

DEPARTMENT OF GEOSCIENCES GRADUATE HANDBOOK

ADMISSIONS

We encourage students with majors other than geology to enter our geoscience graduate program, particularly those with degrees in complementary disciplines such as chemistry, physics, geography, or computer science. We do not require an exact equivalent of our undergraduate curriculum in geology. Those with deficiencies in geology, or with non-geology undergraduate majors, will meet with their prospective thesis advisor to design a suitable schedule of remedial course work.

The successful applicant will have completed at least one year each of geology, calculus, physics, and chemistry. Course deficiencies may be satisfied in the applicant's first semester at The University of Montana, at the discretion of the Graduate Admissions Committee. A minimum GPA of 3.0 (in geosciences and related sciences) and GRE scores in the 70th percentile or higher are required for standard admission. A personal statement with a clear discussion of research interests is also required for admission. Finally, applicants must be accepted by a provisional advisor prior to their first year of study. Candidates are strongly encouraged to read the faculty summaries in this document and on the Department web pages (<http://www2.umt.edu/Geology>) and to contact prospective advisors during the application process. In special cases, the Graduate Admissions Committee may temporarily waive one or more of these requirements, and the applicant granted provisional admission. Any waived requirements must be satisfied in the first year of study at UM. All courses taken while on provisional status must be taken for a grade.

FINANCIAL AID AND THESIS RESEARCH FUNDING

Several forms of financial aid are available through the Department. We support some graduate students with teaching assistantships (TAs) made available by the Graduate School. These TAs are generally awarded to incoming students based on merit and, with satisfactory performance, continued for a second year for M.S. students and occasionally a third year for Ph.D. students. Research assistantships, off-campus internships, or other awards in lieu of the TA will not extend the four-semester duration of the total award for M.S. students. A TA who resigns an assistantship for one or more semesters within the two-year period, and hopes to resume TA duties after returning, must first receive written permission from the Department to again hold the TA. Other funding opportunities, including occasional one-semester teaching assistantships, are advertised within the Department.

Faculty members may also provide research assistantships through their grants and contracts or they may provide limited research funds from their grants. The number of research assistantships varies considerably from year to year; the direction of those funds is the responsibility of the individual faculty member with research support. Work-study jobs in Geology are sometimes advertised in the Department; general on-campus work study jobs are posted in the Financial Aid Office. Students must qualify for work-study through the Financial Aid Office before March 1. It is best to register for work-study upon arrival on the campus. Further information is available from the Financial Aid Office in the Lodge.

Many professional societies provide small grants to assist student research. These small grant programs include: *Geological Society of America* graduate student Penrose research grants (February 15), *Geological Society of America* Harold T. Stearns Fellowship program, *American Association of Petroleum Geologists* (January 31), *Sigma Xi Scientific Research Society*, (March 15 and October 15), *Tobacco Root Geological Society (MT)* (February 1), and the *Montana University Joint Water Resources Research Center*. Application forms and a list of requirements can be obtained at:

1. Geological Society of America: <http://www.geosociety.org/grants/gradgrants.htm>
2. AAPG Grants-In-Aid Program: <http://foundation.aapg.org/gia/>
3. Sigma Xi Grants-in-Aid of Research: <http://www.sigmaxi.org/programs/giar/index.shtml>
4. Tobacco Root Geological Society: <http://trgs.org/scholar.htm>

The National Science Foundation, the Department of Energy, NASA, and the American Chemical Society's Petroleum Research Fund award graduate fellowships as well as faculty research grants. These are highly competitive awards open mostly to faculty and Ph.D. candidates.

Other agencies that have funded graduate study at The University of Montana include the Montana Bureau of Mines and Geology, the U.S. Geological Survey, the U.S. Forest Service, the Bureau of Land Management, and the Environmental Protection Agency. Some companies also supply support for graduate research. If a private firm provides funding, the sponsored candidate must provide a letter from the company specifying that raw data and results may be included in public documents. Various other awards and scholarships are also available at the university and within the Geosciences Department.

GRADUATE PROGRAM

Advising

Interaction between graduate students and advisors is an integral part of the graduate education in the Department of Geosciences. Admission to the graduate program requires a provisional advisor with expertise in the student's intended field of study. The advisor is responsible for ensuring that the student satisfies the requirements for the graduate degree outlined below. The advisor is also responsible for supervising the graduate research and mentoring the student in the field of study.

Courses

Graduate students in degree programs must register for credits each Fall and Spring semester (with exceptions including some distance learning programs, or the School of Education where students may be registering primarily in the summer). Graduate students must register for thesis or dissertation credits each semester they are working on them. Full-time student status requires at least 9 credits during the regular session, and 4 credits during a summer half-session. Full-time Teaching and Research Assistants must carry at least 9 credits per semester. These credits may include Geol. 599 (thesis research) or Geol. 699 (dissertation research). Undergraduate level courses are acceptable for this course load requirement if they are deemed appropriate to the program of study. However, undergraduate credits do not apply to graduate degree requirements, unless designated UG in the catalog. They also must meet the restrictions on undergraduate credits.

Students must petition for a leave-of-absence if they are not continuously registered. Students who step out of their graduate programs without an approved leave-of-absence for more than two consecutive semester terms will be dropped from their program's roster and will need to petition their program and the Graduate School for readmission. The petition for readmission will require an evaluation of the

student's progress and a plan for completing the degree. Not all students will be readmitted.

All graduate students must register for at least one credit in their final semester. Readmitted students who took unauthorized leave may, on the recommendation of the Graduate School based on discussions with the Department, be required to register for four terminal credits for not meeting the continuous registration requirements. Students who leave the state for a year will be subject to out-of-state tuition.

Transfer Credits

Graduate transfer credits for Geosciences courses will not be allowed from a school that does not have a graduate program in Geosciences or Geology. After satisfactory performance in graduate courses at The University of Montana, and upon recommendation of the department chairman, up to 9 credits may be transferred from another school after one semester of residence at The University of Montana. Thesis credits and credits for courses with grades of C or lower are not transferable. A Ph.D. student may transfer 30 credits from a completed M.S. degree.

Grades

A grade point average of 3.0 or better must be maintained throughout the graduate program. Courses with grades of C or lower are not acceptable for the degree program, but are included in the calculation of grade point average. Grades of N (continuing) and CR/NCR (Credit/No Credit) are given for credits in Thesis Research, Geol. 599, and Dissertation Research, Geol. 699. Many courses numbered Geol. 500 or above, including Geol. 580, 581, 592, 593, 584, and 597, are graded on a CR/NCR basis. The instructor may offer any of these courses for a letter grade. If a seminar is offered on a graded basis, it must be taken for a grade to apply toward a degree program.

MASTER'S DEGREE

Master's degree requirements include: A minimum of 28 credit hours in formal course work plus 6 credit hours of thesis research for a total of 34 semester credits. Successful completion of a master's degree also requires submission of a research proposal by the last day of classes of the second semester, a draft thesis by the end of the eighth semester, submission of a final thesis, and a successful defense of that thesis. Students are strongly encouraged to submit a draft thesis by the end of the third semester, and defend by the end of the fourth semester. Further details of these requirements are provided below. A checklist and timetable of degree requirements for the masters are provided in Appendix A.

Advisor and Committee

Part of the graduate admissions process entails the selection of an advisor. This advisor should have expertise in the candidate's field of study. Faculty of the Department are not required to advise any graduate candidate, rather, they select candidates based on their scientific interest, capabilities, and funding opportunities. Once an advisor accepts a student, the relationship may be terminated by a failure to satisfy any of the degree requirements outlined below, or a failure to progress toward the degree, at the discretion of the advisor. A preliminary warning must be provided to the student prior to termination of the advising relationship. In the case of termination, a candidate has one semester to find an alternate advisor. If no other faculty member is willing to take on the advisor role, the candidate will be asked to leave the program.

The advisor is responsible for ensuring that the candidate is aware of the requirements outlined below, as well as for training a candidate in the techniques and concepts of the area of research.

A master's candidate must also choose two additional members of the faculty to constitute the research committee, one of whom must be a faculty member outside of the Department. This committee is responsible for evaluating the candidate's research, and for providing supplemental instruction in their research specialties to complement the primary training of the candidate. Members of the committee should be selected by the pertinence of their expertise in the intended course of study. Not more than one member of the committee may be emeritus faculty of the Department.

Proposal

An initial draft of the master's thesis proposal must be submitted to the candidate's committee by the start of the candidate's second semester of enrollment. A final version of the proposal must be approved by the full faculty of the Department by the last day of classes in that second semester. The proposal must be submitted **two weeks** prior to the end of classes so that the faculty have ample time to review the proposal before the final faculty meeting of the semester. The proposal should be limited to five pages of text, with additional pages as required for appropriate figures and scientific references. The content of the proposal must include a concise description of the scientific problem to be addressed, a summary of current research relevant to that problem, and a description of the experiment design or methodology. This content should demonstrate the basic scientific literacy of the candidate as well as his familiarity with his specialization. The proposal must also include a statement that the candidate has secured sufficient financial resources to undertake the described research. Examples of successful master's proposals may be requested from the Geosciences Department office. Failure to submit an acceptable proposal in the required time constitutes grounds for probationary academic status, loss of financial support, or dismissal from the graduate program at the discretion of the full faculty of the Department.

Courses

Only courses designated for graduate credit in the university catalog apply to the 34 credits beyond the Bachelor's degree required for graduation. Full-time graduate students must register for at least 9 credits each semester while working towards a degree. A minimum of 20 credits, excluding GEOL 599 and 699, must be geology courses. A maximum of six credits of GEOL 599, Thesis Research, can be applied toward the degree. An additional 3 credits may be from GEOL 496, Independent Study. No more than 15 credits are allowed for UG courses at the 300 and 400 level, courses carrying the undergraduate/graduate credit designation. Core curriculum courses required for a B.A. in geology at The University of Montana, or their equivalent taken elsewhere, are not valid for graduate credit. Because the specific topic varies for each offering, seminars, with course numbers 58x, may be taken more than once, with the consent of the instructor. A maximum of three credits for field trip courses can be applied towards M.S. and Ph.D. degrees. A minimum of 24 credits applied toward the degree must be taken on the University of Montana - Missoula campus. A maximum of eight credits of course work may be repeated upon approval of the Department.

Cognate science courses, taken outside the Geosciences Department, may be required, depending on the field of study, advisor, or research. Cognate courses are generally in Math, Physics, Chemistry, or Computer Science. The nature of the cognate work will be decided in consultation with the thesis committee.

Time Limit

The Graduate School requires that the Master's degree be completed within five years of beginning course work at The University of Montana. This includes any credits being transferred from another university. A leave of absence does not waive these time limits except when the leave is granted prior to

commencing course work. A leave of absence or delayed admission requires a "Request for Leave of Absence from the M.S. Program" form from the Graduate School. Such a leave of absence is for a maximum of one calendar year. The Graduate School upon receipt of a written request may grant a 12-month extension to a leave of absence from the student and concurrence of the Geosciences Department.

The Master's Thesis

The Master's thesis must present the results of original scientific research in the field of specialization in an appropriate scientific style and format. Length and content requirements are subject to the advisor and the committee. However, an advanced degree in the physical sciences requires a demonstration of competence in scientific method, as well as familiarity with the current state of knowledge in a specialty. In general, a successful master's thesis in the geosciences will include a concise description of a scientific problem, a thorough review of published and prior work relevant to that problem, a description of the experimental methods used to address that problem, experimental results, and a robust interpretation of those results. All graduates of the program must demonstrate a thorough understanding of the principles in their specialization, current techniques and methods in that field, a thorough understanding of scientific data analysis and error, and competence in scientific writing. The faculty strongly encourages candidates to submit part or all of the content of their thesis research for publication in peer-reviewed journals.

Thesis Defense

The thesis defense has two parts; a public oral presentation to students, faculty, and other interested members of the public, and the oral examination conducted by the faculty. The presentation typically includes 45 minutes allotted to the presentation and several minutes for questions from the audience. The final exam follows the public talk. The exam includes the defense of the thesis as well as questions designed to test competence in the course of study. The exam is conducted by the committee, and chaired by the advisor, but the exam is open to interested members of the university faculty as well. There are three possible outcomes of the exam:

- a. Pass with thesis accepted as it stands.
- b. Pass with minor revisions required on thesis.
- c. Fail, or major revision required on thesis.

After a failure, a second defense is allowed after the waiting period required by the Graduate School. Only one repeat exam is permitted. The defense must be held during the period of a regular Fall or Spring semester and must be completed at least 15 days before graduation.

Application for Graduation

At least one semester before the Master's degree or Ph.D. degree is to be awarded, the student must submit to the Graduate School three copies of the Application for Graduation form and a graduation fee. See the Calendar of Deadlines on their website, <http://www.umd.edu/grad>, for the exact dates to file paperwork. The Graduate School will conduct a degree audit and send two copies of this form back to the Geosciences Department (one departmental copy and one student copy) early in the graduating semester. The faculty and student should note any problems and rectify them at least two weeks prior to the end of the final semester by using a Graduation Amendment Form. If the student fails to meet the original graduation date as requested on the form, the student may request the application be reactivated for the following semester by notifying the Graduate School one semester prior to the revised completion date.

After defending

After the defense, the successful candidate must:

1. Prepare final copies of the thesis that conform to Graduate School format.
2. Submit three initialed copies of an approved abstract of the thesis to the Graduate School.
3. Prepare an original and at least seven photocopies of the thesis with the abstract, including three for the Graduate School, one for the library thesis collection and one for each member of the committee. The latter must be bound. The university will bind the copies submitted to the Graduate School.
4. Deposit three unbound copies, and three initialed copies of the abstract, with the Graduate School and pay the required binding fee.
5. Where appropriate, the advisor may require a representative collection of samples, specimens, thin sections or other materials for the departmental collections.
6. Clean up all lab and office space and return any departmental equipment and keys (remember to claim key deposits!). Be sure to return any books or other items borrowed from the faculty.
7. Provide forwarding contact information to the department secretary.

DOCTORAL DEGREE

Many of the requirements of the Master's degree also apply to the Doctoral degree. Admission to the graduate program does not automatically entail admission to the Doctoral program, but requires satisfaction of an additional set of requirements described below. A checklist and timetable of all Doctoral degree requirements is provided in Appendix B. These generally include residence, course work, comprehensive examinations, admission to candidacy, and the dissertation.

Advisor and Committee

Part of the graduate admissions process entails the selection of an advisor. This advisor should have expertise in the candidate's field of study. Faculty are not required to advise any graduate candidate, rather, they select candidates based on their scientific interests and capabilities. Once an advisor accepts a student, the relationship may be terminated by a failure to satisfy any of the degree requirements outlined below. In that case, a candidate has one semester to find an alternate advisor. If no other faculty member is willing to take on the advisor role, the candidate will be dismissed from the program.

The advisor is responsible for ensuring that the candidate is aware of the requirements outlined below, as well as for training a candidate in the techniques and concepts of the area of research.

A Ph.D. candidate must also choose four additional members of the faculty to constitute the research committee. This committee is responsible for evaluating the candidate's research, and for providing supplemental instruction in their research specialties to complement the primary training of the candidate. Members of the committee should therefore be selected by the pertinence of their expertise in the intended course of study. Candidates must also include at least one committee member from outside the Department of Geosciences. Not more than one member of the committee may be emeritus faculty of the Department.

Courses

A minimum of 60 graduate credits beyond the Bachelor's degree is required for the Ph.D. degree at The University of Montana. The committee may require additional course work beyond the minimum of 60 credits. Up to 30 of the 60 credits may be transferred from a completed Master's degree. Candidates entering the Ph.D. program without a Master's degree may transfer 9 graduate credits from another institution. No more than 15 geology credits at the 300 and 400 level designated UG may be applied toward the Ph.D. degree. This limit includes courses taken for the Masters. A maximum of 12 credits of GEOL 699, dissertation research, may be applied toward the degree. A maximum of 6 credits of GEOL 496, Independent Study, may be applied toward the degree. A minimum of 12 graduate credits of course work must be taken outside of the Geosciences Department. This course work must comprise a coherent program relevant to the dissertation research and/or professional goals. This cognate-area course work, approved by the dissertation advisor, must be completed by the fourth semester in residence. Courses taken for the Master's degree may be applied toward the 12 credit cognate requirement with the approval of the advisor. Cognate courses are generally in Math, Physics, Chemistry, or Computer Science. Some courses in the life sciences and geography may be suitable for some fields of study.

Extensive background in relevant industry or governmental work in geology-related sciences may be constitute grounds for a special program of graduate study. Such a program may include reduced or modified formal course requirements and residence requirements and would be designed under the supervision of an advisor and research committee. A modified course of study must meet the majority approval of the Department of Geosciences faculty and the Dean of the Graduate School.

Residency

A minimum of three semesters, two of which must be consecutive and before admission to candidacy, must be spent in graduate residence at The University of Montana. A full semester of residence is at least 9 approved credits in any semester. With prior approval of the Geosciences Department and Graduate School Dean, a student admitted to candidacy may register for and receive credit for dissertation research done in absentia. The Graduate School requires all full-time Teaching and Research assistants to carry at least nine graduate credits per semester.

Time Limit for Degree Work

All requirements for the degree must be completed within seven years of commencing graduate course work at The University of Montana. Candidates are not excused from program time limitations by virtue of a Leave of Absence except when the Leave is granted prior to commencing course work.

Ph.D. Comprehensive Exams

The Ph.D. comprehensive exams include both written and oral examinations. They will be structured, written, and administered by the committee, and must be completed by the end of the second year in residence. Only after successful completion of the comprehensive examinations does a student become a doctoral candidate.

Admission to Candidacy

Successful completion of the comprehensive examinations is required for a candidate to be admitted to the Doctoral program. Upon approval of the research proposal by the committee following the oral examination, the candidate may proceed with the described research. This work should constitute the core of the doctoral dissertation. The approved proposal with the signatures of all committee members

and a time schedule, must be submitted to the Graduate School Dean at least four semesters before the date of expected completion of the dissertation and defense. This proposal is subject to review by the University Graduate Committee.

The Doctoral Dissertation

The Doctoral dissertation must present the results of original advanced scientific research in the field of specialization in an appropriate scientific style and format. Length and content requirements are subject to the advisor and the committee. However, an advanced degree in the physical sciences requires a demonstration of competence in scientific method, as well as familiarity with the current state of knowledge in a specialty. In general, a successful dissertation in the geosciences will include an exhaustive description of a scientific problem, a complete review and discussion of published and prior work relevant to that problem, a description of the experimental methods used to address that problem, experimental results, and a robust interpretation of those results. Alternatively, a set of papers submitted for publication may satisfy the dissertation requirement. The dissertation research must represent a substantive new contribution either to the body of methodology or the body of theory in the field of expertise. All graduates of the program must also demonstrate a thorough understanding of the principles in their specialization, current techniques and methods in that field, a thorough understanding of scientific data analysis and error, and competence in scientific writing. The faculty strongly encourages candidates to submit the full content of their dissertation research for publication in peer-reviewed journals.

Dissertation Defense

The oral defense of the dissertation may be scheduled only after the committee has approved the draft text. Place a copy of the accepted and corrected committee draft of your dissertation in the department office at least one week before the defense for inspection by any university faculty member. The defense will be no later than three weeks before the end of the semester in which the degree is to be granted; defenses are not conducted during summer sessions.

The dissertation defense has two parts; a public oral presentation and the examination conducted by the faculty. The public presentation is open to all students and faculty of the Department and any other interested people.

The final defense before the dissertation committee and members of the university faculty follows the public presentation. The purpose of this defense is to test general comprehension of the dissertation project and related material. Following a period of questioning, the committee will meet in closed session to vote. Possible outcomes are:

- a. Unanimous pass without revision.
- b. Unanimous pass with minor revisions to the dissertation.
- c. Failure of defense that, in most cases, will lead to major revisions of the dissertation. If a failing vote is cast, the candidate must make the changes required by the committee and may defend again after 30 days. A second failure is final.

Application for Graduation

At least one semester before the Master's degree or Ph.D. degree is to be awarded, the student must submit to the Graduate School three copies of the Application for Graduation form and a graduation fee. See the Calendar of Deadlines on their website, <http://www.umd.edu/grad>, for the exact dates to file paperwork. The Graduate School will conduct a degree audit and send two copies of this form back (one departmental copy and one student copy) early in the graduating semester. The department and student

should note any problems and rectify them at least two weeks prior to the end of the final semester by using a Graduation Amendment Form. If the student fails to meet the original graduation date as requested on the form, the student may request the application be reactivated for the following semester by notifying the Graduate School one semester prior to the revised completion date

Final Steps

Final requirements for graduation with a Ph.D. are the same as those outlined in the master's degree section above.

APPLICATION OF STANDARDS AND RULES

All graduate students are also subject to the general rules of the Graduate School of The University of Montana. Exceptions to the Department rules may be made with unanimous consent of the faculty of the Department. Exceptions to the University rules are occasionally allowed by petition to the Graduate School.

PUBLICATIONS AND PROFESSIONAL PRESENTATIONS

The Department of Geosciences strongly encourages graduate students to submit their scientific work for publication in peer-reviewed journals and for presentation at national and regional meetings. Presentation of findings should be undertaken with the supervision of the advisor or members of the committee. Peer-reviewed presentation and publication requires compliance with specific requirements of both content and form.

The Department and the Graduate School may help defray the expense of presenting a paper at a professional meeting. Notice of accepted publications, awards, and presentations must be provided to the committee and to the department secretary, and should also be added to a CV, which may also be held by the department secretary.

APPENDIX A: Master's degree checklist

Application to the UM Geosciences program <i>(Note that most teaching assistant decisions are made in mid-January, so applications submitted after that date are less likely to receive TA support.)</i>	preferably 3 months prior to start of first term
Acceptance by a provisional advisor:	3 months prior to start of first term
Submission of the thesis proposal:	end of second semester
Submission of the thesis draft:	end of fourth year (RECOMMENDED: end of third semester)
Completion of 34 graduate credits with > 3.0:	end of fifth year (RECOMMENDED: end of second year)
Master's thesis defense:	end of fifth year (RECOMMENDED: end of second year)

APPENDIX B: Ph.D. checklist

Application to the UM Geosciences program: <i>(Note that most teaching assistant decisions are made in mid-January, so applications submitted after that date are less likely to receive TA support.)</i>	preferably 3 months prior to start of first term
Acceptance by a provisional advisor:	prior to start of first term
Ph.D. written comprehensive exam:	2 nd week of November in second year
Ph.D. oral comprehensive exam:	end of second year
Submission of the dissertation draft:	before the end of the sixth year (RECOMMENDED: end of ninth semester)
Completion of 60 graduate credits with > 3.0:	end of seventh year (RECOMMENDED: end of fifth year)
Dissertation defense:	end of seventh year (RECOMMENDED: end of fifth year)