



DEPARTMENT OF EARTH SCIENCES

NGEO303 Stable Isotope Tools in Earth System Science, 3 credits

Stabila isotopverktyg i jordsystemvetenskap, 3 högskolepoäng

Third-cycle level / Forskarnivå

Confirmation

This syllabus was confirmed by the Department of Earth Sciences on 2019-05-14, and is valid from Spring semester 2019.

Responsible Department

Department of Earth Sciences, Faculty of Science

Entry requirements

Admitted to third cycle education.

Learning outcomes

The main goal of the course is to offer a broad introduction to the use of stable isotopes (SI) in Earth Systems Sciences (Biosphere, Geosphere, Hydrosphere and Atmosphere). Lectures will give an overview of the major SI of carbon, nitrogen, oxygen and hydrogen used in studies of the Earth System. Topics addressed include (a) fractionation and mixing processes that affect isotope distribution, (b) the use of SI as tracers by using either their natural abundance distribution or labelling experiments, (c) modelling of processes at meso- and global scale. Questions related to instrumentation, technology and measurement (IAEA standards) will also be highlighted.

Complementary practical works and computing exercises will be conducted in small groups. For the laboratory exercises, we will utilize the Stable Isotope Facility at Earth Science laboratories (ISOGOT infrastructure), including mass spectrometry and laser technologies

Knowledge and understanding

1. Stable isotopes in Earth systems and isotopic fractionation.
2. Understanding of the instrumentation and the use of IAEA certified standards.
3. Knowledge on the use of carbon isotopes in studies on plants, soil and atmosphere

Competence and skills

1. Presentation in seminar form of own isotope related work
2. Presentation and critical discussion of scientific paper
3. Planning and conducting stable isotope projects
4. Applying relevant data analysis tools (e.g. isotope mixing models)

Judgement and approach

1. Critical evaluation of stable isotope use in Earth System science
2. Judging the reliability of stable isotope measurements and data interpretation

Course content

Lectures and classroom discussion:

1. Basic knowledge on SI (Fractionation processes, natural abundance).
2. Instrumentation, technology and measurement (IAEA standards).
3. Photosynthesis, C3 C4 plants and CO₂.
4. Atmosphere and Greenhouse gases.
5. Dynamics of nitrogen studied with ¹⁵N tracing and labelling.
6. Water isotopes in the landscape

Introduction of instrumentation

1. Demonstrations of mass spectrometers and laser analysers at ISOGOT

Practical exercises (laboratory and calculation)

1. Microbial activity during decomposition of organic matter enriched with ¹³C.
2. Gross nitrogen mineralization: ¹⁵N-NH₄ pool dilution
3. Water isotopes
4. Mixing model: source partitioning

Types of instruction

1. Lectures and classroom discussion:
2. Demonstrations of mass spectrometers and laser analysers at ISOGOT
3. Practical exercises (laboratory and calculation)

Language of instruction

The course is given in English.

Grades

The grade Pass (G) or Fail (U) is given in this course.

Types of assessment

Active participation in all lectures, discussions and exercises (practical and calculations).

All practical and calculation exercise are assessed by an individually report.

At the last course day, groups present the outcome of the laboratory exercises with a poster

session.

Course evaluation

The course evaluation is carried out together with the Ph.D. students at the end of the course by individual, anonymous survey followed by an open discussion with the entire class.

Other information

Prior to the course weeks, students are expected to read and be familiar with the textbook:

B. Fry: Stable Isotope Ecology (selected chapters)

Additional scientific literature will be provided prior and during the course.