Syllabus for Basic Marine Geology

“海洋地质基础”教学大纲

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Module Code/课程代码：	3422315
Module Title/课程名称:	Basic Marine Geology/海洋地质基础
Credit Weighting/学分:	2
Periods per Week/周学时：	4
Target Students/面向对象：	International Students/留学生
Pre-requisites/预修课程要求：	None/无

1. INTRODUCTION/课程介绍

Marine geology is one of the four fundamental courses in modern marine sciences. It is the prerequisite and the basis for further studies on marine chemistry, marine biology, marine geophysics, and so on. This course includes: 1) the main characteristics of ocean, the compositions and the tectonic structures of lithosphere covered by modern seawater, the seafloor spreading and the plate tectonics; 2) geological processes and marine geological processes, such as hydrothermal processes, volcanic eruption, and so on; 3) the behavior of elements and isotopes during marine geological processes; and 4) seafloor mineral resources caused by marine geological processes.

海洋地质学是现代海洋科学学科的四大基础学科之一，是学生进一步学习化学海洋学、生物海洋学和海洋地球物理学及其它专业课的重要基础。本课程主要涉及以下内容：一、海洋的主要特征,现代海水覆盖下岩石圈的物质组成与地质构造,海底扩张与板块构造学;二、地质作用与海洋地质作用，如海底热液作用、火山作用等；三、海洋地质过程中元素和同位素的行为；四、海洋地质过程相关的海底矿产资源。

2. GENERAL AIMS& SPECIFIC LEARNING OUTCOMES/学习目标及可测量结果

2.1 GENERAL AIMS/学习目标

Marine geology is an important branch of marine science. It is one of the three frontier subjects of modern geology. Marine geology studies the temporal and spatial rules on the development, variations, and distributions of the earth's surface that was covered by seawater. Through the introduction on plate tectonics, continental margins, ocean structures, marine geological processes, seafloor mineral resources, and related referencing, the students are expected to acquire the basic research ability on marine geology. It is aimed to lay the solid basis for other marine science subjects as well, such as marine chemistry, marine biology, marine geophysical prospecting, marine geochemistry, and so on.

海洋地质学是海洋科学的重要分支学科，也是当代地质学的三个主要前沿学科之一，主要研究被海水所覆盖的地球在时间和空间上发展、变化、分布等规律的科学。本课程通过对板块构造理论、大陆边缘和大洋洋底构造、海洋地质作用、海洋矿产资源等方面的介绍以及相关课外阅读资料的讲解，试图让学生掌握海洋地质学的基本知识、概念和理论，形成海洋地质学文献尤其是英文文献的查阅、阅读及理解能力，从而初步形成海洋地质学研究的能力，并为海洋科学其他领域如海洋化学、海洋生物学、海洋地质勘探、海洋地球化学等学科提供坚实的基础。

2.2 SPECIFIC LEARNING OUTCOMES/可测量结果

- ✧ Acquire the basic knowledge, concepts, and theories on plate tectonics, continental margins, ocean structures, and marine geological processes;
  熟悉并掌握板块构造理论、大陆边缘和大洋洋底构造、海洋地质作用等的基础知识、基本概念和基本理论；
- ✧ Understand the basic concepts and methods on geological surveys, geological dating, elemental and isotopic geochemistry, and seafloor mineral resources;
  了解常规的海洋地质调查的基本技术和方法、地质年代学、元素与同位素地球化学、海洋矿产资源等的基础知识和概念；
- ✧ Be familiar with the common vocabularies on marine geology. Be capable of

searching, reading, and reviewing marine geology references;

掌握常见的海洋地质学专业词汇，形成海洋地质学文献的查阅、阅读及理解能力；

- ✧ Be aware of the research progress on marine geology. Be able to conduct marine geology research;

  认识和了解海洋地质学研究的发展前沿，具备海洋地质学研究的能力（提出问题、解决问题、展示成果的能力）；
- ✧ Have a strong spirit of teamwork via group reading and discussing.

  发挥团队合作精神，在分组阅读和讨论过程中发挥团队协作能力。

All the outcomes could be evaluated by discussions during class, homework and peer assessment, presentation.

注：以上结果可以通过课堂讨论、作业、作业互评和期末报告等环节测量。

3. CURRICULUM REQUIREMENT/课程要求

This course will combine theory teaching and self-practicing by students together. a. Lecture on key knowledge, Q&A. b. Do the extracurricular reading according to the references and reading list; discuss the reading materials in groups; write the course paper according to reading materials. c. Hold in-class discussion on the course projects. d. Take an open-book examination at the end of the semester. The specification on the assessment is listed as follows (Full marks: 100):

课程内容通过课堂讲授和学生实践两种方式实现，a. 教师授课（讲授核心内容，归纳总结、提示今后内容，答疑）；b. 课后阅读（根据授课内容推荐参考资料和文献，分小组进行阅读和讨论，撰写课程论文）；c. 课堂讨论（根据课后阅读结果，分小组进行课程报告并由此展开交流）。

具体考评标准详如下（满分 100）：

- ■ Attendance (16 marks): totally 16 times (2■8), 1 for each attendance;

  到课率：16 次(2■8)，每次 1 分，共 16 分；
- ■ Homework (36 marks): totally 3 times, 10 for each time (The homework should be completed on time);

  作业：共 3 次，每次 12 分；共 36 分；（每次作业要按期提交）；
- ■ Final project: write an essay with topics related to marine geology (18

points); give an presentation on research results(30 marks): present your own research work;

期末作业：期末课程论文（18 分）；口头学术报告（共 30 分）：展示自身研究成果；

2. COURSE ARRANGEMENTS/教学安排

Week	Outline		Content	Periods	Teaching method
Week 1	1	Course overview	Introduction to Marine Geology	4.0	Teaching
	2	Origin of the Earth, Ocean, and Atmosphere	Introduce the theories and hypotheses related to the origin of the earth, ocean, and atmosphere		
	3	Ocean and Ocean Floor	The basic characteristics of the five oceans, the features of the ocean floor.		
	4	Methods to study the Ocean	Videos to show the fundamental methods to survey and study the ocean		
教学模块	**教学单元**		**内容提要**	**学时数**	**授课方式和相关环节**
第 1 章 课程概况、绪论	1	课程概况	介绍本课程主要内容	4.0	课堂讲授
	2	地球、海洋与大气的起源	介绍地球、海洋和大气起源相关的理论和假说		
	3	海洋与海底概况	五大洋的基本特征、海底的基本地形、地貌等特征		
	4	研究海洋的方法	通过视频学习调查海洋、研究海洋的方法		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 2	1	Relative age	Determination of relative age	4.0	Teaching
	2	Absolute age	Methods to determine the absolute age, principles and application of radiocarbon dating,		
	3	Unconformity	Disconformity, angular unconformity, nonconformity		
	4	Geological cycles	Carbon cycle, water cycle, nitrogen cycle, rock cycle, and tectonic cycle		
教学模块	**教学单元**		**内容提要**	**学时数**	**授课方式和相关环节**
第 2 章 地质年代与地质作用	1	相对年龄	确定相对地质年龄的方法	4.0	课堂讲授
	2	绝对年龄	确定绝对地质年龄的方法，尤其是 ^{14}C 定年方法的原理及应用		
	3	不整合	完全不整合、角度不整合、非整合		
	4	地质循环	碳循环、氮循环、水循环、岩石循环、以及构造循环等		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 3	1	Geological	Major layers within the earth, folds and faults	4.0	Teaching

		structures			
	2	Continental drift	Basic concepts and evidence of continental drift		
	3	Seafloor spreading	Concepts and evidence of seafloor spreading		
	4	Plate tectonics	Plate boundaries and tectonic cycle		
	5	Homework 1	Describe the mechanism, characteristics, and typical places of oceanic obduction		
教学模块	**教学单元**		**内容提要**	**学时数**	**授课方式和相关环节**
第 3 章 大陆漂移、海底扩张、板块构造	1	地质结构	地球的主要结构组成，褶皱，断层	4.0	课堂讲授
	2	大陆漂移	大陆漂移学说的基本概念和证据		
	3	海底扩张	海底扩张学说的基本概念和证据		
	4	板块构造学	板块边界与构造循环		
	5	作业 1	简述洋壳仰冲的机理、特征及典型地区		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 4	1	Volcanic eruptions	Distribution, characteristics, and hazards of volcanic eruptions	4.0	Teaching
	2	Earthquakes and tsunami	Distribution, formation mechanism, hazards, assessment, and forecast of earthquakes and tsunami		
	3	Elemental geochemistry	The behavior of trace elements and REE during geological processes		
	4	Isotopic geochemistry	Isotopic composition and fractionation of C, O, H. Some important isotopic tracers (He, Sr, Fe…)		
教学模块	**教学单元**		**内容提要**	**学时数**	**授课方式和相关环节**
第 4 章 元素及同位素的海洋地质行为	1	火山作用	火山活动的分布、基本特征及危害	4.0	课堂讲授
	2	地震与海啸	地震与海啸的分布特征、形成机理、危害、评估及预测		
	3	元素地球化学	微量元素与稀土元素在地质过程中的行为		
	4	同位素地球化学	C、H、O 的同位素组成及其在地质过程中的分馏，一些重要的同位素追踪物如 He、Sr、Fe 等		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 5	1	Coastal processes	Coastal erosion by wave, tide, turbid current, and marine organism; transportation by seawater	4.0	Teaching
	2	Marine sedimentation	Coastal, shallow-sea, and deep-sea sedimentation processes ; the origin, classification, and distribution of sediments; the geochemical characteristics of sediments; sedimentation rate		
	3	Global sea level change	sea level change in the geological time and in modern times, and their mechanisms		

教学模块	教学单元		内容提要	学时数	授课方式和相关环节
第5章 海洋沉积作用、海平面及海岸带变迁	1	海岸作用	海浪、潮流、浊流、海洋生物等的侵蚀作用，海水的搬运作用	4.0	课堂讲授
	2	海洋沉积作用	滨海、浅海、深海的沉积作用，沉积物的来源、分类及分布；沉积物的地球化学特征；沉积速率与沉积分布规律等。		
	3	全球海平面变迁	地质时期海平面的变化及特征；现代海平面的变化及原因		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 6	1	Introduction	Discovery, formation mechanism and distribution patterns of seafloor hydrothermal processes	4.0	Teaching
	2	Vent fluids	Chemical and isotopic compositions of vent fluids, factors controlling the vent fluids		
	3	Ecology	Chemosynthesis, biological community related to seafloor hydrothermal vents		
	4	examples	3 examples on seafloor hydrothermal systems		
	5	Homework 2	Describe the chemical composition and its controlling factors of vent fluids from Mid-Ocean Ridge hydrothermal systems		
教学模块	教学单元		内容提要	学时数	授课方式和相关环节
第6章 海底热液活动	1	简介	海底热液体系的发现、形成机理、分布特征	4.0	课堂讲授
	2	热液流体	热液流体的化学和同位素组成特征，控制热液流体地球化学特征的因素		
	3	热液生态	化能自养作用，热液喷口相关的生态群落特征		
	4	实例	关于海底热液系统的三个实例展示		
	5	作业2	简述洋中脊热液流体的含量组成及受控因素		
Week	**Outline**		**Content**	**Periods**	**Teaching method**
Week 7	1	Gas hydrate	Formation mechanism, distribution, and basic characteristics of gas hydrate	4.0	Teaching
	2	Manganese nodules	Formation mechanism, distribution, and exploiting perspective of manganese nodules and cobalt-rich crust		
	3	Massive sulfides	Recent advances in the research of massive sulfides		
	4	Homework 3	Describe the formation mechanism, chemical composition of hydrothermal massive sulfide		
教学模块	教学单元		内容提要	学时数	授课方式和相关环节
第7章 海底矿产资源	1	天然气水合物	天然气水合物的形成机理、分布规律以及基本特征	4.0	课堂讲授
	2	锰结核	锰结核和富钴结壳的形成机理、分布特征以及开发前景		
	3	块状硫化物	当前热液块状硫化物的研究现状与进展		
	4	作业3	简述热液硫化物的主要产地、含量组成及形成机理		

Week	Outline		Content	Periods	Teaching method
Week 8	1	Introduction of lab methods	Lab instruments, methods, and application examples to study marine geology	4.0	Teaching and Discussion
	2	Presentations by students	Each student gives an presentation referring to an international conference procedure (<8 min speaking + 2 min Q&A) Note: the grade of the presentation is decided by both the other students (50%) and the teacher (50%)		
	3	Review and Summary	Review the whole course and make a summary about the problems of each section.		
Total Periods: 32					

教学模块	教学单元		内容提要	学时数	授课方式和相关环节
第 8 章 口头报告、课堂总结	1	实验室手段	研究海洋地质学的仪器、方法及应用实例	4.0	课堂教学与课堂交流讨论
	2	口头学术报告	学生逐一展示自己的学术报告，每位学生做完后，请其他同学就报告内容进行提问（<8 分钟报告，2 分钟提问）。老师总结出现的问题。(学生和老师共同打分，各占 50%)		
	3	课程回顾	对整个课程内容进行回顾，总结各个实践环节的问题		
	合计学时：32				

REFERENCES

1. Marine Geology, Prentice Hall, James P. Kennett, 1982
2. Marine Geology - Exploring the new frontiers of the Ocean, Facts on File, Jon Erickson, 2009
3. Earth Science - An illustrated guide to science, Chelsea House Publishers, 2006
4. The sea floor: an introduction to marine geology, Springer, Eugen Seibold and Wolfgang H. Berger, 1996

WEBSITE

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