Course Change Request

New Course Proposal

Date Submitted: 01/25/22 10:42 pm

Viewing: GEOL 741 : Isotopes in Geology

Last edit: 02/17/22 11:25 am

Changes proposed by: ggilleau

Programs referencing this course

: Geology and Earth Sciences, PhD

In Workflow

1. **AOES Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 01/20/22 11:48 am Mark Uhen (muhen): Rollback to Initiator
2. 01/31/22 2:27 pm Mark Uhen (muhen): Approved for AOES Chair

Are you completing this form on someone else's behalf?

No

Effective Term: Fall 2022

Subject Code: GEOL - Geology

Course Number: 741

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Isotopes in Geology

Banner Title: Isotopes in Geology

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May be only taken once for credit, limited to 3 attempts (N3)

Max Allowable Credits: 9

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

An undergraduate degree in physical or natural sciences that includes at least one semester of chemistry, introductory physical geology, and preferably, a course in mineralogy, or permission of instructor.

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

Applications of isotope geochemistry to problems in geology, including both radioactive and stable isotopes, and low-temperature and high-temperature processes. Introduction to isotopes as a premier tool for tracing natural processes on Earth and in the solar system.

Justification:

What: Creating a new course.

Why: Isotopes are a powerful tool utilized in every area of Earth science research. The isotope geochemistry of natural samples (water, soil, rocks, air, ice) has provided a wealth of information about Earth's history and future, and has informed our understanding of Earth's habitability and place in the cosmos. Isotopes are currently not covered at all in the AOES curriculum, leaving a substantial knowledge gap for our graduate students. This course will touch on all important aspects of isotopes in Earth science and will be an important course for our future PhD program in Geology and Earth Science. It also may be attractive to graduate students from CHEM or ESP.

Does this course cover material which crosses into another department? Yes

Impacted Departments:

Department
CHEM - Chemistry & Biochemistry
ESP - Environmental Science & Policy

Learning Outcomes:

Understand: the physics of the atomic nucleus; radioactive decay; analytical methods in isotope geochemistry; the basis geochronology; and the evolution of the mantle and crust through geologic time; as well as stable isotope applications in oceanography, climate science, environmental science, tectonics, and paleontology.

Attach Syllabus

Isotopes_syllabus.pdf

Additional Attachments

Staffing:

Prof. Geoff Gilleaudeau

Relationship to Existing Programs:

Useful for students in the ESS MS degree and for the future PhD program in Geology and Earth Science. Could also be attractive to graduate students in CHEM or ESP.

Relationship to Existing Courses:

GEOL 403 and proposed graduate-level GEOL 603 (Geochemistry) present a very basic introduction of isotope geochemistry that will be expanded upon greatly in this course.

Additional Comments:

Reviewer Comments

Mark Uhen (muhen) (01/20/22 11:48 am): Rollback: updates

Key: 17512

GEOL 741: ISOTOPES IN GEOLOGY

Syllabus

Professor: Dr. Geoff Gilleaudeau
Lecture Meeting Time: Twice per week (1.25 hours each meeting)
Lecture Meeting Place: Exploratory Hall Room 1005
Professor's Office: Exploratory Hall Room 3452
Professor's Email: ggilleau@gmu.edu

Course Textbook: "Isotope Geochemistry" by William M. White

Course Goals:

Differences in the number of neutrons (and thus differences in mass) between varieties of the same chemical element (i.e., isotopes) are recognized throughout the cosmos. Many processes on Earth and in the solar system, both modern and ancient, act to separate atoms by mass, making the measurement of isotope ratios in natural samples a powerful tool for fingerprinting many processes in nature. Radioactive isotopes form the basis of geochronology, which has transformed our understanding of Earth and solar system history. Isotopes were fractionated during planetary differentiation on early Earth, and the long-term evolution of Earth's mantle can be tracked using isotopes in igneous rocks. At Earth's surface, isotopes are fractionated during nearly all physical, chemical, and biological processes, and can be used to track changes in climate, ocean circulation, ocean-atmosphere oxygenation, and weathering, among others. This course is designed to survey all major applications of isotope chemistry to problems in geology, ultimately providing a wealth of information on modern and ancient processes on Earth.

Learning Outcomes:

Understand: the physics of the atomic nucleus; radioactive decay; analytical methods in isotope geochemistry; the basis geochronology; and the evolution of the mantle and crust through geologic time; as well as stable isotope applications in oceanography, climate science, environmental science, tectonics, and paleontology.

Grading Scheme for GEOL 741:

30%: Weekly problem sets and write-ups
30%: Class presentations and discussion leads
30%: Final term paper
10%: Final presentation

Grade scale:

A+ = 97 - 100%, A = 94 – 97%, A- = 90 – 94%, B+ = 87 – 90%, B = 84 - 87%, B- = 80 - 84%, C = 70 - 80%, F = 0 - 70%

The course will draw heavily on the primary scientific literature to understand applied isotope methods in geology. Weekly problem sets will combine theoretical calculations and considerations with exercises involving real datasets. They will be written in narrative scientific style with figures and citations. The primary literature on specific topics will also be discussed openly in class with student-led discussions on assigned papers. Each student will also be responsible for picking a topic related to isotopes in geology for a final term paper and

presentation. The term paper exercise will involve a first draft, double-blind peer review, and subsequent revision. The final presentation will be a 12-minute conference-style talk with 3 minutes allotted for questions. The lowest grade for a problem set or weekly assignment will be dropped.

Semester Schedule:

Day	Lecture Topic	Activity
Mon	Physics of the atomic nucleus, nucleosynthesis	Lecture
Wed	Radioactive decay	Lecture
Mon	Analytical methods	Lecture
Wed	Geochronology in igneous and metamorphic rocks	Student-led presentation and in-class exercise/discussion
Mon	Geochronology in sedimentary rocks	Student-led presentation and in-class exercise/discussion
Wed	Isotopes in Earth's mantle	Student-led presentation and in-class exercise/discussion
Mon	Evolution of the crust and mantle through geologic time	Student-led presentation and in-class exercise/discussion
Wed	Cosmogenic isotopes and planetary applications	Student-led presentation and in-class exercise/discussion
Mon	Basic principles of stable isotope geochemistry	Lecture
Wed	Hydrothermal processes and ore genesis; Economic geology	Lecture
Mon	Stable isotopes in the oceans I	Lecture
Wed	Stable isotopes in the oceans II	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes in the biosphere I	Lecture
Wed	Stable isotopes in the biosphere II	Student-led presentation and in-class exercise/discussion
Mon	Discussion of term paper guidelines and introduction to scientific writing	Lecture and discussion
Wed	Stable isotopes in the terrestrial weathering environment	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes for paleo-redox I	Lecture
Wed	Stable isotopes for paleo-redox II	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes in climate studies I	Lecture
Wed	Stable isotopes in climate studies II	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes in climate studies III	Student-led presentation and in-class exercise/discussion
Wed	Stable isotopes in paleontology	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes in archaeology and anthropology	Student-led presentation and in-class exercise/discussion
Wed	Stable isotopes in neotectonics	Student-led presentation and in-class exercise/discussion
Mon	Stable isotopes in environmental geology I	Lecture

Wed	Stable isotopes in environmental geology II	Student-led presentation and in-class exercise/discussion
Mon	Noble gas isotopes	Lecture
Wed	Mass-independent isotope fractionation	Lecture
Mon	Final presentations I	Final presentations
Wed	Final presentations II	Final presentations

Academic Integrity

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. If you have any doubts about what constitutes plagiarism, please see me.

Disability Accommodations

Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Then please discuss your approved accommodations with me. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu | Phone: (703) 993-2474

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