

Fall 2018
Environmental Tracers in Water

INSTRUCTOR

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MEETING PATTERN & LOCATION

MW 9:00 - 10:20am Geology Building 302, 3 credits

MS students (GEOL 5320, **CRN 18369**)

PhD students (GEOL 6342, **CRN 18370**)

COURSE DESCRIPTION

The principles of stable, radiogenic, and radioactive isotope chemistry of natural waters, as well as the geochemical processes affecting isotopic compositions of surface waters, soil waters, and groundwater; The applications of isotopic techniques in determining groundwater residence times, flow paths and recharge conditions.

REQUIRED TEXTBOOK

Clark I.D. and Fritz P. (1997) *Environmental Isotopes in Hydrogeology*. Lewis Publishers, NY, 328pp.

RECOMMENDED READING

Kendall C. and McDonnell J.J. (Eds) *Isotope Tracers in Catchment Hydrology*. Elsevier, NY, 839pp.

Recent journal articles and review papers will also be discussed throughout the course. Materials and lecture slides will be provided as PDFs on Blackboard. ***It is highly recommended to have a physical copy (or electronic copy) of the textbooks for your course work and as reference books for your future research work.***

COURSE OBJECTIVES

- 1) Learn the fundamentals of stable, radioactive, and radiogenic isotope geochemistry
- 2) Understand why there are natural variations in isotope ratios
- 3) Apply these concepts to hydrogeologic systems
- 4) Learn to critically evaluate and interpret isotopic data
- 5) Learn the principles in groundwater age dating

In addition to the above general course objectives, I would like to see how this course could provide knowledge and tools that are useful to your future research work. So please also think about how your research work may utilize the various isotope systems in natural waters. This will be beneficial for your final class project for this class.

SCHEDULE OF TOPICS – *subject to change!*

Date:	Topic:	Reading assignments*
Week 1	Introduction to environmental isotopes, isotope terminology, fractionation, Rayleigh distillation	Chapter 1
Week 2-5	Tracing the hydrologic cycle:	
	O-H stable isotopes – evaporation	
	(O-H) precipitation	
	(O-H) Rivers and groundwaters – modern recharge	
	(O-H) Paleorecharge conditions, plants, climate change	
	O-H tracers of hydrologic, biologic and/or geologic processes	
Week 6	Nitrogen isotopes: biogeochemical processes & water quality	
	Sulfur isotopes: biogeochemical processes & water quality	
Week 7-8	Sr, Ca, and Fe isotopes: mineral weathering & fluid mixing	
Week 9	Carbonate speciation in waters	Mid-Term Exam
	Carbon isotopes: tracing the carbon cycle	
	Carbon isotopes (DOC)	
Week 10-13	Age dating – modern waters (^3H , ^3He)	
	Age dating – modern waters (CFCs, SF ₆ ...)	
	Age dating – old waters – carbon 14	
	NETPATH	
Week 14	Noble Gases: groundwater dating and paleo-climate	
	U-Th isotopes: transport and contamination	
Week 15	Student project presentations	Final class project

*Reading assignments will be announced prior to the lectures, please make sure you have time to go over the reading assignments as a part of class preparation.

Grades:

Mid-term (40%)

Project presentation and term paper (20%)

Homework (20%)

Participation in classroom discussion (20%)