

## Geology and Geological Engineering at CSM Message from the Department Head

The mission of the Geology and Geological Engineering Department is to provide undergraduate and graduate students with a world-class education that provides them with the skills necessary for a broad variety of employment opportunities. We maintain strong, innovative applied research programs in hydrogeology, geological engineering and environmental geology, geochemistry, and both minerals and energy resource exploration and production with a firm foundation of basic geosciences. Our faculty work cooperatively on a number of research and educational projects. In addition, we integrate our research and teaching with individuals in other departments and institutes on the Colorado School of Mines campus, as well as with national and international societies, government agencies, academic institutions, and private corporations.



We pride ourselves on providing our undergraduate students with a solid scientific and engineering foundation for practical application and research. Our bachelor of science graduates are hired by mineral and petroleum resources companies, geotechnical and hydrogeological consulting firms, and research organizations that apply current geoscientific and geoenvironmental principles and practices. Because of our interdisciplinary emphasis, our graduates are well prepared to deal with complex "real-life" problems.

We have one of the largest graduate programs in the U.S. in the geological sciences and geological engineering. Our research funding comes from the private sector as well as from the federal and state governments. We have extremely active research in geochemistry, geohydrology, engineering geology, economic geology, and petroleum geology. Current research programs in the Department span the globe from Alaska to Patagonia and from the western U.S. to Asia, Australia, and southern Africa. The Department maintains a number of analytical tools and utilizes additional

analytical equipment on campus and at the nearby U.S. Geological Survey laboratories. The CSM region is ideally suited for geosciences study. The Colorado Rockies offer one of the most varied geologic provinces and natural laboratories on Earth. Denver is home to many mining, petroleum and geotechnical/hydrological companies that provide training, research, and employment opportunities. Regional offices for the U.S. Geological Survey, the Department of Energy, the Environmental Protection Agency,



and other government agencies and national centers are located nearby.

Come join us! If you are interested in the CSM Department of Geology and Geological Engineering, please call, write, or e-mail me. I look forward to hearing from you.

Murray W. Hitzman, Department Head  
[mhitzman@mines.edu](mailto:mhitzman@mines.edu)

Department of Geology and Geological Engineering  
Colorado School of Mines  
Golden, Colorado 80401  
Phone: 303-273-3800  
FAX: 303-273-3859  
URL: <http://www.mines.edu/Academic/geology/>

## Geology & Geological Engineering at CSM

The Colorado School of Mines is a highly inter-disciplinary educational environment. We offer a rare opportunity of combined science and engineering programs that provide fundamental principles with practical methods and techniques.

In the Geology and Geological Engineering program, students develop a curriculum that suits their educational objectives. The four most popular areas are petroleum geology, mineral deposits/economic geology, geotechnical engineering and hydrogeology/waste management. Students also may pursue a basic geoscience sub-discipline such as petrology, geochemistry, or structural geology.

### Research

Our faculty supports both traditional and modern research fields such as predictive sediment modeling, paleo-hydrology, petrophysics, aquifer-contaminant flow modeling, waste management, and water-rock interactions. The educational experience is enhanced through departmental research centers including the Lewis Shale Project, the International Ground Water Modeling Center, the Petroleum Technology Transfer Council: Rocky Mountain Region, Potential Gas Agency/Institute for Energy Resource Studies, Petroleum Exploration and Production Center, the Slope and Basin Consortium and the ChevronTexaco Center of Research Excellence. In addition, personnel and resources of the U.S. Geological Survey in Denver are readily available, and cooperative research programs are common.

Below are the current research areas of the Department.

### Petroleum Geology

Areas include: Occurrence, origin, and timing of petroleum systems; Reservoir characterization and analogue studies; In-reservoir cracking of oil and gas; Sequence stratigraphy, genetic stratigraphy.

### Economic Geology

Areas include: Geology of ore systems; Geology and geochemistry of precious metal deposits; Geology of Ironoxide-Cu-Au ore systems; Genesis of Central African Copperbelt; Carbonate-hosted base and precious metal systems; Design of exploration geochemical programs; Multivariate statistics.

### Geohydrology

Areas include: Non-equilibrium mass transfer and transport of NAPL mixtures in groundwater; Site- and watershed scale flow and transport in groundwater systems; Characterization of subsurface heterogeneity; Inversion and uncertainty of groundwater flow/transport models; Hydrologic site investigations.

### Engineering Geology

Areas include: Engineering geology and geotechnics; Geologic hazard assessment and mitigation; Landslide and rock-fall analysis and mitigation; Expansive soil and bedrock; Aggregate resource assessment.

### Structural Geology

Areas include: Salt tectonics; Structural geology of base/precious metal ore deposits; Tectonics of the Andes; Cenozoic and Quaternary faulting; Seismotectonic and volcanotectonic field mapping; Fracture analysis/fluid flow in hydrothermal and petroleum systems.

### Igneous and Metamorphic Petrology

Areas include: Experimental petrology; Petrogenesis of continental rift volcanic rocks; Volatiles in igneous systems.

### Remote Sensing and Computing

Areas include: Application of remote sensing to mineral exploration; Application of remote sensing to land use; GIS applications in land use planning, site selection and environmental problems; Development of expert systems.

### Degree Programs

The Department of Geology and Geological Engineering offers masters and doctoral degrees in geochemistry, geology, and geological engineering. Graduate students wishing to study ground water, engineering geology/geotechnics, mining engineering geology and some environmental applications should pursue the geological engineering degree. Students wishing to study petroleum or minerals exploration or development sciences, geo-chemistry and/or geology generally pursue geology or geochemistry degrees.

The Department also offers a variety of Professional Masters degrees in conjunction with other CSM departments. A Professional Masters degree is similar in scope to the traditional Master of Science degree however does not require research. The programs focus in emerging multidisciplinary fields of study and are designed to provide career-oriented skills and knowledge. Details of these programs as well as the traditional masters and doctoral programs are explained below.

### Professional Masters

All Professional Masters programs are non thesis and require 36 credit hours of coursework. Up to 15 credits may be transfer credit, including CSM distance learning courses. No fewer than 15 credits must be earned on campus.

## Geology & Geological Engineering at CSM

Students can also earn up to six credits through independent study, professional development, internship or co-op experiences. Applicants must possess an appropriate geosciences undergraduate degree or its equivalent.

### *Professional Masters -- Petroleum Reservoir Systems*

This is a non-thesis, interdisciplinary masters degree program jointly administered by the Departments of Geology and Geological Engineering, Geophysics, and Petroleum Engineering. This program consists of coursework in petroleum geoscience and engineering. The degree is particularly suited for employees of service companies and non-U.S. professionals from the international petroleum sector. It is also attractive for individuals with a BS degree who desire a graduate-level credential for employment in the petroleum industry.

A 9 credit hour core curriculum consists of the following:

- GPGN 419/PEGN 419 Well Log Analysis and Formation Evaluation **or** GPGN 519/PEGN 519 Advanced Formation Evaluation

2 courses from

- GEGN 439/GPGN 439/PEGN 439 Multi-Disciplinary Petroleum Design
- GEGN 503/GPGN 503/PEGN 503 Integrated Exploration and Development I
- GEGN 504/GPGN 504/PEGN 504 Integrated Exploration and Development II

Nine additional hours must consist of one course each from the 3 participating departments (Geology and Geological Engineering, Geophysics, and Petroleum Engineering). The remaining 18 hours may consist of graduate courses from any of the participating three departments, or other courses approved by the committee. Up to 6 hours may be taken as an independent study or an industry project.

### *Professional Masters -- Environmental Geochemistry*

The proposed program is intended to provide: 1) an opportunity for CSM undergraduates to earn a Master's degree in one extra year of study, and 2) additional education for working professionals in the area of geochemistry as it applies to problems relating to the environment. This non-thesis program consists primarily of course work in geochemistry and allied fields, with an emphasis on environmental applications. CSM students pursuing the Combined BS/MS format may transfer in 6 credits of 400-level or above courses taken as part of their undergraduate curriculum.

A recommended 17 credit-hour core program consists of:

- CHGN 403 - Environmental Chemistry
- GEGN 467 - Groundwater Engineering
- CHGC 503 - Introduction to Geochemistry

- GEGN 509 - Aqueous Geochemistry
- GEOL 530 - Clay Characterization
- CHGC 504 - Methods in Geochemistry

An additional 12 credit hours must be chosen from a select list of courses. Free electives may be taken to complete the 36-hour requirement. Free electives can be course credits or can be independent study credits taken to fulfill a research, cooperative, or other professional development experience.

### *Professional Masters in Mineral Exploration and Mining Geosciences*

This is a non-thesis, masters degree program jointly administered by the Departments of Geology and Geological Engineering, Geochemistry, and Geophysics. Students gain admission to the program by application to any of the sponsoring departments and acceptance through the normal procedures of that department.

A 15 credit-hour core program consists of:

- GEGN 403 Mineral Exploration Design
- GEOL 515 Advanced Mineral Deposits-Magmatic and Syngenetic Ores **or** GEOL 516 Advanced Mineral Deposits-Epithermal Hydrothermal Systems **or** GEGN 528 Mining Geology
- GEGX 571 Geochemical Exploration
- GPGN 530 Applied Geophysics
- EBGN 504 Economic Evaluation and Investment Decision Making **or** EBGN 510 Natural Resource Economics **or** EBGN 512 Macroeconomics **or** MNGN585 Mining Economics

Fifteen additional hours must be selected from selected courses in Geochemistry, Geology and Geological Engineering, Geophysics, Economics and Business, Environmental Science and Engineering, and Metallurgy and Materials Engineering. Six additional credits may be independent study or may be taken from the selected course list.

### **Geology Degrees**

The *Master of Science (Geology)* is a research-oriented degree requiring a minimum of 36 credit hours, 24 of which must be course work. Twelve of the 36 may be research hours. All Master of Science candidates must also complete an appropriate thesis, based upon original research they have completed.

The *Doctor of Philosophy (Geology)* program requires a minimum of 72 credit hours. At least 48 of these must be course work, including 12 hours in a minor field. A minimum of 24 hours must be research credits. A maximum of 24 course credit hours, including those for the minor field, may be awarded for completion of a Master of Science degree.

## Geology & Geological Engineering at CSM

All Doctor of Philosophy (Geology) candidates must also complete an appropriate dissertation that will make a new contribution to the geologic sciences.

M.S. and Ph.D. students in geology require one graduate level course in each of the following areas. Ph.D. students must also take GEOL 511 History of Geologic Concepts.

- Stratigraphy/Sedimentology
- Structural Geology/Tectonics
- Petrology

At the discretion of the student's thesis advisory committee, an appropriate course from a program other than Geology may be substituted for one of the courses above.

### *Prerequisites*

Applicants to the geology programs should have completed coursework in the following subjects: general geology, structural geology, field geology (6 weeks), mineralogy, petrology, historical geology, stratigraphy, chemistry (3 semesters, including physical or organic), calculus (2 semesters), physics (2 semesters), and an additional science course other than geology or advanced mathematics. Courses not completed as an undergraduate can be made up as deficiencies at the beginning of your graduate work.

### **Geological Engineering Degrees**

The geological engineering program is offered as a Master of Engineering, Master of Science or Doctor of Philosophy. Three specialty areas are offered -- Engineering Geology/Geotechnics, Ground Water/Hydrogeology, and Mining Geology. Requirements for these programs are explained in further detail.

### *Master of Engineering -- Geological Engineer*

This non-thesis program requires a minimum of 30 credit hours of coursework and 6 credit hours of independent study. The independent study requires a project and report that demonstrate competence in the application of geological engineering principles. All students must complete the core course GEGN 532 Geological Data Analysis. In addition, students must satisfy requirements specific to their chosen field of specialization. Free electives can be taken in addition to the outlined requirements.

### *Engineering Geology/Geotechnics*

- Engineering Geology & Geotechnics
- Groundwater Engineering
- Case Histories in Engineering Geology **or** Advanced Engineering Geology
- Geological Engineering Site Investigation
- Landslides: Investigation, Analysis & Mitigation **or** Advanced Geotechnics
- An advanced course in both soil and rock engineering

### *Ground Water/Hydrogeology*

- Groundwater Engineering I
- Mathematical Modeling of Groundwater Systems
- Aqueous Geochemistry **or** Principles of Aquatic Chemistry
- Vadose Zone Hydrology **or** Advanced Hydrogeology
- Ground Water Engineering Design **or** Hazardous Waste Site Remediation
- Applications of Geographic Information Systems
- One additional advanced course in hydrogeo-chemistry

### *Mining Geology*

- Engineering Geology & Geotechnics **or** Groundwater Engineering
- Advanced Mineral Deposits-Magmatic and Syngnetic Ores
- Advanced Mineral Deposits-Epigenetic Hydrothermal Systems
- Special Topics-Surface Mine Design **or** Special Topics-Underground Mine Design
- Mineral Exploration **or** Mining Geology
- Applied Structural Geology

Students can select elective courses from the following topics: mineral deposits geology, mineral exploration, mining geology, mineral processing, ore microscopy, remote sensing, applied geophysics, applied geochemistry, engineering geology, environmental geology, geostatistics, geographic information systems, environmental or exploration and mining law, engineering economics/management, and computer sciences.

### *Master of Science -- Geological Engineering*

This research-oriented degree requires a minimum of 36 credit hours. At least 12 of these credits must be research hours. A graduate thesis that demonstrates creative and comprehensive ability in the development or application of geological engineering principles is also required. All students must complete two core courses, GEGN 532 Geological Data Analysis and GEOL 607 Geology Seminar. In addition to these requirements, students must satisfy requirements specific to their chosen field of specialization.

### *Engineering Geology/Geotechnics*

- Engineering Geology & Geotechnics
- Groundwater Engineering
- Case Histories in Engineering Geology
- At least two of the following
  - Advanced Engineering Geology
  - Geological Engineering Site Investigation
  - Landslides: Investigation, Analysis & Mitigation
  - Advanced Geotechnics

## Geology & Geological Engineering at CSM

### *Ground Water/Hydrogeology*

- Groundwater Engineering I
- Mathematical Modeling of Groundwater Systems
- Engineering Geology and Geotechnics I
- Groundwater Engineering Design
- 2 courses selected from the following
  - Principles of Environmental Chemistry **or** Introduction to Aqueous Geochemistry
  - Environmental Pollution **or** Advanced Groundwater Engineering

### *Mining Geology*

Students must take either Mining Geology or Mineral Exploration. Additional electives can be selected from the following topics: mineral deposits geology, mineral exploration, mining geology, mineral processing, ore microscopy, remote sensing, applied geophysics, applied geochemistry, engineering geology, environmental geology, geostatistics, geographic information systems, environmental or exploration and mining law, engineering economics/management, and computer sciences.

### *Doctor of Philosophy -- Geological Engineering*

The PhD requires a minimum of 72 credit hours beyond the bachelor's. At least 24 of these credits must be research hours culminating in a doctoral dissertation. The dissertation must make a new contribution to the geological engineering profession. The remaining credit hours can be coursework, of which 24 hours can be transferred from another institution. All students must complete two core courses, GEGN 532 Geological Data Analysis and GEOL 607 Geology Seminar. A minor area of study consisting of 12 credit hours of coursework is also required. In addition to these requirements, students must satisfy requirements specific to their chosen field of specialization.

### *Engineering Geology/Geotechnics*

- Engineering Geology & Geotechnics
- Groundwater Engineering

Additional requirements are tailored to the individual's interests. Courses are generally selected from the following topics: engineering geology, groundwater engineering, groundwater modeling, soil mechanics and foundations, rock mechanics, underground construction, seismic hazards, geomorphology, geographic information systems, construction management, finite element modeling, waste management, environmental engineering, environmental law, engineering management, or computer programming. The minor course of study typically is in geotechnical engineering, rock mechanics/earth systems engineering, environmental engineering, groundwater engineering or geology.

### *Ground Water/Hydrogeology*

- Advanced Groundwater Engineering
- Advanced Topics in Engineering Hydrogeology
- Vadose Zone Hydrology
- Advanced Groundwater Modeling

Additional course work tailored to the student's specific interests are likely to include chemistry, engineering, environmental science, geophysics, mathematics (particularly Partial Differential Equations), microbiology, organic chemistry, contaminant transport, soil physics, optimization, shallow resistivity or seismic methods.

### *Mining Geology*

- Engineering Geology & Geotechnics **or** Groundwater Engineering
- Advanced Mineral Deposits-Magmatic and Syngenetic Ores
- Advanced Mineral Deposits-Epigenetic Hydrothermal Systems
- Special Topics-Surface Mine Design **or** Special Topics-Underground Mine Design
- Mineral Exploration **or** Mining Geology
- Applied Structural Geology

Students can select elective courses from the following topics: mineral deposits geology, mineral exploration, mining geology, mineral processing, ore microscopy, remote sensing, applied geophysics, applied geochemistry, engineering geology, environmental geology, geostatistics, geographic information systems, environmental or exploration and mining law, engineering economics/management, and computer sciences. The minor area of study may be in geotechnical engineering, rock mechanics/earth systems engineering, environmental engineering, groundwater engineering, mining engineering, mineral economics/engineering economics or geology.

### *Prerequisites*

Applicants should have completed coursework in the following or equivalent subjects: Mathematics (2 semesters of calculus and one semester of any two of Calculus II, Differential Equations, Probability and Statistics, Numerical Analysis, Linear Algebra, Operations Research, and Optimization); Chemistry (2 semesters); Physics (2 semesters); Mineralogy/Petrology; Stratigraphy/ Sedimentation; Physical Geology/ Historical Geology; Computer Programming; Structural Geology; 4 of the following (one semester each): Physical Chemistry/ Thermodynamics, Soil Mechanics, Statics, Fluid Mechanics, Dynamics, Rock Mechanics, Mechanics of Materials; and Field Geology. As part of the graduate program the student must take 1 semester in 2 of the following subjects if such courses were not taken for a previous degree: Mineral Deposits/Economic Geology, Hydrogeology, Engineering Geology.

## Geology & Geological Engineering at CSM

In addition, as part of the graduate program the student must take 1 semester in 3 of the following subjects if such courses were not taken for a previous degree: Foundation Engineering, Engineering Hydrology, Geomorphology, Airphoto Interpretation or Photogeology or Remote Sensing, Petroleum Geology, Introduction to Mining, Introductory Geophysics, Engineering Geology Design, Mineral Exploration Design, Groundwater Engineering Design, or other engineering design courses as approved by the program committee.

### *Western Regional Graduate Program*

The Geological Engineering programs (ME, MS, and PhD) at CSM are members of the Western Regional Graduate Program (WRGP), which allows students who are residents of 14 western states to enroll in these programs at resident tuition rates. Details are explained later in this brochure.

### **Geochemistry Degrees**

The *Master of Science in Geochemistry* is designed for students who wish to learn the skills and methods of scientific research. It requires 36 hours of course work and research combined, including a sequence of interdisciplinary core courses covering appropriate aspects of geology and chemistry, followed by a wide selection of courses from the optional areas of specialization and a thesis.

A *PhD in Geochemistry* requires at least 72 hours beyond a bachelor's degree, of which no less than 24 hours should be research credits. A minimum of 30 hours must be taken at CSM. A maximum of 36 hours can be derived from a master's degree in a related field. A candidate will defend a dissertation that describes a significant and original research program. The core courses required by MS and PhD Geochemistry students are

- CHGC 503 - Introduction to Geochemistry
- CHGC 504 - Methods in Geochemistry
- CHGN 503 - Advanced Physical Chemistry (PhD students only)
- One hour laboratory course

In addition, students must take two courses from the following list:

- CHGC 509/GEGN 509 - Introduction to Aqueous Geochemistry
- CHGC 610 - Nuclear and Isotopic Geochemistry
- CHGN 503 - Advanced Physical Chemistry
- GEOL 512 - Mineralogy and Crystal Chemistry

Beyond the core requirements, all geochemistry students, with advice from their advisors and/or thesis committees, may elect courses in one of four optional tracks: Mineralogy- Petrology, Aqueous-Environmental, Ore deposits- Exploration, or Organic-Petroleum.

### **Admissions & Entrance Requirements**

Our graduate program is designed to accommodate students with undergraduate degrees in geology and geological engineering. Students wishing to enroll will need a general engineering and mathematical background. Those without the equivalent of earth science degrees may be admitted, but may need to take appropriate background courses.

Applications are reviewed twice a year; applications are accepted until March 1 for fall admission and until November 1 for spring admission. Students wishing to apply to the Geology & Geological Engineering Department should submit a complete application to the Office of Graduate Studies. Students must also submit two official transcripts of all previous college work, three letters of recommendation, GRE results, financial affidavit (international students), and any supporting materials that the applicant wishes to provide. Foreign students whose native language is not English, except for those with degrees from English-speaking universities, must submit TOEFL or IELTS scores. For more information or to access our online application, see Graduate Admissions (<http://www.mines.edu/Admiss/grad>).

### **Western Regional Graduate Program**

The Geological Engineering programs (ME, MS, and PhD) at CSM are members of the Western Regional Graduate Program (WRGP), which allows students who are residents

of 14 western states to enroll in these programs at resident tuition rates. WRGP is one of the programs established by WICHE, the Western Interstate Commission for Higher Education, to promote the sharing of higher education resources. Students applying to the Geological Engineering programs who are residents of participating WICHE states may enroll as WRGP students. Applicants do not have to meet specific financial criteria, but they must meet all admissions requirements and deadlines set by CSM. Residents of Alaska, Arizona, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming are eligible for this program.

<b>Geology &amp; Geological Engineering at CSM</b>																																																																																																			

**Financial Assistance**

Financial aid for graduate studies is available through teaching assistantships, research assistantships, and scholarship and grant programs. There is considerable competition for these awards, but financial assistance can generally be found for strong students, if not the first year then after an advisor is found and selected area of research determined. Decisions on financial support are made in conjunction with the admission process. No additional application is necessary.

Graduate students are also eligible for student loans through the Office of Financial Aid. For more information, see Funding Your Studies ([http://www.mines.edu/admiss/grad/funding\\_studies.htm](http://www.mines.edu/admiss/grad/funding_studies.htm)).

If you have questions about the admission process or if you wish to discuss potential programs, please contact Dr. Greg Holden, Assistant Department Head and Chairman of the Graduate Advisory Committee, 303-273-3855 or email:

[gholden@mines.edu](mailto:gholden@mines.edu). or write:  
Department of Geology and Geological Engineering  
Colorado School of Mines, Golden, CO 80401  
Phone: 303-273-3800 FAX: 303-273-3859  
URL: <http://www.mines.edu/Academic/geology>

## Geology & Geological Engineering at CSM - Faculty

**Donna Anderson**, Research Assistant Professor. BA California State, Fullerton; MS University of California, Los Angeles; PhD Colorado School of Mines. Applied sedimentary geology; stratigraphic controls on hydrocarbons and diagenesis.

**David A Benson**, Associate Professor. BS New Mexico State University; MS San Diego State University; PhD University of Nevada, Reno. Analytical Methods in Hydrogeology; Numerical Methods; Contaminant Fate and Transport.

**Andreas Dietrich**, Research Associate Professor. Ms, PhD Technical University of Clausthal, Germany. Economic Geology/Ore Deposits.

**Mason Dykstra**, Research Associate Professor. BS Northern Arizona University; MS University of Colorado, Boulder; PhD University of California, Santa Barbara. Sedimentology; Deep-Marine Channel-Levees.

**Mary Carr**, Research Assistant Professor. BS, MS University of Texas, Arlington; PhD University of Texas, Austin. Deepwater systems stratigraphy and modeling.

**L. Graham Closs**, Associate Professor. AB Colgate University; MS University of Vermont; PhD Queen's University, Canada. Geochemical exploration for base and precious metals deposits; open pit planning and optimization; geostatistical ore reserve estimation.

**John B. Curtis**, Associate Professor, Director, Petroleum Exploration and Production Center. BA, MS Miami University; PhD The Ohio State University. Petroleum geology and geochemistry; evaluation of energy resources.

**Michael A. Gardner**, Research Associate Professor. BA University of Colorado, Boulder; PhD Colorado School of Mines. High resolution sequence stratigraphy; clastic sedimentology; basin analysis; reservoir characterization.

**Michael N. Gooseff**, Assistant Professor. BCE Georgia Institute of Technology; MS, PhD University of Colorado. Hydrology; groundwater-surface water interactions; aquatic biogeochemistry; solute transport and fate.

**Nicholas B. Harris**, Research Associate Professor. BA, Amherst College; MS, PhD Stanford University. Petroleum geology; sedimentary geology and geochemistry; clastic diagenesis and reservoir quality; hydrocarbon source rocks; studies of west Africa .W

**Wendy J. Harrison**, Professor. BS, PhD University of Manchester, Great Britain. Geochemical models of reactions in low temperature, aqueous fluids; experimental and theoretical studies of trace element geochemistry; geochemistry of groundwater contamination; theoretical, experimental, and field studies of acid mine drainage; sedimentary diagenesis.

**Jeffrey W. Hedenquist**, Research Assistant Professor. BA Macalester College; MA John Hopkins University; PhD University of Auckland. Economic geology; geochemistry; volcanology.

**Jerry D. Higgins**, Associate Professor. BS Southwest Missouri State University; MS, PhD University of Missouri, Rolla. Engineering geology and geotechnics, including assessment and mitigation of geologic hazards, rock and soil slope stability studies, rock-fall analysis and mitigation, engineering geologic mapping, expansive and collapsible soils and bedrock, and construction aggregates.

**Murray W. Hitzman**, Charles F. Fogarty Professor of Economic Geology, Department Head. BA Dartmouth College; MS University of Washington; PhD Stanford University. Economic geology; geology of metallic and nonmetallic mineral deposits; integrated methods of mineral exploration; geosciences; and public policy.

**Gregory S. Holden**, Associate Professor, Assistant Department Head. BS University of Redlands; MS Washington State University; PhD University of Wyoming. Metamorphic and igneous petrology; regional geology and mapping.

**John D. Humphrey**, Associate Professor. BS University of Vermont; MS, PhD Brown University. Carbonate diagenesis and geochemistry; carbonate sedimentology and stratigraphy; isotope geochemistry; paleoclimatology.

## Geology & Geological Engineering at CSM - Faculty

**Neil F. Hurley**, Research Professor. BS University of Southern California; MS University of Wisconsin, Madison; PhD University of Michigan. Integrated reservoir studies; fractured reservoirs; borehole-imaging logs; carbonate sedimentology; diagenesis; horizontal drilling.

**Charles F. Kluth**, Distinguished Scientist. BA Augustana College; BS, MS Northern Arizona University; PhD University of Arizona. Structural geology and tectonics related to petroleum geology.

**Kevin Mandernack**, Associate Professor. BS University of Wisconsin, Madison; PhD Scripps Institute, UC San Diego. Environmental microbiology; biogeochemistry of aquatic and terrestrial environments; stable isotope geochemistry.

**Meghan M. Morrissey**, Research Assistant Professor. BS Michigan Technological University; MS University of Texas at Arlington; PhD Arizona State University. Active volcanoes; computer modeling.

**Eric P. Nelson**, Associate Professor. BS California State University, Northridge; MA Rice University; PhD Columbia University. Structure; tectonics; metallogeny.

**Douglas Paton**, Research Associate Professor. Stratigraphy; Sedimentology.

**Piret Plink-Bjorklund**, Associate Professor. BS, MS Tartu University, Estonia; PhD Goteborg University, Sweden. Sequence Stratigraphy; Clastic Sedimentology; Basin Analysis.

**Eileen P. Poeter**, Professor. BS Lehigh University; MS, PhD Washington State University. Identification of aquifer heterogeneities; groundwater flow and transport modeling; inversion; geophysics applied to groundwater problems.

**David Pyles**, Research Associate Professor. MS Colorado School of Mines. Stratigraphy; Sedimentology.

**Samuel B. Romberger**, Professor. BS, PhD The Pennsylvania State University. Solution chemistry and mineral phase equilibria applied to metal fate and transport in acid mine water systems; the genesis of hydrothermal mineral deposit; precious and base metal and uranium ore deposits.

**Paul Santi**, Associate Professor. BS Duke University; MS Texas A&M University; PhD Colorado School of Mines. Engineering geology; hydrogeology.

**Geoffrey D. Thyne**, Research Associate Professor. BA University of South Florida; MS Texas A&M University; PhD University of Wyoming. Water-rock interactions, especially the interactions of biological, chemical and physical factors that control elemental behavior between the solid, aqueous, and non-aqueous phases.

**Bruce D. Trudgill**, Associate Professor. BS University of Wales; PhD Imperial College. Petroleum geology; structural geology; salt tectonics; seismic stratigraphy.

**A. Keith Turner**, Professor. BS Queen's University, Canada; MA Columbia University; PhD Purdue University. Engineering geology; hydrogeology; computer applications; geographic information systems; remote sensing; expert systems; site selection; environmental assessment.

**Richard F. Wendlandt**, Professor. BA Dartmouth College; PhD The Pennsylvania State University. Igneous petrology; continental rifting; petrophysics; experimental petrology; mineral phase equilibria.