

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	生物同位素科学 Biological Isotopes
2.	授课院系 Originating Department	海洋科学与工程系 Department of Ocean Science and Engineering
3.	课程编号 Course Code	OCE423
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业选修课 Major Elective Courses (请保留相应选项 Please only keep the relevant information)
6.	授课学期 Semester	秋季 Autumn
7.	授课语言 Teaching Language	中英双语 English & Chinese (请保留相应选项 Please only keep the relevant information)
8.	授课教师、所属学系、联系方式 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	周友平, 海洋科学与工程系, 13679176429 Youping ZHOU, Department of Ocean Science and Engineering, 13679176429
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced (请保留相应选项 Please only keep the relevant information)
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements					
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	高级生物及医学同位素科学 Advanced Biological and Medical Isotopes				
14. 其它要求修读本课程的学系 Cross-listing Dept.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程面向本科生，通过 48 学时的理论和实践课，让学生：1) 了解不同生命体如动物，植物，微生物和人体及不同圈层（岩石圈、土壤圈、水圈、大气圈和地外星体及等）中元素(H、C、O、S 和 N 等)的稳定同位素分布（丰度），2) 熟悉这些同位素丰度及变化所代表的物质（特别是有机分子的）合成、保存、代谢、迁移，降解（及衰减）移过程以及伴随这些过程的物理、化学和生物变化；3) 初步熟悉如何从天然物质（特别是有机分子）中提取（化学及）同位素丰度，并对这些分子同位素所记录的生物合成途径、代谢方式、环境及气候信息进行初步解译。

This 48-credit-hours undergraduate level course will be delivered via regular online and/or offline lectures. The attendees will acquire: 1) a basic knowledge of the isotopic abundances of elements such as C, H, O, N and S found in animals, plants, microbes and human beings and in the lithosphere, pedosphere, hydrosphere, atmosphere and extraterrestrial bodies, and a basic understanding of the underlying processes that govern their distributions amongst the different spheres; 2) a functional understanding of the origin of natural (in particular bio-organic) molecules in the different spheres, and their biosynthesis, metabolism, preservation, migration and degradation (natural attenuation) processes and how such processes are embodied in the isotopic signatures of the biomolecules at various temporal and spatial scales and vary from individuals to populations; 3) theoretical understanding of how to extract isotopic signals from such molecules and how to interpret such isotopic signatures in terms of biosynthetic pathways, mechanisms of metabolic reactions, and extraction of environmental and climatic signals.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生将认识和了解地球不同圈层，特别是生物圈层中不同元素的同位素分布规律、决定这些分布的生物、物理和化学过程，以及同位素分布和变化可能记录的生物合成，代谢，环境，气候信息。通过教学，激发学生对同位素科学的兴趣，理解同位素在科学特别是海洋科学中的潜能，培养提取同位素信号及利用这些信号解决科学问题的能力。

Students in this course will learn about isotopic distributions in different natural systems and the physical, chemical and biological processes that underlie such distributions, variations, and changes. Students will also be able to apply the fundamentals to the studies of biosynthesis of organic molecules, metabolism, environmental and climate reconstruction. The course also serves as a precursor to advanced understanding and applications of isotope systematics in science and especially in marine science studies, as well as ability to obtain the isotopic signals and make use of these signals to resolve scientific problems.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

Chapter 1 同位素理论及实验原理（6 学时）

Chapter 1 Theoretical and experimental principles (6 credit hours)

同位素基本特征；同位素效应；同位素分馏过程；质谱基本原理；同位素标准

General characteristics of Isotopes; Isotope Effects; Isotope Fractionation Processes; Basic Principles of Mass Spectrometry; Isotope Standards.

Chapter 2 同位素分馏过程（12 学时）

Isotope Fractionation Processes of Selected Elements: H, Li, B, C, N, O, Mg, Si, S, Cl, Ca, Cr, Fe, Cu, Zn, Br, Sr, Mo, Cd, Sb, Hg, U (6 credit hours)

H, Li, B, C, N, O, Mg, Si, S, Cl, Ca, Cr, Fe, Cu, Zn, Br, Sr, Mo, Cd, Sb, Hg, U 的同位素分馏过程

Chapter 3 同位素比的自然变化（36 学时）

Chapter 3 Variations of Stable Isotope Ratios in Nature (36 credit hours)

1. Biosphere-I (3 credit hours)

生物圈同位素组成-I（3 学时）

2. Biosphere-II (3 credit hours)

生物圈同位素组成-II（3 学时）

3. Isotopes in Human Beings (3 credit hours)

人体同位素组成-II（3 学时）

4. Hydrosphere (3 credit hours)

水圈同位素组成（3 学时）

5. Atmosphere (3 credit hours)

大气圈同位素组成（3 学时）

6. Dissolved and Particulate Compounds in Ocean and Fresh Waters (3 credit hours)

大洋及淡水水体中溶解及颗粒态物质的同位素组成（3 学时）

7. Sedimentary Rocks and Historical Isotope Composition of the Ocean (3 credit hours)

沉积岩同位素组成（3 学时）

8. Palaeoclimatology (3 credit hours)

同位素古气候学（3 学时）

9. Extraterrestrial materials: Chondrites; Moon; Mars; Venus (3 credit hours)



地外物质：球粒陨石、月亮、火星及金星同位素组成（3学时）
10. Earth's Upper Mantle, Metamorphic Rocks, Magmatic and Hydrothermal Systems (3 credit hours)
上地幔、变质岩、岩浆及水热系统同位素组成（3学时）
11. Analytical Methods of Isotopes (3 credit hours)
同位素分析方法（3学时）
12. Isotope systematics: a synthesis (3 credit hours)
同位素系统综合（3学时）

18. 教材及其它参考资料 Textbook and Supplementary Readings

1. Joechen Hoefs (2015) Stable Isotope Geochemistry. 7 th edition. Springer.
2. Zachary Sharp (2017) Principles of Stable Isotope Geochemistry. 2 nd edition. https://doi.org/10.25844/h9q1-0p82
3. Guillaume Tcherkez (2010) Isotopie biologique: Introduction aux effets isotopiques et à leurs applications en biologie. Éditions Tec et Doc/Lavoisier.
4. 黄达峰, 罗修泉, 李喜斌, 邓中国等编著, 同位素质谱技术与应用 (2006), .化学工业出版社
5. 郑永飞, 陈江峰编著. 稳定同位素地球化学 (2000), 第 1 版本, 科学出版社.



课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance		5		
小测验 Quiz		5		
课程项目 Projects				
平时作业 Assignments		30		
期中考试 Mid-Term Test				
期末考试 Final Exam		50		
期末报告				

Final Presentation

其它（可根据需要
改写以上评估方
式）

**Others (The
above may be
modified as
necessary)**

20. 记分方式 **GRADING SYSTEM**

- A. 十三级等级制 **Letter Grading**
 B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过

This Course has been approved by the following person or committee of authority

海洋科学与工程系本科教学委员会
 Department of Ocean Science and Engineering Undergraduate Committee