Environmental Reconstruction Using Stable Isotopes
(Earth Sc 4CC3/Envir Sc 4CC3)

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Prerequisite(s): EARTH SC 3CC3 or ENVIR SC 3CC3. One of EARTH SC 2E03, ENVIR SC 2E03, & ISCI 2A18 is strongly recommended.

Co-requisite(s): WHMIS 1A00 (Must be completed prior to the first lab if not already completed)

Course Outline:

Stable isotopes, such as $^{16}$O, $^{17}$O, and $^{18}$O, are widely used in today’s earth and environmental sciences because their unique chemical properties enable us to reconstruct past and current environmental processes. This course will cover the principles of stable isotope geochemistry, such as equilibrium and non-equilibrium isotope effects, and introduce the basic analytical techniques in the field of stable isotope geochemistry. Furthermore, this course will also focus on the applications of stable isotopes to paleoclimatology and environmental reconstruction studies. Students will be exposed to the theoretical and practical aspects of the most active discipline in geochemistry.

Course Objectives:

By the end of this course, students should be able to:

• Be familiar with the common notations used in stable isotope geochemistry.
• Interpret/understand stable isotope data from various sources of literature.
• Gain a basic understanding of modern analytical techniques in stable isotope geochemistry.
• Explain the concepts of geochemical proxies used in environmental reconstruction.

Course Structure:

• Two 1-hour lectures per week will be given on Tuesday (9:30 am -10:20 am) and Friday (9:30 am - 10:20 am) in BSB-105. All students are expected to attend all lectures.

• Laboratory sessions will be held on Wednesday (Session 1: 8:30 am - 11:20 am) or Thursday (Session 2: 2:30 pm - 5:20 pm) in BSB-315 or GSB-401. A series of laboratory tasks will be assigned, demonstrated, and carried out during the laboratory sessions. Attending the laboratory sessions is mandatory (see the laboratory schedule for details).
Required Textbook:

- Stable isotope geochemistry. 6th edition by Jochen Hoefs, Springer

Course Evaluation:

- In-Class Quizzes 10%
- Laboratory Participation/Exercises 15%
- Assignment (Topic review) 10%
- Mid-Term Exam (Feb. 26, 2016) 24%
- Final Exam (cumulative, during exam period) 41%

(Late penalty for the course evaluation component: 15% of total mark (/100%) per day)

If you are unable to submit one of these evaluation components for a legitimate reason: (1) you must get proper documentation and submit it to the Associate Dean’s office of your faculty OR you can submit the McMaster Student Absence Form (MSAF), once per term, to request academic accommodation due to medical or personal situations that last up to 3 days, (2) you must then contact the Instructor in order to find out what, if any, accommodations will be made for the missed evaluation components. See Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work” for details. Please note these regulations have changed in the beginning of the Fall term, 2015.

Typically, your grade for the missed evaluation will be applied to the Final Exam (i.e., if you miss the assignment, the 10% will be applied to the Final Exam, making it worth 50% of your final course mark). If you do not complete these two steps within 7 calendar days of the missed component, you will receive a grade of zero for it.

Grade Appeal Policy:

You will have 7 calendar days from the date when your grade for a particular course evaluation component (e.g., Assignment) is released to appeal your grade. If you wish to appeal a grade, you must leave a written note (including your name, McMaster email address, and student ID number) in the Earth Sc 4CC3/Envir Sc 4CC3 drop box, stating the component that you wish to be investigated and justifying why you wish to have the evaluation reviewed. If the written request is found to be insufficiently justified (e.g., simply wanting a higher mark is insufficient), the appeal will not be investigated further.

Lecture Outline: The proposed outline may change depending on feedback from the class.

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<tr>
<th>Week beginning:</th>
<th>Lecture Topics</th>
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<tr>
<td>Jan. 3</td>
<td>Introduction /Terminology</td>
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<tr>
<td>Jan. 10</td>
<td>Standards/ Principles of Mass Spectrometry</td>
</tr>
<tr>
<td>Jan. 17</td>
<td>Isotope Exchange Reactions/Stable Isotope Effects</td>
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<tr>
<td>Date</td>
<td>Event Description</td>
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<tr>
<td>Jan. 24</td>
<td>Isotope Fractionation Processes and Analytical Techniques - H &amp; B</td>
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<td>Jan. 31</td>
<td>Isotope Fractionation Processes and Analytical Techniques - C &amp; N</td>
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<td>Feb. 7</td>
<td>Isotope Fractionation Processes and Analytical Techniques - N &amp; O</td>
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<td>Feb. 14</td>
<td>Mid-Term Recess</td>
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<td>Feb. 21</td>
<td>Isotope Fractionation Processes and Analytical Techniques - S /Guest Lecture (TBA)</td>
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<td>Mid-Term Exam (Feb. 26, 2016)</td>
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<td>Feb. 28</td>
<td>Variations of Stable Isotope Ratios in Nature - Hydrosphere</td>
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<td>Mar. 6</td>
<td>Variations of Stable Isotope Ratios in Nature - Atmosphere</td>
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<td>Mar. 13</td>
<td>Variations of Stable Isotope Ratios in Nature - Biosphere</td>
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<td>Mar. 20</td>
<td>Variations of Stable Isotope Ratios in Nature - Lithosphere</td>
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<td>Mar. 27</td>
<td>Variations of Stable Isotope Ratios in Nature - Paleoclimatology - I</td>
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<td>Apr. 3</td>
<td>Variations of Stable Isotope Ratios in Nature - Paleoclimatology - II</td>
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**Academic Integrity:**

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at [http://www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity)

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.