Professional Science Master’s Degree in Economic Geology
Department of Geosciences, College of Science, University of Arizona

EXECUTIVE SUMMARY

The Department of Geosciences proposes to offer a new master's degree to serve the needs of working professionals in the global mineral industry, including those in Arizona. The degree is targeted primarily at economic geologists in the minerals industry who seek to return to college for additional education, although students interested in land management and public policy would also be well served. The new Professional Science Master’s degree (PSM) in Economic Geology would be based in the Geosciences Department and affiliated with the Professional Master’s Degree Program of the College of Science at the University of Arizona. The new degree would be distinct in name and content from the existing Master of Science in Geosciences and would be the only degree of its kind in economic geology in the United States. The new program would contribute to fulfilling the goals of the national initiative by the Alfred P. Sloan Foundation to implement new science master's programs at a number of American universities, joining existing programs in Applied and Industrial Physics, Applied Biosciences, and Mathematical Sciences at the University of Arizona and a track in Bioinformatics at Arizona State University.

HISTORICAL BACKGROUND AND INDUSTRY CONDITIONS

Economic geology is the study and analysis of geologic bodies and materials that can be utilized profitably by man and the application of geologic knowledge and theory to the search for and the understanding of mineral deposits. There are thousands of economic geologists in the United States, who work mostly in the minerals industry but also in academia and government. The mineral industry is a significant segment of the Arizona.

Many science departments historically have not offered a Master’s program—Master’s degrees primarily have been awarded to those who left a Ph.D. program for whatever reason. An initiative by the Alfred P. Sloan Foundation has been attempting to change this condition by promoting the creation of Professional Science Master’s (PSM) degrees.

Geology departments, in contrast, have a long history of having stand-alone Master’s programs. The Master’s degree typically serves multiple purposes. In some cases, students may view the Master’s degree as a “terminal” degree that fulfills requirements for certain jobs in industry. In other cases, students interested in a career in research may, nonetheless, complete the same Master’s degree requirements before entering a Ph. D. program. As a result, many Master’s degrees in geology have had a research focus. Graduate course requirements have been highly flexible but rarely require classes outside of geosciences. Completion of a formal thesis commonly has been required. The existing Master of Science in Geosciences at the University of Arizona fits this model.

A Master’s degree is generally required to obtain a career-track job in developed countries in the minerals and petroleum exploration and environmental consulting professions. The Master’s degree also is the most common degree held by professionals in those fields. An exception is that only a Bachelor’s degree
is required for mine geologists. Nonetheless, more and more mine geologists hold advanced degrees as the requirements of the job become more complex and multi-disciplinary.

Many of the most promising areas to explore for new mineral deposits and to put new mines into production are in developing and undeveloped countries, where the job requirements and education and training situations are different. Geologists with advanced degrees in developing countries are rare for several reasons. First, quality training in economic geology beyond the Bachelor’s degree is not offered in many countries. Second, many students may not be able to afford graduate education, whether the degrees are offered in country or overseas. Third, job offers after receiving a Bachelor’s degree have been so attractive in certain countries that the minerals industry has siphoned off the best students before they could proceed to graduate school, in country or abroad.

Exploration and mining companies working in developing and undeveloped countries—many of which are headquartered in developed countries—generally prefer to operate there the same way they do in developed countries, with entirely local staff and with professionals with the same standards of education and training as in developed countries. Because of the shortage of well-trained geologists with advanced degrees in developing and undeveloped countries, many companies operate there with a staff comprised of a few expatriate geologists and a larger body of local professionals, many of whom do not have the level of education that is standard for the industry in developed countries. The expatriate geologists generally have a graduate degree and additional business experience, but their total compensation packages are extremely expensive. Hence, young professional geologists—especially those in developing and undeveloped countries—have an incentive to seek additional education and training so that they can take the place of the expatriates. Likewise, companies have incentives to help the young professionals acquire the education and training they will need to be competitive for management positions.

The University of Arizona was fortunate to have a benefactor from industry, David Lowell, who was willing to fund the Lowell Chair in Economic Geology, with the purpose of starting a new Master’s Degree program for geologists from the minerals industry. His vision for the program is rooted in his perception of the industry’s needs, and his opinion carries considerable weight with others in industry. We have sought advice from other managers in industry, and many of them also want an alternate type of Master’s program in economic geology to be offered. They want a program that (1) delivers high-quality geologic content and critical-thinking and quantitative skills but also cross-disciplinary material from other technical fields (e.g., engineering and business) that are directly relevant to the larger business of mining, (2) contains an important field-based geologic component, and (3) returns their employees to the work force as quickly as possible. In the case of the first point, many companies will not support their own employees for programs that nominally take two years or more; they will only support students for programs where it might be possible to complete the degree in about a year. Industry is not insisting that an internship program be a part of this program because this type of student has already been exposed to industry through an existing job.

PROPOSED NEW PROGRAM AT THE UNIVERSITY OF ARIZONA

The Lowell Program in Economic Geology proposes to offer a Professional Science Master’s Degree in Economic Geology with four emphasis areas: (a) exploration geology, (b) development geology, (c) mining geology, and (d) environmental geology. Each emphasis area corresponds to a career track of geoscience-based professionals in the minerals industry. (a) Exploration geologists locate, test, and evaluate prospects that may lead to discovery of a new orebody, generally working in teams dominated by geoscientists. (b) Development geologists conduct advanced exploration activities and technical evaluations that may lead to development of prospects into mines, generally working in teams that are dominated by engineers. (c) Mining geologists explore for additional reserves on or near the mine site and support the efficient extraction and processing of ore in mine planning and operations, generally working
in teams dominated by mining operators and support staff. (d) Environmental geologists support exploration, development, mining and processing, and closure activities, generally based either in a corporate office or at a project site. Any of the above functions may be fulfilled while working in a major or junior company or in a consulting capacity.

The activities of the mineral industry can be regarded as occurring in four subject areas: (1) exploration and development, (2) mining and processing, (3) economics, business, and people, and (4) health, safety, and environment. Because of the breadth of the University and its strength in geosciences and mining, the University of Arizona already offers many semester-length courses pertinent to all four of these subject areas. Only one or two new courses, which could be offered as short courses or modules, would be offered to fill out the curriculum of the Lowell Program. Students would be required to take at least one course from three of the four subject areas. The University’s Center of English as a Second Language (CESL) offers optional English language training on the front end of the program to students whose first language is not English.

In common with other M.S. degrees, a minimum of 30 semester credit hours would be required. All students would be required to take at least one qualifying course from three of the four subject areas. The proportion of courses from the various subject areas would depend on the student’s area of emphasis. For instance, a student in the environmental geology track would take more courses in the health, safety, and environment subject area than students pursuing other tracks. All students, however, would be required to take a business course and a proposed course in Project Stages and Best Practices, which incorporates a mineral industry colloquium. Certain courses may be offered as modules and short courses during the Winter Session and over spring break. Although a formal thesis would not be required, students would be required to complete a research project with a written report and a presentation (talk or poster) of the results of their research in a public forum, such as the Geosciences Department’s annual GeoDaze meeting. Students are encouraged to bring the topic of the research project with them from industry. An internship requirement will be waived for students who already have industry experience (the waiver has no impact on the number of units required for the degree).

The program would be supported by an industry advisory board and a faculty committee drawn from several departments. We would expect students to enter the program with full financial support, as a result of employer funding, personal savings, or scholarships. Consequently, the department would not be supporting these students with Teaching Assistantships and Research Assistantships. Moreover, the students could focus entirely on their studies, rather than devoting part of their time to supporting themselves. If students take full schedules and modules over the Winter session and spring break, it will be possible to complete this intensive program in one year. Although we expect the tuition for this program to be higher to support the emphasis on intensive field-based courses and intersession modules and short courses, the total cost of obtaining the degree (including room and board, which is likely to include the family of a young professional) would be relatively inexpensive because it would be possible to complete it in one year.

COMPARABLE PROGRAMS ELSEWHERE

There is no comparable program in the United States today. The existing programs most similar to the one proposed here are the Master’s in Minerals Exploration (MinEx) at Queen’s University, Ontario, Canada, and the National Master of Economic Geology at the Center for Ore Deposit Research (CODES) at the University of Tasmania, the University of Western Australia, and James Cook University, Queensland, Australia. There also was an earlier program at Imperial College in London, England. Some of these programs have thrived for decades, and their graduates include prominent members of the mineral industry worldwide.
The programs that are most comparable to the Lowell Program in Economic Geology attract some of the very best students, so it is not surprising that these individuals not only hold important positions in industry, but they also play leading roles in professional societies and science. One individual, for instance, currently is an Associate Editor of the most prestigious scientific journal in the field and a frequent author of papers in the journal.

COMPETITIVE ADVANTAGES

A Professional Science Master’s Degree in Economic Geology at the University of Arizona would have a number of competitive advantages. The university has a longstanding reputation in economic geology and mining, and the breadth of the university would support the cross-disciplinary nature of the program without additional infrastructure. The climate and proximity to spectacular geologic exposures is ideal for running field-based courses during the school year. The location is appealing because Tucson remains a well known center in the mineral industry; it is in the midst of a famous copper mining province, there are varied geologic exposures and additional types of mineral deposits within a long day’s drive, and the mountainous desert setting is reminiscent of mining regions in South America. The Geosciences Department has excellent connections in Latin America, which is a major potential market of potential students. We have found a strong interest in this type of degree in both the United States and abroad.

Successful implementation of this new program would contribute to fulfilling the goals of the national initiative by the Alfred P. Sloan Foundation to implement new science master's programs. The program would be affiliated with the Professional Master’s Degree Program of the College of Science at the University of Arizona, joining the existing programs in Applied and Industrial Physics, Applied Biosciences, and Mathematical Sciences that were initiated with the aid of seed money from the Sloan Foundation. The Sloan Foundation also supported the launching one track in Bioinformatics at Arizona State University. Approval of a PSM in Economic Geology at the University of Arizona guarantees listing in the PSM national data base and on the PSM web site. Approval also would provide opportunities to interact with many other PSM programs in geology, geographical information systems (GIS), and environmental science. The Lowell Program would be part of a national community of similar programs that is gaining greater attention.