GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2017-2018

Stable Isotope Geochemistry (C004050)

Course size (nominal values; actual values may depend on programme)

Credits	3.0	Study time	90 h
Contact hrs	30.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	English	lecture	15.0 h
		seminar: coached exercises	15.0 h

Lecturers in academic year 2018-2019

Goderis, Steven	WE06	lecturer-in-charge
Claeys, Philippe	WE13	co-lecturer

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Marine and Lacustrine Science and Management	3	A

Teaching languages

English

Keywords

geology, stable isotope

Position of the course

The goal of this course is to familiarize the students with the basic physics and chemical concepts of stable isotope geochemistry. The emphasis is set on the experimental use of stable isotopes as an experimental research methodology in various domains of the Earth Sciences, Biogeochemistry and Environmental Sciences. In the various sub-disciplines of these scientific fields, the potential applications of the H, O, C, N and S isotopic system will be presented. This way, the students will be exposed to the wide-ranging research possibilities provided by stable isotope geochemistry. These goals develop the following competences and skills for the master program in Geology, basin dynamics and soil and groundwater, in particular : M.1.1, M. 1.2 , M.1.4, M.1.6, M.2.1, M.2.3, M.2.5, M.2.6, M.3.1, M.4.2, M.4.3, M.O.1, M.O.2, M. ORB.2, M.ORB.3, M.ORB.4, M.ORB.6, M.ORB.8 & M.OSG.1.
The above mentioned objectives also contribute to the competence of other Master programs.

Contents

Lectures:
Introductory concepts: natural stable isotope systems (D/H, C, N, O, S), abundances, ratios, delta-notation, fractionation mechanisms (physical and chemical, in equilibrium and kinetic), fractionation factors (alpha) and their temperature dependence, analytical methods, standards, delta-differences DELTA, and relations between delta, alpha, T and DELTA.
Hydrogen- and oxygen isotopes in the hydrosphere: processes and applications.
Introduction to the use of stable isotope ratios as tracers.

- Carbon- and oxygen isotopes in the sedimentary environment: processes and applications in palaeoclimatology and palaeo-environment reconstruction.

Introduction to the use of stable isotope ratios as palaeothermometers.

- Isotopic aspects of the biogeochemistry of carbon: fractionations in equilibrium, fractionations in biological processes, interactions between organic and inorganic reservoirs, applications in biogeochemistry, stratigraphy and geology of hydrocarbons.
- Isotope geochemistry of nitrogen and sulphur: fractionation mechanisms, biogeochemical cycles, reservoirs, and applications.
- Isotope geochemistry of hydrogen, carbon, oxygen and sulphur in processes of

weathering, sedimentation, diagenesis, hydrothermalism, metamorphism, magmatism. Applications in petrology, ore geology, stratigraphy, geotectonics, 'global change' research, etc...

Illustrations of applications in material sciences, in biomedical and clinical research, in archaeology, in environmental sciences, etc.

Practical classes:

- Exercises, fundamental and application-oriented, on the relations between delta, alpha, T, and DELTA.
- Demonstrations and simple laboratory work on analytical techniques.
- Tutorials and/or seminars on case studies.

Initial competences

Basic general physics, chemistry and geology.

Final competences

1. After completion of the course, the students will be able to use the stable isotopes to address a broad range of problem in the fields of Earth Sciences, biogeochemistry and Environmental Sciences. Moreover, they will be familiar with the analytical techniques to be applied to specific problems.
2. The students will be able to think critically and in a multidisciplinary context about research and application possibilities of the H, C, O, N, S isotopic systems in the various disciplines of the fields.
3. They will also be aware of the published literature.
4. Thanks to the exercises and team projects carried out in the class, the students will be able to address complex problems in different fields, summarize important issues and using the English language present a structured argumentation and defend it in front of an audience of peers.
5. The priority will be given to a problem solving approach, where the students will address research questions from an analytical stand point, including the designing and carrying out experiments.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, integration seminar, practicum, seminar: coached exercises

Extra information on the teaching methods

B-hours exercises, divided in ca. 15 hours of seminar/discussion and ca. 10 hours of lab work and ca. 5 hours of applied exercises.

Learning materials and price

The student takes notes during lectures and practical classes. These notes are supplemented with provided texts, figures and maps, short texts, syllabi, articles and about certain subjects.

Additional study material: During lectures, information and advice is given on textbooks, reference books and other scientific publications.

Cost: 10 EUR

References

Important books and other references will be discussed:

- HOEFS, J. (2004). Stable Isotope Geochemistry, 5th ed., Springer Verlag, Berlin, 244 pp.
- FAURE, G. (1986). Principles of isotope geology, 2nd ed., John Wiley & Sons, Inc., 589 pp.
- MOOK, W. (2000). Environmental isotopes in the hydrological cycle. Principles and applications, Volume 1. Introduction. Theory Methods Review, UNESCO, Paris, 280 pp.
- SWART, P.K., LOHMANN, K.C., MCKENZIE, J. & SAVIN, S. (1993). Climate Change in continental Isotopic Records, in: Geophysical Monograph Series 78, American Geophysical Union, Washington, USA.
- FRITZ, P. & FONTES, J.CH. (1986). Handbook of Environmental Isotopes Geochemistry, Elsevier, Amsterdam.

Course content-related study coaching

The course occurs in an open and interactive way, with ample time for questions and discussions. The exercises take place in groups, are project oriented and directed by the professor and/or researchers currently working in the lab. During the seminars, the accent lies on discussions and debates.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Oral examination

Examination methods in case of periodic evaluation during the second examination period

Oral examination

Examination methods in case of permanent evaluation

Assignment

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Extra information on the examination methods

- Oral examination at the end of the semester, with time for written preparation of the answers.
- Permanent evaluation during the exercises and lab work.

Calculation of the examination mark