UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Geochronology and Archeometry

2324-1-F7401Q052

Aims

The course provides a summary of the fundamental principles of Geochemistry, in particular of Isotopic Geochemistry. Students learn to recognize and interpret chemical and isotope fractionation processes, and use elements and isotope ratios as tracers of geological, geodynamic, petrogenetic and volcanological processes. The knowledge on the radioactive decay of the most used radionuclides, the implications on geochronology and the main dating methods used will be deepened.
Students, through a multidisciplinary approach, learn to use geochemical tracers (stable isotopes, radiogenic and noble gases) in fluids and rocks to reconstruct the cycle of volatiles in the earth's mantle, placing them in relation to petrogenesis, geology and geodynamics, and evaluate the their return to the atmosphere and/or marine environment through volcanism. The course allows students to acquire the skills of geochemical modeling and application to the main natural processes involved in the cycle of volatiles.

Contents

Basic notions of the principles of Geochemistry. Isotope geochemistry, fractionation and mixing processes. Radioactive decay, basics of Geochronology. Geochemistry of radiogenic isotopes. Geochemistry of noble gases. Elements of geodynamics and petrogenesis. Behavior of volatiles in different geodynamic contexts. Fluid systematics during mantle melting and metasomatism. Geochemistry of magmatic volatiles. Solubility of volatiles in magmas and distribution of species among the various coexisting phases. Magmatic degassing. Crust contamination processes. Volcanism and degassing in submarine and subaerial environments. Visualization and processing of geochemical data.

Detailed program

Presentation of the course. Basic notions of Geochemistry. Geochemical affinity of the elements, their influence on geochemical behaviour. Geochemical spheres.
Geochemistry of stable isotopes (H, O, C, N, S). Delta notation, fractionation and enrichment factor. International standards. Isotopic fractionations.
Mechanisms of radioactive decay, general equation of radioactive decay. Main geochronological methods (Rb-Sr, Sm-Nd, U-Th-Pb, K-Ar and 39Ar-40Ar). Geochemistry of radiogenic isotopes. Principles of mass spectrometry. Geochemistry of noble gas isotopes.
Elements of geodynamics and petrogenesis. Partial melting of the mantle. Potential mantle reservoirs identified based on radiogenic isotopes and noble gases, in relation to geodynamics. Geochemistry of volatiles in the mantle. The behavior of volatiles during mantle melting and metasomatism. Partition of volatiles between mantle and melt. Relations between volatiles and chemical composition of minerals. The recycling of volatiles in the mantle.
Geochemistry of magmatic volatiles. Solubility of volatiles in magmas and distribution of species among the various coexisting phases. Magmatic degassing. The role of oceanic and continental crust in the contamination of magmatic fluids rising to the surface. Volcanism and outgassing of volcanic gases, the composition of volcanic gases, gas-water-rock interaction processes, and hydrothermal systems.
Main methods of sampling fluids and rocks, laboratory analytical techniques. Methods of visualization and processing of geochemical data.

Prerequisites

Chemistry, Physics, Geochemistry, Petrography

Teaching form

Lectures (6 CFU)

Textbook and teaching resource

Slides provided during the lessons

BOOKS

W.M. White, Geochemistry
McSween H.Y., Richardson S.M. Jr., Uhle M.E., Geochemistry (Pathways and Processes)
Walker M., Quaternary Dating Methods, Wiley
A. Longinelli, S. Deganello, Introduzione alla Geochimica
Ozima M. & Podosek F.A. (2002), Noble Gas Geochemistry, Cambridge University

Burnard P., The Noble Gases as geochemical tracers, Springer
Dongarrà G. & Varrica D. (2004) “Geochimica e ambiente” EDISES
Faure G. (1998), Principles and Applications of Geochemistry
Krauskopf K.B. & Bird, D. K., Introduction to Geochemistry, 1995. McGraw-Hill International Editions.
J. Hoefs, Stable isotope Geochemistry
C.J. Allègre, Isotope Geology

Semester

I semester

Assessment method

Oral exam consisting of an interview on the topics developed during the course. The exam consists of at least three open questions, the first of which is a topic of the program chosen by the student. The teacher will evaluate the knowledge and deepening of the concepts, the ability to connect the topics, the expository clarity, the use of a language appropriate to the subject, and the commitment made to prepare for the exam

Vote out of thirty

Office hours

To make an appointment, please write to andrealuca.rizzo@unimib.it

Sustainable Development Goals