Geology

Degrees Offered
- Master of Science
- Doctor of Philosophy

Nature of the Program
The graduate program in geology provides study opportunities in the following areas:

- Hydrogeology and environmental geology with strengths in ground water flow and modeling; aqueous, contaminant and isotope geochemistry; mine reclamation; and floods and debris flows
- Basin analysis and sedimentary geology with strengths in seismic modeling, basin structures, deposition analysis, sequence stratigraphy, biostratigraphy, diagenesis, and plate tectonics
- Energy geology and geophysics with strengths in the exploration and development of oil, gas, and coal; and environmental impacts of fossil fuel usages
- Paleobiology and paleontology with strengths in macroevolution, paleoecology, and phylogenetics, particularly in relation to arthropods and mass extinctions
- Igneous petrology and volcanology with strengths in arc magmatism and the emplacement of lava flows and pyroclastic deposits
- Geochemistry. In particular aqueous geochemistry, stable isotope geochemistry and organic geochemistry
- Surficial processes and landscape evolution
- Tectonic evolution of the Appalachian, Cordilleran and Himalayan orogens

Tracks within the Masters Degree

- The Research Track requires students to complete independent scholarly research culminating in a thesis. This track is intended for students interested in a research-based graduate degree.
- The Professional Studies Track requires students to complete Professional Development credits/tasks in place of thesis-based research. This track is intended for students looking to obtain additional knowledge and skills for their professional careers in Energy, Geology, or Environmental Geology.

FACULTY

CHAIR
- Brent McCusker - Ph.D. (Michigan State University)
  Social theory, Development

ASSOCIATE CHAIR
- Jaime Toro - Ph.D. (Stanford Univ.)
  Structure and Tectonics

PROFESSORS
- Kathleen Benison - Ph.D. (Univ. of Kansas)
  Sedimentology, Stratigraphy, Evaporites
- Dengliang Gao - Ph.D. (Duke Univ.)
  Geophysics, Petroleum
- Shikha Sharma - Ph.D. (Univ. of Lucknow, India)
  Isotope Geochemistry, Biogeochemistry, Energy
- Jaime Toro - Ph.D. (Stanford Univ.)
  Structural Geology, Tectonics, Energy
- Dorothy Vesper - Ph.D. (Penn State Univ.)
  Geochemistry, karst, hydrogeology

ASSOCIATE PROFESSORS
- James Lamsdell - Ph. D. (Univ. of Kansas)
  Paleobiology, Paleoecology, Macroevolution
Admissions

M.S. IN GEOLOGY

The Geology program at WVU gives students the opportunity to earn the master’s degree by completing either a professional studies track or a research track. In addition to WVU’s general admission requirements, all applicants should possess an undergraduate GPA of 3.0 or higher and a GPA of 3.0 or higher in any graduate coursework. Applicants to the professional studies track must hold a B.A. or B.S. degree in a STEM or relevant field that includes coursework in general physics, chemistry and calculus. Complete coursework in the field of Geology is preferred. Applicants to the research track must hold a B.A. or B.S. degree in a STEM or relevant field that includes coursework in the equivalents of Geology and allied sciences and mathematics. Completed coursework in Geology is preferred. In the personal statement, M.S. applicants must identify their intended track (research or professional studies) and their preferred faculty advisor. Information on faculty and their research areas can be found here. Applicants are required to contact potential advisers among the faculty prior to application and name potential advisors in their Statement of Purpose as acceptance into the graduate program is contingent on placement with a graduate faculty advisor willing and able to advise the prospective student.

GRE scores are not required for admission. All applications are considered for Department funding through Teaching or Research Assistantships.

PH.D. IN GEOLOGY

Applicants to the doctoral program must hold a master’s of science. In addition to WVU’s general admission requirements, all applicants should possess an undergraduate GPA of 3.0 or higher and a GPA of 3.0 or higher in any graduate coursework. In the personal statement, Ph.D. applicants must identify their preferred faculty advisor. Information on faculty and their research areas can be found here. Applicants are required to contact potential advisers among the faculty prior to application and name potential advisors in their Statement of Purpose as acceptance into the graduate program is contingent on placement with a graduate faculty advisor willing and able to advise the prospective student.

GRE scores are not required for admission. All applications are considered for Department funding through Teaching or Research Assistantships.

List of Admission Requirements:

- See the steps to apply for admissions and access the application here
- Transcripts from all institutions attended (note: official transcripts are required to finalize an offer of admission to the graduate program)
- Three Letters of recommendation
• Curriculum Vitae or Resume
• Statement of Purpose (note: topics covered should include the names of prospective advisors and details of any contact you have had with them and why you want to work with them; subject areas that interest you; any prior research experience you have had; you career goals and how a graduate degree will help you fulfill these goals; and any achievements or pertinent issues that might influence your academic record that may not reflect your full potential)

International Applicants:
• See the steps to apply for admissions and access the application here (https://graduateadmissions.wvu.edu/how-to-apply/)
• International applications should view additional requirements here (http://catalog.wvu.edu/graduate/graduateeducationatwestvirginiauniversity/#internationaltext) and here (https://graduateadmissions.wvu.edu/information-for/international-students/)
• Language proficiency is required in order to hold a graduate teaching assistantship. See here (https://elli.wvu.edu/testing-resources/english-proficiency-gtas/).

Application Deadlines:
• The Geology program admits students for the Fall and Spring semesters
• The deadline for Fall semester admission is January 15th
• The deadline for Spring semester admissions is October 1st
• All application materials, including completed recommendation letters, must be submitted by the deadline in order to ensure full consideration.
• In exceptional circumstances, we will review applicants received after the January 15th and October 1st deadlines on a space-available basis
• Exceptional PhD applicants may be nominated by the Geology program for competitive University Fellowships. All University Fellowship require admittance into the graduate program in the Fall semester. Eligible applicants that wish to be considered for University Fellowships must have completed applications submitted by December 31st. Qualified applicants will be notified if they are nominated. More information on WVU fellowships can be found here (https://graduateeducation.wvu.edu/fellowships/).

Admission Requirements 2023-2024
The Admission Requirements above will be the same for the 2023-2024 Academic Year.

Major Code: 1445

For specific information on the following program, please see the link to the right:
• Geology, M.S.

For specific information on the following program, please see the link to the right:
• Geology, Ph.D.

Degree Progress - Masters
• Students whose GPA falls below 3.0 will be put on probation for one semester. If they remain below 3.0 for a second semester, they are dismissed from the program.
• Students are discouraged with withdrawing from courses, and should only do so after a discussion with their advisor or the Graduate Program Committee.
• Students must complete annual progress reports (see graduate handbook for details)
• For students completing the Research track, milestone deadlines are below:
  • Target Date - Indicates excellent progress.
  • Deadline - Indicates reasonable progress. Students who do not meet this deadline will be placed on probation.
  • Funding termination date - Students not meeting this deadline will no longer receive department funding and support.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Start Semester</th>
<th>Target</th>
<th>Deadline</th>
<th>Funding termination date</th>
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<tr>
<td>Proposal Defense</td>
<td>Fall</td>
<td>May 1, Year 1</td>
<td>Aug 1, Year 1</td>
<td>Dec 1, Year 2</td>
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<td>Spring</td>
<td>Aug 1, Year 1</td>
<td>Dec 1, Year 1</td>
<td>May 1, Year 2</td>
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<tr>
<td>Thesis defense and submission</td>
<td>Fall</td>
<td>May, Year 2</td>
<td>Support typically not available after 2 years</td>
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<tr>
<td>Spring</td>
<td>Aug, Year 2</td>
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Degree Progress - Ph.D.

- Students whose GPA falls below 3.0 will be put on probation for one semester. If they remain below 3.0 for a second semester, they are dismissed from the program.
- Withdrawing from classes is only permitted with the permission of the student's advisor or the Geology Graduate Program Committee.
- Students must complete annual progress reports (see graduate handbook for details).
- Milestone deadlines are below:
  - **Target Date** - Indicates excellent progress.
  - **Deadline** - Indicates reasonable progress. Students who do not meet this deadline will be placed on probation.
  - **Funding termination date** - Students not meeting this deadline will no longer receive department funding and support.

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<tr>
<th>Milestone</th>
<th>Start Semester</th>
<th>Target Date</th>
<th>Deadline</th>
<th>Funding termination date</th>
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<tr>
<td>Preliminary Exam</td>
<td>Fall</td>
<td>May 1, Year 1</td>
<td>Aug 1, Year 1 (for retakes only)</td>
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<tr>
<td>Spring</td>
<td>Dec 1, Year 1</td>
<td>May 1, Year 2</td>
<td>Dec 1, Year 2</td>
<td>May 1, Year 3</td>
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<tr>
<td>Proposal/ Comprehensive Exam</td>
<td>Fall</td>
<td>May 1, Year 3</td>
<td>Dec 1, Year 3</td>
<td>Support typically not available after 4 years</td>
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<tr>
<td>Dissertation defense</td>
<td>Dec 1, Year 2</td>
<td>May 1, Year 4</td>
<td>Support typically not available after 4 years</td>
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**COURSES**

**GEOL 505. Scientific Writing.** 3 Hours.
Fundamentals of effective science communication with emphasis on the skills and ethical practices required to produce high-quality, long-form writing projects. Course work involves all aspects of the writing process, including planning, drafting, editing and revising. Course also addresses how to identify and target different audiences using alternative science communication formats. Emphasis on geoscience but applicable to all natural sciences.

**GEOL 510. Computer Aided Subsurface Interpretations.** 3 Hours.
PR: GEOL 311 and GEOL 341. Develop subsurface interpretations from integrated geological, geophysical and engineering databases in a computer workstation environment. Construct maps and 3D visualizations of subsurface structure, seismic horizons, layer properties, etc., for prospect location and subsurface assessment.

**GEOL 511A. Sedimentary Geology in Ireland - Travel.** 1 Hour.
Travel portion of GEOL 511. See GEOL 511 for description.

**GEOL 522. Surficial and Glacial Geology.** 3 Hours.
PR: GEOL 321 or GEOG 321 or consent. Analysis of late Cenozoic landscapes, especially those caused by glaciers or otherwise influenced by global climate change. Required weekend field trips at student's expense. (Also listed as GEOG 522.)

**GEOL 525. Problems in Geomorphology.** 4 Hours.

**GEOL 543. Tectonics.** 3 Hours.
PR: GEOL 341 and GEOL 311; undergraduates need Consent. Investigation of patterns and processes of large-scale deformation mechanisms that shape the earth. Focuses on the structural evolution and modeling process of various plate boundaries.

**GEOL 556. 3-D Seismic Visualization.** 3 Hours.
This course focuses on the application of 3-D seismic data visualization and interpretation technologies to the characterization of subsurface structure, facies, and reservoirs, with particular reference to hydrocarbon exploration and CO2 sequestration.

**GEOL 558. Seismic Attribute.** 3 Hours.
PR: GEOL 341 and GEOL 311 and MATH 155. The effective seismic attribute technologies and attribute interpretation workflows, their application to the characterization of subsurface structures, facies, and reservoir properties, with particular reference to hydrocarbon exploration and CO2 sequestration.

**GEOL 562. Quantitative Hydrogeology.** 3 Hours.
PR: MATH 156 or GEOL 351 and GEOL 463 or Consent. Mathematical and computer analysis of groundwater flow, aquifer systems, radial-flow solutions; well/aquifer test methods; superposition, boundaries; dispersive/advective transport.

**GEOL 564. Environmental Hydrogeology.** 4 Hours.
PR: GEOL 101 and GEOL 102 and GEOL 463 and (PR or CONC: GEOL 562). Seminar reviewing groundwater occurrence, flow, quality, and exploration in various geologic terrains; groundwater pollution and dewatering; and groundwater technology. Includes topical literature review.

**GEOL 575. Imperial Barrel Competition.** 3 Hours.
The students will participate in the Imperial Barrel Award competition sponsored by the American Association of Petroleum Geologists (AAPG). They will evaluate a real-world petroleum basin using industry seismic and well data and will make a presentation to a panel of professional judges recommending an exploration strategy. Travel to the regional and national AAPG meeting may be required.
GEOL 579. Applied Petroleum Geoscience. 3 Hours.
Students work in teams to conduct integrated characterization of a petroleum reservoir, develop numerical simulation, consider technical options, perform economic analyses and make a final report to the company/organization.

GEOL 580. Organic Contaminant Geochemistry. 3 Hours.
This course focuses on fundamental chemical properties and structures of organic contaminants that control their functionality, fate, and transport in the environment. Natural organic matter and inorganic phases are discussed relative to contaminant mobility.

GEOL 585. Optical Mineralogy and Petrology. 3 Hours.
PR: GEOL 285. Introduction to the optical properties of minerals and the use of the petrographic microscope. Interpretation of sedimentary, igneous, and metamorphic rocks based on microscopic examination of thin sections. (Offered alternate years.).

GEOL 586. Advanced Isotope Geochemistry. 3 Hours.
PR: GEOL 485. Advance the understanding of isotopic systems by comprehensive discussion of selected research publications. Laboratory exercises will provide hands-on training in stable isotope measurement techniques. Study topics will focus on use of isotopes to address research questions in variety of fields, including geology, biology, forensics, environmental sciences and energy.

GEOL 588. Aqueous Geochemistry. 3 Hours.
PR: GEOL 101 and CHEM 112 or CHEM 116, or Consent. Review of basic chemical principles as they apply to aqueous geochemical environments. Properties of water and the types, sources, and controls of the common and environmentally significant chemical species dissolved in water.

GEOL 591. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOL 593. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

GEOL 594. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOL 615. Advanced Stratigraphic Methods. 3 Hours.
Advanced discussion of stratigraphic correlation techniques, including sequence stratigraphy, to analyze deposition of clastic and carbonate sediments, with emphasis on assessing porosity development in sandstones and limestones, organic matter deposition, and flow of fluids, such as water, gas and oil, through rock.

GEOL 616. Advanced Sedimentation. 4 Hours.
PR: GEOL 311 or Consent. (Required field trips at student's expense.) Origin of sedimentary rocks; principles involved in interpretation of ancient geography, climates, animals, and plants. Emphasis on detrital sediments and rocks.

GEOL 621. Advanced Fluvial Geomorphology. 4 Hours.
PR: GEOL 321 or GEOG 321 or Consent. Analysis of stream processes, landforms, deposits, including paleohydrology and Appalachian surficial geology. (Required weekend field trips at student's expense; also listed as GEOG 521.).

GEOL 632. Paleoecology. 3 Hours.
PR: GEOL 331 and GEOL 311 or Consent. Methods of paleoecologic analysis in sedimentary geology. Topics include trace fossil analysis, shell biogeochemistry, community paleoecology, biofacies analysis of basins, and Precambrian paleoecology.

GEOL 642. Advanced Structural Geology. 3 Hours.
PR: GEOL 341. Theoretical and observational aspects of the development of geological structures. Problems ranging from the microstructural to the orogenic scale will be addressed.

GEOL 645. Basin Analysis. 3 Hours.
PR: GEOL 341 and GEOL 311 or equivalent. The origin, development, and distribution of basins and the structure found within basins throughout the world are studied. The techniques used for investigating basin evolution are emphasized. The effects of basin processes on the occurrence of energy resources are addressed.

GEOL 659. Quantitative Methods in Geoscience. 3 Hours.
PR: STAT 312 or STAT 511 or Consent. Brief review and introduction to multivariate quantitative techniques as applied to geology and geography.

GEOL 665. Groundwater Modeling. 4 Hours.
PR: GEOL 562 or Consent. Theory and application of groundwater flow modeling, focusing on MODFLOW; numerical methods; discretization and boundaries; parameterization and calibration; problems and case histories.

GEOL 666. Karst Geology. 3 Hours.
PR: Consent. Review of karst terrain hydrogeology and geomorphology, emphasizing origins and nature of caves, sinkholes and other karst landforms, environmental problems of karst, and its water and mineral/ petroleum resources.

GEOL 680. Masters Project Research. 1-5 Hours.
Planning and presentation of a professional project, including proposal, work plan execution, and project report. Status reports and timeline planning. Must be taken in two consecutive semesters, totaling to 6 credits.
GEOL 681. Grad Internship in Geology. 1-6 Hours.
PR: Be enrolled in the Geology MS with a Professional Studies AOE and consent. To obtain practical work experience in a professional setting while obtaining skills and knowledge as a geologist.

GEOL 682. Masters: Professional Studies Track Cohort Seminar. 1 Hour.
PR: Registered students in the Geology MS - Professional Studies Track. This seminar will provide graduate students with the information, tools and resources needed to succeed in the Masters of Geology Professional Studies Track.

GEOL 690. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of geology. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It also provides a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.).

GEOL 691. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOL 692. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

GEOL 693. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

GEOL 694. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

GEOL 695. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOL 696. Graduate Seminar. 1-3 Hours.
PR: Consent. Series of meetings that may include research presentations by students, faculty, or visitors; discussions of professional issues or current literature; or other varying topics.

GEOL 697. Research. 1-9 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

GEOL 698. Thesis or Dissertation. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

GEOL 699. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking course work credit, but who wish to meet residence requirements, use the University facilities and participate in its academic and cultural programs. NOTE: Graduate students not actively involved in course work or research or enrolled, through enrollment in his/her departments Graduate Colloquium, to consult with graduate faculty, participate in both formal and informal academic activities sponsored by his/her program and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for master's programs.

GEOL 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of geology. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.).

GEOL 791. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

GEOL 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

GEOL 796. Graduate Seminar. 1-3 Hours.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

GEOL 799. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use of the University's facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department’s 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.
GEOL 930. Professional Development. 1-6 Hours.
Professional development courses provide skill renewal or enhancement in a professional field or content area (e.g., education, community health, geology). These tuition-waived continuing education courses are graded on a pass/fail grading scale and do not apply as graduate credit toward a degree program.