The College of Science is encouraged by the many positive letters supporting the proposed Geosciences Doctoral Program. We are resubmitting the proposal with changes recommended by the Department of Anthropology and the Department of Plant, Soil Science and Agricultural Systems. Faculty from the Department of Plant Biology have also requested that they be included in the program and their biographies have been added to the proposal.

We would like to address concerns about the Geosciences Doctoral Program expressed by two of the Directors of the Environmental Resources and Policy Program (ER&P) and the faculty of the Department of Geography and Environmental Resources.

Department of Geography and Environmental Resources

The faculty of Geography and Environmental Resources presented three issues regarding the proposed Geosciences Doctoral Program. The complete text of each issue is provided here (in italics), with our response (in plain font).

First, the term "geosciences" encompasses several key subfields, as seen in departments nationwide. For example, Texas A&M is a well-known program in which geosciences include atmospheric science, geography, geology, geophysics, oceanography, and a water resources program. At the University of Arizona, geosciences include geophysics, biogeochemistry, climatology, and GIS. Princeton University's geosciences program is comprised of atmospheric/oceanic sciences and the solid earth. Oregon State University runs a geosciences department that includes geography, geology, and a GIS certificate. Another important indicator that describes the scope of this field is the journal Nature Geoscience, which publishes articles on geochemistry, oceanography, atmospheric sciences, and geology. Given these accepted definitions of geosciences by the academic world, it is clear that several geographic subfields are included, namely atmospheric science and GIScience, which are areas of strength in our department.

The term "geology" is associated with a fairly limited number of sub disciplines, including sedimentology, stratigraphy, mineralogy, petrology, geomorphology, resources geology (economic minerals and energy resources), geochemistry, and paleontology. Some geologists, but not all, would include geophysics within geology. Most scientists consider the term "geoscience" more general, including all of the sub disciplines in geology as well as atmospheric and oceanic sciences, physical geography, and geographic information science. The proposed Geoscience Doctoral Program includes sub disciplines outside of geology, involving faculty in chemistry, microbiology, and plant biology working in the areas of paleoclimate, environmental contamination, and biogeochemistry. The proposed program does not include all of the sub disciplines associated with geosciences, nor should it. Very few, and only the largest of geoscience departments include all of the sub disciplines. The program at Texas A&M, which has a *College* of Geosciences, is one of these.

The American Geological Institute tracks geology, earth science, and geoscience departments, programs, and faculty in the United States and Canada. An analysis of geoscience programs at U.S. universities does not support the Department of Geography and Environmental Sciences contention that term "geoscience" has a unique or accepted definition. In fact, almost half of the

geoscience departments in the U.S. have faculty only working in geology sub disciplines. We found Universities with geoscience departments or schools (University of Iowa and the University of Texas at Austin), that also had geography departments. In no case could we find a university with a geoscience department that also had a geology department. The Department of Geography and Environmental Resources specifically reference the geoscience program at the University of Arizona to make their case. Arizona, however, has separate geoscience and geography departments. Oregon State does have a geoscience department that has faculty with expertise in geology and geography, but it also has a separate *college* of oceanic and atmospheric sciences.

Second, it is clear that the newly proposed geosciences Ph.D. program significantly affects our department, given the topical coverage. We thoughtfully considered this proposal, but, in fact, we are satisfied in our current situation. We have an active Master of Science in Geography and Environmental Resources, and we participate in the interdisciplinary Ph.D. in Environmental Resources and Policy. Looking back at the history of our programs, it is interesting to note that Geography and Geology followed a similar path. Both had small, vulnerable departmental Ph.D. programs until the 1990s. Then, the ER&P program was established to create interdisciplinary synergies and draw from numerous faculty and departments across campus. We don't want to go back to the less successful, individual Ph.D. program.

We agree that ER&P serves the Department of Geography and Environmental Resources well. Even the new name of the Department reflects this fact, and most students in the ER&P program choose to work with faculty in Geography and Environmental Resources. Their desire not to "go back" makes sense for them, but not to the College of Science and the Department of Geology.

We also agree that geoscience includes many of the classic sub disciplines in geography, such as physical geography and geographic information science and recognize that many faculty working in geography departments consider themselves geoscientists. We met with the faculty in the Department of Geography and Environmental Resources to discuss their concerns. At that time, we invited faculty in the Department to become part of the faculty in the Geoscience Doctoral Program. We also promised to link their Department, and the Environmental Resources and Policy Program, to the Geosciences Doctoral Program Web site. Faculty from Geography and Environmental Resources could choose to take students in the Geoscience Doctoral Program, or when contacted by a prospective student, encourage them to apply to the Environmental Resources and Policy Program. Having both a Geosciences Doctoral Program and ER&P creates a synergistic effect, enhancing the overall reputation of Southern Illinois University Carbondale in environmental sciences.

During our meeting, faculty from Geography and Environmental Resources encouraged us to find another name for the Geosciences Doctoral Program. The faculty in the Department of Geology met to discuss different options, but ultimately voted unanimously to keep the name Geosciences. Our rationale is simple. The proposed program clearly includes sub disciplines outside of those normally in the field of geology. Other suggested program names did not adequately describe the program and were more complicated. Students searching for a program like the one proposed, would use the term "geoscience" in their Web searches. Calling the program anything else complicates the search, and creates the very real risk that students would

not be able to find our program. The Web site would direct prospective students finding our program, with interests more in line with faculty in Geography and Environmental Resources, to ER&P. An argument could be made that more students would find their way to the ER&P program with the addition of a Geoscience Doctoral Program.

Third, we appreciate the issues outlined in the geosciences proposal, and we understand that Geology may wish to refine the ER&P to better represent their research foci. We are happy to work toward better integrating geology into the ER&P program. We suggest revising the specializations and perhaps updating the title to Geosciences and Environmental Management (GEM). This may create an updated and relevant program which would benefit the SIUC campus as a whole.

The ER&P program would have to radically change to serve the needs of the disenfranchised faculty in the Department of Geology. Making the program more relevant to faculty in Geology may impact the program's current mission.

Environmental Resources and Policy Program

Two of the co-Directors of the Environmental Resources and Policy Program felt that the Geosciences Doctoral Program is unnecessary, listing a series of issues. Here we address each of their issues (in italics) with our response (in plain font):

1) The interdisciplinary nature of the geosciences as described in the proposal is in fact a strong argument for the Environmental Resources and Policy (ER&P) program that has been successful since 2001. Moreover, with 41 faculty with Direct Dissertation status, ER&P has the critical mass to implement a truly interdisciplinary environmental program that the Geology Department may lack.

We recognize that the ER&P program has been very successful, offering an interdisciplinary program in the physical and social sciences. However, the Geoscience Doctoral Program would foster a link mainly between the physical (chemistry, geology, and physics) and biological sciences. Most of the faculty in the Department of Geology are having difficulty attracting students to the ER&P program because of its link with the social sciences. We suspect that students are driven away by the required courses in social sciences and the name of the program.

2) ER&P already serves well the needs for Ph.D. education most of the areas detailed in the Geosciences proposal through its specializations in Energy and Mineral Resources and in Earth Processes.

If ER&P serves the needs of Ph.D. education as detailed in the Geosciences Doctoral Program, why do most of the faculty in Geology have difficulty attracting students?

3) If some geology faculty feel that the current ER&P program or its existing concentrations do not completely fulfill their Ph.D.-level educational needs, for example in Geophysics, the ER&P co-Directors are ready and willing to add or modify the concentrations offered by the program

to fulfill those needs. This willingness has been communicated to ERP co-Director and Geology Chair, Dr. Steven Esling.

Modifying the curriculum may impact the current mission of ER&P, which has its own distinct niche linking the physical and social sciences. For those students that would like an interdisciplinary program in the physical and social sciences, the curriculum of the ER&P program makes sense. For someone in geochemistry, geophysics, or stratigraphy working on academic, rather than applied, research, ER&P is not appropriate.

4) While it is correct to state that there can be "a reluctance of some promising faculty to join programs which do not have access to doctoral students" (bottom of p.4), all Geology faculty with Direct Dissertation status currently have access to doctoral students through ER&P. Some of these students have received their degrees with Geology faculty as advisors (e.g., Reuben Heine, Jonathan Remo, Abani Samal) and others are progressing successfully in the program (e.g., France Belley, John Keller, Brendan Lutz). This excellent access to Ph.D. students should be communicated to faculty interviewing for positions in the Geology Department. Moreover, ER&P students are already included on grants from NSF and elsewhere for which Geology faculty serve as Principal Investigator. The new program would thereby not create any value-added in terms of faculty access to Ph.D. students or scientific funding programs.

Yes, several ER&P students working with a few faculty in the Department of Geology have received their degrees, and others are now progressing toward their degrees. However, the success of these students does not tell the entire story and a closer look at each case only points out how the ER&P program fails to serve the needs of many students working with Geology faculty. France Belley, John Keller, Brendan Lutz, and Jonathan Remo all expressed a desire for a program of study more in line with their interests in the physical sciences. They had no other choice, and entered the ER&P program because they wanted to work with specific faculty. They are very concerned about the title of their degree and they would have preferred a curriculum without the required ER&P social science courses. Abani Samal entered the program without an advisor. He did not share a research interest with any member of the faculty in the Department of Geology and Richard Fifarek reluctantly agreed to serve as his advisor. Reuben Heine is the only student that specifically sought the link between the physical and social sciences that chose to work with a member of the Geology faculty. Forcing students into a curriculum they do not want in order to work with a particular member of the faculty is not the way to provide a strong and responsive graduate program at this University.

The success of students in the ER&P program working with faculty in Geology has been communicated to applicants for open positions in the Department of Geology. The two most recent hires still expressed serious concern that they could attract students into ER&P. In fact, these recent hires expressed this concern to the Dean of the College during the interview process. They were encouraged when they were told that he intended to seek a Geoscience Doctoral Program. It is very questionable that Dr. Sue Rimmer would have accepted the offer of employment here without the Dean's support of this initiative.

5) ER&P currently works closely with the Coal Research Center and Center for Ecology and is in fact better positioned to do this than the proposed program in Geosciences. This is supported

by the proposal itself, citing economic benefits and policy considerations with clean coal development and other energy or environmentally-related initiatives. Moreover, the citations illustrating vibrant career opportunities emphasize resource management and policy considerations that are a current focus of ER&P, with its commitments from geographers, agricultural economists, the law school, and others.

Not all research in the field of energy or the environment requires a background in policy or economics. In fact, at the doctoral level, students cannot master all aspects of a every field related to resources and the environment. Some may choose to focus on policy and the physical sciences, others may prefer to blend chemistry or microbiology with geology. All will bring important skills to solving future resource and environmental problems.

The proposal does not *emphasize* resource management and policy considerations when illustrating vibrant career opportunities in geosciences. U.S. Bureau of Labor information, which does note career opportunities in these fields, is supplemented with other material showing high demand for individuals trained in the physical sciences; specifically sciences addressing the development of energy and mineral resources. The revised proposal now includes a statement indicating that the Bureau of Labor information does not only apply to the physical sciences.

Before ER&P existed, the Department of Geology had a long-standing relationship with the Coal Research Center and the Materials Technology Center as well as the Departments of Civil and Environmental Engineering and Mining and Mineral Resources Engineering. Adding a program in geosciences would not diminish any other academic program and would enhance existing centers of research and degree programs, including ER&P and the Department of Geography and Environmental Resources.

6) ER&P Ph.D. students have performed well as teaching assistants in Geology classes (e.g., John Keller, Donald Rehmer, Jonathan Remo, Daniel Vaughn) and will continue to do so.

We are not sure how this is relevant. All doctoral programs on campus seek quality students that will perform well as teaching assistants.

7) At other U.S. Universities, (e.g., Oregon State) "Geosciences" normally includes both Geography and Geology. While Geography and Environmental Resources was not consulted in the development of this proposal, ER&P currently creates a framework for cooperation between Geology and Geography and Environmental Resources. Moreover, these two departments mirror one another in their size and excellent recent progress in quality of faculty and research productivity, especially in the period since 2001 when the ERP program came into effect. Thus, both of these departments have demonstrably improved under ER&P in comparison to the period prior to 2001 when they had independent Ph.D. programs. It thus seems unwise to return to a Ph.D. program model that has historically proven less effective than the current ER&P program.

Geosciences does not *normally* include both geography and geology. We addressed this issue in our response to the letter from the Department of Geography and Environmental Resources. The fact that both the Department of Geology and the Department of Geography and Environmental Resources have improved has nothing to do the ER&P Program. Rather, these programs have

improved because of their faculty, and the care they have taken in recent searches. The ER&P directors chose a date of 2001 to make their case. However, the size of the Department of Geology contracted during the early 90's, which lead to a decline in research productivity. Faculty that were added in the 90's, like Dhananjay Ravat, Nicholas Pinter, and Scott Ishman were very productive prior to the establishment of the ER&P program and their accomplishments are a large part of the success the Department of Geology has had early this century.

8) Through these collaborations fostered by ER&P, an NSF IGERT program in Watershed Science and Policy has twice been invited by NSF for submission of a full proposal with the second now under review for over $3 million.

ER&P has been successful over the past eight years and faculty involved with the program played an important role in the recent NSF IGERT grant. That success, however, is not an argument against the establishment of a Geosciences Doctoral Program.

9) There are already five Ph.D. programs in Geology in Illinois. If the proposed program would be distinct, it would be through its inter-disciplinary collaborations, already evident in ER&P. Moreover, "Geosciences" normally includes oceanography, which is not included in the proposal, and atmospheric sciences and physical geography, which are currently addressed primarily through Geography and Environmental Resources.

The Geoscience Doctoral Program will be distinct from the other doctoral programs in Illinois, as documented in the revised proposal for the degree. Programs in the geosciences do not *normally* include fields such as oceanography, atmospheric sciences, and physical geography. We addressed this issue in our response to the letter from the Department of Geography and Environmental Resources.

We do not feel that the Geoscience Doctoral Program threatens ER&P or any program in the Department of Geography and Environmental Resources. In fact, a Geosciences Doctoral Program would only enhance other graduate programs at the University. We envision cases where students initially seeking the Geoscience Doctoral Program may ultimately choose ER&P, and vice versa. The existence of both programs would further the overall reputation of the University in environmental studies, just as the Coal Research Center, the Center for Ecology, and the Materials Technology Center create a synergistic effect on campus.