



University of Colorado **Boulder**

2019 Program Review

Department of Geological Sciences

Academic Review and Planning
Advisory Committee Report

Approved

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Provost and Executive Vice Chancellor for Academic Affairs | Date

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Process Overview

The Academic Review and Planning Advisory Committee (ARPAC) review of the Department of Geological Sciences (Geology) was conducted in accordance with the 2019 program review guidelines. Self-study responses were prepared by the unit and checked by an internal review committee composed of two University of Colorado Boulder (CU Boulder) faculty members outside of the unit. The internal reviewers submitted a summary of findings derived from the self-study and from interviews and/or surveys with faculty, staff, and student unit members. An external review committee, consisting of two experts from outside of CU Boulder, visited the unit and submitted a report based upon review of relevant documents and interviews with faculty, staff, and student unit members and university administrators. Internal and external reviewer comments and recommendations are shared when relevant throughout this report.

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Academic year 2019-20
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Unit Overview

The Office of Data Analytics (ODA) maintains a standardized description of the Department of Geological Sciences [on its website](#). ODA updates the profile annually in the fall semester. This report cites data posted in October 2019, reflecting the state of the department as of the academic year (AY) 2018-2019.

Disciplinary context

The Department of Geological Sciences is an international leader in advancing earth science. CU Boulder's world-class faculty members in the Department of Geological Sciences are at the forefront of research and pedagogy, with strengths in a wide range of subdisciplines of geology, including geodynamics, past global change, economic resources and stratigraphic sciences, hydrogeosciences, space sciences, quantitative morphology, and geochemistry.

The department's vision and mission are clearly articulated and congruent with the chancellor's and provost's priorities. The self-study states, "the Department of Geological Sciences is part of a leading global comprehensive research university committed to a more sustainable and understanding world that shapes tomorrow's leaders, drives innovation, and has positive impact on humanity."

The department embraces a broad set of research emphases, including:

- Studying the processes that regulate the solid earth, as well as related processes on other planets.
- Exploring the unique perspective provided by the geologic record to understand the origin and evolution of life, the solid earth, the oceans, and the enveloping atmosphere.

- Investigating Earth processes that operate on human time scales and pose risks to humans, and research human-driven influences on Earth’s systems that stress sustainability.
- Making field observations around the world and from space, developing and applying theoretical and mathematical techniques, and developing and operating analytical laboratory facilities.
- Discovering how novices think about Earth processes and phenomena and how to enhance the development of more expert-like ways of thinking about the Earth and communicating about it.

Research
and
scholarship

The external reviewers note that the department’s faculty members are “exceptionally strong” and “have competitive grants involving colleagues from other institutions both nationally and internationally.” The department employs highly research-active scholars who collectively hold a deep inventory of awards and prestigious leadership positions in the field. Well over a dozen faculty members are editors and associate editors for 25 major peer-reviewed journals, several are elected presidents of the societies in their fields, one is a principal investigator of the National Aeronautics and Space Administration (NASA) Mars Atmosphere and Volatile Evolution (MAVEN) mission, and another leads a nine-institution NASA project on rock powered life. Many play important roles on U.S. government or international panels and in organizations on climate change. Nearly a dozen are members of prestigious societies including the American Geophysical Union and the Geological Society of America. In 2014, one of the department’s faculty members received the Crafoord Prize (equivalent to a Nobel Prize, but in complementary fields). Junior and mid-career professors have received the NASA Early

Career Award, two National Science Foundation (NSF) CAREER awards, and a US Department of Energy (DOE) Early Career Award and a Packard Foundation Fellowship.

Collaborations

The department collaborates with entities across campus including the Cooperative Institute for Research in Environmental Sciences (CIRES), the Institute of Arctic and Alpine Research (INSTAAR), the Laboratory for Atmospheric and Space Physics (LASP), the CU Natural History Museum, and national and international agencies and organizations including UNAVCO, the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology (NIST), the US National Center for Atmospheric Research (NCAR), and the United States Geological Survey (USGS). The Energy and Minerals Applied Research Center (EMARC), housed in Geology, is one of the main centers in the United States that provides training for students in petroleum geosciences.

National and international context

The Department of Geological Sciences is a central part of CU Boulder's earth sciences, which as an interdisciplinary group of units were globally ranked first in 2018 by three prominent ranking organizations (U.S. News and World Report, the Center for World University Rankings, and the Academic Ranking of World Universities [the "Shanghai Rankings"]). The unit was ranked 13th in the National Research Council's (NRC) 2010 "Data-Based Assessment of Research-Doctorate Programs in the United States," which evaluates faculty research achievement (including publication totals, publication citations, grant activity, and awards), student support and outcomes, and the diversity of the academic environment. According to the NRC's "S-ranking," CU Boulder's Department of Geological Sciences is on par with peers including the University of Arizona, the University of California Los Angeles, Pennsylvania State University, the University of Michigan, and Yale

University. The self-study states, “Thomson Scientific ranked CU Boulder’s geology department first among all universities in the world. The only institutions to rank higher were the U.S. Geological Survey and NASA. This ranking lists the institutions with the highest total citations to their papers published in ISI-indexed Geosciences journals during the ten-year interval considered. Further, National Taiwan University has CU ranked at number one for scientific papers in geosciences worldwide.”

Campus
context

The self-study calls the Department of Geological Sciences “the hub of CU’s multi-faceted geosciences program.” The unit offers, on average, about 55 courses per academic year to undergraduates and those offerings cover a variety of earth science topics. Majors and non-majors alike take the department’s courses and the unit offers first-year seminars on topics ranging from Mars to energy to mountains around the world. The commitment to interdisciplinary research and teaching is evident in the many collaborations the unit maintains across campus as listed above, including curricular collaborations with the BioFrontiers Institute’s Interdisciplinary Quantitative Biology Program and the geophysics and hydrological sciences programs.

Faculty
and
research
personnel

According to the Office of Data Analytics (ODA) data for AY 2018-2019, the department employs 32 tenured and tenure-track faculty (one distinguished, 16 full, eight associate, and seven assistant), two instructor-track faculty (one senior instructor and one instructor), two lecturers, 19 teaching assistants/graduate student part-time instructors (TAs/GPTIs), 14 research faculty and six research associates. The department hired ten new faculty between 2014-2018, which greatly expanded its research coverage. Three faculty members hold administrative appointments outside the department (a vice provost, an interim dean, and a divisional dean).

The unit anticipates the total number of affiliated tenure-stream faculty to reach nearly 40 by 2020, depending on the pattern of hires in allied units and numbers of faculty who choose to affiliate with Geology. A significant number of faculty (the ODA reports 13) are affiliated with research institutes, a fact which, while serving to enhance the unit's standing, has also had other impacts as outlined below.

Faculty salaries overall are generally comparable to those in the Association of American Universities (AAU) peer departments; however, associate professor salaries tend to outpace peers (104%), while assistant (94%) and full professor (95%) salaries tend to lag.

In order to bring the unit on par with its peers, the self-study argues a 1:1 teaching load would need to be implemented. Concerns about the teaching load were recognized by the external reviewers as legitimate. However, as discussed below (Section 3, "Past Reviews"), the unit has seen a continued decline in the number of student credit hours (SCH) taught by tenure-stream faculty members, a concern previously noted by ARPAC in its 2012 review of the department. This is the case even though tenure-stream faculty numbers have increased and total SCH taught by the department have declined in the five-year period preceding the current review.

The internal reviewers commented that assistant professors feel that the annual merit review and promotion processes are unclear and not transparent. The external reviewers reported that associate professors expressed a lack of support or clarity about the process for promotion to full professor, and also that many demanding service positions in the department (e.g., associate chair) are filled by associate rather than full professors.

Staff According to the ODA AY 2018-2019 unit profile, the department employs five exempt professional university staff members, two classified staff members, and 20 student hourly employees. The external reviewers noted that the department is significantly understaffed and recommended the addition of at least one full-time staff member to alleviate current staff concerns about feeling under-supported. The self-study expresses the need for several specific new staff positions: a dedicated technician to staff the rock preparation lab (the “rock shop”), maintain field equipment, and serve as a laboratory building proctor; and an increase in the 0.5 FTE research management position to 1.0 FTE.

Undergraduate
education

The department offers a Bachelor of Arts (BA) in geological science with tracks in geology, in which students study broad aspects of geosciences and geophysics, and focus on the scientific study of the interior of the earth. A geological sciences minor is also offered.

The self-study states that the department serves 216 undergraduate majors and 46 minors. The ODA fall 2018 count of Geology majors is 213 (a five-year 11% decrease), down from the unit’s peak in 2015 of 292 majors and roughly equivalent to fall 2011 levels. The department awarded 71 bachelor’s degrees in AY 2018-2019, which represents a 54% five-year increase and reflects the graduation of the larger numbers of majors at the unit’s peak of enrollments. The number of minors in fall 2018 is 58 (a five-year 66% increase).

Undergraduate student credit hour (SCH) totals for AY 2018-2019 were 8,567, 71% of which were taken by non-majors. This represents a five-year decline in undergraduate SCH of 12%. Fifty-two percent of the total undergraduate SCH were taught by tenure-stream faculty members, 13% by instructor-rank faculty, 18% by graduate part-time instructors (GPTIs) and

teaching assistants (TAs), and 18% by “other,” a category that includes lecturers. While the SCH taught by tenure-stream faculty in AY 2018-2019 represented a 20% decline over the previous five years, the percentage of total SCH taught that year by tenure-stream faculty (52%) increased significantly over the previous year (43%). According to the self-study, the drop in SCH taught by tenure-stream faculty has been addressed through a two-pronged approach that will encourage instructors to teach smaller, focused courses at the upper level, while expanding the topics of lower level courses to better align with tenure-stream faculty research interests.

In addition to courses for majors, the unit recently revamped and expanded its 1000-level course offerings for non-majors in response to the recent changes that the College of Arts and Sciences made to their general education requirement. These 1000-level courses account for approximately 70% of the SCH taught in the unit and are anticipated to grow as students learn about these new offerings.

The Geology honors program averages between four and ten students annually, with 13% of students completing the program between 2014-2018. In addition to an honors program, the department offers field-based courses at all undergraduate levels, plus meaningful opportunities for educational experiences outside of the classroom such as mentored research (via a mentors program). In 2016, the department instituted an undergraduate research program with the support of two Chancellor’s Awards for Excellence in STEM Education. The program has seen positive outcomes thus far. Additional programs for peer learning assistants and graders have also been established. Finally, Geology also developed several successful new first-year seminars in response to a 2017 campus initiative.

In a survey of the undergraduate majors administered in January 2019 as part of the internal review (which received 70 responses), almost all students (65 respondents, 93%) reported themselves “satisfied” or “very satisfied” with the major. The external reviewers note that the undergraduate cohort in the geology/geophysics program (approximately 200) seem generally happy with their experience. Additionally, an ODA survey of graduating seniors in spring 2016, which received responses from 33 Geology students, reflected high satisfaction with the major as a whole (91%) and effectiveness of courses in providing a good general education (88%). These metrics measured well against the overall CU numbers (fifth out of 46 and sixth out of 46, respectively), as well as against units being evaluated in the current review cycle (first out of eight departments in both instances).

The survey noted some dissatisfaction with undergraduate career advising and the department chair has indicated that the issue has been taken up with the dean and the advising director in the College of Arts and Sciences; however, improvements are still outstanding. The self-study also reflects departmental dissatisfaction with the 2015 centralization of college advising that eliminated advising responsibilities for several Geology instructors and shifted advising to an advisor without expertise in the field. The external reviewers also report this issue and note that the department was developing a new mentor system for undergraduates that might provide some solutions, in which several Geology instructors were given roles in advising. Advising support is one of the key requests of the unit in the self-study.

The external reviewers note that strong enrollment numbers and excellent opportunities for undergraduate research distinguish the program. The question of the value of a Bachelor of Arts versus a Bachelor of Science designation for the undergraduate

degree was a concern to them. The external reviewers believe the current requirements for the BA are equivalent to those associated with a BS, which is a more attractive degree to many undergraduate constituencies. The question remains whether the program should pursue a degree change and/or parallel offering. The external reviewers strongly recommend a change that would add the BS and possibly revise the BA degree requirements.

Graduate education

The department offers an MS in geological sciences and a PhD in geological sciences with an option in hydrologic sciences. The department also offers a PhD in geophysics with an option in hydrologic sciences.

The Office of Data Analytics Fall 2018 census reports 68 graduate students, of whom 16 are master's students and 52 are doctoral students. In FY 2018-2019, the department conferred 10 master's degrees (a five-year 67% increase) and 11 doctoral degrees (a five-year 38% increase). Students in the graduate program tend to follow one of three career trajectories: entry into academia, or entry into scientific education and outreach, or as government lab or industry researchers.

The self-study explains that new faculty hires have expanded the curriculum's research topics, as well as the equipment and instrumentation available to graduate students as a training and mentorship opportunity. The students also gain from access to interdisciplinary and thematic labs such as the Sustainability, Energy and Environment Lab.

The self-study also mentions graduate student teacher training opportunities, including via the Graduate Teaching Program (GTP) and its Certificate in College Teaching (CCT), both of which have garnered increasing interest and participation. The

number of GPTIs is perceived to be low in proportion to the number of graduate students seeking to gain experience as an instructor of record, and the unit is requesting more GPTI lines so that they can be offered to more students, and earlier in their matriculation. It is widely recognized that competitive career placement is directly linked to prior experience teaching as instructor of record.

The self-study recognizes that while flexible degree requirements respect the uniqueness and diversity of student research interests, a growing number of faculty members are advocating for more structured requirements to address fundamental skills and knowledge that they believe are important for graduate students to acquire. The self-study reports the department's graduate program committee has begun discussions toward such curricular revisions starting in AY 2018-2019.

The external reviewers commented on the graduate student climate and concluded that graduate students are generally pleased with their program experience. The internal review survey of January 2019 engaged the participation of 43 of 68 graduate students, and 41 (95%) responded they were "satisfied" or "very satisfied" with the program.

The primary challenge mentioned by the self-study in relation to the graduate program is a shortage of TA/GPTI positions and other support that would make offers to prospective students more competitive with peer programs. This situation is compounded by the department's convention of admitting only the number of students for which they know they have TAships (rather than leveraging the assumption that acceptance rates will not be 100%). The unit's commitment of only one or two years of funding up front, when in fact most students receive five years of funding over the period of their matriculation, is a

conservative practice that is also perceived to be adversely impacting competitive positioning against peers in admissions processes.

Postdoctoral
training

The department has two postdoctoral fellows, though their specific affiliation (department or institute) is not indicated and details regarding mentoring or training are not clear.

Budget

Geological Sciences receives \$3.24 million annually, with the lion's share from the College of Arts and Sciences and a small portion from the Graduate School to fund faculty, staff, and graduate student teacher salaries, to award graduate fellowships, and to run its graduate and undergraduate programs and its administrative office.

In 2018, departmental administration indirect cost recovery (DAICR) generated by the unit's faculty for the university stood at a record \$3.52 million. After the institute-department split, the overhead credited from the college to the department is \$956,000. The college does not appear to reserve any overhead for itself.

The endowment is approaching \$8 million, not including an additional recent gift of \$5 million to support the Rady Chair. Recent collaborations between the department and the CU Foundation's advancement office have resulted in robust fundraising in recent years, including to finalize three bequests and to establish four new endowments. One of the endowments is a single donor gift that emphasizes the promotion of student diversity; the first of this kind for the department.

In its discussion of the undergraduate program, the self-study describes a shortfall in funds for field course vehicle rentals, and describes the College of Arts and Sciences funding

mechanism that replaced program and course fees as inadequate to address this problem.

Space
and
infrastructure

The Benson Earth Sciences Building serves as the department's primary facility. Recent lab renovations there have helped to shore up the department's needs; however, office and research spaces as well as teaching spaces are reported to be in short supply.

The self-study lists the most urgent space needs as: first, increased office and research space for co-affiliated Geology faculty, researchers, and students; second, increased office and research space for postdoctoral scientists and professional researchers; third, more laboratory and deployment space for field missions; and fourth, increased and enhanced teaching spaces (for example, smart classrooms and geophysics and geochemistry labs).

The external reviewers note that the department's research associates and graduate students appear to be assigned sub-par spaces and furniture; a shortfall they recommend redressing.

Support
needs

As described above, the self-study notes the need for additional personnel to support the "rock lab", to maintain the department's field equipment, and to serve as a building proctor for laboratory space, as well as the need to revise the funding mechanism that replaced course and program fees, so that vehicle expenses for field courses might be covered adequately.

Governance

The unit bylaws appear to be robust, regularly reviewed, and revised as needed. As an example, the department recently updated its merit review and tenure and promotion processes after newer faculty members expressed concern that these

processes demanded more transparency. The department has a robust and longstanding mentoring program for untenured faculty members. In contrast, the external reviewers report that associate professors seem unsure about the standards and processes for promotion to full professor.

The unit has yet to address feelings of disenfranchisement expressed by researchers and technical staff regarding decision-making and inclusion in department governance. The external reviewers commented on this fact, recommending that a researcher-scientist track be introduced and defined as a means of better integrating this constituency in the unit's growth.

The unit follows a shared governance model, relying heavily on its executive committee and sub-committees, with graduate students increasingly included in faculty meetings and sub-committees. The external reviewers' assessment suggests that, other than promotion and tenure processes, which as just mentioned have been revised, or the noted concern of researchers and technical staff, department members had no specific complaints about representation in decision-making processes. The external reviewers praised the department on its inclusion of pre-tenure faculty in promotion and tenure deliberations, which demonstrates an unusual degree of transparency.

Inclusive
excellence

The external reviewers note that 36% of unit faculty members identify as women, which differs from the 33% reported by ODA. They suggest that, while this number is generally low given the number of doctorates awarded in the field, it is on par with peer programs. Looked at by rank, a significant number of the women faculty are associate or full professors. Faculty member diversity has improved in terms of gender since the

last review in 2012, though not as significantly as in the student populations.

The external reviewers also note that a relatively low number of faculty members identify as a member of a minority or underrepresented group, saying that this is reflective of the field as a whole. ODA data indicate that as of fall 2018, 9% of the faculty members identified as a member of a minority group, but none as members of underrepresented minority groups.

The external reviewers commended the unit on its efforts to increase graduate student diversity, where significant increases have been measured over the past five years. The undergraduate population has also seen a significant rise in diversity over the past five years, which is commendable.

The unit is especially buoyed by the new endowed fellowship for minority and underrepresented graduate students, and the external reviewers encouraged the unit to make requests for even more support from the university in this area.

Climate
and
culture

The department's staff members register significant climate concerns, and these appear to be tied to a workload that feels insurmountable without increased support. As reported in the self-study, staff stress has resulted in high turnover and retirements. The resulting lack of institutional knowledge is detrimental not only to new staff who are unfamiliar with processes and protocols but also to faculty members whose research is hindered by a lack of continuity in managing accounts and reports, general office support and the regular maintenance of facilities and safety standards. The staffing shortfall stands out prominently in the unit's self-study as an impediment to a good climate.

A March 2018 ARPAC-administered climate survey addressed to Geology faculty, staff, and graduate student appointees revealed a mostly positive working environment; however, there were troubling indications in the graduate student surveys. The survey, and external reviewers' interviews, reveal that many students have experienced faculty members who "say things or behave in ways that humiliate or intimidate graduate students." The external reviewers report that women and LGBTQ students are disproportionately affected by this behavior. The external reviewers understand that a small number of faculty behave in this manner, but they also note that attempts to modify this behavior have been ineffectual.

Past Reviews

Many of the recommendations in the 2012 ARPAC report have been successfully addressed. These include: strategic planning (in the form of planning new initiatives and creating a hiring plan); restructuring the graduate curriculum and especially the introductory core course; raising funds for graduate fellowships; revising the undergraduate curriculum in the direction of more flexibility; offering more field courses and more teaching-support roles for undergraduates; increasing the diversity of the student population; revising the bylaws to include instructor participation in appropriate departmental roles and voting.

The department considered but declined to pursue the ARPAC recommendations to revise its PhD comprehensive examination and to convert the MS program into a professional master's program.

A key theme in the 2012 ARPAC report was the tension expressed between faculty rostered solely in Geology, versus those who hold research institute appointments. A 'have and have-nots' culture had emerged in the unit where the resources available to institute faculty were significantly different and more plentiful than resources available to faculty who were singly affiliated with the department. This is an issue of climate and culture, as much as it is an issue of resource allocation and incentive structures. The unit response to this observation by the internal and external reviewers in the last review seemed to suggest an attitude of resignation or what the external reviewers referred to as conflict aversion. Follow-up responses by the unit to the ARPAC recommendations suggested that this tension did not exist, and that department-institute practicalities like DAICR split were going smoothly. On the other hand, the follow-up responses also described an increased effort by the department to work with the institutes' interests in hiring faculty, for example, building a new faculty and student cadre through the "Geobiology Initiative." The 2019 external

reviewers, however, say that tension remains in the sense that non-institute-affiliated faculty feel underserved and also believe that the department's faculty hiring is determined primarily by the institutes' hiring agenda (and secondarily by the need for partner hires).

Another prominent issue in the 2012 ARPAC review was the decline in the percentage of student credit hours (SCH) taught by tenure-stream faculty members in relation to the SCH taught by instructors, lecturers, and graduate part-time instructors (GPTIs) and teaching assistants (TAs). The department responses to the ARPAC review in the subsequent three years indicated mixed plans for addressing this issue, ranging from declining to change any departmental practice (2015 response) to limiting the number of course buyouts for faculty (2014 response) to resolving to increase the sizes of sections taught by tenure-stream faculty members (2016 response). Meanwhile, the ODA unit profile for 2018-2019 indicated a further sharp drop in the previous five years (-20%) of SCH taught by tenure-stream faculty members, despite significant growth in the tenure-stream faculty numbers since the 2012 review. Geology ranks third of eight units in this review cycle for the percentage of SCH taught by tenure-stream faculty members (52%). Given that the total number of SCH taught by the department declined by 12% over the same five-year period, these shifts cannot be attributed to meeting increased demand. These data seem to militate against the unit's proposal that the Geology tenure-stream faculty teaching load be reduced from its current rate of 2.5 courses per academic year.

Other issues from the 2012 ARPAC recommendations continue to register as areas for further effort by the department, including increasing faculty diversity; strengthening the career advising offered to undergraduate students; and research faculty (and, presumably, postdoctoral fellows) feeling

uninvolved in and underappreciated by the department. The department responses to the 2012 ARPAC review indicated strengthening of its mentoring program for untenured faculty, but the issue of mentoring and preparation for promotion review came up again in the current review. These areas of concern are not unique to Geology, but nonetheless will continue to require attention on the departmental level even while they should also be addressed by the college and campus.

Analysis

Geology's strategic plan appears to have momentum. It primarily extends the unit's 2012 vision of growth in faculty numbers and research directions into the future, and expresses the needs for support (staff, graduate funding, etc.) described elsewhere in this review. One issue that the strategic plan mentions relates to the interrelation between the unit and the institutes when it comes to faculty hiring: institute hiring has caused Geology's faculty research agenda to change in "unexpected but mutually beneficial ways." ARPAC encourages the unit and the institutes to focus together on making a mutually beneficial hiring plan that lends a more expected tenor to this aspect of the department's research identity. ARPAC notes its past recommendation in its 2012 review of Geology and its affiliated institutes to come to a better accommodation in regards to faculty recruitment. The recent shift of oversight of the institutes to the Research and Innovation Office (RIO) and the vice chancellor for research and innovation as dean of the institutes may provide a new structure in which to pursue this aim.

Undergraduate education

In general, Geology's undergraduates feel satisfied with the department and its educational program. This review and its associated undergraduate survey reaffirms what the earlier 2016 senior survey showed: a student population that expresses not only contentment but enthusiasm for their major of choice.

But popularity with students imposes organizational stresses. Among the biggest challenges faced by the undergraduate program is a lack of teaching assistants for large-enrollment general education courses (enrolling more than 100 students). The external reviewers observed, "Compared to competitive schools, this is highly unusual and places undue burden on faculty members who teach these courses. Moreover, a lack of

a laboratory or discussion sections in such courses severely limits the possibility for active learning in these classes.”

Another challenge is the undergraduate advising scheme. Under the current system, Geology majors are advised at the college level. However, the college advisors have little familiarity with the major, or knowledge of potential career paths in the field. This means that many students struggle to determine the optimal course plan. The external reviewers note that, as of spring 2019, “there is a new mentoring program whereby knowledgeable instructors can provide advice to majors.” ARPAC agrees with the external reviewers that the department “should track whether this new program alleviates the difficulties currently being experienced by majors.” ARPAC also applauds the efforts the unit has made to expand undergraduate access to faculty mentors, and encourages further efforts along these lines.

Finally, the current undergraduate curriculum, which only offers one degree option, the Bachelor of Arts, overlooks the opportunity to offer the Bachelor of Science with no significant revisions, based on the current requirements of the BA. The BS would be attractive to a significant number of students. ARPAC does not find the department's argument convincing that revising the BA or adding the BS degree would be too time-consuming.

Graduate
education

As already noted, Geology’s graduate program is highly ranked and successful in attracting top applicants. However, the department's lower funding level (relative to peers) and conservative strategy toward extending funding (described earlier) dampen its recruitment success. Furthermore, the practice of offering only one or two years of support in the initial offer, rather than the full five years that is ultimately delivered, puts the program at a disadvantage compared to programs that

offer students multi-year funding upfront. ARPAC urges the department to pursue a more ambitious recruitment strategy and asks the college to extend additional TA support. ARPAC also believes the department should make a case for appointing more PhD students into GPTI rather than TA positions, to increase those students' stipends and to offer them experience as instructor of record.

Budget The department's financial health and advancement efforts are commendable. Fundraising efforts have been remarkably successful, and an available \$8 million endowment has helped to fund various expenditures. Recent gifts supporting efforts to promote student diversity and an additional endowed chair are especially noteworthy. Like many units, Geology would like a larger share of DAICR to be allocated from the university to departments, programs and institutes; ARPAC understands that this is a perennial theme and believes that Geology and its partner units in the natural sciences and the institutes should engage with the dean of the College of Arts and Sciences and the dean of the institutes to advocate for changes to the campus-department percentage share.

One approach to DAICR is for the college dean to reserve a share of funds before distributing the remainder to the departments, for use in funding common or cross-departmental needs or special projects. The College of Arts and Sciences does not appear to take this approach, leaving fewer resources for departmental appeals for particular needs like staffing. ARPAC wonders whether the college might consider this direction for DAICR allocations. Alternatively, Geology might consider increasing this practice within its own department, in order to allocate more funds from grants to support common departmental needs such as staffing.

Space,
Infrastructure,
and
staff support
needs

Though the need for more and better office, research, and teaching spaces was articulated in the self-study, the most pressing need at the moment seems to be better space and furniture accommodations for research faculty and graduate students. Beyond these reasonable upgrades, the unit's infrastructural needs seem less urgent than those of many other campus units. The self-study expresses the need to overcome a financial limit on vehicle expenses for class field trips, and frustration with the financial model that replaced course and program fees. It is ARPAC's understanding that this model, which had just been instituted at the time of the self-study's writing, has been modified at the campus and college levels to address such issues. However, field trip vehicle expenses may require revenue beyond what is provided through these funds.

There is a need for support staff in several areas. The department appears to be significantly understaffed, especially considering the increased number of faculty members since the last review, and considering that faculty numbers may continue to grow. ARPAC supports additional staff lines for the department. A partnership between the College of Arts and Sciences and the institutes may help fund a position for a "rock shop"/field equipment/laboratory technician-manager, as requested in the self-study. In addition, lower-cost options like hiring work-study students for "front office" roles could lighten the administrative staff's workload. The department also requests an increase in its research management/accounting tech position from 0.5 to 1.0 FTE.

Governance

The department is to be commended for revising its bylaws to include instructors in unit governance. However, the current review revealed dissatisfaction raised by research and technical staff that seemed to focus on a lack of integration and inclusion of their concerns and perspectives in decision-making. ARPAC urges the unit to expand the participation of research and

technical staff in appropriate decision-making discussions and processes.

Inclusive
excellence

While the external reviewers praise Geology's efforts to improve graduate student diversity, they would like to see the department offer more fellowships to support students who identify as belonging to underrepresented populations. ARPAC would like to see a strategic plan for diversifying the department's faculty contingent as another urgent focus.

Climate
and
culture

The department is to be commended for its overall positive working environment. However, responses to the March 2018 climate survey administered by ARPAC staff reveal troubling behavior among a small group of faculty members that undermines the fostering of a respectful workplace environment. The external reviewers note that their interviews revealed similar findings and provided more detail:

- Interviewees described poor behavior especially toward women and LGBTQ undergraduate and graduate students; and
- Interviewees believed that departmental efforts to address poor behavior had been ineffectual.

Other pockets of dissatisfaction that exist have different causes that are addressed elsewhere in this analysis. Dissatisfaction raised by research and technical staff seemed to focus on a lack of integration and inclusion of their concerns and perspectives in decision-making. Faculty rostered fully in the department feel like 'poor cousins' to the faculty housed in research institutes which undermines a sense of cohesion in the unit. Staff morale appears to be quite low because of overwork, since growing faculty numbers have not been matched by more staff positions.

Recommendations

The members of the Academic Review and Planning Advisory Committee address the following recommendations to the Department of Geological Sciences and to the offices of responsible administrators:

To the Unit:

1. Make a case to the dean of the College of Arts and Sciences and the dean of the institutes to secure additional full-time staff positions to alleviate deteriorating workplace climate and high staff turnover:
 - a. Evaluate past funding decisions made in relation to staff for the “rock shop,” for maintaining field equipment, and for laboratory building proctor duties, and make a proposal to the dean of the institutes for a shared funding model to support a staff position for these functions.
 - b. Make a proposal to the dean of the College of Arts and Sciences to increase the 0.5 FTE research management/accounting tech staff position to 1.0 FTE.
2. Deploy undergraduate work-study employees to help out in the front office (e.g., greeting visitors, and other tasks) to lessen the burden on the staff who have more than a full-time workload associated with their assigned duties.
3. Initiate a faculty task force to evaluate the potential benefits of instituting a departmental contribution from research grants sufficient to support additional staff and other resource needs. This may involve gathering data from peer units for comparison.
4. To encourage timely promotion from associate to full professor, provide mentoring to associate professors by more senior faculty and shift large service commitments within the department from associate to full professors.

5. Revise graduate student recruitment processes to be more competitive with peer practices (i.e., extending more offers than anticipated yield, committing to multiple years of funding).
6. Make a case to the dean of College of Arts and Sciences for more TA and GPTI positions as part of the overall strategy to recruit and retain top graduate-student candidates and to give PhD students teaching experience as instructor of record.
7. Develop and implement a concrete plan to improve tenure-stream faculty diversity that lives up to CU Boulder's inclusive excellence standards. Developing this plan should include, but not be limited to, consulting with personnel in the Office of Diversity, Equity and Community Engagement and the Department of Human Resources.
8. Continue and expand the new departmental mentoring program to provide faculty career advice to undergraduate majors, to guide them in developing an educational plan that suits their career goals. Information should be provided in multiple venues, such as during advising meetings, in group meetings, on relevant websites, and by the listserv or other e-mail or social media communications that are normally sent to the undergraduates.
9. Track whether the new advising program, which draws upon instructors (extending them course release time to focus on advising), alleviates the difficulties currently being experienced by majors, and if not, then take additional actions to ensure that majors receive competent advising.

10. Engage in the broader college-wide conversation regarding the relationship between the BA and the BS and the benefits of offering the BS in programs where it doesn't currently exist. Consider also offering a BA with different requirements.
11. Explore sources for new program support monies (in addition to those provided by the College of Arts and Sciences in the wake of the elimination of course fees) to fund field trips for undergraduates, including transportation costs. This may be an opportunity for targeted fundraising to augment gift funds already used for this purpose.
12. Establish better communication between the department and its affiliated institutes throughout hiring processes and to create joint hiring plans.
13. Allocate department funds to provide safe and functional space and furniture to graduate students and postdoctoral fellows.
14. Consider revising formal and informal structures within the department to include the participation of research and technical personnel in decision-making in appropriate areas.
15. Open a sustained departmental conversation and apply campus policy to address the complaints registered in the March 2018 climate survey regarding comments made by faculty that compromise a civil and respectful work environment. With the assistance of the Department of Human Resources, require training for faculty who need to be made aware that their interactions with others in the department, particularly students, can come off as demanding and disrespectful. Faculty members should be reminded to treat all people with respect, and should be

educated about respectful behavior, in particular toward individuals who identify as women and/or LGBTQ. Follow up on continued poor behavior with sanctions as outlined in the campus policy of *Professional Rights and Duties of Faculty Members*.

To the Dean of the
College of Arts and
Sciences:

16. Consider the unit's proposal for more staff hires.
17. Consider the possibility of addressing department-specific staff and resource requests through a proposed percentage DAICR contribution to the college.
18. Explore further opportunities to support units across differential DAICR resources.
19. Consider providing funding for more TA/GPTI positions to assist with the department's graduate student recruiting efforts.
20. Encourage broad participation in a college-wide conversation regarding the relationship of the BA to the BS and the benefits of offering a BS in programs that do not currently offer one.

To the Vice Chancellor for
Research and Innovation
and the Dean of the
Institutes:

21. Consider a joint proposal from the Department of Geological Sciences and aligned institutes for staff positions to take charge of the "rock shop," maintain the field equipment, and provide laboratory management.

Required Follow-Up

The chair of the Department of Geological Sciences shall report annually on the first of April for a period of three years following the year of the receipt of this report (i.e., April 1st of 2022, 2023, and 2024) to the divisional dean for natural sciences and the dean of the College of Arts and Sciences and to the provost on the implementation of these recommendations. Likewise, the dean of the College of Arts and Sciences shall report annually on the first of May to the provost on the implementation of recommendations addressed to the program. The provost, as part of the review reforms, has agreed to respond annually to all outstanding matters under their purview arising from this review year. All official responses will be posted online.