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**	同位素示踪原理和应用 Isotopic Tracing and Application
2.	**授课院系 Originating Department**	地球与空间科学系 Department of Earth and Space Sciences
3.	**课程编号 Course Code**	ESS404
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	春季 Spring
7.	**授课语言 Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	陈斌，地球与空间科学系 邮箱：chenb6@sustech.edu.cn 电话：0755-88015516 办公室：创园 9 栋 407 Bin Chen, Department of Earth and Space Sciences Email: chenb6@sustech.edu.cn Tel: 0755-88015516 Office: Innovation Park #9-4107
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
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	42	6			48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 NA
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	
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

本课程讲授主要的放射性同位素和稳定同位素地球化学的基本原理及其在地球科学各领域的应用, 为地球物理、海洋地质/化学、环境科学、行星科学和地质学专业本科生的专业基础课。

This course aims to teach the principles of major radiogenic and stable isotope geochemistry and their applications in different fields of Earth Sciences. It is extremely important to undergraduate students of Geophysics, Ocean Geology/Chemistry, Environmental Sciences, Planetary Sciences, and Geology.

16. 预达学习成果 Learning Outcomes

学生完成本课程后，将会掌握以下知识：

1、了解同位素地球化学在地球科学中的地位，同位素地球化学基本问题、研究现状和展望；

2、掌握微量元素的基本性质和分类、元素在岩浆起源、岩浆-水热体系演化和地表过程的地球化学行为；

3、掌握放射性同位素的基本原理和同位素示踪方法, 同位素测年的原理和应用；

4、掌握稳定同位素（包括传统的 C-H-O-S 和非传统的稳定同位素如 Fe, Mg, Cu, Ca, Zn, Li, B, Cl 等）的基本原理，同位素分馏机制和影响因素；

5、利用同位素地球化学原理研究岩浆的起源和演化、岩浆-水热体系性质和相关成矿机理、俯冲带过程、造山带演化、水-岩相互作用，以及大陆风化及其对海洋化学、古气候-古环境研究的意义。

Upon completing the course, students will acquire the following knowledge:

1. To understand the role of isotopic geochemistry in Earth Sciences, the fundamental scientific issues, proceedings and prospects of isotopic geochemistry;

2. To command the basic concepts and classification of trace elements, and the geochemical behaviour of trace elements in magma origin, magmatic-hydrothermal system evolution and surface processes;

3. To command the basic principles of radiogenic isotopes and isotopic tracing, theories of isotopic dating and applications in different fields of Earth Sciences;

4. To command the basic principles of stable isotopes (including the traditional C-O-S-H and non-traditional stable isotopes such as Fe, Mg, Cu, Zn, Li, B, Cl, etc.), isotopic fractionation mechanisms and factors that control the fractionation processes;

5. To understand magma origin and evolution, magmatic-hydrothermal systems and associated metallogenesis, subduction zone processes, evolution of orogenic belts, water-rock interaction, and continental weathering and relationship with paleo-environmental/climate change using isotopic data.

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.)

第一章 同位素地球化学在地球科学领域的意义（4 学时）

（1）介绍同位素地球化学基本问题、同位素地球化学的研究现状及其在地球科学中的地位；
（2）介绍地球系统的结构和化学组成；地球动力学体系与地球化学过程的关系；壳幔物质循环过程；表生过程和化学演化。

第二章 微量元素的分类和地球化学行为（6 学时）

介绍微量元素分类、性质；微量元素在矿物、熔体和流体中的配分和影响因素；微量元素地球化学示踪和模拟；微量元素现在俯冲带过程、地幔交代、岩浆起源、岩浆-水热过程和成矿作用，以及水-岩相互作用领域的应用。

第三章 放射性同位素基本原理和地质年代学（14 学时）

介绍主要放射性同位素（如 Rb-Sr, Sm-Nd, Re-Os, Lu-Hf, U-Pb, K-Ar 等）的原理和同位素示踪方法；同位素定年的原理和方法。

第四章 稳定同位素 C-H-O-S 的原理和应用（8 学时）

介绍常规的稳定同位素 C-H-O-S 的原理，同位素分馏机理及其热力学、动力学条件；在岩浆起源、水-岩相互作用、成矿机理、俯冲带脱水、地幔交代作用、大陆风化和海洋沉积作用领域的应用研究。

第五章 非传统稳定同位素原理和应用(16 学时)

主要介绍 Fe, Cu, Zn, Ca, Mg, Li, B, Cl 等非传统稳定同位素的地球化学性质、分馏机理和影响因素，及其在玄武质岩浆起源和演化、壳-幔相互作用、俯冲带过程、地壳深熔作用、成矿过程、水-岩相互作用、大陆风化和碳循环等研究领域的应用。

Chapter 1 Role of isotopic geochemistry in earth sciences (4 hours)

(1)To introduce the basic concepts of isotopic geochemistry, fundamental academic issues, research proceedings, and roles in earth sciences; (2) To teach the structure and chemical compositions of Earth Systems, geodynamic systems and relationship with geochemical processes, mantle-crustal interaction, surface processes and chemical evolution.

Chapter 2 Trace elements classification and geochemical behaviour (6 hours)

Classification and nature of trace elements; partitioning of trace elements in minerals, melt and fluid, and factors that control the partition of elements between different phases; element geochemical tracing and modelling; behaviour of trace elements in subduction zone processes, mantle metasomatism, magma generation, magmatic-hydrothermal processes and associated metallogeny, and water-rock interaction.

Chapter 3 Radiogenic Isotopes, Isotopic Tracing and Geochronology (14 hours)

To introduce the principles and isotopic tracing of major radiogenic isotopic systems such as Rb-Sr, Sm-Nd, Re-Os, Lu-Hf, U-Pb and K-Ar; principles, methods and application of isotopic dating.

Chapter 4 Conventional Stable Isotopes (C-H-O-S) and Applications (8 hours)

Principles of conventional stable isotopes C, H, O, S, the isotopic fractionation mechanism and thermodynamic and kinetic conditions that govern the isotopic fractionation, use of stable isotopes in magmatism, water-rock interaction, ore-forming processes, dehydration and melting of subducting slab, mantle wedge metasomatism, continental weathering, and marine sedimentation.

Chapter 5 Non-Traditional Stable Isotopes and Applications (16 hours)

Geochemical behaviour of non-traditional stable isotope systems (Fe, Cu, Zn, Ca, Mg, Li, B, Cl) and factors that control the isotopic fractionation; the application of non-traditional stable isotopes in basalt generation, mantle-crustal interaction, subduction zone processes, crustal anatexis, ore-forming mechanism, water-rock interaction, continental weathering and carbon cycling.

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

参考资料：

1 Francis Albarède, Geochemistry: An Introduction. Cambridge University Press, 2003;

2 Rollinson, H., Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman, Harlow, 1993.

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		5		
课堂表现 Class Performance		5		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		30		
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告		60		

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

地球与空间科学系本科教学指导委员会 Undergraduate Teaching Steering Committee of the Department of Earth and Space Sciences