

Department of Earth & Planetary Sciences

GRADUATE GUIDEBOOK
ACADEMIC YEAR
2013-2014



EPS GRADUATE STUDENTS

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INTRODUCTION

This *Guidebook* summarizes the departmental programs and requirements for graduate students in Earth and Planetary Sciences. The Department of Earth and Planetary Sciences (EPS) is part of the Weinberg College of Arts and Sciences. The academic life of graduate students is, to a large degree, guided by the rules of the Graduate School (TGS), the administrative unit for all graduate programs at Northwestern. Each department has its own supplementary rules concerning the fulfillment of the requirements for graduate degrees.

In this *Guidebook* you will find information specifically related to our department, such as an explanation of the various paths through the graduate curricula, possibilities for financial support, and faculty research interests. Additional information about university policies relating to graduate students can be found in the following electronic publications (available through TGS Web Site):

The Graduate School (TGS) is located in the Rebecca Crown Center at 633 Clark Street,
www.tgs.northwestern.edu

The Graduate School – PhD Degree Policies
www.tgs.northwestern.edu/academics/academic-services/phd/index.html

The Graduate School – Academic Services

www.tgs.northwestern.edu/academics/academic-services/index.html

Academic Calendar

PhD Degree Policies - www.tgs.northwestern.edu/academics/academic-services/phd/index.html

Registration

Withdrawal

Forms for Graduate Students

Grading Systems

Satisfactory Academic Progress

Academic Integrity - www.tgs.northwestern.edu/academics/academic-services/integrity/index.html

Leave of Absence

Hooding and Commencement Ceremonies

Readmission

Graduation and Diploma Mailing

Frequently Asked Questions

Northwestern University Student Handbook,
www.northwestern.edu/studentaffairs/publications/media/pdfs/handbook.pdf

Class Schedules and course descriptions are available electronically via the online CAESAR system. You will need a NetID to log in.

www.northwestern.edu/caesar

The EPicentreS annual reports are also useful as you familiarize yourself with the department –
www.earth.northwestern.edu/news/epicentres.html

While ample advice is available from faculty and staff to assist students in planning their academic and research programs, ***it remains the responsibility of the student to know the University and department rules and meet all the requirements and deadlines.***

ACADEMIC PROGRAM

1. General Requirements

All graduate students are expected to have minimum levels of proficiency in basic science and mathematics before undertaking their graduate studies. To satisfy departmental general requirements for the Ph.D. program, **students must have completed any combination of FOUR from the following SIX options** before qualifying for candidacy:

- A) One year of **Calculus** through calculus of several variables, equivalent to MATH 220-0, MATH 224-0, and MATH 230-0;
- B) Elementary **Differential Equations**, equivalent to MATH 250; OR **Statistics** through multivariate methods, equivalent to a course sequence such as STAT 320-1 plus ANTHRO 362-0.
- C) One year of calculus-based **Physics**, equivalent to PHYSICS 135-1, 2, and 3, or PHYSICS 125-1, 2, and 3;
- D) One year of **Chemistry**, equivalent to CHEM 101, 102, and 103.
- E) **Thermodynamics and/or kinetics** (advanced physical chemistry), equivalent to CHEM 342-1, EARTH 302, MAT_SCI 314, CHEM 303, CHEM 329, or CHEM 342-3.
- F) One year of **Biology**, equivalent to BIOL 210-1, 2, and 3.

All students are encouraged to gain literacy in scientific computer programming (e.g., FORTRAN or a comparable language); **some courses require programming knowledge** (e.g., EARTH 323).

First-year graduate students may take a maximum of half of their total credits in any given quarter as EARTH 499 - Independent Study. (www.tgs.northwestern.edu/academics/academic-services/phd/coursework-registration/index.html).

2. Spoken English Proficiency

TGS requires students to demonstrate proficiency in spoken English before they become teaching assistants, receive a Master's Degree, or take the Qualifying Examination. The Graduate School, along with the Department of Linguistics will test all incoming international students, and make a recommendation for any needed ESL coursework (www.tgs.northwestern.edu/financial-aid/graduate-assistantship/)

3. Teaching Requirement

Teaching experience is a crucial aspect of graduate student training and is generally required of Ph.D. students during their time in the program. Effort is made to exempt first year students, students in the final stages of dissertation writing, and students with externally funded fellowships, but at times members of these groups are needed to fully staff departmental TA jobs. Graduate students lead discussion or lab sections, grade homework and exams, and occasionally present class lectures. Our students have found teaching experience to be a valuable asset, and potential employers, especially in academia, commonly inquire about the quality of teaching performed by job applicants.

The Searle Centre for Teaching Excellence provides opportunities for graduate students to

develop teaching skills throughout the year.

<http://www.northwestern.edu/searle/programs/graduateandpostdoctoral/index.html>

Of particular value, is the New TA Conference held in September of each year.

<http://www.northwestern.edu/searle/programs/graduateandpostdoctoral/new-ta-conference.html>

The Course and Teacher Evaluation Council (CTEC) electronically collects teaching evaluations for every class, with evaluations of graduate TA's included in these reports. The CTEC results may be accessed online after grade submission for a course. With appropriate interpretation, CTEC can help improve quality of teaching.

A teaching portfolio is commonly a required component of the application package for academic positions. Student evaluations of teaching in CTEC's provide this component of a comprehensive teaching portfolio. It is often best to collect CTEC and other materials for a teaching portfolio as they are generated.

4. Master's Degree

Students who pass the Ph.D. Qualifying Examination may apply to receive a Master's degree from the Graduate School. Students who do not achieve Ph.D. candidacy by passing the qualifying exam may also earn the Master's degree, pending approval of the faculty. In each case, the student must meet requirements for the Master's degree established by The Graduate School and EPS. Graduate School requirements are summarized on the TGS website at:

www.tgs.northwestern.edu/academics/academic-services/masters/index.html

Departmental requirements for the M.S. in Earth and Planetary Sciences include the following:

- A) Twelve courses from among those bearing graduate credit in science or engineering.
- B) A Master's thesis approved by the student's Advisory Committee. The thesis is ordinarily the result of Independent Study course work (EARTH 499) taken by the student within the required 12-course total and should be formulated as a manuscript of publishable quality, submitted or ready for submission to a geoscience journal.

Note: The Graduate School stipulates that no more than one-third of the courses qualifying for credit can be Independent Studies (Earth-499). The Earth-590 Research is the only course for which the Pass/No Pass option is acceptable.

5. Ph.D. Degree Requirements

Students in the Ph.D. program should enter with a background in basic sciences and mathematics as noted above. Any deficiencies should be made up as soon as possible after admission to the program.

The department's specific Ph.D. requirements complement the more general Graduate School's degree requirements as set out in the Policy and Course Catalog:

<http://www.tgs.northwestern.edu/about/policy/index.html>

The aim of these requirements, in addition to providing the training necessary for your graduate research, is to develop professional breadth through exposure to different areas of faculty expertise, to provide a deeper knowledge of other scientific and/or engineering disciplines, and to encourage acquisition of complementary knowledge and research skills.

The PhD requires a total of 16 courses that should be taken within the first eight quarters of residence. These courses are grouped into three categories as follows:

Group A) Six 300- level courses in Earth and Planetary Sciences, taken with regular letter grades;

Group B) Two 300- or 400-level courses in mathematics, statistics, natural sciences or engineering, taken with regular letter grades;

Group C) Eight other courses bearing graduate credit in science or engineering, including Independent Study courses (499's), and other courses in Earth and Planetary Sciences. Other courses may be considered towards fulfillment of group C by written application to the Director of Graduate Studies. A maximum of two courses outside of EPS may be taken in this group with a P/N (pass/no pass) option. ***Some graduate level courses completed to fulfill "General Requirements" may also be counted towards Group A, B, or C requirements upon approval of the Director of Graduate Studies.***

In addition, a **dissertation** under the direction of a faculty member and approved by a dissertation committee appointed by the Director of Graduate Studies is a requirement of the degree. See also the FINAL EXAMINATION section.

TRANSFER OF CREDIT

Important rules concerning the transfer of credit for graduate work completed elsewhere are listed in The Graduate School's General Degree Requirements and Policy and Course Catalog.

The student may petition the Director of Graduate Studies for a waiver of up to three courses, which will be counted toward the requirements of course group "C" for the Ph.D. In some circumstances, the student may also petition for the transfer of credit to be counted toward some of the six-courses in group "A." The total number of credits that may be approved against the courses in group "C" and /or "A" will not be greater than 3 courses. In such a case, the student will need to successfully complete a total of 13, not 16, courses before the Qualifying Examination.

The department reserves the right to require students with transfer credit to complete the full 16 courses required for Ph.D. students.

GRADES

The letter grade system employed at Northwestern University is explained at <http://www.tgs.northwestern.edu/academics/academic-services/grading-systems/>

Not more than two courses outside Earth and Planetary Sciences among those of group "C" above may be taken for a P/N (Pass/No Pass) grade. All other courses, including Independent Study courses (499's), are to be taken for letter grades (A, B, C, or F).

The Graduate School requires that students maintain a B average; that is, any C grade must be balanced by an A. If a student receives an F or fails to make up an incomplete grade (X or Y) within one year, the student will need to register in the future for an additional course at his or her own expense.

COURSE CREDIT

Only the courses listed in the Graduate School Bulletin bear graduate credit. In sciences and engineering these are ordinarily 400-level, and most 300-level courses, but BE AWARE - not all 300-level courses bear graduate credit.

Students taking courses that do not bear graduate credit (e.g., courses to obtain the minimum proficiency levels in mathematics and science, given above) must take at least three approved graduate courses each quarter to maintain eligibility for financial support.

RESIDENCY

The Graduate School requires eight quarters of residence to be completed consecutively over two years, including summers.

The Graduate School will not award any residency credits for work completed outside the Northwestern Graduate School.

Students who have completed Ph.D. course requirements, but need to fulfill residency in a given quarter (prior to the qualifying exam) should register for TGS 590.

RESPONSIBLE CONDUCT OF RESEARCH TRAINING

All graduate students must complete the Responsible Conduct of Research Training in their first year of the program. This training includes 6 online "CITI" modules, and a minimum of 2 face-to-face discussion sessions. New students should contact Assistant Chair Beddows about RCR training.

THE PROSPECTUS (Dissertation Proposal)

Students must have a dissertation proposal approved by their Graduate Committee no later than the beginning of the fifth year of study to remain in good academic standing. Any student not meeting this milestone will be considered not in good standing and therefore will not be eligible for fellowships, traineeships, teaching or research assistantships, and scholarships. Students who do not meet published requirements of satisfactory academic progress may be excluded from TGS. A petition for extension of the prospectus deadline may be approved by The Graduate School under certain circumstances, such as medical or family leave.

The prospectus must be approved by the graduate committee, comprised of a minimum of three Northwestern University graduate faculty. The Ph.D. Prospectus form is submitted by the student via the online CAESAR system.

GOOD ACADEMIC STANDING & EXCLUSION POLICIES

Good Standing - To be in good academic standing in The Graduate School (TGS), a student must meet both the standards set by the degree program in which the student is enrolled and those set by TGS. The student must also make satisfactory progress toward fulfilling all requirements for the degree as set forth by the applicable degree program and by TGS. In the Department of Earth and Planetary Sciences student whose overall grade average is below B, or who has more than two incomplete grades, or who

fails to make satisfactory progress toward the degree in accordance with the standards adopted by the program or the Graduate Faculty and the applicable degree program, is not in good academic standing.

In general, incomplete grades should be rectified (by earning an acceptable letter grade) as soon as possible. After one year from the date of the incomplete these grades will convert to a grade of "F" and result in automatic suspension of financial support.

Probation and Exclusion - A student whose overall grade average is below B or who has more than two incomplete grades will be placed on probation by TGS. A student who fails to resume good academic standing after being placed on probation by TGS, who fails to make satisfactory progress toward the degree in accordance with the requirements adopted by the program or the Graduate Faculty, or who otherwise fails to meet the requirements set by the degree program or TGS may be excluded from TGS. Failure to make satisfactory academic progress may be a result of, but not limited to: poor performance in classes, poor performance on qualifying exams, unsatisfactory research progress, or the inability to meet other program requirements (such as language proficiency). Cases of improper research conduct and inappropriate or unprofessional behavior are considered outside the boundaries of "satisfactory academic progress" and are addressed according to the University's existing disciplinary procedures, which may result in a range of sanctions up to and including exclusion from the University.

No "Individual Exclusion/Dismissal" Policy - No exclusion of a student from a program (or dismissal of a student by a faculty mentor or adviser) may be made solely by an individual faculty member, but rather must require the approval of the program. Therefore, a faculty member who wishes to exclude a student must make his/her case for exclusion to and receive approval for this termination from both the program chair and the Director of Graduate Study. The reason for exclusion from a program (or dismissal from a faculty laboratory) must be made on the basis of the student's inability to maintain good academic standing, as outlined by TGS policy. In cases where a faculty member is unwilling to continue supporting a student, and it is deemed by the program that the student had been making satisfactory academic progress, that program must provide interim funding to the student as he/she tries to find another faculty mentor or adviser or transfer to another program. Such interim funding can come from program resources and/or the faculty member who wishes to dismiss the student. TGS requires that programs must fund dismissed students who have been deemed to have been making satisfactory progress for a minimum of five weeks. If a student has been deemed by the program to not have been making satisfactory academic progress, the student may be excluded from TGS according to stated policy.

Notification of Termination - When a decision to exclude is made, both the student and TGS must be informed of this decision in writing and sent the withdrawal document(s) within three business days. Students should be told clearly the reason(s) for their dismissal, and these reasons must be in line with written program and TGS guidelines.

Published Appeal Process - The appeal process for students who have been dismissed or excluded will follow existing appeal procedures published by TGS; specifically, all appeals must first come from the student to the Dean of The Graduate School. The Dean will determine if the appeal should be administered within TGS or through UHAS (University Hearing and Appeals System). All programs must refer (in a printed handbook and/or on the Web) to policies regarding the appeal process for students that have been dismissed and/or excluded. Appeals must be made in writing to the Dean within ten days of the dismissal or exclusion date. Any supporting materials must be provided with the written appeal.

Departmental Ombudsman – Two faculty members, Prof. Yarrow Axford and Prof. Steve Jacobsen, are available to serve as advocates for students who feel that they may have experienced any form of harrassment in the workplace.

FINANCIAL SUPPORT

Students may be supported during the academic year by University Fellowships, Teaching Assistantships, Research Assistantships and Research Grants, as well as other (e.g., external) Fellowships. Internal awards and appointments are made by The Graduate School acting on the recommendations of the department. Financial support is normally awarded for 9 months (3 quarters), providing a living stipend and covering the graduate tuition fees. Continuing financial support in the graduate program is contingent on satisfactory academic performance, which is evaluated by the departmental faculty each quarter. Twice a year, in the fall and spring, each student's thesis committee meets to review past accomplishments and future plans. At these times, decisions about the continuation and type of support are made. After the first year, students may apply for summer research funding through the Sloss Research Awards (see below) to augment the 9-month support.

•**University Fellowships** are typically provided by TGS for first-year graduate students.

•**Teaching Assistantships** are provided to students in the first and subsequent years. Teaching is an essential element of the education and training experience of PhD students at Northwestern. The Graduate School requires that all PhD students serve in some instructional capacity for at least one academic quarter during their graduate education at Northwestern. This teaching requirement is an integral aspect of professional development. The Graduate School strives to ensure that teaching demands are equitable across academic programs.

•**Research Assistantships** represent a principal source of financial support for students admitted to Ph.D. candidacy. Research Assistantships are obtained by faculty members from outside sources for research on specific topics. Each student is urged to identify fields of interest as early as possible and to contact the relevant faculty members about the possibility for employment as a Research Assistant. Research projects and financial support are arranged by mutual consent of the student and faculty members.

•**Sloss Fellowships** are supported by endowment funds and provide a tuition scholarship and stipend to qualified graduate students.

•**Sloss Research Awards** are granted annually, whenever possible, based on evaluation of research proposals written by the students. To compete for the award, students must be in good academic standing and demonstrate financial need (no other sources of support). Awards typically help to offset the costs of field work and/or summer research.

•**Boos Fellowships** are supported by endowment funds and provide a tuition scholarship and living stipend to qualified female graduate students.

•**Minority Fellowships** from external sources can be found through The Graduate School's external fellowships for minority students page at :
<http://www.tgs.northwestern.edu/diversity/funding-opportunities/>

•**Health insurance** - All graduate students are required by the University to carry health insurance. The Department and the Graduate School support the annual premium for a health insurance plan that is provided through the University.

TGS External Award Policy. TGS strongly encourages every graduate student to apply for funding from a source external to the University sometime before the end of his or her fourth year. Please follow this link for more details: <http://www.tgs.northwestern.edu/financial-aid/fello-schola-grants/external-funding/>).

Examples of awards include but are not limited to:

- NSF Graduate Research Fellowship: www.nsf.gov/funding/pgm_summ.jsp?pims_id=6201
- US EPA – National Centre for Environmental Research Science To Achieve Results (STAR) Fellowships For Graduate Environmental Study: <http://www.epa.gov/ncer/rfa/>
- NASA Earth System Science Fellowship Program:
<http://science.nasa.gov/researchers/sara/student-programs/#grad>
- Other fellowships can be found through The Graduate School's fellowship and scholarship information pages at: <http://www.northwestern.edu/fellowships/fellowships/for-graduate-study/index.html>

CONFERENCE TRAVEL

First-year students wishing to present research completed *prior* to arriving at NU must seek travel funds from former advisors or major professional associations such as AGU, GSA, and others.

Students who have completed at least 3 quarters of full-time registration may apply for a Graduate School Conference Travel Grant (<http://www.tgs.northwestern.edu/financial-aid/fello-scholarships/university-fello/travel/>) for one award of \$500 per year, which may be further supplemented by \$300 from the Department, upon written application to the Department Chair. The application email sent to the Chair and the Business Manager should include a copy of the research abstract, and be submitted ideally 60 days prior to the conference, but no later than 1 month beforehand. **Students are eligible for a maximum of two grants over the entire course of their graduate career.** See the TGS website for further eligibility requirements (<http://www.tgs.northwestern.edu/financial-aid/fello-scholarships/university-fello/travel/>).

For travel to a second annual meeting, departmental support of up to \$300 may be awarded upon application. In general, students should remind their faculty advisors that conference travel for presenters should be supported by the research grants funding their work. Students may also seek additional funding for conference attendance awarded on a competitive basis from sources such as the major professional associations (AGU, GSA, etc.).

SPECIAL AWARDS

The primary responsibility for support of the student's research rests with the student's advisor. The department may provide additional support, if needed, for specific items, including field work, research equipment, acquisition of data or travel to meetings. Needs of this nature should first be discussed with the student's advisor, and requests for support made in writing to the Chair of the Department.

The department recognizes excellent performance in teaching and research by graduate students. Our alumni have generously endowed the *Horace A. Scott Awards* for outstanding research, and the *Marion Sloss Award* to an outstanding Teaching Assistant. These awards are made at the spring graduation reception every year.

Students may also be eligible for other National or University awards, and these opportunities should be brought to the attention of the research advisor, the Director of Graduate Studies, or the Chair's Office so that nomination of the student may be considered.

PATH TO THE Ph.D. DEGREE

ADVISING

The first step in the advising process is for the student to meet with the Director of Graduate Studies and determine whether all General Requirement prerequisites have been met, and if not, to plan appropriate coursework. A *Worksheet for Ph.D. Requirements* is included at the back of this *Guidebook* to aid each student in academic planning. Please submit annual updated copies of this form to the office for inclusion in your permanent file.

Each newly admitted graduate student is assigned an initial faculty adviser based on research interests expressed in the graduate application. The faculty advisor works together with the Director of Graduate Studies to provide initial research and curricular consultation. During the first year, students should identify faculty advisors for their (two) qualifier propositions (usually, but not always, the initial faculty advisor remains the lead dissertation mentor). By the end of the first year the Director of Graduate Studies will appoint a qualifying exam committee consisting of the two qualifier advisors and one additional faculty member from the department. Students meet regularly with their lead advisor, and meetings of the entire committee to review course work and research activity are scheduled for the Spring and Fall quarters. Based on these meetings, summaries of student progress are filed with the Director of Graduate Studies.

If a student decides to change their research specialization during the first year, he or she may switch research advisors by submitting a written request to the Director of Graduate Studies; approval for such a change must also be obtained in writing.

Students are encouraged to make progress in research work as soon as possible, and to choose a curriculum that provides needed training for their research. However, course work should also expand one's knowledge beyond their subdiscipline. Advisory committees will assist in guiding each student's selection of courses.

In addition to regular appointments with their research advisor to discuss research, students are required to schedule two formal advisory meetings per year with their full advisory committee; the Fall meeting must be completed before the end of October. The Spring meeting must be completed before the end of May.

One week prior to the scheduled meeting the student should provide each committee member:

- An unofficial transcript for pre-candidacy students;
- An updated *Curriculum Vita* including activities and accomplishments for the reporting period (i.e., since the last committee meeting);
- A summary of **academic** and **research** objectives for the reporting period, progress and results, and objectives for coming year.

During the meeting with the student, the committee chair will record the discussion in a brief synopsis to accompany the materials prepared by the student. This synopsis must be signed by all participants. Summaries of the meetings are to be filed with the Director of Graduate Studies and the departmental office. ***This system of documentation is now a requirement of the Graduate School - failure to file summaries by stated deadlines will result in suspension of departmental financial support.***

The members of the Advisory Committee can be changed by request of the student to the Director of Graduate Studies. Such requests should be made and approved in writing.

THE QUALIFYING EXAMINATION

The Qualifying Exam consists of an oral defense of two written research propositions on different subjects prepared under the guidance of two faculty advisors. The nature and scope of the two propositions are chosen and approved in consultation with the student's advisor and the Director of Graduate Studies. Propositions commonly are the result of the student's work in Independent Study courses (499's) and form the basis for future thesis research. The examination itself focuses on the development of the research question, the significance of the research, the student's command of relevant disciplines, and the appropriateness of the methods used, as outlined in the propositions. For students entering with a Master's degree, one of the propositions may be based on their Master's thesis, but only with prior approval of the student's advisor and the Director of Graduate Studies.

As soon as practically possible, but no later than the end of the first year of residence, students should submit, in writing, the titles of the two research propositions they will defend in the Qualifying Examination to the Director of Graduate Studies, including the name of the advisor for each proposition. This is a requirement before scheduling of the Qualifying Examination can proceed. To schedule the Qualifying Exam, students should contact the Director of Graduate Studies and submit a completed Outline of Ph.D. Requirements form.

Students entering with a Bachelor's degree are required to take the Qualifying Examination by the end of their sixth quarter in residence. Students entering with a Master's degree who wish to use the Master's research for one proposition must take the exam by the end of the fifth quarter of residence. The Director of Graduate Studies will appoint an Examining Committee consisting of the two faculty supervising the propositions and one more faculty member. Propositions should be in the hands of the Examining Committee not less than 5 working days before the examination. The Qualifying Examination is open to departmental faculty, in addition to the members of the Examining Committee.

Foreign students from non-English-speaking countries must meet the minimum score requirements in TOEFL and TSE as set by The Graduate School before taking the Qualifying Examination.

Students who pass the Qualifying Examination are admitted to Ph.D. candidacy by the Graduate School. In the event of a failed examination, the student may be invited to take another Qualifying Examination, no later than one quarter after the original exam. If the committee does not recommend a second exam, the student will be expected to leave the program by the end of the quarter, at which time financial support will cease.

DISSERTATION RESEARCH

Students should formally identify the research topic of the Ph.D. dissertation as soon as practically possible, but no later than 3 months after having passed the Qualifying Examination. By that time the Ph.D. candidate should prepare and give to the Director of Graduate Studies a brief statement identifying the subject matter of the thesis, the name of the lead thesis advisor, and an outline of the research involved. The statement is not binding on the student as far as the field and nature of the upcoming research are concerned, but any substantive changes in topic or any change of thesis advisor(s) must be submitted in writing to the Director of Graduate Studies as soon as such changes occur.

At the end of the sixth year after matriculation, each doctoral student must submit to the Graduate School a statement of progress and timetable for completion of the dissertation, signed by the student and endorsed by the dissertation advisor.

THE FINAL EXAMINATION

A completed dissertation must be read and approved by the principal thesis advisor. It is subsequently read and approved by two or more additional faculty members, who, along with the principal advisor, constitute the Final Examination committee. The Final Examination can be scheduled only after all the committee members have approved the dissertation. One copy of the approved version of the dissertation must be placed in the Department Office not less than 10 days before the Final Examination.

The Final Examination is an oral presentation and defense of the dissertation held in an open-lecture format. Following the presentation, the thesis committee meets to decide on final approval of the thesis and recommendation to confer the degree. Following a successful defense, students are asked to provide a final bound copy of the dissertation to the Department of Earth and Planetary Sciences.

All requirements for the Ph.D. degree must be met within eight years of initial registration in the doctoral program. Thus, the Final Examination on a completed dissertation and the dissertation's submission to the Graduate School must fall within this period.

Students who are completing their degree will submit the following TGS forms through the online CAESAR system:

- 1) Application for Degree;
- 2) Final Exam Form via which must be approved by the department;
- 3) NRC Survey of Earned Doctorates which will be sent to you by TGS.
- 4) Online submission of dissertation via UMI ProQuest. www.etsdadmin.com/cgi-bin/home

It is the student's responsibility to ensure that all requirements of the Graduate School are fulfilled in order to graduate.

DEADLINES AND EXTENSIONS

The Graduate School mandates that all requirements for the Ph.D. degree must be met within **nine years** of initial registration in a doctoral program. Thus the Final Examination on a completed dissertation and its subsequent submission to the Graduate School in a required format must fall within this period.

A one-time extension of the deadline for two additional years may be granted by the Dean of the Graduate School upon submission of an extension petition. The petition must be signed by the student and all members of the dissertation committee.

During the period of extension, the student is not required to be in residence or register for courses. However, a student who is supported by a scholarship, needs University health insurance, access to certain University facilities, or must meet registration requirements for foreign students, must register for TGS 503 Resident Research Continuation.

CORE FACULTY

YARROW AXFORD Assistant Professor. Ph.D., University of Colorado, 2007. Quaternary Geology and Paleoclimatology. *Research Interests:* Records of ongoing climate and ecological change from lake sediments, glaciers, and soils; ice sheet dynamics; northern arctic environments.

PATRICIA A. BEDDOWS Lecturer and Department Assistant Chair. Ph.D., University of Bristol, 2004. Carbonate hydrogeochemistry and karst systems. *Research Interests:* Climate change, landscape evolution, and sea level changes as recorded in speleothems, cave sediments, and karst geomorphology; resource management.

CRAIG R. BINA Wayne V. Jones II Professor and Department Chair. Ph.D., Northwestern University, 1987. Thermodynamics, mineral physics, geophysics. *Research Interests:* Composition, structure, and thermal regime of the Earth's interior from mineral physics data and seismological observations.

NEAL BLAIR Professor, joint appointment in Civil and Environmental Engineering. Ph.D., Stanford, 1980. *Research Interests:* Biogeochemical cycling of carbon, with emphasis on the use of stable and radiocarbon isotopes as probes into biogeochemical processes.

MATTHEW T. HURTGEN Associate Professor. Ph.D., Pennsylvania State University, 2003. Earth history, biogeochemical cycles, and sedimentary geology and geochemistry. *Research Interests:* Earth system evolution—identification of the complex set of couplings and feedbacks that link the biogeochemical cycles of carbon, sulfur, phosphorus, and oxygen. The evolution of oxygen in the ocean-atmosphere system.

STEVEN JACOBSEN Associate Professor. Ph.D., University of Colorado, 2001. Mineral Physics and Earth's interior. *Research Interests:* Effects of hydration on the physical properties of mantle minerals, Earth's deep water cycle, hydrogen bonding, elastic properties of minerals, iron in minerals, crystallography, spectroscopy, high-pressure research, activity at the Advanced Photon Source, Argonne National Laboratory.

ANDREW D. JACOBSON Associate Professor. Ph.D., University of Michigan, 2001. Low-temperature isotope geochemistry. *Research Interests:* Controls on the major ion and radiogenic isotope (Sr, Ca, U-Th) geochemistry of major rivers, streams, and groundwater systems; the biogeochemistry of microbial interactions with geologic materials.

DONNA M. JURDY Professor. Ph.D., University of Michigan, 1974. Geophysics and Planetary Sciences. *Research Interests:* Plate kinematics and dynamics; hotspots, their origin and utility as a reference frame; driving forces of plate tectonics, tectonics of Venus and Mars.

ABRAHAM LERMAN Professor Emeritus. Ph.D., Harvard University, 1964. Geochemical processes and transport. *Research Interests:* Global geochemical cycles of carbon, nitrogen, and phosphorus; environmental geochemistry; transport processes in rivers, lakes and marine sediment-water systems; chemical diagenesis and weathering; settling and reactivity of modern sediments.

EMILE A. OKAL Professor. Ph.D., California Institute of Technology, 1978. Seismology and plate tectonics. *Research Interests:* The generation, propagation, and social effects of tsunamis following large earthquakes and underwater landslides; the generation and propagation of acoustic energy in the water body of the world's oceans from earthquakes, underwater landslides, volcanic eruptions and man-made explosions.

MAGDELENA OSBURN Assistant Professor, Ph.D. CalTech 2013. Isotope biogeochemistry and geobiology. Will join the faculty in Fall 2014.

BRADLEY B. SAGEMAN Professor. Ph.D., University of Colorado, 1991. Stratigraphy, geochemistry, and paleobiology of ancient organic-rich facies. *Research Interests:* Development of astronomical time scales and reconstruction of carbon cycle dynamics for Cretaceous Ocean Anoxic Events; analysis of proxies for pCO₂, paleoproductivity, and paleoredox conditions, such as stomatal index, sedimentary Phosphorus, and other elemental and isotopic indicators; tectonic evolution of the Western Interior basin.

SETH A. STEIN William Deering Professor. Ph.D., California Institute of Technology, 1978. Earthquake seismology and plate tectonics. *Research Interests:* Earthquakes and their relation to plate tectonic processes; physical processes at plate boundaries.

SUZAN VAN DER LEE Associate Professor. Ph.D., Princeton University, 1996. Seismic tomography, plate tectonics. *Research Interests:* Tomographic modeling of the mantle in North America, South America and the Mediterranean region; use of seismic tomography in combination with geodynamic modeling to explain plate motions.

TIMETABLE OF THE PH.D. DEGREE

START	Upon arrival, meet with the Director of Graduate Studies. Meet with various faculty to discuss research interests. Start courses, teaching, and research.
3 quarters from start	Submit to Director of Graduate Studies: 1) possible titles of propositions, 2) names of faculty advisors 3) anticipated date of Qualifying Examination 4) submit Worksheet for PhD Requirements and CV to EPS files
After 1 year	Preparation for Qualifying Exam: 1) consult your Advisory Committee and the Director of Graduate Studies about the appointment of the Examining Committee 2) studying and mentoring in preparation of the exam 3) book a date for Qualifying Exam
Spring Quarter of Year 2	Qualifying exam completed no later than the end of the first month of the Spring Quarter. Submit completed Worksheet for PhD Requirements and CV to EPS files.
~3 months after Qualifying Exam	Inform the Director of Graduate Studies of the selected Ph.D. dissertation topic and research advisor.
5 years from start	Obtain approval from the department of your Prospectus (dissertation proposal). Submit your Prospectus to the Graduate School via CAESAR online.
9 years from start	Final deadline for completion of dissertation. Final Examination. Submission of dissertation.
More than 9 years, but less than 11 from start	It is possible to petition the Graduate School for a 2 year extension beyond the 9-year deadline.

WORKSHEET FOR PH.D. REQUIREMENTS

All requirements must be completed prior to scheduling the Qualifying Examination.

Student _____

Start Date _____ Current Date _____

REQUIREMENT	COURSES	WHEN TAKEN	GRADE
Four of the following six:			
Calculus - Multivariate	_____	_____	_____
Differential Equ. or Statistics	_____	_____	_____
Physics	_____	_____	_____
Chemistry	_____	_____	_____
Thermodynamics or P. Chem	_____	_____	_____
Biology	_____	_____	_____
A) SIX REQUIRED	1. _____	_____	_____
300-level courses in Earth and Planetary Sciences	2. _____	_____	_____
	3. _____	_____	_____
	4. _____	_____	_____
	5. _____	_____	_____
	6. _____	_____	_____
B) TWO REQUIRED	1. _____	_____	_____
300- or 400-level courses in math, statistics, natural sciences or engineering	2. _____	_____	_____
C) EIGHT REQUIRED	1. _____	_____	_____
Other graduate courses, of which: - Maximum two P/NP grades - Minimum two 499 with two different faculty	2. _____	_____	_____
	3. _____	_____	_____
	4. _____	_____	_____
	5. _____	_____	_____
	6. _____	_____	_____
	7. _____	_____	_____
	8. _____	_____	_____

NOTE: Indicate any awarded transfer credits (max. 3) for graduate courses completed elsewhere.

PROPOSITIONS

Advisor _____ Title _____

Advisor _____ Title _____

Qualifying Exam Date _____