
WVU Geology
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Graduate Program

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cover:
Tuscarora Sandstone on Peters Mountain near Gap Mills, WV. photo: Dorothy Vesper.
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1 INTRODUCTION

From its inception at WVU in 1877, the Department of Geology has focused on study of the natural resources of West Virginia: coal, oil, natural gas, water, and salt. Early faculty and students of the Geology program played a key role in the development of the oil industry in the Appalachian basin, the principal hydrocarbon province of the world at that time. Key areas of early specialization were petrology, stratigraphy, structural geology, paleontology and paleobotany. Since 1970, the Department has grown to encompass geophysics, geomorphology, hydrogeology, aqueous and isotope geochemistry, remote sensing, geological education, remote sensing, and GIS. Following 1980, the Geography side of the department blossomed and grew, and today the Geology and Geography faculties are of equal size. In 2007, the Department moved from its former home in White Hall into a newly-renovated Brooks Hall overlooking the Monongahela River from the downtown campus.

WVU Geology has remained a scientific research center with an applied focus. The job market for WVU geologists remains strong in both the oil and gas industry and environmental fields. Our M.S. graduates find virtually 100% job placement in technical fields. We believe that the diversity in professional fields requires a diverse geoscience education and that research problems tackled by faculty and students in the department are often multidisciplinary in scope. Faculty and student publications reveal depth and variety in research that is recognized for its regional, national and international contributions.

Tonoloway-Helderberg limestones, along US Rte. 48 near Needmore WV. Photo: Tom Kammer
West Virginia spans nearly the entire Appalachian basin from the Allegheny Plateau to the Appalachian Great Valley. Recent discovery of the largest gas field in the continental U.S. - the Marcellus shale -- has created an exploration boom which translates into unprecedented research and work opportunities for our students in all fields. The mountainous nature of West Virginia creates great scenic beauty, as well as spectacular geologic hazards (floods and landslides). Research opportunities also abound in hydrogeologic and geochemical problems related to water supply, coal mining, and acid-mine drainage. West Virginia is the second largest coal producer in the country and has a wide variety of environmental problems studied by WVU geoscientists.

The Geography Program (within the same department) stresses GIS applications that complement Geology research initiatives, including economic planning for resource utilization and environmental studies. Both programs rely heavily on state-of-the-art computer facilities as research tools, not only in quantitative fields such as geophysics and hydrogeology but in the more traditional disciplines as well. The WVU geoscience experience has a strong information-technology flavor.
2 GEOLOGY FACULTY

2.1 GRADUATE FACULTY

Graham Andrews (Ph.D. Leicester, UK, 2006) Assistant Professor -- Petrology

Kathy Benison (Ph.D. Kansas, 1997) Associate Professor – Sedimentary Petrology.

Timothy Carr (Ph.D. Wisconsin) Department Chair; Marshall Miller Energy Professor of Geology – Petroleum Geology.


Dengliang Gao (PhD. Duke, 1997) Professor, Geophysics.

Steven Kite (Ph.D. Wisconsin, 1983) Associate Professor - Quaternary Geology, Surficial Geology, Geomorphology, Geoarcheology.

Lamsdell, James (Ph.D., Kansas, 2014) Assistant Professor -- Paleontology

Shikha Sharma (Ph.D. Lucknow, 1998) Associate Chair for Geology, Associate Professor -- Stable isotope geochemistry


Dorothy J. Vesper (Ph. D. Penn State, 2002) Associate Professor – Aqueous Geochemistry, Karst Geology


Amy Weislogel (Ph.D. Stanford, 2006) Associate Professor, Sedimentology, Stratigraphy, Sedimentary petrology.


2.2 EMERITUS FACULTY

Alan C. Donaldson (Ph.D. Penn State, 1959) Professor (Emeritus) – Sedimentation, Stratigraphy.

Tom Kammer (Ph.D. Indiana, 1981) Professor (Emeritus) – Paleontology

Helen Lang (Ph.D. Oregon, 1983) Associate Professor (Emeritus) – Petrology, Mineralogy

Henry Rauch (Ph.D. Penn State, 1972) Professor (Emeritus) – Hydrogeology, Geochemistry.
John J. Renton (Ph.D. WVU, 1965) Professor (Emeritus) – Coal Geology, Geochemistry.


2.3 TEACHING FACULTY


Kenneth Brown (Ph.D. Miami OH, 2015) Teaching Assistant Professor

Joseph Lebold (Ph.D. West Virginia, 2007) Teaching Assistant Professor

Field camp GTAs and faculty at Devils Tower National Monument. Photo: Steve Kite
3 RESEARCH LINKAGES IN MORGANTOWN

The WV Geological and Economic Survey (WVGES), located 5 miles from Morgantown, makes available laboratory equipment, fossil collections, cataloged drill cuttings and core, and subsurface logs from deep wells in the region. The Survey also offers students work and thesis opportunities in coal resources and petroleum geology. Several survey geologists are adjunct faculty.

The National Energy Technology Laboratory (NETL) of the U.S. Department of Energy laboratory located in Morgantown and Pittsburgh carries out and funds research on fossil-fuel resources and environmental problems. NETL projects support Geology faculty and graduate-student research.

The West Virginia Water Research Institute (WVWRI), led by Director Dr. Paul Ziemkiewicz, is the premier water research center in West Virginia and an international leader in certain fields. The Institute is based at the National Center for Coal and Energy at the Evansdale Campus of WVU.

The Marcellus Shale Energy and Environment Laboratory (MSEEL) aims to demonstrate the best approach to drill, complete, and produce a new horizontal well that minimizes any environmental and social costs, while maximizing economic productivity. The MSEEL Director is Dr Tim Carr.

The WVU Institute for Water Science and Security (IWSS), led by Dr. Jason Hubbart, coordinates and promotes campus-wide research in all pivotal areas of water, including stewardship, management, resources, innovations, policy, human health, land-use practices and sustainability. It is housed in the Davis College of Agriculture, Natural Resources and Design. The Institute is currently in the process of setting up an outdoor water laboratory for research in Morgantown.

The West Virginia GIS Technical Center, housed in Brooks Hall, is the central source for geographic information science resources in West Virginia. The Tech Center is responsible for scanning and digitization of USGS DLGs, DOQs, and a host of other data products. The Center provides technical-support services for the development and operation of GIS in West Virginia. A limited number of RA opportunities are available related to Center activities.
4 FACILITIES

4.1 COMPUTER FACILITIES AND NETWORK

Both research and teaching computing facilities are outstanding for a department of fewer than 100 grad students. These facilities are centered on a Windows client-server network. The research cluster has access to >5 terabytes of redundant networked storage based on a series of RAID servers, as well as diverse networked printers, large-format plotters, large-format digitizers, and scanners. The teaching cluster provides interactive computing resources for >130 students on networked Windows + Linux-based computers, including a dual-screen workstation-class lab with industry geophysics and exploration software. There is an interactive 3-D GeoWall teaching laboratory. Classroom demonstration facilities are available in all teaching labs. All resources are regularly-upgraded with a replacement period of 2-3 years. Clusters for the GEO workgroup are linked across the NT intranet to the WVGIS center and have gateway access to the University backbone. Ethernet cabling reaches virtually every lab, office, and classroom in the building. Networked computers are provided in nearly all grad student offices.

4.2 SOFTWARE

The Department maintains software for instructional and research usage. A full range of common applications software is available on all network machines. In addition, statistical packages (SAS, R) allow students to undertake detailed statistical analysis, whereas graphical analysis packages (Surface III, Mapping Contour System, TruFlite, Surfer) enable users to render both 2D and 3D surfaces. GIS licenses include ARC GIS and IDRISI, all accessible to students for integration of complex geological and geophysical data. ERDAS IMAGINE provides a suite of image-processing tools for analyzing remotely sensed data. AutoCAD, Adobe Illustrator, CorelDraw, and other graphics design packages allow accurate rendering of technical diagrams.

State-of-the-art geophysical modeling and processing software are available for instructional and research use. We have considerable Windows based software that includes Schlumberger’s Petrel software along with several Ocean plugins that include SpecDecomp, Microseismic and Mangrove, and separate TekLog, PetroMod, Eclipse and Intersect packages; IHS’s Kingdom Suite including 2D/3D Pak, GeoSyn and Microseismic modules; Petra, GeoTeric and FracMan: software resources that give us a spectrum of powerful tools to interpret and analyze 3D seismic reflection data and well logs. There is also a 3D Seismic Attribute Visualization & Interpretation Lab, featuring Linux/windows dual-boot workstations along with state-of-the-art 3D seismic visualization software (VoxelGeo plus 3D Canvas), sponsored by Paradigm Geophysical Inc. Interpex Ltd. terrain conductivity, resistivity, gravity and magnetic modeling software are also available.

Software for groundwater simulation includes aquifer characterization packages (AQTESOLV), finite-difference flow and particle-tracking codes (MODFLOW2000, MODPATH3), solute-transport codes (MT3D, MODFLOWT), and preprocessors (Groundwater Vistas). Streamflow-modeling capabilities includes RIVERMORPH, HEC-2 step-backwater and peak value flood frequency software.
For structural geology studies we use 2Dmove (Midland Valley), in addition to standard structural analysis software. Basin modeling and evaluation of the generation of hydrocarbons are carried out with the GENEX (Beisip-Franlab) software.

4.3 LABORATORY AND FIELD INSTRUMENTATION

GEOLOGICAL

The department has a rock-crushing room equipped with jaw crusher and disk grinder as well as laboratories devoted to geological sample preparation which include standard mineral separation equipment (Frantz magnetic separator, Gemini table, and heavy liquids set-up). For additional details contact Dr. Jaime Toro (Jaime.Toro@mail.wvu.edu).

GEOPHYSICAL

The department owns the GEM-2, a multifrequency terrain conductivity developed by GeoPhex Ltd. We also own a Geonics very low frequency (VLF) EM meter (Phoenix and Geonics EM16) and an EM34 terrain conductivity meter. Along with the EM16 we have the EM16R resistivity attachment. We also have a Geometrics Magnetometer. For seismic work we have a Bison Instruments 12 Channel Seismograph. The department and geophysics lab offers large format plotting on 24-42 inch HP plotters. For additional details contact Dr. Tom Wilson (Tom.Wilson@mail.wvu.edu).

GEOCHEMICAL

The department has a state-of-the-art Stable Isotope facility equipped with a Finnigan Delta Advantage continuous flow mass spectrometer connected to three peripherals i.e. Gas bench Device, Element Analyzer and TC/EA via a Conflo IV interface. This interface allows immediate switching between three sample preparation devices significantly reducing idle time while increasing sample throughput. The instruments are set-up for measuring the C, N, O and H isotopes in a wide variety of substrates ranging from waters, gases, and sediments to plant/animal tissues. The isotope laboratory also serves as a hands-on teaching and training facility for graduate students. For additional details contact Dr. Shikha Sharma (shikha.sharma@mail.wvu.edu).

The Department also has access through the WVU Shared Research Facilities to major instrumentation including a Panalytical Xpert Pro X-Ray Diffraction unit, a JEOL JEM-2100 Transmission Electron Microscope, a Hitachi S-4700 Scanning Electron Microscope, an Asylum MFP-3D Atomic Force Microscope (AFM), and numerous other instrumentation.

HYDROGEOLOGICAL

Groundwater field equipment includes an array of pressure transducer/datalogger instruments, Grundfos 4” and Redi-Flo 2 pumps, as well as a variety of generators, sampling pumps, flumes, pH and conductivity meters, bailers, and current meters. For additional details contact Dr. Joe Donovan (jdonovan@wvu.edu).
QUATERNARY GEOLOGY AND GEOMORPHOLOGY

Quaternary Geology and Geomorphology research is served by a particle-size analysis laboratory as well as field instrumentation such as Garmin and Trimble GPS units, its, Leica laser levels, and a Leica TC400 electronic distance meter. For additional details contact Dr. Steve Kite (jkite@wvu.edu).

REMOTE SENSING

The Remote Sensing Laboratory supports licenses for ERDAS Imagine, ENVI/IDL, Idrisi, ArcInfo, eCognition and Terasolid lidar software. The department has outstanding computing facilities. The remote sensing field program is supported by a portable full-range (0.4 to 2.5 micrometer) ASD spectroradiometer. The laboratory also coordinates the West Virginia View state remote sensing consortium. For additional details contact Dr. Tim Warner (Tim.Warner@mail.wvu.edu).
5 GRADUATE PROGRAM ADMISSION AND SUPPORT

The Department offers Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Geology. The M.S. degree is a nominal 2-year program, generally completed in between two and three years. The Ph.D. degree requires from three to six years of study. Currently there are approximately 50 graduate students, about 65% M.S. and 35% Ph.D. program.

5.1 REQUIREMENTS FOR ADMISSION

Applicants should have a bachelor's degree in geology or a related field. However, students with a strong record and willingness to take additional courses to make up deficiencies in geology and related sciences are encouraged to apply. A grade-point average of 3.5 or higher is most competitive for financial assistance, students must have GPAs of at least 3.0 to be accepted. All candidates must apply through the WVU grad application website http://graduateadmissions.wvu.edu/, submit general GRE Test scores (verbal, quantitative, and analytical), provide academic transcript(s) of all college courses, and request 3 letters of recommendation to be submitted directly to WVU from the referees. Although the admission process continues until all positions are filled, applicants seeking financial support should apply before February 1 (for Fall admission) or before October 15 (for Spring admission). Nearly all new graduate students begin during the fall semester.

International students are required to take either the TOEFL or IELTS exam (see university policy: http://graduateadmissions.wvu.edu/information-for/international-students).

Additional information regarding admission to the graduate program can be found online: http://www.geology.wvu.edu/graduate-studies/prospective-students

5.2 FINANCIAL SUPPORT

Support for graduate students is available from a variety of sources, including Graduate Teaching Assistantships (GTAs), Research Assistantships (GRAs), and Fellowships. It is a general policy of the Program to financially support all grad students that we choose to accept for a minimum of 4 semesters (MS) or 6 semesters (PhD). Provisional students or students with remarkably productive records may receive extended support. Support is contingent upon making good progress towards timely completion of the degree.

TEACHING ASSISTANTSHIPS (GTAs)

Approximately 10 GTAs are awarded to new entering Geology graduate students each year. A TA for an M.S. student is a nine-month appointment paying about $13,350 in addition to a waiver of full-time University tuition (up to 12 credit hours per semester). In return for this stipend, the student works about 20 hours per week teaching and/or assisting in undergraduate labs and classes. Summer University tuition is waived for students who held a TA or RA during the preceding two semesters. Ph.D. students receive a stipend of $15,750 for a nine-month appointment plus a tuition waiver.
All students are required to pay College Tuition and University Fees. During the 2016-2017 academic year, college tuition was $279/semester for residents and $531 for non-residents. University fees were $630/semester. Updated information on tuition and fees are posted on [http://financialservices.wvu.edu/home/wvu-tuition-and-fees](http://financialservices.wvu.edu/home/wvu-tuition-and-fees).

TA awards are competitive and normally tendered only to the strongest students. Students hoping to obtain a TA are encouraged to visit the WVU campus during fall or winter of the year prior to entry and to meet with WVU faculty in areas of their research interests. We should receive the complete application by February 1.

Positions are normally filled by April 15. Whereas most TAs start in Fall, there is occasionally a TA vacancy beginning in January.

International applicants desiring Teaching Assistantships for financial support must also pass a WVU-administered SPEAK examination in oral English (in the Intensive English program). If interested, contact the Grad Program chair.

RESEARCH ASSISTANTSHIPS (GRAs)

Research Assistantships are positions that support student research under supervision of a faculty member with funded research grants and are competitively awarded. Terms of RA employment vary and pay commensurately to GTAs and also include a full waiver of tuition. Normally the research performed is part of the student’s thesis or dissertation. Students interested in obtaining RA support should contact faculty working in their field of interest.

UNIVERSITY FELLOWSHIPS

Incoming graduate students are eligible for nomination for one of a series of competitive fellowships. All such nominations must be submitted by a G/G faculty member (e.g., the applicant's prospective advisor). Students cannot themselves apply for this fellowship. Nominators should visit the Fellowships Nomination Information page for details on fellowships for which they may be qualified and for instructions on how to be nominated for such a fellowship.


DEPARTMENTAL ENDOWMENTS

The Geology Program has access to a number of funded endowments supplying smaller amounts of funding per annum, in the range of $250-$2500, to support graduate student research. The designated use(s) of such funds and student eligibility varies from source to source. Students will be notified in March of each year to submit applications the Associate Chair in a specified research proposal format. Funds will be awarded competitively, with funds available normally after July 1. The amount of funds disbursed will vary from year to year based on availability of endowment earnings.
In addition to these endowments, the Milton Tidd and Doris E. Heald Promising Researcher Award, recognizes the significant contributions that Milton Tidd Heald, a former WVU Professor of Geology, and his supportive wife, Doris Ethier Heald, gave to the geology community in the research areas of quartz cementation and sedimentary diagenesis. The award supports Geology Graduate students who show an aptitude and desire for advanced research in geology at the M.S. or Ph.D. level. The award will be based on an annual open competition. Graduate students wishing to apply shall submit their thesis or dissertation proposal to the Associate Chair for Geology and include a summary statement that discusses why the research is significant to the graduate researcher and to the discipline of geology in general. Generally, one or two awards are made annually.

FINANCIAL SUPPORT FROM LOCAL AND UNIVERSITY RESEARCH UNITS

The National Energy Technology Laboratory (NETL), the West Virginia Geological and Economic Survey (WVGES), and the National Research Center for Coal and Energy (NRCCE) sponsor research-assistant positions that provide hourly wages for some students. These positions may in some cases include tuition waivers. Students also gain employment at the WV GIS Technical Center, in Brooks Hall.
6 GENERAL REQUIREMENTS FOR ALL GRADUATE PROGRAMS

6.1 SUMMARY OF REQUIREMENTS BY GRADUATE DEGREE

<table>
<thead>
<tr>
<th>Summary of Geology Degree Requirements</th>
<th>M.S. Option I. Research</th>
<th>M.S. Option II. Professional Studies</th>
<th>Ph.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursework Credits</td>
<td>24</td>
<td>33</td>
<td>As determined by research committee</td>
</tr>
<tr>
<td>Colloquium Credits (GEOL 699)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PhD Seminar Credits (GEOL 796)</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Research Credits &amp; Requirements</td>
<td>6 (GEOL 697)</td>
<td>6 (GEOL 680)</td>
<td>Unspecified (GEOL 697)</td>
</tr>
<tr>
<td>Original Research Thesis</td>
<td></td>
<td>2-Semester professional-style project</td>
<td>Original Research Dissertation</td>
</tr>
<tr>
<td>Total Required Credits</td>
<td>32</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Milestones</td>
<td>Thesis Proposal</td>
<td>Research Plan</td>
<td>Preliminary Exam</td>
</tr>
<tr>
<td></td>
<td>Thesis Submission</td>
<td>Project Defense</td>
<td>Dissertation Defense</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Report Submission</td>
<td>Dissertation Submission</td>
</tr>
</tbody>
</table>

6.2 PLAN OF STUDY

New students are required to develop a Plan of Study within their first month in the program. The purpose of the Plan of Study is to identify the courses and requirements the student must meet to obtain their desired degree. Masters students will initially develop this with an Advising Committee. PhD students will develop this in conjunction with their advisor.

The original signed Plan of Study is given to the Graduate Secretary for placement in the student file. The Plan of Study can be revised at any time with the agreement of the student and the appropriate advising/research committee. The final Plan should reflect the actual courses taken by the student and be signed by their research committee.
6.3 PROJECT/THESIS/DISSERTATION PROPOSAL

All students must complete a written proposal and formal proposal defense. The purpose of a proposal is for the student to present their planned research in a concise and cogent document that illustrates (1) the need for the research, (2) that clear objectives exist for the project, and (3) the work is feasible.

Once the advisor has approved the proposal for sharing with the research committee, the student circulates a publication-quality written proposal to committee members. The faculty members will review the proposal and decide if it is defensible. The student should assume this process will take at least one week. If all committee members approve the written proposal, the student may schedule their proposal defense date.

This proposal defense must be advertised at least 1 week prior to the event by (1) notifying the graduate secretary, (2) sending an email to the Department, and (3) by posting notices in Brooks Hall.

The student will present their proposal in approximately 30 minutes. Following the oral presentation, the student will respond to questions from the general audience, and then from the student’s Research Committee. After the public session, the Committee will meet with the student in closed session to examine the research plan, the feasibility of the proposed goals, the practicality of the work plan/ scope, and the appropriateness of the methodology. The proposal will be judged as pass or fail, based on a closed vote of the respective committee. Passing votes must be unanimous or nearly unanimous (with only 1 dissenting vote allowed). One reexamination only is allowed for each proposal.

6.4 PROJECT/THESIS/DISSERTATION DEFENSE

All students must complete a written and formal defense of their final document (report, thesis or dissertation). The final defense cannot take place during the same semester as the proposal defense.

Once the advisor has approved the final document for distribution to the research committee, the student circulates the document to committee members. The faculty members will review the document and decide if it is defensible. The student must provide the dissertation defense draft to all Committee members at least 2 weeks prior to scheduling a defense date.

If all committee members approve the written draft document, the student may schedule their defense date. Once a date is selected, the student will obtain a Thesis/Dissertation Date Declaration Form from Eberly College of Arts and Sciences web site, for which they will obtain approval signatures from all Dissertation Committee members, then deliver to Hope Stewart for scheduling. The dissertation defense may be scheduled no sooner than 2 weeks following submission of the signed Thesis/Dissertation Date Declaration Form.

The defense must be advertised at least 1 week prior to the event by (1) notifying the graduate secretary, (2) sending an email to the Department, and (3) by posting notices in Brooks Hall.
The student will present their research in approximately 30 minutes or as agreed upon with the research committee. Following the oral presentation, the student will respond to questions from the general audience, and then from the student's Research Committee. After the public session, the Committee will meet with the student in closed session to evaluate the written document and oral defense.

The defense will be judged as pass or fail, based on a closed vote of the respective committee. Passing votes must be unanimous or nearly unanimous (with only 1 dissenting vote allowed). One reexamination only is allowed for each defense.

6.5 MILESTONE TRACKING FORMS

Upon completing a degree milestone, all students will complete a Milestone Completion Form (found in the presentation and conference rooms). This is signed by the faculty committee and the student and specifies the outcome of the milestone event along with any required future actions. The original signed form is given to the graduate secretary and is placed in the student file.

6.6 GEOLOGY COLLOQUIUM

All graduate students are required to complete 2 hours of Graduate Colloquium (GEOL 699) for graduation. The graduate colloquium is taken by all grad students for 1 credit per semester during two different semesters.

6.7 ANNUAL PROGRESS ASSESSMENT

All graduate students will normally have their progress reviewed each spring during residence, as a condition of continued financial support. Students must show demonstrated progress towards completion of their degree in a timely fashion. Assessments will be done in coordination between the Associate Chair, the student's graduate advisor, and the Geology Grad Program Committee and will be used in determining continuation of financial support.

6.8 WITHDRAWING FROM COURSES

Graduate students are not permitted to withdraw from classes unless they have permission from their advisor AS WELL AS the Graduate Program Committee. Students interested in doing so must provide a written statement explaining the rationale for the change.

6.9 MINIMUM GRADES AND COURSE LOAD

A graduate grade-point average of at least 3.0 must be maintained by students to continue their TA or RA appointment and to qualify for graduation. Full-time students under financial support must normally maintain a minimum load of 12 hours each semester.

6.10 WVU GRADUATE CATALOG

Graduate students are responsible for reviewing the specific degree requirements, including the payment of necessary fees noted within the current electronic WVU Graduate Catalog. The WVU graduate catalog is found at: http://catalog.wvu.edu/graduate/.

7 MASTER OF SCIENCE (M.S.) DEGREE IN GEOLOGY

7.1 OVERVIEW OF MS DEGREE OPTIONS

The M.S. degree has two options with different course and research requirements. The prospective candidate should choose an option no later than the beginning of the second semester in residence.

OPTION I: M.S. GEOLOGY -- THESIS

Option I is the traditional thesis model for research. The Thesis option involves focused course work plus a relatively open-ended research project, of broader scope than the Professional Studies project (see Option II below), with original content and of approximately one-year duration. It requires fewer total course credits carefully chosen to serve the thesis needs. Students considering a future Ph.D. or seeking employment in geological research are advised to choose this option.

Option I requires a minimum of 24 formal course credits plus 6 research credits (GEOL 697) and 2 hours of Graduate Colloquium (GEOL 699) for graduation. A thesis based on original research is required. The thesis is done under supervision of a faculty Advisor and a Research Committee of three faculty including the Advisor. Two of the three committee members (including the advisor) must be a regular graduate faculty member, and all must have attained the degree of MS or higher.

The Option I student must write a proposal stating the research problem, methods, and time-line for their thesis, and they must formally present this proposal to their research committee. For timely completion of the M.S. degree, students are advised to submit their proposal by the end of their first year of residence.

OPTION II: M.S. GEOLOGY -- PROFESSIONAL STUDIES

The Professional Studies Option provides a non-thesis research opportunity for students in the WVU Geology M.S. program. A project totaling at least 6 hours must be completed over two consecutive semesters (or equivalent alternate timeframe), in addition to completion of at least 33 hours of formal graded (non-S/U) graduate courses from at least 5 different graduate instructors. This M.S. degree option is designed to develop problem-solving skills essential to a working geoscientist and simulates projects in which geoscientists must find and report the answer to a well-defined question before an inflexible deadline. In contrast, the traditional M.S. thesis option is comprised of more open-ended research with few fixed deadlines. The Professional Studies Option is not recommended for students considering eventual doctoral research.
Specific goals of the Professional Studies problems are:

- to gain experience in supervised investigation of a single topic or problem, in more depth than a formal course permits;
- to gain discipline and experience in meeting deadlines;
- to gain experience in summarizing and presenting results in oral and written form; and,
- to provide solutions to well-defined problems of academic, societal, economic, or environmental importance.

### Comparison of MS theses (Option I) and projects (Option II)

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<tr>
<th></th>
<th>Traditional MS Thesis</th>
<th>Professional Studies Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timetable</strong></td>
<td>Open-ended, but generally designed to be completed within a year of successful proposal (full-time students).</td>
<td>Fixed, designed to be completed within 4-5 months of successful proposal.</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>On par with peer-reviewed publications in the discipline.</td>
<td>Highest attainable within fixed deadlines.</td>
</tr>
<tr>
<td><strong>Originality of research methods</strong></td>
<td>Expected. Where application of existing techniques is involved, student is expected to assess how the technique might be adapted or improved.</td>
<td>Optional. Commonly will involve application of proven techniques to a new study area. May involve creation of baseline data for future study or reassessment of a previous study.</td>
</tr>
<tr>
<td><strong>Supervision</strong></td>
<td>Varies from project to project.</td>
<td>Structured, with explicit fixed intermediate deadlines.</td>
</tr>
<tr>
<td><strong>Mastery of Literature</strong></td>
<td>In depth for subject chosen.</td>
<td>Non-detailed; restricted to that required to execute project.</td>
</tr>
<tr>
<td><strong>Contribution to the Discipline</strong></td>
<td>Could lead to publication in peer-reviewed literature with student as major author.</td>
<td>Not likely to lead to peer-reviewed publication, except as part of a broader research effort.</td>
</tr>
</tbody>
</table>

### 7.2 GENERAL MS DEGREE REQUIREMENTS

#### 7.2.1 Plan of Study

Masters students are assigned to an Advising Committee with whom they develop their Plan of Study. Each student is also assigned an Interim Advisor, one of the members of his/her Advising Committee. Advising Committees meet in early Fall before the beginning of classes, typically on the same day as Geology Graduate Student Orientation. After students establish a Thesis or Project Committee, that committee will replace the Advising Committee and Interim Advisor in guiding the student’s Plan of Study. Students must choose their research option and identify an Advisor (Thesis or Project) by the end of their first year in residency.
The student will, under the direction of his/her Advisor and Advising Committee, draft a Plan of Study, to be completed and filed by the end of the first week of classes. The M.S. Plan of Study identifies a two-year course program as well as prospective research area(s) and advisor(s). The Plan of Study must be completed by the student/Grad Program Committee and signed by his advising committee within one month of the start of the student’s first semester.

7.2.2 Coursework

Relevant graduate-level (400, 500, 600, or 700 level) courses in Biology, Chemistry, Physics, Computer Science, Mathematics, Engineering, Soil Sciences, Business, or Law may be taken as outside courses by Geology graduate students, subject to approval by their advisor or graduate research or advising committee.

All course work applied towards the degree must be at the graduate level (numbered 400 or higher). A maximum of 12 hours 400-level for Option I and 16 hours for Option II can be applied towards degree requirements. Courses fulfilling undergraduate deficiencies or prerequisites in Geology may not count towards the M.S. degree.

7.2.3 Geology deficiencies

Students entering the Master's program must have completed or intend to complete the equivalents of all science (geology, chemistry, physics) and mathematics (calculus, statistics) courses required for the Geology BS at WVU. If a student did not take these courses formally, they will normally be required to make them up while at WVU (deficiency). Specific undergraduate prerequisites include the following:

- GEOL 101,102: The Planet Earth (4 credits)
- GEOL 103,104: Earth through Time (4 credits)
- GEOL 284: Rocks and Minerals (4 credits)
- GEOL 311: Stratigraphy and Sedimentation (3 credits)
- GEOL 341: Structural Geology (3 credits)
- GEOL 404: Geology Field Camp (6 credits)
- STAT 211 (3 credits: STAT 531 or GEOL 659 may be used as a substitute with the permission of instructor)
- MATH (6 credits): MATH 115 + 116 OR MATH 115 + GEOL 351 (Geomath)
- CHEM (6 credits): CHEM 115 and 116
- PHYS (6 credits): PHYS 101 and 102a OR PHYS 111 and 112 (GEOL 454 or AGRN 430 may be substituted with the permission of the instructor)

Similar courses from other universities or relevant experiences may be substituted with approval of the student’s Advising Committee.
7.3 MS DEGREE OPTION I (Thesis)

Option I requires 24 formal course credits; Option II requires 33 course credits. Research credits, undergraduate course credits, and credits applied for other degrees, may not be included in this total.

The student must identify a willing Advisor who is a Regular member of the Graduate Faculty. The research committee must consist of no fewer than three members; no more than one person may be a non-graduate-faculty member.

A suggested schedule for the completion of MS milestones is provided below. For students to maintain good progress in their degree, they should adhere to this milestone structure.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Milestone/Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1</td>
<td>Complete Plan of Study</td>
</tr>
<tr>
<td></td>
<td>Find an Advisor</td>
</tr>
<tr>
<td></td>
<td>Decide on thesis topic with advisor</td>
</tr>
<tr>
<td>Semester 2</td>
<td>Establish a research committee</td>
</tr>
<tr>
<td></td>
<td>Propose your research</td>
</tr>
<tr>
<td></td>
<td>Conduct research</td>
</tr>
<tr>
<td></td>
<td>Conduct Research</td>
</tr>
<tr>
<td>Semester 3</td>
<td>Conduct Research</td>
</tr>
<tr>
<td></td>
<td>Begin writing thesis</td>
</tr>
<tr>
<td>Semester 4</td>
<td>Complete writing thesis</td>
</tr>
<tr>
<td></td>
<td>Distribute thesis to committee members for review</td>
</tr>
<tr>
<td></td>
<td>Schedule defense date and complete Defense Declaration Form</td>
</tr>
<tr>
<td></td>
<td>Defend</td>
</tr>
<tr>
<td></td>
<td>Make remaining edits</td>
</tr>
<tr>
<td></td>
<td>Submit ETD to Wise Library</td>
</tr>
<tr>
<td></td>
<td>GRADUATE!</td>
</tr>
</tbody>
</table>

GRADUATE!
7.4 MS DEGREE OPTION II (Project)

In addition to the general MS degree requirements above, the Option II project follows a strict deadline-based process. Sufficient resources must be available to solve the problem on schedule. The problem design must not require more work than credit hours justify or deadlines permits.

7.4.1 Project Execution Steps

PRE-SEMESTER ONE
- selection of an advisor
- discussion of potential projects
- identification of a topic, title, and scope

SEMESTER ONE:
- complete research plan (within 1 week of the start of semester one)
- literature review
- conceptualization and design
- background data collection or compilation
- proposal development, review and revision
- presentation and successful defense of proposal

SEMESTER TWO:
- workplan execution, including fieldwork and new data collection
- analysis of results
- project report development, review and revision
- presentation and successful defense of report

7.4.2 Timelines and Deliverables

Students should enroll in GEOL 680: Directed Studies: Project Research for a total of 6 credits during Semester One and Semester Two (or alternate timeframe) of project execution. Different numbers of credits summing to 6 may be taken, but the project must be begun and completed in two consecutive semesters.

Semester One should be devoted to literature review, problem identification and definition, and research proposal formulation, presentation, and defense. Semester Two (or alternate timeframe) will be devoted to execution of the research plan, preparation of a final research report, and a successful public project defense.

The deliverables for Semester One include a completed final committee draft of the proposal, approved by the student’s committee. The proposal may be defended before the end of Semester One or, with permission from all the Committee, within the first 2 weeks of Semester Two. Failure to comply with these deadlines will be basis for a grade of “F” in GEOL 680 for Semester One.

The deliverables for Semester Two include a completed project report, approved by the student’s committee, and a successful oral defense of the report. The defense must be
completed before the end of Semester Two. Failure to comply with these deadlines will be basis for a grade of “F” in GEOL 680 for Semester Two.

Alternate timeframes: Projects may be completed in two academic semesters; in one academic semester followed by one summer; or in one summer followed by one academic semester. All projects must be done in consecutive (back-to-back) academic terms, barring extreme unforeseen circumstances. Projects that are substantially incomplete and followed by student non-residence for reasons of taking employment or personal choice will result in a grade of F in GEOL 680 for that semester and the project will be terminated without completion. Exceptions to this rule may be based on medical exigencies only, and must be approved in appeal to the Graduate Program Committee, in conjunction with the student’s Advisor. Note that for the purpose of deadlines, summer term (3 months) is equated to a semester (4.5 months) during which a student takes formal classes.

7.4.3 Project Administration
To oversee the project, the student must identify a willing Advisor, who must be a Regular or Associate member of the Graduate Faculty. This is done in the semester before Semester One, in order to allow scheduling of GEOL 680 for Semester One. The student is also required to convene a Project Committee, in consultation with his/her Advisor. Professional Studies M.S. project committees must consist of no fewer than three members, at least one of whom must be a regular graduate faculty member. No more than one person may be a non-graduate-faculty member, and a non-member cannot be chair (primary advisor).

The selection of a committee must be completed no later than the end of the first week of Semester One. The student will at that time file a completed Research Plan with the Graduate Program Committee Advising Chair, which will thereupon become attached to the student’s Study Plan.

Once formed, the student’s Project Committee will take over the tasks of the student’s Advising Committee in monitoring his/her academic progress, including submission/revision of the college Plan of Study. Grades in GEOL 680 will be determined and administered by the student’s committee + advisor at the completion of the proposal (Semester One) and Defense (Semester Two) and may be either A, B, C, D or F. A grade of “Incomplete” (“I”) will only be given for extraordinary circumstances truly beyond all control of the student, and this grade must be based on successful appeal to the Graduate Program Committee in conjunction with the advisor. If an “Incomplete” grade is approved, an Incomplete Contract must be filled out by the student and advisor and filed in the Department Office.

The Project Advisor and Project Committee are responsible for monitoring/submitting all requirements for graduation, including the defense scheduling request, the defense approval, the departmental Milestone form, and the ETD for the project.

The minimum requirement for Option II is 33 formal for-grade course credits plus 6 project credits (GEOL 680) and 2 hours of Graduate Colloquium (GEOL 699) for graduation. Project credits may be earned in conjunction with off-campus experiences by consent of the candidate’s project committee.

Required to graduate: 41 credits (33 course, 6 project, 2 colloquium) including courses taught by at least five different faculty members.
<table>
<thead>
<tr>
<th>Semester</th>
<th>Milestone</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Semester One</td>
<td>identification of a willing advisor</td>
<td>in enough time to schedule GEOL 680 for Semester One</td>
</tr>
<tr>
<td>Semester One</td>
<td>formation of Project Committee and submission of Research Plan</td>
<td>end of first week in Semester One</td>
</tr>
<tr>
<td></td>
<td>draft proposal completed</td>
<td>submission be advisor as required by advisor</td>
</tr>
<tr>
<td></td>
<td>proposal submission to Project Committee</td>
<td>one-to-two weeks before scheduling proposal meeting</td>
</tr>
<tr>
<td></td>
<td>proposal defense</td>
<td>end of Semester One</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO LATER THAN 2ND WEEK OF SEMESTER TWO</td>
</tr>
<tr>
<td>Semester Two</td>
<td>report draft submission to advisor</td>
<td>as required by advisor</td>
</tr>
<tr>
<td></td>
<td>final report draft: submission to committee</td>
<td>two weeks before defense</td>
</tr>
<tr>
<td></td>
<td>report defense</td>
<td>end of Semester Two</td>
</tr>
<tr>
<td></td>
<td>Submission of ETD</td>
<td>before graduation is approved</td>
</tr>
</tbody>
</table>
8 DOCTOR OF PHILOSOPHY (PH.D.) IN GEOLOGY

8.1 PLAN OF STUDY

Students admitted to the Ph.D. program will have identified a prospective research area(s) and advisor(s) prior to admission. Immediately on arriving on campus, the student will name a tentative advisor and, under the direction of the Advisor draft a Plan of Study, to be completed by the end of the first month in residence and filed in the student's file. The Plan of Study will identify a preliminary dissertation topic, coursework, and areas of specialization for the Ph.D. student.

8.2 Ph.D. COMMITTEE

As stated in the WVU Graduate Catalog (see general requirements), the Dissertation Committee for a Ph.D. student must consist of at least four members, three of whom must have regular graduate faculty status. The committee chairperson, who is the research advisor, must be a regular graduate faculty member and at least three members of the committee (including the advisor) must be members of the WVU graduate faculty. At least one member of the committee must be from outside the WVU Department of Geology and Geography; this outside member, for example, may be adjunct faculty, from another department at WVU, from another university or college, or from a state, federal, or other agency. The outside member must hold a degree equivalent to the Ph.D. The Ph.D. committee should be approved by the Eberly College as early as possible by submission of a Plan of Study listing the committee members' names.

8.3 COURSEWORK

With the exception of 2 hours of Geology 796 (1-credit Ph.D. Seminar) and 2 hours of Geology (Graduate Colloquium), there are no formal course requirement for the Ph.D.; however, Ph.D. students are required to register for at least 1 course or research credit hour per semester, including during the semester they expect to graduate; they are not required to register during the summer terms except if they graduate then. Also, foreign (non-U.S. citizen) students are required to maintain their Visa status. Courses are to be selected by the Ph.D. student in collaboration with his/her initial advising committee (if needed) and then with his/her Dissertation Committee. The student should strive to finish coursework in the first 2 years of his/her program if they are full-time residents at WVU. Ph.D. students are required to maintain a GPA in all formal graduate courses of at least 3.3 to graduate.

8.4 RESIDENCY

Ph.D. students normally are required to spend at least one academic year (two semesters) in residence doing full-time graduate studies at WVU. However, the WVU Graduate Catalog states that "an individual student or graduate committee may propose an alternative plan by which the student can gain equivalent educational experience to meet the residency requirement. For example, the plan of study may require the student to spend time in residence at a national or foreign laboratory, institute, archive, or research center as partial fulfillment of the residency requirement." This means, for example, that Ph.D. students
employed full time at a State agency such as the West Virginia Geological and Economic Survey, or at a U.S. governmental agency, like DOE or OSM, could be exempt from the residency requirement, with the permission of their Dissertation Committee.

8.5 **Ph.D. SEMINAR**

Each student must enroll for GEOL 796, Ph.D. seminar, for 1 credit during 2 separate semesters. The Ph.D. student is required to take his/her first GEOL 796 seminar during his/her first year of study. The seminar will meet formally or informally, at the discretion of the faculty seminar leader.

8.6 **PRELIMINARY EXAMINATION**

The purpose of the preliminary (prelim) examination is to evaluate a student’s abilities in scientific writing, oral presentation, and critical thinking, all fundamental for completion of a doctorate. The exam will have both written and oral portions in which students demonstrate, by review and analysis of existing literature and scientific ideas, that they have the skills for conducting original research. The topic should lie within their general area of scientific interest yet NOT be based on or derived from earlier research already performed by the student (e.g., their M.S. thesis) or their advisor (e.g., a research proposal for funding). The topic should be of specific interest to the student and of their own choosing, in consultation with their advisor. The exam will NOT be a test of comprehensive knowledge, examination of geological background, or a pre-proposal of the student’s intended dissertation topic.

The prelim topic can be based on the critical evaluation of a topic, a research technique, or the development of a new research idea. It should be chosen by the student and fall within the student’s area of academic interest and demonstrate awareness of key ideas in the current literature. For example, a student planning to conduct Ph.D. research on Paleozoic paleoclimatic signals preserved in the sedimentary record might prepare a prelim paper reviewing how stable isotopes are currently used in paleoclimate research and problems associated with their interpretation. The intent is for the student to learn about a topic that will enhance their development as a scientist.

In preparing the written paper, students may ask their advisor to review and/or discuss one early draft for appropriateness of ideas, scope, and direction, but the paper will otherwise represent, largely or wholly, independent effort and ideas of the student. Students who seek assistance with editorial aspects (grammar, punctuation, idioms, writing style, syntax, etc.) may utilize the WVU Writing Center. The paper will be maximum 10 pages of text (not including figures, references, and table of contents), doubled spaced, and be in the format of a formal manuscript. The deadline for the final written paper to, at least 1-2 weeks prior to the exam date. The deadline for the defense is March 1 (November 1 for spring admits), both in the second semester of residence. The time, date, room number, and paper title will be publicized by email to all Geology faculty and graduate students at least 1 week prior to the defense date and a flyer will be posted on the 3rd floor Brooks bulletin board (by the mail room).

The preliminary committee will include the advisor plus 2 faculty chosen at random by the Grad Program Chair. Both written and oral portions will be evaluated based on the student’s clarity of thought and presentation, organizational ability, oral and written communication skills, and ability to critically evaluate literature. After the oral exam, the
committee members will convene to assign both exam portions, together, either a Pass or Fail grade. Should a student fail the exam, it may be retaken once, on a similar, modified, or alternate topic as directed by the committee, to be prepared and defended no later than May 1 (December 15 for spring admits). Students not successfully passing a retake, or not completing an exam at all, will not continue in the program beyond their second semester.

8.7 DISSERTATION PROPOSAL PLUS ORAL CANDIDACY EXAM

The student will present his/her formal dissertation research proposal by the end of their fourth semester of studies. The student will circulate a publication-quality written proposal to committee members at least 2 weeks in advance of the scheduled proposal date. This exam must be advertised at least 1 week prior by email to the Department and by posting notices in Brooks Hall. Following the oral presentation, the student will respond to questions from the general audience, and then from the student’s Dissertation Committee. After the public session, the Committee will meet with the student in closed session to examine the research plan, the feasibility of the proposed goals, the practicality of the work plan/scope, and the appropriateness of the methodology. In addition, the student will answer questions that demonstrate mastery of the general area of knowledge of his/her dissertation research. In preparation for this examination the committee will provide the student with a list of the relevant literature. The Dissertation Proposal and Oral Examination will be graded separately as pass/fail. In the event the student failing either section, he/she will have the option of retaking it/them once, at a date established by the Dissertation Committee. Even if the student passes the proposal, the committee may determine that additional work is required to make it acceptable.

Upon the successful completion of this exam the student becomes a Ph.D. Candidate.

8.8 WAIVER OF DEADLINES

Students who for reasons related to health, financial support, or other circumstances cannot meet any of these deadlines may petition the Geology Graduate Program Committee in advance of the deadline for its postponement. The request should indicate the circumstances, the proposed new deadline, and the student’s modified Plan of Study thereafter. The request must have the support of the student’s Ph.D. advisor. Students are reminded that postponement of deadlines may delay their graduation.

8.9 Ph.D. DEGREE TIME LIMIT

Ph.D. students have a maximum of 5 years following their advance to candidacy, to complete their other degree requirements and graduate. For rules regarding the Ph.D. time limit, refer to the most recent copy of the WVU Graduate Catalog.

8.10 EVALUATION OF EXAMINATIONS

All exams will be judged as pass or fail, based on a closed vote of the respective committees. Passing votes must be unanimous for the Prelim Committee test (3 out of 3), and unanimous or nearly unanimous (with only 1 dissenting vote allowed) for the Dissertation Committee tests (for the proposal and oral test, and the final dissertation defense). One reexamination only is allowed for each exam or defense. Students retaking an exam need to do that before any time deadlines stated for the original exam. Students must pass all examinations to meet requirements for award of the Ph.D. degree.
8.11 DISSERTATION DEFENSE

The dissertation defense before the Dissertation Committee cannot occur until both the proposal and oral candidacy examination has been passed and all other requirements for the degree have been met. Following preparation and circulation of the final (deemed defensible) draft of the dissertation, the student and his/her committee will plan on a particular date, place, and room for the dissertation defense meeting.

The oral defense presentation by the student will normally last 30 to 60 minutes (in consultation with their advisor), outlining highlights of research results. After the presentation, the student will respond to questions from the general audience and then to questions from the Dissertation Committee, pertaining to the research results and the defensibility of the conclusions drawn. Upon completion of the defense, a Thesis/Dissertation Defense Form will be signed and completed by the Dissertation Committee and returned by the student to Hope Stewart with either a P or F grade within 24 hours after the defense.

Following the dissertation defense, final revisions of the dissertation will be made by the student according to committee comments. After final approval by all Dissertation Committee members, the dissertation will be submitted online to the WVU ETD site as an Electronic ETD PDF copy. Also to be submitted to the Wise Library is a completed ETD submission packet with original Dissertation Committee signatures and payment for required fees. See https://etd.lib.wvu.edu for information on dissertation submission.
### Ph.D. Milestones and Deadlines

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Purpose</th>
<th>Format</th>
<th>Evaluated by</th>
<th>Recommended Deadline</th>
<th>Deadline type</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Plan of Study</td>
<td>Outline program goals, courses, potential advisor</td>
<td>Advisory Committee product</td>
<td>Advisor</td>
<td>2 weeks into Year 1, first semester of study</td>
<td>Required</td>
</tr>
<tr>
<td>PhD Seminar (to be taken twice)</td>
<td>Develop research acumen</td>
<td>Seminar/ Colloquium</td>
<td>Faculty Leader</td>
<td>First seminar taken during 1st year of study</td>
<td>Required</td>
</tr>
<tr>
<td>Preliminary Exam</td>
<td>Test communication &amp; reasoning ability</td>
<td>Preparation of written paper with oral presentation and defense</td>
<td>Preliminary Committee of 3 faculty members selected by GGPC</td>
<td>By week 7 in the 2nd semester of study</td>
<td>Required</td>
</tr>
<tr>
<td>Formulate research plan, assemble research committee</td>
<td>Start dissertation research, initiate search for funding</td>
<td>Interaction with advisor and committee</td>
<td>Advisor</td>
<td>By end of Year 1 of study</td>
<td>Guideline</td>
</tr>
<tr>
<td>Dissertation proposal and Oral Candidacy Exam</td>
<td>Present detailed research goals and methods; test background knowledge</td>
<td>Written proposal; oral presentation and defense</td>
<td>Dissertation Committee</td>
<td>By end of Year 2 of Study</td>
<td>Guideline</td>
</tr>
<tr>
<td>Dissertation defense</td>
<td>Present research results</td>
<td>Written dissertation, oral presentation and defense</td>
<td>Dissertation Committee</td>
<td>Within 5 years of Oral Candidacy Exam</td>
<td>Required</td>
</tr>
</tbody>
</table>