Professor: William M. White  
4112 Snee; 255-7466; wmw4@cornell.edu  
Office Hours: most times except Tu/Th mornings  
Text: White: Isotope Geochemistry, Wiley  
Grades: 30% Prelim  
30% Problems Sets (there will be 4 to 6)  
40% Final or term paper  
Information on the course, handouts, and problem set solutions are posted on the World Wide Web at:  
http://www.geo.cornell.edu/geology/classes/Geo656/656home.html

Part I: Radioactive and Radiogenic Isotope Geochemistry  
A. Physical Fundamentals  
Reading: Chapter 1  
1 Introduction, Physics of the Nucleus, Radioactive Decay Jan 26  
2 Nucleosynthesis, Radioactive Decay Jan 31  
B. Geochronology  
Reading: Chapter 2  
3 Equations of Radioactive Decay and Radiogenic Growth; The K-Ar System Feb 2  
4 The Rb-Sr & Sm-Nd Systems Feb 7  
5 Lu-Hf, Re-Os & Other Decay Systems Feb 9  
Reading: Chapter 3  
6 U-Th-Pb System Feb 14  
7 Short-lived Isotopes of the U-Th Decay Series Feb 16  
Reading: Chapter 4; Appendix  
8 Cosmogenic Isotopes (\(^{14}\)C, \(^{36}\)Cl, \(^{10}\)Be, etc.); Fission Track Dating Feb 23  
9 Analytical Methods Feb 28  
C. Radiogenic Isotope Geochemistry  
Reading: Chapter 5  
10 Cosmochemistry and Cosmochronology Mar 2  
11 Cosmochemistry and Cosmochronology II Mar 7  
Reading: Chapter 6  
12 Isotope Geochemistry of the Earth's Mantle Mar 9  
13 Mantle and Whole Earth Geochemical Models Mar 12  
14 U-Series Isotopes and Melt Generation Mar 16  
Reading: Chapter 7  
15 Evolution of the Mantle and Crust Mar 21  
16 Evolution of the Continental Crust; Subduction Zones Mar 23  
PRELIM EXAM (Approx. Date) Mar 28  

Part II: Stable Isotope Geochemistry  
Reading: Chapter 8  
A: Fundamentals  
17 Stable Isotope Theory Mar 30  
SPRING BREAK Apr 3-7  
18 Isotope fractionation in the Biosphere Apr 9  
B: Igneous and Hydrothermal Systems  
Reading: Chapter 9  
19 Stable Isotopes in Igneous Systems Apr 11  
20 Stable Isotopes in igneous Systems II Apr 13  
21 Hydrothermal Systems and Ore Genesis Apr 18
C: Low Temperature Applications

Reading: Chapter 10
22 Applications to Archeology and Paleontology Apr 20
23 Paleoclimatology Apr 25
24 Carbon Cycle and Climate Apr 27

Reading: Chapter 11
25 Mass Independent Fractionation; Isotope Clumping May 2
26 Non-Conventional Isotopes May 4

Reading: Chapter 12
17 Noble Gases May 9

Final Exam: TBA

Learning Objectives

Principal Goal
Understand how variations in the isotopic abundances of elements are used to understand how the Earth and biosphere work and how it has evolved over time.

Detailed Objectives

Understand the structure of atomic nuclei and how this affects nuclear stability
Be able to explain the processes by which the chemical elements have been synthesized over the history of the cosmos.
Understand and be able to use the various techniques of radiometric dating to determine the age of geologic materials and events.
Understand and be able to explain the evidence for the existence of extinct radioisotopes in the early solar system and the Earth and how these provide a detailed chronology of early solar system history.
Be able to explain how radiogenic isotopes are used as tracers of geologic and oceanographic processes, including evolution of the continental crust and mantle, and ocean circulation.
Be able to explain how slight differences in mass lead to slight differences in chemical behavior of isotopes of an element.
Be able to explain how isotopes of carbon, nitrogen, and sulfur can be used to reconstruct the history of life and how they are used to infer diets and paleodiets of animals and humans.
Be able to explain how isotopes of oxygen and sulfur are used to understand interaction between magma and surrounding country rock and the genesis of metal ores.
Be able to explain how isotopes of oxygen and carbon are used to understand the carbon cycle and to reconstruct the Earth’s climate history, including recent anthropogenic changes.