

Program Review for the Department of Geological Sciences

Dear Dr. denBoer:

We respectfully submit to you our review of the Department of Geological Sciences at California State Polytechnic University, Pomona. As part of our review, Vicki Pedone and Matthew Shumaker visited the campus on May 13 on meet with University administrators, as well as Geological Sciences faculty and students. Prior to our visit, we reviewed the Department's self-study, which included reviews of previous program reviews, program description, program assessment, program quality, resources, and suggestions for action. Some key components of the appendices included the departmental strategic plan, assessment reports and departmental annual reports, placement of geology graduates, and letters of support from alumni and stakeholders.

Summary and Recommendations

Our review finds that the Cal Poly Pomona Geology department is a department in transition, with a strong tradition of excellent preparation of students for professional careers and graduate school and a bright future for building new programs that will maintain excellent preparation for students in the 21st century. The transitional position of the depart stems from two sources: retirement of core tenured faculty and the program changes made in response to economic pressures to increase efficiency. Much of this review will focus on the impact from these sources of change. Changes made by the department over the past two years show they willing and able to create new programs geared toward strategic hiring areas. This curriculum design is highly appropriately to the mission of a polytechnic institution. We have concerns about a few of the details of the curriculum, but we praise the overall strategy.

We begin with the aspects of the department that merit particular commendation, then move to the greatest challenges that the department faces, and conclude with recommendations that will enable the department to capitalize on its full potential. The remainder of the report addresses items specified in the "External Reviewer's Responsibilities, Review, and Report," which accompanied our charge letter.

Commendations

- The Department Chair, Jon Nourse, is to be commended for his passion and vision for the department. Through his leadership, the department conducted a thorough *ad hoc* program review in 2009 that demonstrated the value of the Department of Geological Sciences to the University and the region.
- Overall, the academic program of the past five years, which is being phased out as of Fall 2011, was fundamentally strong and did a good job of preparing students for graduate school and professional careers.
- The department is forward-looking in building the new program with concentrations in areas of earth sciences that are interdisciplinary and projected to be relevant to research and societal needs in this century.
- The department has been diligent in identifying and relieving bottlenecks and in making efficiencies in the curriculum. One such creative activity is to share classes with CSULA.

- Recruitment efforts have significantly increased the number of geology majors over the past five years.
- The quality and quantity of scholarly productivity, grantsmanship, and teaching achievements of the faculty are impressive.
- Student involvement in research has resulted in numerous abstracts authored by students and a high level of satisfaction with career preparation and readiness received at CPP.
- Strong faculty-student relationships create an atmosphere in the department that is friendly and respectful. The faculty are deeply dedicated to student welfare and providing quality training for graduate school and professional careers. Students overall were satisfied with their classes and by the approachability and mentorship of the faculty.
- Inter-departmental service and collaboration are good, as the department offers courses for Civil Engineering, Liberal Studies (a service-learning course) and the Center for Regenerative Studies.

Challenges

- The numerous retirements and faculty in FERP within the past few years presents challenges in balancing historic strengths with new directions.
- Embarking on a Master's program in 2012 with only four non-FERP tenure/tenure-track faculty risks negatively impacting the undergraduate program, in which many core classes are already taught every other year.
- Instruction by part-time faculty represented 31% of the instruction in 2010-2011 (2.0 of the 6.5 FTEF utilized). Although the instructional quality of the part-time faculty is good, they cannot provide the grantsmanship and research training needed to build top-quality undergraduate and Master's programs.
- The Department of GSC at CPP has made deliberate and successful efforts to increase its SFR and FTES/WTU through increased enrollment in its courses. The challenge is to continue to increase these numbers.

Recommendations

- Increase the tenured/tenure-track faculty to at least 7 members over the next five years. We regard this as a minimum of faculty needed to provide quality undergraduate and Master's programs. Key hires include expertise in sedimentary processes and petrology/economic geology.
- Insure that GSC 425L Igneous and Metamorphic Petrology Lab includes a significant component of hand-specimen identification and revise Track 2 Geophysics/Resource Exploration to include GSC 424 and 425L.
- Reconsider launch date of the graduate program if there will be only four non-FERP tenure/tenure-track faculty (one of whom is half-time chair) on staff in Fall 2012.
- Develop a comprehensive plan to assess student learning in the new three new concentrations that focuses on desired program outcomes rather than individual course objectives.
- Develop a comprehensive plan to recruit majors and consider factors such as using your enthusiastic students as ambassadors and scheduling vibrant tenured/tenure-track faculty to teach introductory courses

- Consider bringing young, working geologists to undeclared major functions as similar ambassadors.
- Increase outreach to alumni and geoscience industry to establish greater financial support for student scholarships and departmental needs. Consider establishing an advisory board to help with this venture. Opportunities may exist with organizations of working professionals, such as the Society for Mining, Metallurgy and Exploration (SME). Such organizations need not necessarily be in-state, if their members believe that CPP's graduates may ultimately become summer or career employees.

Responses to the seven *Suggestions for Action* described in the self-study

1. Expand curriculum and faculty expertise in the discipline of Hydrogeology/Water Resources

Accomplishment of this items seems well in hand with the hire of a new faculty member with expertise in hydrogeology. The faculty member has been given sufficient startup funds and space to create a new hydrogeology wet lab, an important new addition to the department. Well trained graduates in this field are critically needed regionally, nationally, and globally. Hence, this new faculty is a key strategic hire, who also will play a critical role in augmenting the depth and breadth of interdisciplinary water-related program at CPP and in developing the strengths of the graduate program.

2. Develop newly-approved Master's degree program.

We believe that the department has excellent potential to establish a strong graduate program, but we have reservations about whether Fall 2012 is the right time to launch it. The greatest problem is the small number of non-FERP tenure/tenure-track faculty. Unless another search is authorized for a Fall 2012 hire, there will be only four, one of whom is dedicate half-time to the position of Department Chair. In addition, two FERP faculty (Jessey and Klasik) commented that they might end FERP at the end of Spring 2012 and hence would not be teaching any of the undergraduate curriculum the following fall. It must be noted that the proposal approved by the Chancellor's Office in Spring 2010 envisioned that there would be seven graduate faculty at the time of implementation of the program. Development of new graduate courses and supervision of multiple MS theses will severely tax four faculty members and likely detract from the undergraduate program and stretch departmental resources very thin.

That said, the faculty are passionate about the Master's program and are eager to get it started. It clearly is a significant factor in promoting job satisfaction of the faculty. In both teaching and research, the excellent qualities of the faculty are well suited to developing and maintaining a Master's program. The department is experienced in strategic planning and would implement the program in a careful, thoughtful manner. The Chair has surveyed the local "client base" regarding interest in an M.S. in Geology and has identified a pool of more than 20 potential applicants. We recommend that the Chair, Dean, and AVP for Academic Programs meet as soon as possible to review plans for implementation and have a full and frank discussion of how they will impact the undergraduate program and department resources and what the hiring outlook of additional faculty within the next few years might be to support the development of the Master's program.

3. Maintain faculty expertise as retirements occur and seek new hires in strategic areas.

Our top recommendation is to increase the number of faculty. Between Fall 2007 and Fall 2011, three faculty have entered FERP (Klasik, Jessey, and Berry) and two hires have been made (Polet in 2007;

hydrogeologist in 2011). Klasik and Jessey have informally announced ending FERP at the end of Spring 2011. Without new hires, an unacceptably high proportion of courses will have to be taught by part-time faculty. This will be detrimental to the efforts that the department has made to create a vibrant new curriculum, recruit more majors, and establish a graduate program.

The department is truly at a crossroad, determining the direction it take for the next few decades by what faculty expertise is hired in the near future. This generates a certain challenge in balancing the traditional strengths of geology programs with developing new trends in the field. The faculty clearly have given serious thought about the developing directions of geosciences and have taken into account market forces and public policy. Interestingly, the department seeks to follow two separate paths in its "makeover": 1) a partial departure from the traditional "rocks and fossils " geology to the more interdisciplinary "earth system science," with emphasis on climate and surface processes, and 2) maintenance of a strength in economic geology, abandoned by too many departments nationwide. Both of these paths represent smart, bold moves and are good ones for Cal Poly Pomona.

The new-hire strategy outlined in the self-study supports all three new tracks by seeking to maintain faculty expertise and to hire in new areas. A new hire in sedimentary geology to replace Klasik could do both. For example, this person could have a research emphasis on climate proxies in the sedimentary record and provide instruction in both classic sedimentary geology and emerging climate science from the geologic perspective. Many sedimentologists also have overlapping interests with hydrogeologists, civil engineers, and urban planners and could provide beneficial collaborations in areas of environmental remediation, water resource exploration, low-temperature geochemistry, and suitability of surface materials for building and land use.

The department has a strong desire to maintain expertise in economic geology, which has been a strength of the department through the research and teaching of Jessey. GSC 433/L Ore Deposits remains a required course in Track 1 of the new major program. Many geology departments nationwide have let this emphasis fade following the downturn in US mineral exploration in the early 1980s. This is the very reason why it is to the benefit of Cal Poly to hire a petrologist with expertise in economic geology and mineral exploration. They can continue to provide training in a field that requires well-trained professionals to supply society with resources needed not only for daily life, but economic growth. Emerging green technologies, as well as advances in material science fields, require metals, rare-earth elements, and other geologic materials. Although much of minerals exploration is currently done in foreign countries, US geologists are part of the exploration teams; and as prices for strategic minerals rise, exploration in the US is likely to return. A faculty in this field will not only provide fundamental instruction in mineralogy, optical mineralogy, igneous and metamorphic petrology, and high-temperature geochemistry, but specialty courses in ore deposits and mining geology not available at other CSU campuses. CPP would attract students seeking this training and be ahead of the curve when demand for more graduates with this training picks up. A faculty hire in this discipline to replace Jessey when he retires is strongly recommended. This person has high potential for collaboration with different fields of engineering and will provide teaching and research clearly tied to the mission of a polytechnic institution.

There is another important aspect of making a hire in petrology with expertise in economic geology. Several years ago, the Society for Mining, Metallurgy and Exploration (SME) proposed a form of certification to selected Economic Geology major programs through the Accreditation Board for Engineering and Technology (ABET). The proposal was made at meetings of academic geological societies. The reaction ranged from lukewarm to indifferent. Based on the visit to CPP and interest of faculty and administration in maintaining this interest, Shumaker contacted the Executive Directors of ABET and the SME to determine if interest could be rekindled. Because of the interest expressed by CPP at all levels, the Executive Director of ABET has expressed considerable interest in establishing an accreditation of CPP's Geology Programs under the auspices their Applied Sciences program. In conversation with Shumaker, the ABET Executive Director, Michael Milligan expressed his belief that it would be best to begin accrediting Geology programs on a test basis. Considering their long-standing and excellent campus-wide Engineering and Applied Science reputation, Milligan believed that CPP would be a good test case. He is eager to begin whenever CPP is ready and would want to involve a professional organization such as SME. Fortunately, according to Dr. Nourse, the Department is already active with the local SME section.

4. Enhance research and analytical capabilities with modern laboratory/field equipment.

During our visit, we asked each faculty member about this, no major concerns were expressed about specific equipment needs that were not met. At least one faculty member expressed a need more Mac computers and a another computing space for them, as the current student computer room has no additional space for expansion. Current faculty generally seemed content with adequacy of teaching/research equipment and its quality, but expressed hopes that funding for additional equipment for new hires would be available to facilitate their success in teaching and research. In addition, several faculty did express need for more technical help in maintaining equipment. The College and/or University might consider increased "sharing" of technical staff between departments and/or colleges; and, as the economy recovers, adding more technical staff. Several also expressed concern about finding the funding to maintain service contracts on high-end equipment.

5. Enhance grant success.

The impact of external funding acquired through proposal submissions is clearly shown in the self-study. These funds result in a high level of faculty and student activity and productivity in research and have been used to acquire equipment used in teaching and research during times when state funding has not been sufficient for these needs. The self-study indicates that the department might provide incentives for grant writing and seek out new sources of funding, but no details of these strategies are elaborated upon in the text. We urge the department and the University administration strengthen the infrastructure to strongly support efforts to obtain external funding and to assist faculty in managing grants. This investment will more than pay for itself in indirect costs returned to the University and department.

6. Maintain and expand interdisciplinary relationships with other colleges and departments on campus.

The department is doing an excellent job at maintaining and expanding its collaboration with other units of CPP, as noted elsewhere in this review. We applaud the department's ideas for continued efforts

outlined in the self-study, such as enhancing service components to other disciplines and developing teaching and research collaborations with faculty from other disciplines. These strategies are important in networking the strengths of the Geology Department with the campus community and increasing its value and contributions to the University.

Assuming that the Department pursues ABET certification, the interdisciplinary relationships with other colleges and departments can become even more fruitful. For example, a major in Civil Engineering will be able to complete an Engineering Geology course in a Geology department that itself possesses ABET certification, just as her or his Engineering Department does.

7. Interact with Geology alumni and industry stakeholders.

The department already has a good relationship with alumni and industry stakeholders, as evidenced by the letters of support of the geology program at CPP received in December 2009-January 2010. Increasing these connections through activities such as invitations to local field trips and Geology Student Research symposiums will greatly benefit the department. Participants cannot fail to be impressed by the faculty and students of the department at CPP. These outreach efforts should result in increased internships and job opportunities for students and increased donations to the department. The department's suggestion of organizing an Advisory Board of alumni and industry stakeholders is an excellent one to keep the department in tune with hiring needs and trends and the curriculum necessary to train students for them. The Board would raise the profile of the department with industry and potentially increase job opportunities for students and generate corporate sponsorship of scholarships and equipment.

Responses to specific topics in External Reviewer's Responsibilities, Review, and Report

Curriculum of the program

As a result of its self-review in 2009, the department changed its undergraduate degree programs to include only one program with three tracks. Overall, we are satisfied that the curricula of the three tracks will prepare students for graduate school and/or professional careers. However, we do have some specific recommendations for revisions to Tracks 1 and 2 to more fully prepare students for their post-graduate endeavors.

Track 1 provides a standard program in geology, well suited for preparation for graduate school and entry-level positions in government and industry. However, we have one recommendation. We note that the course GSC 145L Megascopic Petrology has been dropped as a core class. We strongly recommend that the inclusion of hand-specimen petrology be included in Track 1, where as an additional unit to GSC 425L or as a separate course. One of the students interviewed lamented the lack of a hand specimen petrology course. He explained that even as he neared graduation, he was unable to identify all of the rocks and minerals in the Department's display cases without the name tags next to them. Shumaker observed that that graduate could be at a competitive disadvantage at a job interview. Hand specimen petrology forms the basis of most field geology, from surface mapping to identifying drill cuttings. In many projects, the provisional field identification of a rock or mineral may be the only identification that time permits. If that identification is wrong, expensive or lethal results could result. Not all projects will support the production of thin sections. Shumaker notes that this knowledge is

essential in the day-to-day demands of an industry career. This addition would be critical if CPP serves as a test case for ABET certification of Economic Geology programs.

Track 2 focuses on hazard evaluation, particularly through the lens of geophysics. This track is designed for students interested in careers in engineering geology (hazard analysis and mitigation). The students in this track will want to pursue technical careers and possibly graduate school. However, this track lacks core training in all of the major rock groups because it does not require sedimentary geology or igneous and metamorphic petrology. We think that complete understanding and mastery of geophysical analysis requires a deeper understanding of rock properties than will be acquired in the required core classes common to all tracks. We strongly recommend that at least GSC 424 and 425L Igneous and Metamorphic Petrology and Lab (including hand-specimen recognition) be required in Track 2. This could be done by eliminating the requirement of the 100-level oceanography or astronomy course. We do not see either of these courses as essential to the goal of the program. In our view, students will not be competitive for graduate programs in geology/geophysics or for entry-level positions in geotechnical industry if they lack petrology.

Track 3 focuses on environmental resources and sustainability issues. It is the most interdisciplinary, with an array of courses from more than six other departments. Graduates would be well suited for careers in K-12 teaching, public outreach and resource evaluation, graduate programs in environmental law and policy. The new Track 3 requires more mathematics (three quarters of Calculus rather than algebra and trigonometry) than the former Integrated Earth Studies degree. The Earth-systems emphasis of this track is a bold and smart move for the department for the following reasons:

- a. it provides programs not currently available at other LA basin CSU campuses. It is likely that program revisions at other campuses will soon develop similar programs, so it is wise for CPP to be ahead of the curve on the curriculum and faculty expertise to teach the programs.
- b. the inter-disciplinary nature of Earth-system science has a solid future and is relevant to societal needs in the 21st century. Graduates should be able to establish excellent careers.
- c. it intertwines Geological Sciences with other departments and programs at Cal Poly Pomona, such as Civil Engineering and Regenerative Studies, providing essential faculty expertise and courses for students from many disciplines and undergraduate programs attractive to students at a polytechnic institution. The new direction expands the value of the department to the University and the region.
- d. Availability of external funding in this area should be significant throughout this century.

Instruction in the program

It was very clear from meeting with every faculty member how deeply they care about the education of the students and the quality of the program. Students expressed satisfaction with the quality of their courses. Furthermore, the cumulative instructional assessment collected by the University each quarter shows that all teaching staff of GSC (full-time and part-time instructors) are rated as good to very good teachers.

Student advising

Students attend an annual meeting called by the Chair to review program requirements, changes, and course offerings for coming year. Well in advance of registration, SOC is posted for coming quarter. Students can gain advisement by making appointments with any of the faculty to review their degree

audit report. Students stated that they were aware of the courses needed for the major and expressed no problems concerning academic advisement.

Faculty participation in research

Data provided in the annual reports in the appendices of self-study show significant faculty activity in research. Moreover, research productivity has significantly increased over the past few years. Interim Dean Srinivas commented on the exceptional level of productivity and well known research of the geology faculty. Three important aspects of active research benefit the department:

- External funding: Four faculty have been successful in garnering \$405,258 in external funding over the past five years. This resource is extremely important because of the concomitant decrease in state funding. The faculty are to be congratulated on the increased pursuit and achievement of external awards. These funds have been instrumental in supporting the quality of the program, superior training of students, maintenance and purchase of equipment, and enhancing the reputation of the department.
- Publications: The faculty have published more than 20 peer-reviewed articles and 43 abstracts since 2007. This productivity is very high, given that many of the faculty teach full or nearly full loads each quarter. This is key to maintaining the excellent reputation of the department.
- Student participation in research: The involvement of students in research is truly exceptional. Between Fall 2007 and Spring 2011, CPP students have coauthored 29 publications or conference presentations. This reflects the faculty involvement in research, faculty success in acquiring external funding, and faculty dedication to involving students in research. This increases the students attractiveness to employers and graduate schools.

The achievement in faculty involvement in research is exceptional based on the small number of faculty. This highlights another reason why expanding the number of faculty will have a wide variety of strengthening the department. New faculty are particularly noted for the number of proposals submitted for external funding, high number of publications, and involvement of students in research.

Faculty service to the University

The service of the faculty to the University is at the level expected for faculty at the different rank of each member.

Cooperation with other academic programs on campus

The Geology department at Cal Poly Pomona are commended for their high level of cooperation with other departments. The department teaches one course required of all undergraduate majors and one course required of all graduate students in Civil Engineering. The excellent array of geophysics courses offered by GSC are also available to CE students as electives. GSC offers two sections of a service-learning course required of Liberal Studies students. These classes (60-80 students per year) include the development of teaching modules for 6th graders, which are implemented at local elementary schools, providing these perspective teachers hands-on training. Finally, CPP has established an innovative Center for Regenerative Studies, which seeks advance the principles of environmentally sustainable living through campus collaboration in teaching and research and community outreach. Two GSC faculty (Nourse and Marshall) developed a course called Watershed Restoration in Spring 2010, which proved so popular that it was taught again in Spring 2011.

Assessing student learning for the purpose of program improvement

The department has a good set of Goals and Learning Outcomes, which were approved in 2008 by the CPP Academic Senate. pre-date the new degree program, Although the goals and learning outcomes were developed before the 2010 curriculum and curriculum revision, they are still relevant and appropriate for all three tracks of the new program, which initiates in Fall 2011. We recommend that the department makes it a priority over the next two years to develop an assessment matrix for the common core and for each tracks. Furthermore, it is critical that the department develop longitudinal assessment measures of student performance that examine achievement at key points in student training. Skills and knowledge defined as learning outcomes should be assessed in some of the earliest core classes, in the upper-division common core, and in the culminating experience and/or senior level courses of their tracks. The growth in achievement will provide a measure of how well the program is meeting its goals.

The self-study gives several examples of improvements in understanding specific concepts in individual courses, but there is a need for much more holistic plan for assessing student performance for each outcome that results in showing value added for the entire program. For example, outcome E states that the students will be able to describe the interrelated processes operating in earth systems over different geologic timescales. An exercise/case study could be developed that would measure the student's ability to do this that could be embedded as part of a lab in three different stages of the program sequence. Perhaps evaluated by a simple rubric, the collective student performance should improve on this exercise as students progress through the program. To make the workload manageable for the faculty, a five-year plan could be developed so that each year only one or two learning outcomes would be assessed in this fashion. Over time, all outcomes are assessed, and the data analyzed and acted upon in a regular cycle. In this way, the faculty can see more clearly how and where the core classes are preparing students for their senior classes and culminating experience; and where improvements could be made. It is essential that all faculty participate; and that as new faculty are hired, they accept assessment as a normal part of their teaching.

Use of resources and facilities and needs for additional resources

Several faculty expressed the need for more space to store teaching and research equipment. They also expressed a very strong need for larger lecture rooms. This would allow the department to increase further its efficiency in FTES/WTU.

Several faculty expressed the hope that when the graduate program begins, there will be funds for teaching assistants in 100-level labs and field courses. As the number of students in field courses increases, the instructors are concerned about safety issues. Students in field courses must disperse over an significant geographic area. Students must always remain at minimum with a field partner, but instructors must still range over the area to provide supervision. It is not practical for one faculty member to do this for more than 10-16 students, depending on the activity. Larger classes should have an experienced teaching assistant to assist in supervision of the activity and safety of the students. Also, in courses that utilize a lot of field equipment, a teaching assistant well versed in its operation is invaluable because his/her assistance with setting up the equipment frees the faculty member to provide the necessary instruction to the class about the purpose and methods of the field activity.

Issues of diversity and campus climate

Diversity of students and faculty is at the level typical of a CSU campus in the greater LA area. We were pleased to see that the student groups with whom we met were diverse in ethnicity and in gender, both of which are important for geology programs. The department has one female faculty member. We recognize the difficulty in increasing faculty diversity because the number of females and under-represented ethnicities in the Ph.D. pipeline is currently low.

Through Shumaker's unorthodox interviewing technique, he identified two students, nearing graduation, who he would have hired on the spot if it had been within his authority to do so. Shumaker, a graduate of the urban California school system from the 4th grade through college, noted the increased diversity of the CPP campus as a whole, as well as within the student population of the department. He was impressed with the drive, the knowledge, and the willingness of all of the students to talk to us. All of the students that we interviewed genuinely seemed to like one another and cooperated in the interviews very well.

Final Summary

The faculty are strong in terms of scholarly productivity, grantsmanship and teaching. They are knowledgeable, friendly, and student-oriented. The students are spirited, collegial, and generally pleased with the training that they are receiving. The new curriculum, with the few exceptions noted above, is well designed to provide skills and knowledge needed for graduate school and professional careers in the coming decades.

As previously noted, our top concern is the small size of the faculty. Additional tenure-track faculty are needed to provide the depth and breadth of specific expertise required of top-quality undergraduate and graduate programs. Such faculty engage in current research that will bring external funding, expansion of state-of-the-art instrumentation, and student involvement in research. They also engage in teaching/research collaborations at the department, university, national, and international levels, which enhance programs with external funding and professional opportunities that increase faculty and student satisfaction. Professional preparation of students through coursework and participation in faculty research cannot reach its full potential without more faculty representing the critical complement of geoscience sub-disciplines.

In addition to increasing the number of tenured/tenure-track faculty, visiting lecturers could be engaged on a part-time basis when their education and career experience can provide a benefit to the students. At present, an economic geologist in the mining industry can command a salary of \$150,000 or more. However a recently retired economic geologist who may be winding down a career might enjoy a part-time teaching position. Their real-world experience will add considerable depth to the class experience. As an alumni of CPP, Shumaker found this to be true.

We hope that you have found our review of the geology program at Cal Poly Pomona to be comprehensive and candid. We thank you for the opportunity to review the program.

Respectfully submitted,



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