Geophysics

Semester/ Year	MS Total # Apps	PhD Total # Apps	MS % Accepted	PhD % Accepted	MS % Enrolled	PhD % Enrolled
F1993	56	69	21	12	42	25
S1994	5	13	20	15	100	100
F1994	59	75	7	9	75	43
S1995	6	118	17	11	100	100
F1995	46	78	15	9	57	29
S1996	7	16	0	13	0	100
F1996	34	82	18	9	80	43
S1997	12	12	30	33	100	100
F1997	39	51	18	12	57	50
S1998	8	10	13	10	100	100
F1998	37	33	24	15	56	60
S1999	5	5	20	40	100	0

Enrollment trends for the G&G department for the past several years reflect the situation common for all of the Manoa campus, i.e. down in all fields except business and education.

B. Attrition Rate in GG Program.

We have not kept statistics on the number of students who have finished vs. dropped out of our program. In checking our files over the last 5 years, there are 79 declared majors who took at least one semester of G&G courses. Seventy-one percent of them graduated. Among those who didn't graduate, the reasons cited most often were:

- low G.P.A. (< 2:0)
- couldn't pass Math 206 and Physics courses with "C" or better
- personal problems

- one-year exchange students from the East Coast or Germany (~10%of dropouts) who returned to their host institution.

Over the last five years, 55 students completed their thesis and graduated. Twenty-one students dropped out. Thus, our attrition rate is 28%. The causes for graduate students dropping out are more varied. A few dropped out the first semester because they didn't like Hawaii. Others failed to pass the general or comprehensive exams. Some of the foreign students returned home for personal reasons after one or two years. Others decided that our program didn't meet their needs. A few were asked to leave due to poor grades or poor work habits.

C. Student Advising.

The Department has a large group of faculty undergraduate advisors, each typically responsible for over-seeing the progress of between 1 and 3 students. This group of advisors is coordinated by one primary undergraduate advisor who has overall responsibility for monitoring the undergraduate majors.

Advising of graduate students begins with the Graduate Admissions Committee and the Departmental Educational Specialist who assign the student an interim advisor and provide him/her a large packet of introductory documents, including the G&G Graduate Student Survival Manual which includes all time-lines for completion of the degree as well as listing of courses and other requirements. The interim advisor is from the same discipline in which the student plans to study and often is his/her employer (for a RA). Upon first arrival at the department, the student has a preliminary conference with Department Chair, a representative from the Graduate Admissions Committee, a representative from the Graduate Studies Committee, and the student's interim advisor to identify any deficiencies. Usually by the end of the first year, the student selects his/her thesis advisor and committee. They meet periodically (but at least once a week) to discuss progress. Finally, every graduate student undergoes an annual evaluation by the Graduate Studies Committee at which time his/her progress toward the degree is assessed and any problems (or potential problems) sorted are out.

D. Average Time for Completion.

Year	M.S. Average Time in Years (Number in Sample)	Ph.D. Average Time in Years (Number in Sample)
Fall 1990-Spring 1993	3.92 (16)	6.39 (22)
1993-94	3.50 (6)	5.05 (7)
1994-95	3.44 (9)	6.33 (7)

1995-96	3.00 (3)	4.83 (8)
1996-97	3.71 (8)	5.89 (3)
1997-98	3.06 (6)	5.00 (8)

Baccalaureate–3 years after students declare their major.
Masters–3 years after starting at Manoa.
Ph.D.–dependent on whether they started with a B.S. or M.S.: starting with M.S.–3 to 4 years starting with B.S.–5 to 6 years.
Geophysics graduate students tend to take longer than geology students because many of them are less prepared to start their thesis research.

E. Where Have the Graduates Gone?

Among the baccalaureate graduates, many have either become teachers (intermediate or high school) or gone on for graduate degrees. Some were able to find jobs with local engineering, environmental, and geotechnical firms or with government agencies. Some went to the mainland to be technicians with engineering or petroleum firms.

Many of the graduate students (especially those who obtain a M.S.) go on to work for oil companies. Others work in groundwater or geotechnical consulting firms. Recently, some of our graduates have accepted academic jobs at other universities or research positions at research institutions or government laboratories. Some have stayed in Hawaii to work at U.H. Manoa, teach high school or work for local government agencies or engineering firms.

Current Job Prospects. Local job prospects are, at best, fair. Local firms and government agencies are hiring fewer people than before due to Hawaii's depressed economy. On the mainland, they are excellent for hydrogeology and engineering geology and poor for petroleum geology (price of oil is low).

The employment outlook in the geosciences on the whole, as in any profession, varies with the economic climate of the country. The long-range outlook is good at this time, according to the American Geological Institute. Dwindling energy, mineral, and water resources along with increasing concerns about the environment and natural hazards present new challenges to geoscientists.

According to the National Science Foundation, about 125,000 geoscientists work in the United States. Most geoscientists are employed by industries related to oil and gas, mining and minerals and water resources. Many geoscientists are self-employed as

geological consultants or work with consulting firms. Most consulting geologists have had extensive professional experience in industry, teaching, or research.

Also, many geoscientists work for the federal government or a state government agency. The U.S. Geological Survey (Department of the Interior), Department of Energy, Department of Agriculture, Forest Service, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, state geological surveys, and state departments of environment and resources all employ geoscientists.

Salary scales vary from employer to employer depending on the career path, location, qualifications of the geoscientist, and, of course, the economy. Salaries for college graduates with bachelor's degrees start at about $29,000. Starting salaries for geoscientists with master's degrees are about $38,000 and about $42,000 for Ph.Ds. As in any profession, the applicants with the best qualifications get the best jobs. Most professional positions in the geosciences require a master's degree. A Ph.D. is needed for advancement in college teaching and in most high-level research positions.

Placement of Students. The G&G Department has no formal procedures for job placement of students. We inform students of all opportunities when we are notified of them. Our network of alumni help new graduates to find jobs in oil industry, and in groundwater and geotechnical consulting firms. Dissertation advisers often aid students in locating suitable post-doctoral positions.

F. Student Questionnaire

To be administered by Review Team.

Section III. Faculty.

A. Number.

In the 10 years since the last 5-year Program Review, the Department of Geology and Geophysics faculty (regular graduate faculty) has diminished from 18.75 to 15.25 FTE. This was mostly due to positions not being replaced after retirement or death, and transfer of positions from G&G to HIGP after the formal establishment of SOEST. Moreover, since the last program review, positions ceased to be split between G&G and HIGP; all positions are now in either G&G or HIGP. The following lists include only G&G faculty, and excludes emeritus, cooperating and affiliate graduate faculty since their locus of tenure is not in the department and/or they are not employed by the university.

Rank	Name	Years at UHM
Professor	D. Bercovici	9
	F.K. Duennebier	18
	P.F. Fan	34
	C.H. Fletcher	9
	L.N. Frazer	20
	M.O. Garcia	23
	C. Glenn	11
	B. Houghton	new hire
	J. Mahoney	13
	R. Moberly	40
	G. Moore	11
	B. Popp	10
	C.B. Raleigh*	10
	J.M. Resig**	34
	S. Self	10
	J.M. Sinton	22
	B. Taylor***	17
	P. Wessel	10
Associate Professor	A. El-Kadi	10
	S.J. Martel	8
Assistant Professor	J.M. Becker	6
	K.H. Rubin	6
Associate Specialist	K.S. Spencer	13
Instructor	P.D. Lee	12

* Dean of SOEST
** Retiring as of 12/31/2000
*** Acting Associate Dean for Research, SOEST

B. Faculty Turnover in Last Seven Years.

Departures:

- G.P.L. Walker, Professor. Retired. Position returned and filled with outstanding scientist Bruce Houghton.
- E. Berg, Professor. Deceased. Position not returned.
- K.J. Pankiwskyj, Professor. Retired. Position not returned.
- F.L. Peterson, Professor. Retired. Position not returned.
- R. Batiza, Professor. Departed University Summer, 2000. Position returned.
- J. Karsten, Researcher. Departed University Summer, 2000.
- C. Todd, Associate Specialist. Departed University Summer, 2000. Position returned.

New Appointments to Graduate Faculty:

- Janet M. Becker, Assistant Professor of Geophysics
- Bruce Houghton, Professor of Geophysics
- Ken H. Rubin, Assistant Professor of Geophysics
- Cliff S. Todd, Associate Specialist

Two tenure-track positions currently are being advertised, one in the area of geobiology, and the other in paleoclimatology or paleoceanography, both to be filled at the assistant professor level.

Significance of Turnover. Over the past seven years, the Department has added only four new faculty members, one of whom was a transfer from another program in SOEST and one of whom is leaving as of August, 2000. Substantial growth in the stature of the Department in the national and international community over the next few years depends on our ability to recruit excellent faculty members to the two currently advertised appointments.

C. Average Instructional Workload of Faculty.

The average teaching load of SOEST instructional faculty is 6-8 units/year (with an additional 6-12 units/year for 699, 700 and 800 courses). The instructional workload is about right for most faculty to allow them to maintain rigorous research programs. Any greater teaching workload would result in a serious reduction in research productivity.

Statistically, all measures of workload have remained steady since 1993. Student semester hours have remained at a relatively constant 1500, with the number of classes dropping from about 40 to 30, and class size increasing from about 12 to 16. In short, we have fewer faculty teaching somewhat larger classes.

D. Student Advising Load.

This is highly variable among faculty members. Some have no students that they are advising; most faculty have 2 or 3 graduate students that they are advising. A few faculty have as many as 5 students. The number of graduate students a faculty member advises is a direct function of their ability to obtain extramural funding because the Department has so few teaching assistantships and we accept no students without financial support. A few of the faculty advise undergraduates on honors thesis projects and/or hire them as helpers on research projects. See Appendix B (attached).

E. Publication Output and Professional Activity of Faculty.

Our faculty maintain a vigorous level of research as evinced by their high output of publications. Although it varies from 0 to 10 papers/year, most faculty publish 2-3 papers/year in refereed journals (see attached curricula vitae for details). Some faculty serve on National Science Foundation and National Academy of Science panels, help plan space missions for NASA and are fellows of various prestigious professional societies (e.g. American Geophysical Union, Geological Society of America and Royal Society of London). Complementing our departmental faculty is a large group of Graduate Faculty who do not hold

Departmental positions. They are usually members of other SOEST units who support the Department by advising students, hiring graduate and undergraduate students and occasionally teaching a course. Most are highly productive researchers (see their attached Forms 2.1 and 2.2).

Section IV. Present and Projected Facilities.

A. Space and Equipment for Faculty.

The Department occupies 18,238.5 square feet of space in the POST building. This includes 9,151 sq ft of office and laboratory space for faculty and 5,275.5 square feet of classroom space. We have adequate space for faculty, students, and assistants and the quality of the space is excellent in general, although some problems remain with built-in laboratory facilities. Some of the POST laboratory and classroom space remains unusable. The Department has one major teaching room (accommodating up to 80 students) and 3 smaller seminar rooms that can accommodate approximately 20-30 each. The Department has jurisdiction over only instructional equipment. Over the past few years and coincident with the move to the new POST building, we have been able to replace old, obsolete equipment. For undergraduates, we have good microscopes, a hydrology testing program, seismic instrumentation and a PC-based computer facility. We are in the process of replacing equipment for teaching geophysics but we have insufficient funds to buy all the needed equipment. Substantial state-of-the-art equipment and facilities have been purchased through extramural funding by Departmental faculty. These include: a thermal ionization mass spectrometer, an x-ray fluorescence spectrometer, computer work stations and marine equipment. We now have access to the equipment needed to do “frontier” science.

The following analytical and experimental laboratories are currently available to faculty and students:

- Radiogenic Isotope Facility, including:
  - VG54-WARP multi-collector high-abundance-sensitivity thermal ionization mass spectrometer (TIMS) for positive and negative ions analysis
  - VG Sector multi-collector thermal ionization mass spectrometer
  - 6 high resolution detector Alpha Spectrometry system
  - class 1000 clean laboratory
  - Radioactive-isotope tracer and dating facilities

- Cameca SX-50 Electron Microprobe
- VG Plasmaquad II+ ICP-MS with laser
- Siemens SRS-303 Automated X-ray Fluorescence Spectrometer (XRF)
- Light Isotope Facility, including:
  - Stable isotope mass spectrometer

- Varian GC/MS system stable isotope lab
- Sedimentology, paleontology, and paleomagnetics (including a 3-axis cryogenic magnetometer) laboratories
- Hydrogeology laboratory
- Fluid mechanics laboratory
- Soil and rock mechanics testing laboratory
- Instruments for measuring electrical conductivity on rocks or rock melts, thermal conductivity and thermal expansion, porosity and gas permeability
- Thin section and rock preparation labs
- Crystal cutting and polishing facilities
- 1 atm gas-mixing furnace and hydrothermal pressure vessels
- PC-based image processing system

The following research vessels and their supporting shipboard technical group, are available to researchers for gathering geophysical, geochemical and other open ocean and coastal data and samples:

- An unnamed SWATH (Small WAterplane Twin Hull) vessel currently under construction.
- R/V *Ka'imikai-o-Kanaloa (submersible and ROV mothership)* .
- *Pisces V* , research submersible with a depth capability of 2000m
- RCV-150, a remotely-operated underwater vehicle

Sea-going instrumentation includes equipment for digital seismic reflection, gravity, magnetics, coring, dredging, and water column studies, the HAWAII MR1 side-scan sonar system, and fiber optic-based deep-towed FOCUS camera system. In addition, software is available for multi-channel seismic processing and geophysical data analysis.

B. Space and Equipment for Students.

Space available for student offices amounts to 3,812 square feet.

The G&G department has excellent computer facilities for its students, presently among the best in the nation. Students have 24-hr access to more than 30 brand new work stations distributed among 3 computer rooms (about equal numbers of 300 MHz PC and MAC workstations, each with 32 MB of RAM and Sun Ultra Sparc unix workstations with at least 64 MB of RAM). All are networked and have open access to the internet and a number of free-use peripherals such as postscript laser printers and digital scanners. Color printing and color slidemaking are available to graduate students through their advisors. Overall, the student to computer ratio in our department stands between 3 and 4, which makes access to computers a non-issue for our students. Students also have unlimited internet access and generous limits on hard disk space for network file storage

(e.g., for email and web documents). In addition to all of the above, SOEST has between its researchers another 100 or so work stations of various types in various laboratories, including a Cray EL92 mini super computer and a number of silicon graphics work stations. These are available to students through arrangement with the director(s) of the individual labs.

C. Space and Equipment for Teaching or Research Assistants.

Space for teaching and research assistants is included in the above.

Section V. Strengths and Weaknesses.

A. Seven Years Ago:

Strengths. Natural strength of location for marine and volcanological programs, some excellent faculty and a good reputation.

Weaknesses. Poor quality space, faculty staffing in hydrology needed, loss of senior faculty (and inability to secure comparable replacements), insufficient number of teaching assistants, inadequate secretarial support, lack of technical support, lack of adequate field training for undergraduates, and lack of adequate operating funds.

B. Current.

Strength. Natural location, excellent faculty, excellent reputation.

Weaknesses. Lack of TAs, inadequate technical support (faculty must look after all our equipment), loss of senior faculty (and inability to secure comparable replacements), inadequate secretarial support, and lack of operating funds. Some new space in the POST building remains unusable because of problems with air conditioning and laboratory built-in equipment.

C. Next Seven.

Strengths. Continued improvement in Department with new faculty and improvements to infrastructure.

Weaknesses. Still need more TAs, staff support (technical and student services) and operating funds.

D. Changes Made Based on Previous Review.

The Department's move into new space was pending as of 1993. New equipment has been purchased for teaching and research. Hiring has not kept pace with departures. We still need the additional resources that were recommended in the review. They are:

1. operating funds;
2. TAs (we have only 5); and
3. faculty in the critical areas of seismology, hydrology, biogeology, and paleoceanography
4. additional staff support

Section VI. Improvements.

A. No Cost Improvements.

- Newsletter to alumni to solicit funds and to keep them in touch with Department activities.
- Open house for high school students and community to publicize the quality and diversity of our program.
- Send new brochures to other schools to advertise new faculty and equipment to attract high-quality graduate students.

All of these improvements are operational. They are not no-cost changes but we are using other resources (non-B funds) to pay for them.

B. Moderate Cost Improvements.

We need more audio-visual support. We need additional funds to purchase geophysics teaching equipment (seismic survey equipment, gravity meter and magnetometer).

C. Major Cost Improvements.

Staff. We desperately need an administrative assistant to manage day to day activities of the Department. Currently the Chairman must handle all routine decisions, teach and still try to maintain a research program. This is a hopeless situation and makes it nearly impossible to do a proper job on any of these activities. A technician is needed to maintain Department equipment (microscopes, geophysics instruments and the computer lab). Faculty members or student help are now responsible for this job. We have >$100,000 worth of equipment that need routine maintenance yet lack service contracts because of the annual expense. Also this technician would be used to design and set up displays and labs for teaching which are badly needed. Faculty time is being poorly used when it is used to do things that someone with a bachelor's degree could do and perhaps do better.

Section VII. BOR Criteria.

A. Direct Relevance of the Contribution of Field of Study to Needs of Hawaii.

As a volcanic-island state, Hawaii needs government leaders and citizens who are informed on marine geological and volcanic issues. These issues range form earthquakes, geothermal energy, volcanic hazards and geological engineering to coastal processes, groundwater recovery and pollution, and natural resources in the exclusive economic zone around Hawaii. Our faculty members provide advice on these issues and prepare our citizens for the complex problems they face from our physical environment. We train professionals for local and national government agencies and private firms that provide essential services for the community.

B. National Needs and Our Strengths.

Our mineral and energy resources are finite and declining in availability. Our water supply is also being rapidly depleted and polluted. Geologists and geophysicists are essential to find new resources and to help plan their wise use.

Geoscientists are stewards or caretakers of Earth's resources and environment. They work to understand natural processes on Earth and other planets. Investigating the Earth, its soils, oceans, and atmosphere; developing land-use plans; exploring other planets and the solar system; determining environmental impacts; and finding new sources of useful Earth materials are just a few of the ways geoscientists contribute to our understanding of Earth processes and history. Geoscientists provide essential information for solving problems and establishing governmental policies for resource management; environmental protection; and public health, safety, and welfare.

Hawaii’s unique position and natural strengths make our program particularly strong, hence its high national visibility. Our marine geology and geophysics, volcanology, and planetary geosciences programs are among the best in the country.

C. International Needs.

The Department is recognized worldwide as a leader in marine geology and geophysics, planetary geosciences, and in volcanology. We attract scientists from all over the world to join us in cooperative research. We have active faculty and student exchange programs with universities in Germany and New Zealand.

D. Educational Needs for Basic Education.

Because we live on volcanic islands, we need to be aware of our natural setting to preserve and utilize it wisely. Geology education provides the framework for understanding natural processes that affect us. These include volcanic eruptions, earthquakes and tsunamis. We also need to be aware of our geothermal and groundwater resources so they may be prudently utilized.

E. Relevance of Geology and Geophysics as a Supporting Discipline for Quality Programs.

Students from engineering, tropical agriculture, geography, education and other physical sciences regularly enroll in GG courses as part of their preparation for their careers. They take GG courses at all levels.