STATE KEY LABORATORY OF MARINE GEOLOGY

2016 ANNUAL REPROT

海洋地质国家重点实验室

2016 年报

同济大学 TONGJI UNIVERSITY

实验室简介

同济大学海洋地质国家重点实验室成立于2006年。实验室以海洋及相邻陆区的环境演变与海底资源为总目标，以与国际接轨的深海基础研究为特色，以古海洋学与古环境、海洋沉积学、海洋岩石圈演化、油气资源勘探、海洋生物地球化学、海底过程与观测等为主要研究方向，重点开展西太平洋地球动力学与古环境演化研究。借助国际大洋钻探、国家长 期海底科学观测等大型研究计划和平台，瞄准地球圈层系统和海陆相互作用中的重大科学问题，开展多时空尺度的基础研究，突出“地球系统科学”的理念，实现海洋与陆地结合，古代与现代结合，科学与技术结合的学科发展之路。实验室坚持国际化发展，依靠国内外的广泛合作和学科的交叉渗透，探索和发展海洋科学研究中的新思路、新途径和新方法。实验室将努力建设成为具有重要国际影响力的深海基础研究和创新性人才培养基地， 同时担负起我国深海科学教育的社会责任，唤醒公众保护地球和海洋资源意识。

Goal and Mission

The State Key Laboratory of Marine Geology at Tongji University was established in 2006 with the endorsement from the Ministry of Science and Technology of China (MOST). The Goal of the Laboratory is to investigate environmental changes and natural resources in global oceans and neighboring continental regions, with an emphasis on Asian marginal seas. By actively involving in international ocean drilling and submarine observatories, and other large international research programs, the Laboratory is committed to understanding the comprehensive earth system science and the interaction between ocean and Earth's other spheres at various spatial and temporal scales.

The Vision of the Laboratory is to maintain unparalleled depth and breadth of expertise in marine geology across a range of oceanographic research areas.

The Mission of the Laboratory is to advance the understanding of interplay between ocean and land through broad national and international collaborations for cross-disciplinary integrations and the application of advanced instruments and novel techniques. The Laboratory is dedicated to communicating the new knowledge to the public for the benefit of society, to training future generations of ocean scientists and engineers, and to expanding public awareness about the importance of the global ocean and its resources.

实验室学术委员会

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Deputy Directors: Shou-ye Yang, Chun-feng Li, Shun-sheng Qin

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大事记
HEADLINES

一月
Jan.

1 月 21-22 日，实验室承办“南海深海过程演变”基金委重大研究计划 2016 年度学术研讨会。

On January 21-22, the laboratory hosted the 2016 annual academic seminar of the “South China Sea Deep Sea Process Evolution” Research Program.

三月
March

3 月 31 日，临港基地一期总体搬迁完成。

On March 31st, the overall relocation of the first phase of Lingang Campus was completed.

四月
April

4 月 22 日，中国工程院院士、国家海洋局第二海洋研究所李家彪所长受聘为同济大学兼职教授，并做学术报告。李家彪院士也是同济大学海洋与地球科学学院校友。

On April 22nd, Jia-biao Li, Academician of the Chinese Academy of Engineering and Director of the Second Institute of Oceanography of the State Oceanic Administration, gave an academic lecture after appointed as an adjunct professor of Tongji University. Academician Jia-biao Li is also an alumnus of School of Ocean and Earth Science, Tongji University.

4 月 29 日，主办同济大学第二届国际青年学者论坛海洋分论坛。

On April 29th, the Laboratory hosted the 2nd International Young Scholars Forum Oceanic Forum of Tongji University.

五月
May

5 月 1 日，周怀阳教授荣获“全国五一劳动奖章”。

On May 1st, Prof. Huai-yang Zhou won the "National May 1st Labor Medal".

六月
June

6 月 6 日，电子探针分析室开放运行。

On June 6th, the electronic probe analysis was opened for operation.

6 月 20-22 日，主办“海洋地球化学研究方法”培训班，荷兰乌特列支大学 Gert J. de Lange 教授主讲。

On June 20-22, the Laboratory hosted a training course on “Methods of Research in Marine Geochemistry”, by Professor Gert J. de Lange from Utrecht University, the Netherlands.

6 月 23-27 日，主办“地球系统史—从元素起源到智能演化”讲习班，美国科学院院士 Falkowski 教授主讲。

On June 23-27, the Laboratory hosted a workshop on "The History of Earth System - From Elemental Origin to Intelligent Evolution", by Professor Falkowski, a member of the American Academy of Sciences.

七月
July

7 月 4-6 日，主办第四届地球系统科学大会。

On July 4-6，the Laboratory hosted the 4th Earth System Science Conference in Shanghai.

十月
Oct.

10 月 13-16 日，主办沉积物 " 从源到汇 " 过程研究国际短训班暨长江 - 东海源汇过程与环境响应研究研讨会。

On October 13-16, the Laboratory hosted the International Short Course on Process Research of Sediments from “Source to Sink” and Research Seminar of the Changjiang-Donghai Source to Sink Process and Environmental Response.

10 月 21-22 日，主办第四届生物 - 有机地球化学研讨会。

On October 21-22, the Laboratory hosted the 4th Bio-Organic Geochemistry Symposium.

10 月 27 日，古地磁学分析室开放运行。

On October 27th, the paleomagnetic analysis room was opened for operation.

十一月
Nov.

11 月 18 日，中国石化石油勘探开发研究院副总地质师兼无锡所所长徐旭辉受聘为同济大学兼职教授。

On November 18th, Xu Xuhui, deputy chief geologist of Sinopec Petroleum Exploration and Development Research Institute and director of Wuxi Institute, was appointed as an adjunct professor of Tongji University.

11 月 24-26 日，实验室在泰国曼谷组织召开第 9 届南海河流沉积物国际学术讨论会。

From November 24-26, the laboratory organized The Ninth International Workshop on the Fluvial Sediment Supply to the South China Sea in Bangkok, Thailand.

十二月
Dec.

12 月 5 日，刘志飞教授获法国政府学术棕榈骑士勋章。

On December 5th, Prof. Liu Zhi-fei received the French Government’s Academic Palm Knight Medal.

12 月 6 日，主办巽他陆架碳循环与植被演变讨论会。

On December 6th, the Laboratory hosted a seminar on the carbon cycle and vegetation evolution of the Sunda Shelf.

12 月 15 日，在美国 AGU 年会期间举办第三次南海研究推介会。

On December 15th, the third South China Sea Research Promotion Conference was held during the American AGU Annual Meeting.

2017 年 1 月 7-8 日，召开实验室 2016 年度学术年会。

From January 7-8, 2017, the annual academic meeting of the laboratory was held.

新进人员
NEW MEMBERS

李家彪 兼职教授，院士
Prof.
Jia-biao Li

同济大学硕士（1989）
中国科学院海洋研究所博士（1999）
自然资源部第二海洋研究所所长（2013-）
研究兴趣：
海底环境与地球动力学

M. S.: Tongji University (1989)
Ph. D: The Institute of Oceanology, CAS（1999）
Director: the Second Institute of Oceanography (2013-)
Research interest:
marine geology and geodynamics

朱伟林 特聘研究员
Senior Researcher
Wei-lin Zhu

同济大学博士（2002）
中国海洋石油总公司总地质师（2007-2016）
研究兴趣：
海洋地质与海洋油气勘探

Ph. D: Tongji University (2002)
Chief geologist: China National Offshore Oil Corporation（2007-2016）
Research interest:
Marine geology, Marine oil and gas exploration

黄恩清 副研究员
Associate Researcher
En-qing Huang

德国不莱梅大学博士（2013）
同济大学博士后（2016）
研究兴趣：
季风系统与西太平洋古海洋学

Ph. D: University of Bremen（2013）
Post-doc: Tongji University (2016)
Research interest:
Paleomonsoon and Western Pacific Paleoceanography

苏妮 副研究员
Associate Researcher
Ni Su

华东师范大学博士（2013）
同济大学博士后（2016）
研究兴趣：
大陆边缘沉积地球化学和海洋环境演变

Ph. D: East China Normal University（2013）
Post-doc: Tongji University (2016)
Research interest:
Sedimentary geochemistry and marine environmental change in continental margin

王跃 副研究员
Associate Researcher
Yue Wang

同济大学博士（2013）
中国气象科学研究院博士后（2016）
研究兴趣：
古海洋与古气候数值模拟

Ph. D: Tongji University (2013)
Post-doc: Chinese Academy of Meteorological Sciences (2016)
Research interest:
Paleoceanographic and paleoclimate numerical simulation

新进人员
NEW MEMBERS

易亮 副研究员
Associate Researcher
Liang Yi

中国科学院烟台海岸带研究所博士（2010）
中国科学院地质与地球物理研究所博士后（2016）
研究兴趣：
海洋地质与古环境研究

Ph. D: Yantai Institute of Coastal Zone Research, CAS (2010)
Post-doc: Institute of Geology and Geophysics, CAS (2016)
Research interest:
Marine Geology and Paleoenvironment

肖文申 助理教授
Assistant Prof.
Wen-shen Xiao

德国 Alfred-Wegener 极地与海洋研究所 /
不莱梅大学博士（2011）
同济大学博士后（2016）
研究兴趣：
极地气候变化

Ph. D: Alfred-Wegener Institute for Polar and Marine Research / University of Bremen（2011）
Post-doc: Tongji University (2016)
Research interest:
Polar climate change

于洋 助理教授
Assistant Prof.
Yang Yu

同济大学博士（2016）
研究兴趣：
海底观测

Ph. D: Tongji University (2016)
Research interest:
Submarine observation

于有强 助理研究员
Assistant Researcher
You-qiang Yu

密苏里科技大学博士 (2015)

研究兴趣：

南海深部构造研究

Ph. D: Missouri University of Science and Technology (2015)

Research interest:

Deep structure of the South China Sea

李超 助理研究员
Assistant Researcher
Chao Li

同济大学博士（2011）

同济大学博士后（2016）

研究兴趣：

沉积地球化学

Ph. D: Tongji University (2011)

Post-doc: Tongji University (2016)

Research interest:

Sedimentary geochemistry

新增科研课题
NEW RESEARCH PROJECTS

2016 年度，实验室共承担的项目 231 个（其中纵向课题 148 项），合同经费计 4.28 亿。其中承担国家级项目 82 个，经费 1.30 亿，包括 973 项目 1 项，子课题 5 个；863 计划子课题 1 个；国家重点研发计划 1 项，子课题 7 项；国家重大专项子课题 7 个；国家自然科学基金重大研究计划项目 9 个，重点项目 2 个，面上项目 32 个，青年项目 14 个。本年度新增纵向科研课题 48 项，合同经费 7781 多万元，项目主要来源于国家自然科学基金委员会、科技部和上海市科委等。

In 2016, the laboratory was operating on 231 scientific research projects (including 148 governmental projects), with a contract funding amount of RMB 428 million. Among them, 82 are national-level projects with a funding amount of RMB 130 million, including 1 “973” project, 5 National Key R&D projects, 1 Major Research Plan of the National Natural Science Foundation project, 7 Key Programs, 32 General Programs and 14 Youth Programs. The rest 48 “vertical” research projects attracted a contract funding of more than RMB 77.81 million. These projects were mainly supported by the National Natural Science Foundation of China, the Ministry of Science and Technology, the State Oceanic Administration, and the Shanghai Science and Technology Commission.

部分新增项目
LIST OF SELECTED NEW PROJECTS

负责人 PI	项目名称 Project Title	经费（万元） Budget (10K RMB)
国家重点研发计划重点专项项目 National Key Research and Development Program		
杨风丽 Feng-li Yang	中新元古代古大陆重建与原型盆地分布预测研究 Paleo-Continent Reconstruction and Distribution of the Meso-Neoproterozoic Prototype Basins, China	1800
科技部国家重大专项 National Major Project of the Ministry of Science and Technology		
蔡进功 Jin-gong Cai	济阳坳陷古近系烃源岩有机 - 无机协同演化及其资源潜力评价 Organic-inorganic co-evolution and evaluation of resource potential of Paleogene source rocks in Jiyang depression	396.84
国家自然科学基金重大研究计划项目 Major Research Plan of the National Natural Science Foundation of China		
刘志飞 Zhi-fei Liu	南海深海沉积过程与机制 Deep sea sedimentary processes and mechanisms in the South China Sea	326
国家自然科学基金重点项目 Key Program of the National Natural Science Foundation		

翦知湣 Zhi-min Jian	晚第四纪冰期旋回中热带海气 CO_2 交换格局的变化及其控制因素 Changes of tropical sea-air CO_2 exchange pattern during the late Quaternary glacial cycles and their controlling factors	290
耿建华 Jian-hua Geng	南黄海中、古生界复杂地质构造地震成像理论与方法 Seismic imaging theories and methods for Mesozoic and Plaeozoic complex structure in the South Yellow Sea	276
国家自然科学基金专项项目 Joint Funds of National Natural Science Foundation of China		
汪品先 Pin-xian Wang	2016 南海深部计划“双鱼座”载人深潜科学考察实验研究 2016 South China Sea Deep Project "Pisces" manned deep dive scientific investigation experimental research	1500
国家自然科学基金面上项目 General Program of National Natural Science Foundation of China		
蔡进功 Jin-gong Cai	泥页岩中有机质的存在对蒙脱石伊利石化进程影响的研究 Research on existence of organic matter influencing the process of smectite illitization in mudstones	88
李丽 Li Li	南海沉积物中支链四醚膜脂的组成和碳同位素特征及其对古气候研究的启示 Composition and carbon isotopic characteristics of branched tetraethers in the sediments of the South China Sea and its implications for the study of paleo-climate	71
张传伦 Chuan-lun Zhang	东海沉积物中细菌和古菌醚脂化合物同向变化机制的研究 Mechanisms underpinning the correlations between bacterial and archaeal tetraether lipids in the East China Sea	72
赵西西 Xi-xi Zhao	中国南海构造演化历史的古地磁约束－ IODP349 航次航后研究 Paleomagnetic Constraints for the Tectonic History of the South China Sea: Post-Expedition Study of IODP Expedition 349	65
董良国 Liang-guo Dong	高精度速度建模的反射波波形反演方法与应用研究 Reflection full waveform inversion methods and application study for high-precision velocity model building	68
程玖兵 Jiu-bing Cheng	微地震弹性波模式解耦矩张量成像与反演方法 Microseismic moment tensor imaging and inversion based upon elastic wave mode decoupling	70
薛梅 Mei Xue	中国海陆水平地震背景噪音的观测和机理研究 The detection and mechanism of the horizontal seismic noises: joint observations of Chinese marginal seas and continents	71
于际民 Ji-min Yu	北太平洋深海碳库对末次冰盛期以来大气 CO2 的影响机制研究 Investigating the deep North Pacific’s role in atmospheric CO2 changes since the Last Glacial Maximum	74

新增科研课题
NEW RESEARCH PROJECTS

钟广法 Guang-fa Zhong	南海深海平原浊流沉积及其构造意义 Abyssal plain turbidites and their tectonic implications in the South China Sea	72
贾国东 Guo-dong Jia	运用叶蜡脂肪酸 C-14 研究粤西近岸沉积物来源与运移过程 Elucidation of sources and transport processes of the inner shelf sediments adjacent to west Guangdong by using C-14 of leaf wax fatty acids	73
李超 Chao Li	我国东部典型河流及边缘海沉积物“从源到汇”时间尺度探究 Time scales of sediment “source to sink” processes for typical riverine and marine sediments in East China	64
吴自军 Zi-jun Wu	南海北部湾沉积物有机质成岩矿化过程及其对孔隙水溶解无机碳（DIC）的贡献 Early diagenetic processes and their contributions to the dissolved inorganic carbon in the pore water of the sediments from the Beibu Gulf, Southern China Sea	69
国家自然科学基金青年项目 Youth Program of National Natural Science Foundation of China		
袁伟 Wei Yuan	阿拉善地块二叠纪古地磁研究 Paleomagnetic study of Permian at Alashan Terrane	22
于有强 You-qiang Yu	基于南海海盆被动源海底地震数据 OBS 接收函数方法研究 Investigations of receiver function method using data from the passive-source ocean bottom seismograph installed in South China Sea basin	20
王跃 Yue Wang	岁差驱动的热带太平洋类 ENSO 型古气候响应 Precessional forced ENSO-like paleoclimate in the tropical Pacific	20
董良 Liang Dong	运用氘同位素标定技术验证沉积物中古菌对 GDGTs 再利用 Identifying the recycling of fossil GDGTs by sediment inhabited archaea using deuterium labeled technique	20
党皓文 Hao-wen Dang	上新世以来热带西太平洋碳循环的长时间尺度演化 Long-term evolution of the western tropical Pacific carbon cycle in the Plio-Pleistocene	20
一般纵向项目 Other Governmental Projects		
徐昌伟 Chang-wei Xu	东海海底观测网运维与应用保障技术 Operation and maintenance technology of the East China Sea submarine observation network	600
吕枫 Feng L ü	大规模缆系海底科学观测网电力系统实验平台研究 Research on Power System Experimental Platform of Large-scale Cable-based Undersea Science Observation Network	300

重点项目课题介绍
Key project introduction

1、中新元古代古大陆重建与原型盆地分布预测研究

Paleo-Continent Reconstruction and Distribution of the Meso-Neoproterozoic Prototype Basins, China

国家重点研发计划项目，2016.06-2020.06，项目负责人：杨风丽

National Key R&D Plan, 2016.06-2020.06, Project Leader: Feng-li Yang

着眼国家“深层超深层新层系”油气资源战略需求，针对中新元古代哥伦比亚和罗迪尼亚超大陆聚散过程与中国华北、扬子、塔里木三大稳定陆块中新元古代盆地形成演化、油气资源潜力评价研究中面临的关键科学问题，本项目的目标任务为：1）提出中国中新元古代古大陆重建与全球对比方案，揭示超大陆聚散背景下原型盆地性质与形成机制；2）查明三大陆块原型盆地发育与后期叠加改造规律；3）厘定影响深层油气地质条件的主控因素，实现中新元古代盆地含油气远景评价。

Owing to the urgent demand for prospecting oil and gas resources from deep to ultra-deep sources, this project focuses on the key scientific problem in the study of the relationship between the process of assembly and breakup of the Columbia & Rodinia supercontinents, the basin formation and the oil and gas prospects in the Meso-Neoproterozoic. The objectives of this project are to: (1) reconstruct ancient continent plates in China during the Meso-Neoproterozoic and unravel the formation mechanisms of the prototype basins during the assembly and breakup processes of supercontinents; (2) uncover the formation and post-reformation of ancient continental prototype basins; (3) determine the main controlling factors that influenced the deep hydrocarbon geologic conditions and evaluate the oil and gas prospects of the Meso-Neoproterozoic basins.

2、晚第四纪冰期旋回中热带海气 CO_2 交换格局的变化及其控制因素

Sedimentary geochemical constraints on key processes for the source to sink system of the river sediments into the East China Sea

国家自然科学基金重点项目，2017-2021，项目负责人：翦知湣

NSFC Key Program, 2017-2021, Leading PI: Zhi-min Jian

随着全球增暖和海洋酸化的加剧，海洋碳循环成为全球变化研究的重中之重。现代海气调查表明，热带海洋是大气 CO_2 的源，在全球气候变化中起举足轻重的作用。然而，晚第四纪冰期旋回中热带海气 CO_2 交换格局如何变化？其机制如何？这涉及到海洋碳循环的物理过程和生物地球化学过程，以及对未来全球变暖与大气 CO_2 浓度变化的预测。为此，本项研究利用国际合作的优势，以南海与赤道西太平洋的深海记录和现代调查为依据，在浮游有孔虫及其壳体化学（氧碳稳定同位素、Mg/Ca 比值、B/Ca 比值、氮同位素）分析的基础上，再造晚第四纪热带太平洋表层和次表层海水的温度以及碳氮同位素的变化历史，第一次获得研究区长时间序列的古海水 pH 值和 pCO_2 记录，进而分析轨道尺度至年代际的热带海气 CO_2 交换格局变化及其与海水温度和表层生产力的关系，并用海气耦合数值模拟进行检验，提出热带海洋碳循环及其在全球气候变化中作用的新认识，实现理论上的突破。

With the intensification of global warming and ocean acidification, ocean carbon cycle has become the first priority for the global change study. Based on the modern sea-air investigation, the tropical ocean is the source of atmospheric CO_2, and plays an important role in global climate change. However, how did the tropical sea-air CO_2 exchange pattern change during the late Quaternary glacial cycles? What is the mechanism? This is related to the physical and biogeochemical processes of ocean carbon cycle, as well as to the prediction of future global warming and atmospheric CO_2 concentration change. Therefore, taking advantage of the international cooperation and on the basis of the deep-sea sedimentary records and modern investigation of the South China Sea and equatorial western Pacific, this study will analyze planktonic foraminifera and its shell’s chemistry (oxygen and carbon stable isotope, Mg/Ca ratio, B/Ca ratio, nitrogen isotope), for reconstructing the late Quaternary changes of surface and subsurface water temperatures, carbon and nitrogen isotopes in the tropical Pacific. The long time series of past seawater pH and pCO_2 records will be obtained for the first time in the studied area. Furthermore, the tropical sea-air CO_2 exchange pattern and its relationship with seawater temperature and surface productivity will be analyzed on the orbital to interdecadal time-scales, and verified by sea-air coupling numerical simulation. This study will provide new knowledge on tropical ocean carbon cycle and its role in the global climate change.

重点项目课题介绍
Key project introduction

3、南黄海中、古生界复杂地质构造地震成像理论与方法

Seismic imaging theories and methods for Mesozoic and Plaeozoic complex structure in the South Yellow Sea

国家自然科学基金重点项目，2017–2021，项目负责人：耿建华

NSFC Key Program, 2017–2021, Leading PI: Jian–hua Geng

以提高南黄海海盆中、古生界复杂地质构造与地层速度大反差界面下地层地震成像质量为目标，以地震速度模型建立为核心，以大震源、长排列拖缆双检地震数据为基础，针对南黄海浅水环境、地质构造复杂、火山岩发育以及能量屏蔽等特殊地震地质条件，研究能量屏蔽界面下复杂地质构造地震成像关键新理论与新方法。研究内容包括：（1）横向各向同性介质（TI）拟声波传播理论；（2）能量屏蔽界面引起的强能量多次波预测与分离方法；（3）基于拟声波方程的大炮检距初至波有限频地震走时层析成像与初至波波形反演理论与方法；（4）基于拟声波方程的叠前逆时深度偏移理论与局部角度域叠前成像以及速度分析方法；（5）用理论合成数据和南黄海实际地震数据验证上述理论与方法的正确性与有效性。推动南黄海中、古生界油气勘探取得突破。

To aim at improving quality of seismic reflections of Mesozoic and Plaeozoic complex structure and the strata shielded by the interface with large velocity contrast in the South Yellow Sea, removing strong multiples, building velocity model and imaging theories and methods are proposed to be studied in shallow water area and complex geological structure underground based on seismic data acquired by large volume of air guan, long offset deep towed dual-sensor streamer. These aims include: (1) To develop the theory of quasi P-wave propagation in transverse isotropic media, (2) To develop strong surface-related multiples and interbed multiples removal methods, (3)To explore Fresnel volume tomography and waveform inversion by first break of large offset based on quasi P-wave equation in transverse isotropic media, (4) To develop quasi P-wave equation-based prestack reverse-time depth migration, imaging in local angle domain, illumination compensation and prestack depth migration velocity analysis in local angle domain, (5)To process synthetic and real data in the south Yellow Sea to verify correctness and validness of new theories and methods above. Ultimately, to promote oil and gas exploration in Mesozoic and Plaeozoic complex structure in the South Yellow Sea is expected.

古海洋和古环境
Paleoceanography and Paleoenvironment

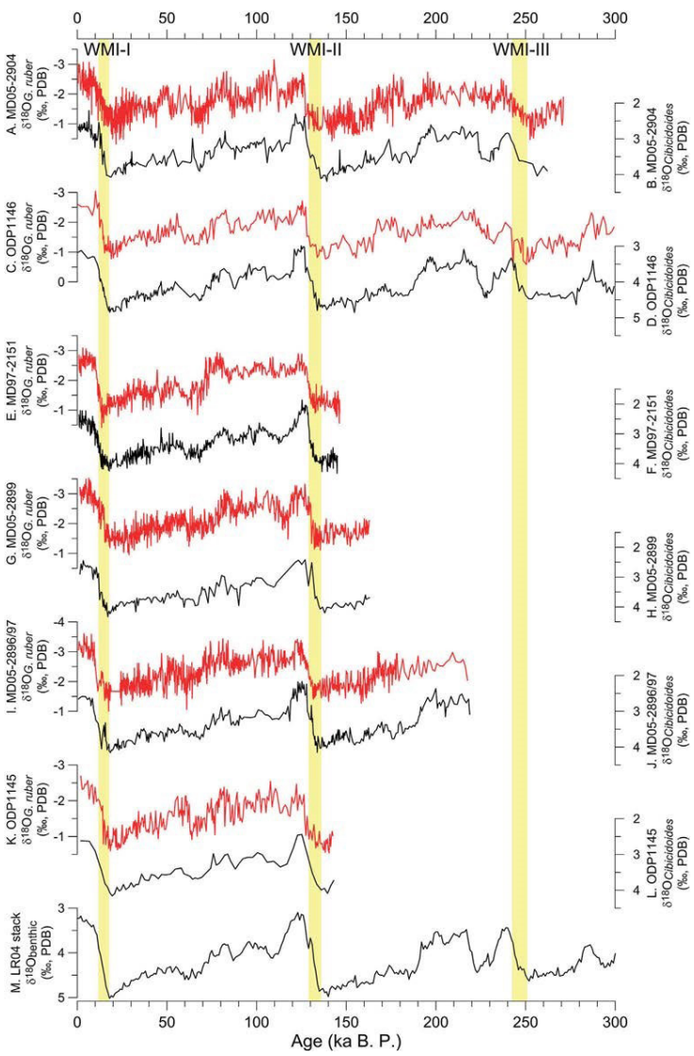
Monsoon influence on planktic δ^{18}O records from the South China Sea

Wang P, Li Q, Tian J, et al. Monsoon influence on planktic δ^{18}O records from the South China Sea. Quaternary Science Reviews, 2016, 142:26-39

汪品先院士在国际重要学术刊物 Quaternary Science Reviews 上发表论文，提出在南海有两类不同的氧同位素曲线：10 万年冰盖周期的“SPECMAP 型”和 2 万年岁差周期的“季风型”。如南海北部 MD05-2904 等剖面表层水 δ^{18}O 与华南石笋相似而与大洋的明显不同，反映出季风区岁差驱动的主导作用，并得到数值模拟研究的支撑，为理解全球季风提供了有力证据。本项研究所获得的新认识是热带气候演变周期性研究的突破性进展。

Abstract:

While the benthic δ^{18}O records from many South China Sea sites mimic the PECMAP/LR04 standard, their paired planktic δ^{18}O curves differ by comparable values at negative peaks corresponding to interstadials, especially between MIS 5.1, 5.3, 5.5, 6.5, and 7.3. Similar planktic δ^{18}O records also occur in some other low-latitude oceans under monsoon influence. Because neither temperature nor salinity effects can fully account for the variations of such δ^{18}O records after derivation from the SPECMAP/LR04 standard, variations in the rain water δ^{18}O affected by regional hydro-climate changes are considered to have played an important role. In contrast to the SPECMAP/LR04 standard δ^{18}O curve prevailed by 100-kyr cycles, these regional planktic δ^{18}O curves are distinguished by 20-kyr precession signal, showing partial similarity to the δ^{18}O records of atmospheric oxygen in polar ice-core bubbles and in stalagmite calcite. We speculate that the common features of these three independent δ^{18}O records are indicative of the effect of evolving hydrological cycling driven by monsoon circulation in low latitudes.



Paired planktic (in red) and benthic (in black) δ^{18}O records from the SCS. (A,B) MD05-2904 (Ge et al., 2010; Wan and Jian, 2014; new data); (C,D) ODP 1146 (Caballero-Gill et al., 2012); (E,F)MD97-2151 (Lee et al., 1999; Wei et al., 2006); (G,H) MD05-2899 (new data); (I,J) MD05-2896/7 (Tian et al., 2010; Wan and Jian, 2014; new data); (K,L) ODP 1145 benthic (Oppo and Sun, 2005); (M) LR04 benthic stack (Lisiecki and Raymo, 2005). Yellow bars denote the “Weak Monsoon Intervals (WMI)” in Cheng et al., (2009). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

科研进展
Research Highlights

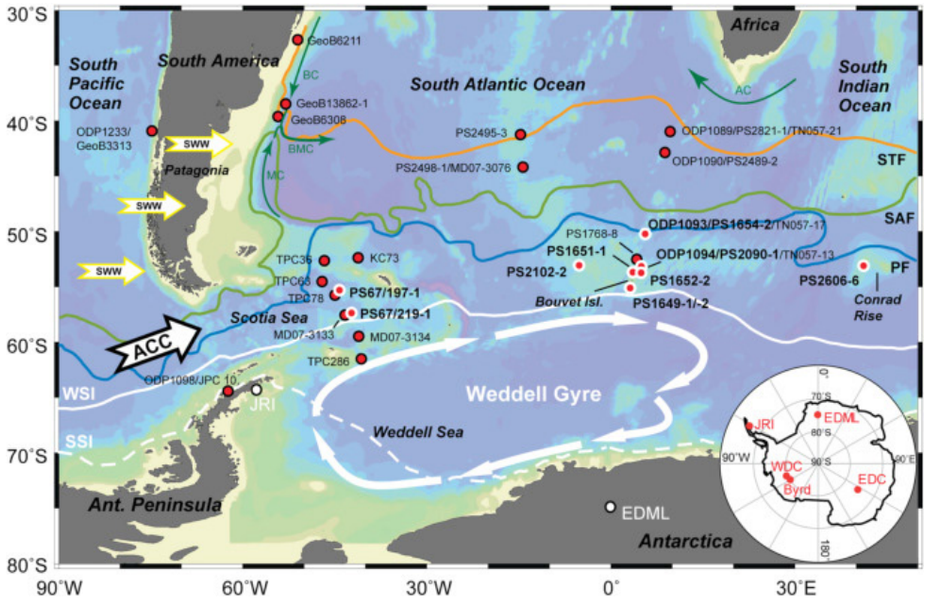
古海洋和古环境
Paleoceanography and Paleoenvironment

Last Glacial – Holocene climate variability in the Atlantic sector of the Southern Ocean

Xiao, W., Esper, O., Gersonde, R. Last Glacial-Holocene climate variability in the Atlantic sector of the Southern Ocean. Quaternary Science Reviews, 2016, 142: 26-39

Abstract:

The Southern Ocean plays a major role in the glacial/interglacial global carbon cycle. However, there is a substantial lack of information from its Antarctic Zone south of the Polar Front (PF) to understand key climate processes (e.g., sea ice variability, productivity changes, CO2 source region, shifts of the Southern Westerly Wind) active in this region during the glacial/interglacial transition, due to the limited high-resolution sediment records from this area. To close this gap, we investigated high resolution diatom records from a series of sediment cores from the Atlantic and Western Indian sectors of the Southern Ocean between the modern PF and the Winter Sea Ice (WSI) edge. Summer Sea Surface Temperature (SSST) and sea ice information spanning the past 30 thousand years were derived from diatom transfer functions and indicators, which augment comprehensive information on past surface ocean conditions and related ocean and atmospheric circulation, as well as opal deposition. These complementary lines of evidences also provide important environmental boundary conditions for climate simulations understanding the past climate development in the high latitudes Southern Ocean. Our reconstructions show that the Last Glacial (LG) SSSTs south of the modern PF are 1 – 3 ° C colder than modern conditions, WSI expanded to the modern PF. Our data suggests effective carbon export in the Antarctic Zone during the LG. Deglacial two steps of warming support the bipolar seesaw mechanism. Antarctic Zone is an important source region for the CO2 deglacial increase. The warming was more suppressed towards south, due to continuous ice discharge from Antarctica. The SSSTs exceeded modern values during the early Holocene optimum, when WSI extent probably retreated south of its modern position. The southern boundary of maximum opal deposition zone may have shifted to south of 55 ° S in the Bouvet Island area at this time. The mid-late Holocene cooling with WSI re-expanding to the Bouvet Island area, probably related to enhanced cold-water export by the Weddell Gyre from the developing cavity under the West Antarctic Ice Shelf. The cooling also suggests a northward shift of the Southern Westerly Wind, at least its southern boundary.



Locations of studied and discussed core sites. New records are marked with white circles and bold numbers. WSI/SSI: modern average winter/ summer sea ice edge (Comiso, 2003); locations of oceanic fronts are according to Orsi et al. (1995). ACC: Antarctic Circumpolar Current; PF: Polar Front; SAF: Subantarctic Front; STF: Subtropical Front; AC: Agulhas Current; BC: Brazil Current; MC: Malvinas Current; BMC: Brazil-Malvinas Confluence; SWW: Southern Westerly Wind.

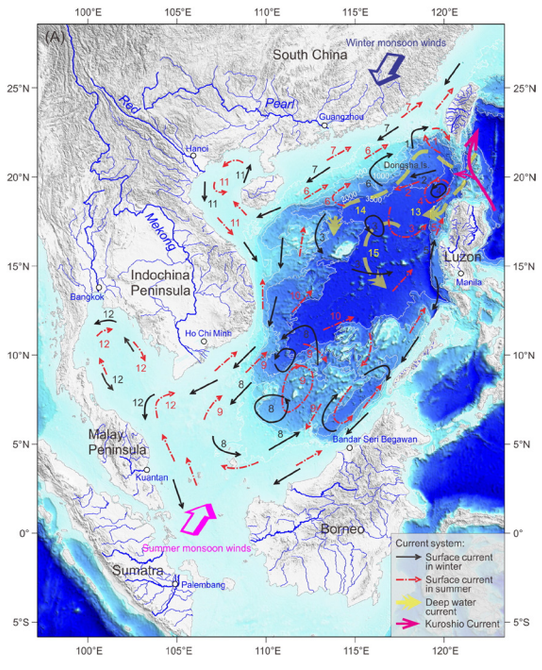
海洋沉积
Marine Sedimentology

Source–to–sink transport processes of fluvial sediments in the South China Sea

Liu Z, Zhao Y, Colin C, et al. Source-to-sink transport processes of fluvial sediments in the South China Sea. Earth-Science Reviews, 2016, 153:238-273.

Abstract:

The South China Sea offers an excellent case for studying source-to-sink transport processes of fluvial sediments among the global marginal seas. This study synthesizes existing clay mineralogical and geochemical data from ~1500 samples from the seafloor and surrounding rivers, deepwater mooring observation results, and high resolution glacial – cyclic clay mineralogy records from six high-quality sediment cores. Source-to-sink sediment transport from the river mouth to the continental shelf and then to the abyssal basin is investigated at two time scales: modern process and Late Quaternary glacial cycles. The results firstly show the high diversity of clay mineralogical and geochemical compositions in riverbed surface sediments surrounding the South China Sea, e.g., dominant illite and chlorite in Taiwan, overwhelming majority of smectite in Luzon, dominant kaolinite in South China, and similar amounts of the four clay mineral species in Red and Mekong river systems. The formation of these fluvial sediments through chemical weathering in surrounding drainage systems is controlled principally by the East Asian monsoon climate with warm temperature and high precipitation, and subordinately by tectonic activity and specific lithological character. The basin-wide distribution of clay mineral assemblages combined with neodymium and strontium isotopic compositions reflects strong provenance control and differential settling effects. The differential settling of kaolinite in slightly saline and proximal regions relative to smectite in more saline and distal regions is well demonstrated in the South China Sea. Through combining clay mineralogical distributions on the seafloor with observed oceanic current systems, the modern transport pathways can be well established, e.g., in the northern South China Sea, illite and chlorite from Taiwan are mainly carried by contour currents with the strong influence of mesoscale eddies. High-resolution sediment dynamic analysis for the Late Quaternary reveals different sediment transport patterns in the northern, western, and southern South China Sea when the land – sea configuration dramatically changed during glacial conditions. In the north, the terrigenous dispersal is mainly controlled by provenance supply and oceanic current transport. In the west, the clay mineral assemblage reflects variations of the prevailing surface current influenced by monsoon winds. In the south, the clay mineral input indicates intensive chemical weathering during interglacial periods and strengthened physical erosion during glacial periods. The transport of terrigenous sediments since the last glaciation is quantitatively reconstructed through studying two deepwater sediment cores located in the northern South China Sea. The relative contributions from three provenances (South China, Luzon, and Taiwan) highlight their distinct variability over the last 28 ka, implying that the southward shift of the inter-tropical convergence zone (ITCZ) at 16 ka BP caused an increased sediment contribution from South China, the intensified influence of the Kuroshio Current intrusion controls more efficient westward transport of Luzon sediments, and the stronger deepwater current transports Taiwan-sourced sediments further westward from the last glaciation to the Holocene.



Monsoon and current systems in the SCS. Monsoon winds after Webster (1994); major surface currents after Fang et al. (1998); Gulf of Tonkin surface currents after Xia et al. (2001) and Wu et al. (2008); Gulf of Thailand surface currents after Wattayakorn et al. (1998) and Tangang et al. (2011); Kuroshio Current after Caruso et al. (2006); deepwater currents deduced from Qu et al. (2006), Wang et al. (2011),and Zhao et al. (2014). Numbers for winter (black) and summer (red) surface currents: 1, Loop Current; 2, SCS Branch of Kuroshio; 3, NW Luzon Cyclonic Gyre; 4, NW Luzon Cyclonic Eddy; 5, NW Luzon Coastal Current; 6, SCS Warm Current; 7, Guangdong Coastal Current; 8, SCS Southern Cyclonic Gyre; 9, SCS Southern Anticyclonic Gyre; 10, SE Vietnam Offshore Current; 11, Gulf of Tonkin Surface Current; 12, Gulf of Thailand Surface Current. Numbers for deep currents: 13, Luzon Deep Current after Zhao et al. (2014); 14, SCS Contour Current deduced after Qu et al. (2006); 15, Deep Cyclonic Current after Wang et al. (2011).

科研进展
Research Highlights

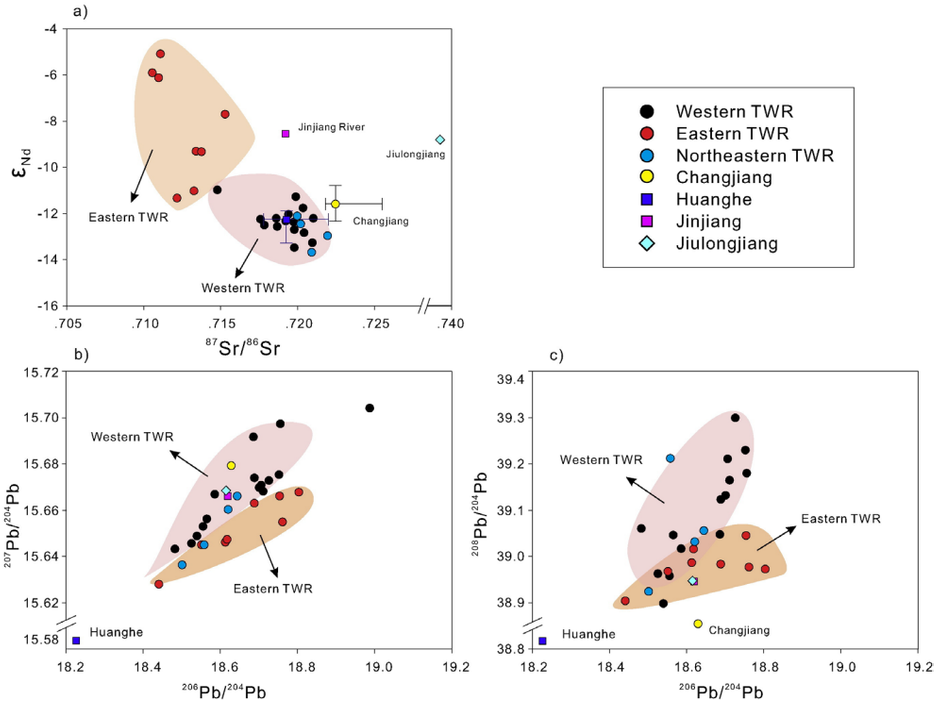
海洋沉积
Marine Sedimentology

Provenance weathering and erosion records in southern Okinawa Trough sediments since 28 ka: Geochemical and Sr – Nd – Pb isotopic evidences

Dou Y, Yang S, Shi X, et al. Provenance weathering and erosion records in southern Okinawa Trough sediments since 28 ka: Geochemical and Sr – Nd – Pb isotopic evidences. Chemical Geology, 2016, 425:93-109.

Abstract:

Geochemical and Sr – Nd – Pb isotopic compositions of the detrital sediments from ODP Hole 1202B and Taiwan rivers were measured in this study, aiming to reveal changes in sediment provenance in the southern Okinawa Trough (SOT) since 28 ka, and to examine the weathering and sediment transport processes in response to monsoon climate variability. Large variations in Sr – Nd – Pb isotopic ratios at 11 – 9 ka suggest changes in detrital sediment provenance in the SOT from a dominance of the paleo-Changjiang (Yangtze River) and/or continental shelf sediment during the late deglaciation and to west Taiwan rivers since 9.5 ka. Volcanic rocks and eastern Taiwan sediments have not significantly contributed to the SOT. The large shift in sediment provenance during the early Holocene marks a major change in oceanic circulation, mainly caused by the intrusion of the Kuroshio Current into the trough. Clay mineral and geochemical proxies suggest that the Taiwan-derived sediments accumulated during the early-mid "Holocene climate optimum" (ca. 9.5 – 4 ka) might be tightly related to the reworking of older altered sediments from terraces and floodplains, rather than having experienced more intense silicate weathering than in the late Holocene (~4 – 0 ka). Overall, silicate weathering in Taiwan was greatly inhibited by accelerating sediment production and transfer from land to ocean caused by monsoon intensification in Holocene. Our study illustrates that the radiogenic isotopic and geochemical compositions of fine-grained detrital sediments are sensitive tools for fingerprinting sediment sources and for reconstructing changes in oceanic currents and monsoon climate in river-dominated East Asian continental margin.



(a) Plot of ε Nd vs. $^{87}Sr/^{86}Sr$ for the sediment samples from Taiwan and mainland China rivers. The isotopic data of the Changjiang (Yang et al., 2007) and Huanghe (Liu et al., 1994; Yokoo et al., 2004) are included for the comparison. (b) Plots of $^{206}Pb/^{204}Pb$ vs. $^{207}Pb/^{204}Pb$, and (c) $^{206}Pb/^{204}Pb$ vs. $^{208}Pb/^{204}Pb$ for these river sediment samples. The lead isotopic data of the Changjiang and Huanghe sediments see Millot et al. (2004).

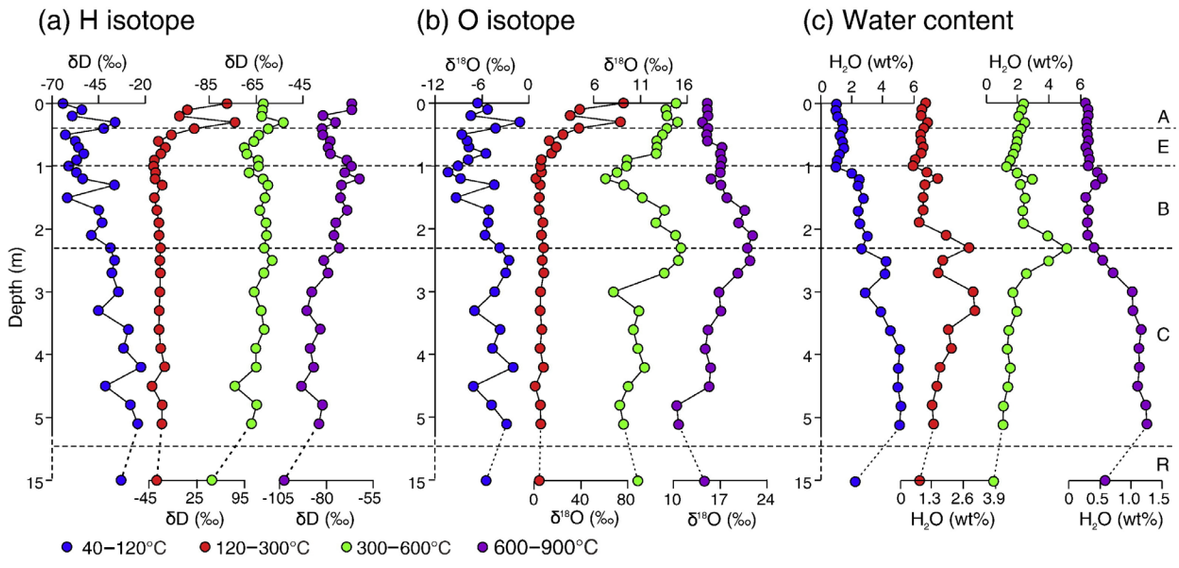
海洋沉积
Marine Sedimentology

Stable hydrogen and oxygen isotopes in mineral–bound water and the indication for chemical weathering intensity

Yang C, Yang S, Su N. Stable hydrogen and oxygen isotopes in mineral-bound water and the indication for chemical weathering intensity. Chemical Geology, 2016, 441:14-23.

Abstract:

Chemical weathering plays a key role in the long-term climate change and global biogeochemical cycle. In this study, a 5.1 m-long basalt-developed weathering profile from Hunan Province, China, was selected for the analyses of major elements, grain size, pH, total organic carbon, thermogravimetric (TG) and differential thermogravimetric properties (DTG), as well as stable isotopes (δ D and δ 18O) in mineral-bound waters. The major purpose is to distinguish different types of mineral-bound water and to verify whether hydrogen and oxygen isotopes of mineral-bound water can indicate chemical weathering intensity. Based on the TG and DTG results, different types of mineral-bound water were extracted by a sequential heating extraction technique (40 − 120 ° C, 120 − 300 ° C, 300 − 600 ° C and 600 − 900 ° C). The mineral-bound water lost below 120 ° C is absorbed water, a mixture of interlayer and crystal waters occurs at 120 − 300 ° C, and above 300 ° C is mostly constitution water. Hydrogen and oxygen isotopic ratios at top ~2 m are subject to the influences of eolian and pedogenic processes. The absorbed water has been exchanged and reached isotopic equilibrium with ambient soil water, while the crystal water and interlayer water cannot be separated by heating method in this study. Hydrogen and oxygen isotopes of constitution water can indicate chemical weathering, showing positive relationships with weathering intensity. Although the mechanism for their indication to chemical weathering remains further investigation, we suggest that the isotopic fractionation between the formation of clay minerals and surface water should be taken into account. This research sheds new light on mineral-bound water phase and a potential proxy for tracing the process of chemical weathering.



Water contents (H2O%), hydrogen (δ D‰) and oxygen isotopic composition (δ 18O‰) vs. depth in the weathering profile. The four colors (blue, red, green and purple) represent four temperature intervals of 40 − 120 ° C, 120 − 300 ° C, 300 − 600 ° C and 600 − 900 ° C respectively. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

科研进展
Research Highlights

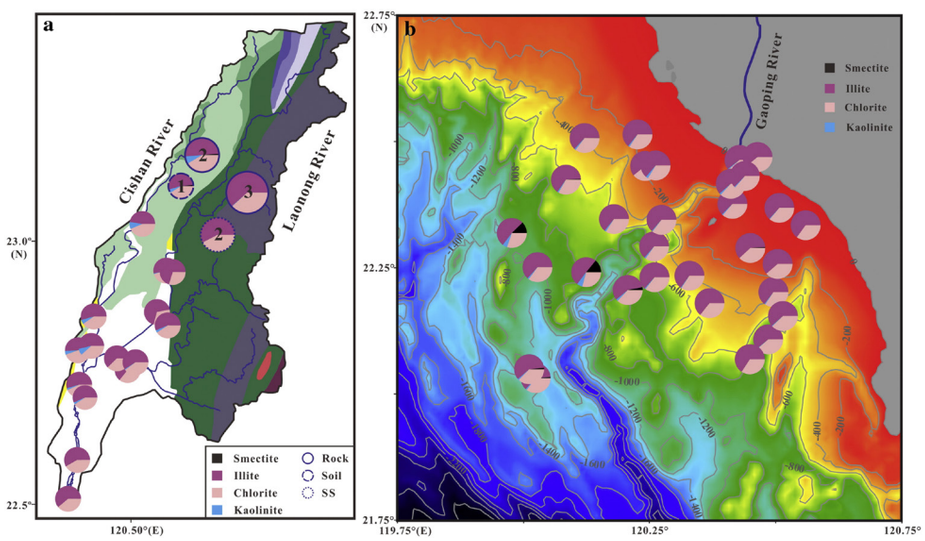
海洋沉积
Marine Sedimentology

Clay–mineral compositions of sediments in the Gaoping River–Sea system: Implications for weathering, sedimentary routing and carbon cycling

Wang Y, Fan D, Liu J T, et al. Clay-mineral compositions of sediments in the Gaoping River-Sea system: Implications for weathering, sedimentary routing and carbon cycling. Chemical Geology, 2016, 447.

Abstract:

Small mountainous rivers (SMRs) play a crucial role in the global sediment and carbon cycle by rapid transfer of huge particulate and dissolved loads into the sea. Gaoping river-sea system is a good representative of SMRs in Oceania, having an extreme high denudation rate (15,000 t km-2 yr-1) and a high burial efficiency of terrestrial particulate organic carbon (POC) in the Gaoping submarine canyon (GPSC). However, it is contentious whether silicate weathering or POC burial plays more important role in long-term carbon cycling in such a high active orogen. Clay minerals of fluvial sediments not only act as an important carrier of POC, but also encode valuable information of weathering regimes on land and dispersal routes in the seas. To uncover these informations, surface and core sediments are systematically collected from the Gaoping river-sea system for clay-mineral analysis. Comparative studies are carried out on the basis of new results and vast published data to better understand weathering processes and products in Oceanian islands and Southeast Asian continent. We find that clay-mineral compositions in the Gaoping River (GPR) and other Taiwan rivers are a legacy from provenance rocks in the alpine reach, characterized by predominant illite and chlorite and limited compositional change throughout the river courses. These sharply contradict the downstream increase in compositional complexity (rich in kaolinite and smectite) and chemical weathering intensity in Southeast Asian large rivers because of strong hydrolysis and active sediment recycling at the lowland reach with extensive floodplains. High consistency of clay-mineral compositions is also observed in the interior and exterior of GPSC. Careful examination shows that a slight off-shore decrease in cumulative illite and chlorite content is accompanied by a slight increase in exotic clay-mineral inputs by ocean circulations. The combination of this finding with previously reported data on the offshore change in δ13Corg and Δ14Corg values suggests that petrogenic POC predominates in the river-dominated Gaoping continental margin with high preservation efficiency due to its tight bandage with clay minerals. Moreover, a tardy response of chemical weathering fluxes to high elevated physical erosion rates is remarkably examined in the Oceanian and global river gauging data. We therefore postulate that rapid transfer and high burial efficiency of terrestrial POC in the tectonically active high-standing islands and their adjacent continental margins play much more important role in the long-term carbon cycle than silicate weathering.



Clay-mineral compositions of surface sediments, suspended sediments (SS), terrace soil and bedrock in the GPR. Digit in the circle denotes the number of samples being included to calculate mean clay-mineral compositions.

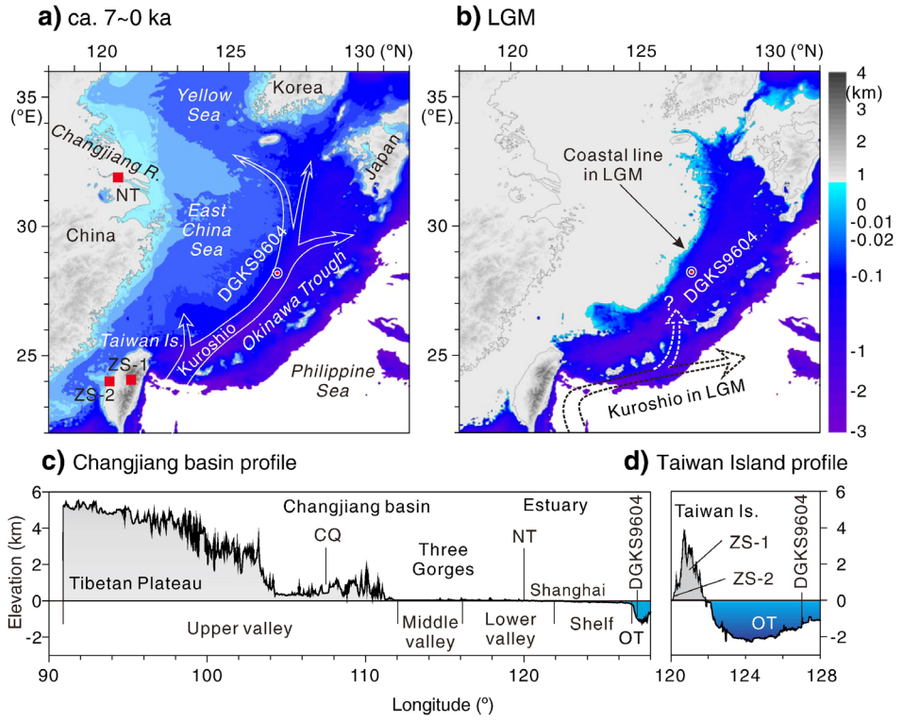
海洋沉积
Marine Sedimentology

Constraining the transport time of lithogenic sediments to the Okinawa Trough (East China Sea)

Li C, Francois R, Yang S, et al. Constraining the transport time of lithogenic sediments to the Okinawa Trough (East China Sea). Chemical Geology, 2016, 445:199-207.

Abstract:

The transport time of siliciclastic sediments from their continental sites of formation to their final location of deposition on the seafloor is an important parameter bearing on land – sea interactions, climate variability and understanding of marine sediment record. $^{234}U/^{238}U$ activity ratios of the lithogenic fraction from late Quaternary sediment deposited in the Okinawa Trough, East China Sea, were reported in this study. On basis of $^{234}U/^{238}U$ activity ratios, the comminution ages and transport times were calculated using recoil loss factors ($f\alpha$) derived from different equations based on grain size distribution. The transport times were longer (approximately 200 ± 100 kyr) for the Okinawa Trough sediments deposited between 27 and 14 ka, decreased gradually between 14 and 7 ka, and stayed relatively short (<100 kyr) thereafter. Mineralogical, geochemical and isotopic evidences indicate that changes in sediment transport time correspond well with the shift of sediment provenance predominantly from Asia's interior prior to 14 ka to Taiwan Island after 7 ka. This study offers the first and robust constraint on time scale of sediment transport process in East Asia marginal sea, which is constrained by unique sediment source-to-sink transport pattern. The result illustrates the potential of this approach to decipher climate-related changes in the mode of supply of lithogenic sediment to marginal seas. It also highlights current difficulties in obtaining quantitative estimates of comminution age, mostly because of uncertainties in estimating the recoil loss factor.



Map of the East China Sea showing the location of core DGKS9604, the coastline and oceanic circulation at present (a) and during the last glacial maximum (LGM) (b). The LGM coastline is based on the 120 misobaths (Ujii é and Ujii é , 1999). The major current system in the East China Sea and pathway of the Kuroshio Current is modified from Ichikawa and Beardsley (2002). Transects of the Changjiang catchment to Okinawa Trough (OT) and Taiwan Island to OT are shown in panel (c) and (d), correspondingly. The Changjiang (CQ and NT) and Zhuoshui River (ZS-1 and ZS-2) samples are also indicated in panel (a), (c) and (d).

科研进展
Research Highlights

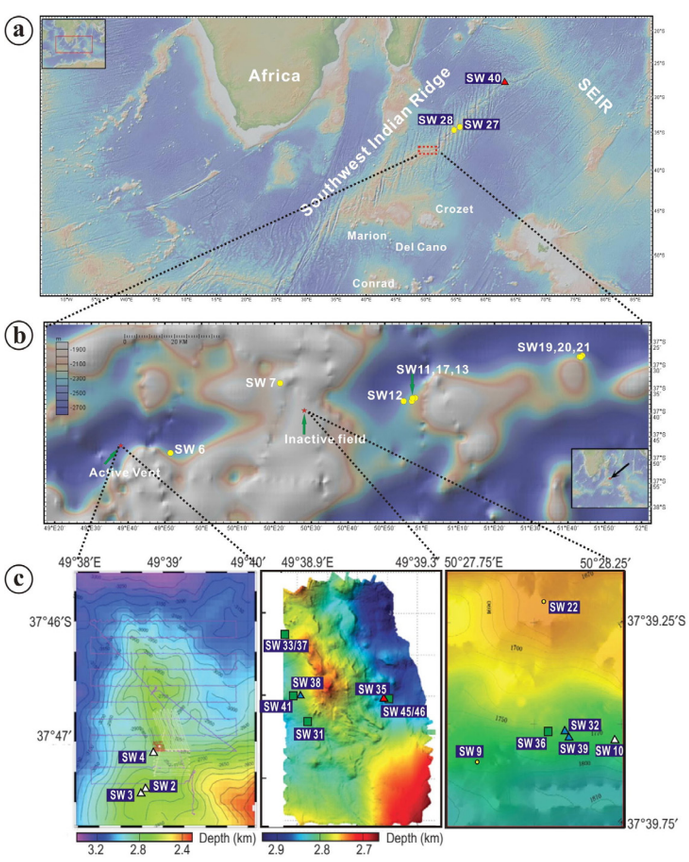
海洋有机生物地球化学
Marine Organic Biogeochemistry

A diagnostic GDGT signature for the impact of hydrothermal activity on surface deposits at the Southwest Indian Ridge

Pan A, Yang Q, Zhou H, et al. A diagnostic GDGT signature for the impact of hydrothermal activity on surface deposits at the Southwest Indian Ridge. Organic Geochemistry, 2016, 99:90-101.

Abstract:

The impact of hydrothermal activity on wider ocean geochemistry and microbial ecology remains a topic of much interest. To explore whether hydrothermal microbial signatures are exported to surrounding marine sediments or if such organisms serve as an important source of sedimentary organic matter, we determined the distributions of glycerol dialkyl glycerol tetraether (GDGT) membrane lipids in surficial normal marine sediments, metalliferous sediments and low-temperature hydrothermal deposits at newly discovered hydrothermal fields and adjacent areas at the Southwest Indian Ridge (SWIR). The GDGTs in those samples varied significantly, evidently representing a variable influence of the hydrothermal activity. GDGT compositions of surficial background sediments in SWIR were similar to those commonly observed in marine sediments, dominated by GDGTs associated with marine planktonic archaea and especially GDGT-0 and crenarchaeol. In contrast, the GDGTs of metalliferous sediments strongly impacted by hydrothermal activity and low-temperature hydrothermal deposits were markedly different, characterized by high relative abundances of isoprenoid GDGTs (iGDGTs) bearing multiple rings (yielding a higher ring index), low relative abundances of crenarchaeol, and the presence of glycerol monoalkyl glycerol tetraether lipids (GMGTs; so called ‘H-tetraethers’) that were absent in the normal marine sediments. Sources for these hydrothermal-specific tetraether lipids likely include metha-nogens and anaerobic methanotrophic archaea (GDGT-0 and GDGT-1-3, respectively), Thermoprotei and Thermoplasmatales (elevated GDGT-3 and 4), and other thermophilic archaea including Methanobacteriales (GMGTs). Deposits influenced by low-temperature hydrothermal activity also con-tained higher abundances of branched GDGTs (brGDGTs) typically attributed to soil bacteria. The more distal metalliferous sediments influenced by the neutrally buoyant plume did not contain putative hydrothermal GDGTs, having the same GDGT distribution as the background sediments. This suggests that the neutrally buoyant plume has a limited potential to directly influence the organic matter inputs to surrounding sediments, due to a rapidly waning chemosynthetic microbial contribution relative to normal marine contributions as the plume dispersed and was diluted.



Location of the samples collected from SWIR. Yellow circles mark background sediments; white, blue and red triangles mark M-T1, M-T2 and M-T3, respectively; green squares mark low-temperature hydrothermal deposits. Panel c modified after Tao et al. (2012).

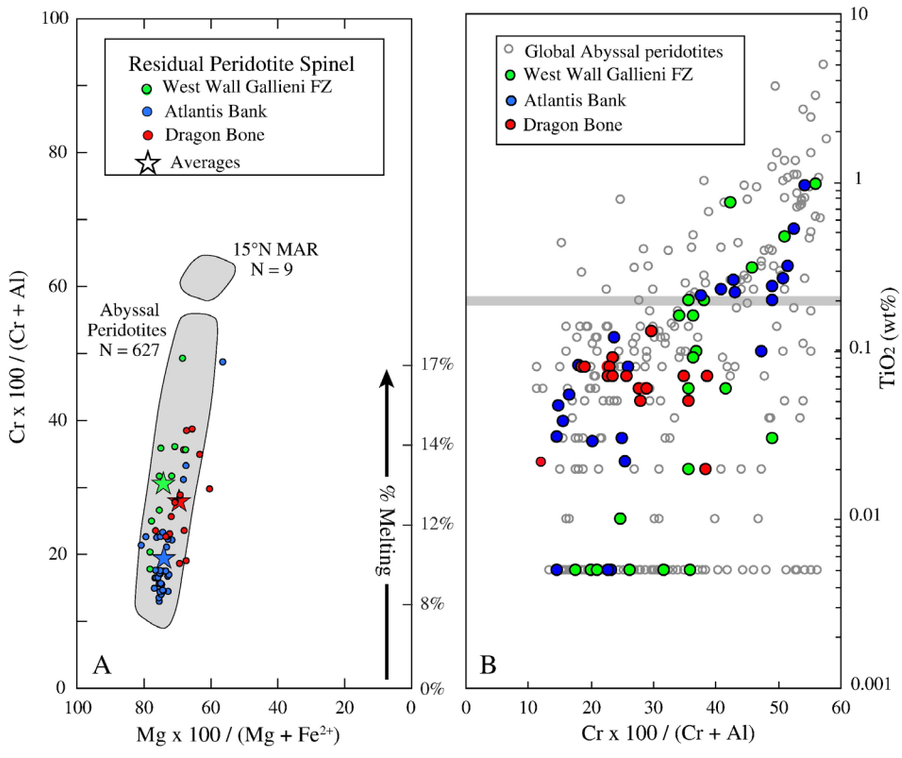
大洋岩石圈演化
Ocean Lithospheric Evolution

Melt extraction and mantle source at a Southwest Indian Ridge Dragon Bone amagmatic segment on the Marion Rise

Gao C, Dick H J B, Liu Y, et al. Melt extraction and mantle source at a Southwest Indian Ridge Dragon Bone amagmatic segment on the Marion Rise. Lithos, 2016, 246-247(1):48-60.

Abstract:

This paper works on the trace and major element compositions of spatially associated basalts and peridotites from the Dragon Bone amagmatic ridge segment at the eastern flank of the Marion Platform on the ultraslow spreading Southwest Indian Ridge. The rare earth element compositions of basalts do not match the pre-alteration Dragon Bone peridotite compositions, but can be modeled by about 5 to 10% non-modal batch equilibrium melting from a DMM source. The Dragon Bone peridotites are clinopyroxene-poor harzburgite with average spinel Cr# ~ 27.7. The spinel Cr# indicates a moderate degree of melting. However, CaO and Al_2O_3 of the peridotites are lower than other abyssal peridotites at the same Mg# and extent of melting. This requires a pyroxene-poor initial mantle source composition compared to either hypothetical primitive upper mantle or depleted MORB mantle sources. We suggest a hydrous melting of the initial Dragon Bone mantle source, as wet melting depletes pyroxene faster than dry. According to the rare earth element patterns, the Dragon Bone peridotites are divided into two groups. Heavy REE in Group 1 are extremely fractionated from middle REE, which can be modeled by ~7% fractional melting in the garnet stability field and another ~12.5 to 13.5% in the spinel stability field from depleted and primitive upper mantle sources, respectively. Heavy REE in Group 2 are slightly fraction-ated from middle REE, which can be modeled by ~15 to 20% fractional melting in the spinel stability field from a depleted mantle source. Both groups show similar melting degree to other abyssal peridotites. If all the melt ex-traction occurred at the middle oceanic ridge where the peridotites were dredged, a normal ~6 km thick oceanic crust is expected at the Dragon Bone segment. However, the Dragon Bone peridotites are exposed in an amagmatic ridge segment where only scattered pillow basalts lie on a partially serpentinized mantle pavement. Thus their depletion requires an earlier melting occurred at other place. Considering the hydrous melting of the initial Dragon Bone mantle source, we suggest the earlier melting event occurred in an arc terrain, prior to or during the closure of the Mozambique Ocean in the Neoproterozoic, and the subsequent assembly of Gondwana. Then, the Al_2O_3 depleted and thus buoyant peridotites became the MORB source for Southwest Indian Ridge and formed the Marion Rise during the Gondwana breakup.



Comparison of Cr# with Mg# and TiO_2 of spinels from the Dragon Bone amagmatic segment peridotites (Zhou and Dick, 2013) and spinel analyses for earlier dredges in SWIR from Dick unpublished data.

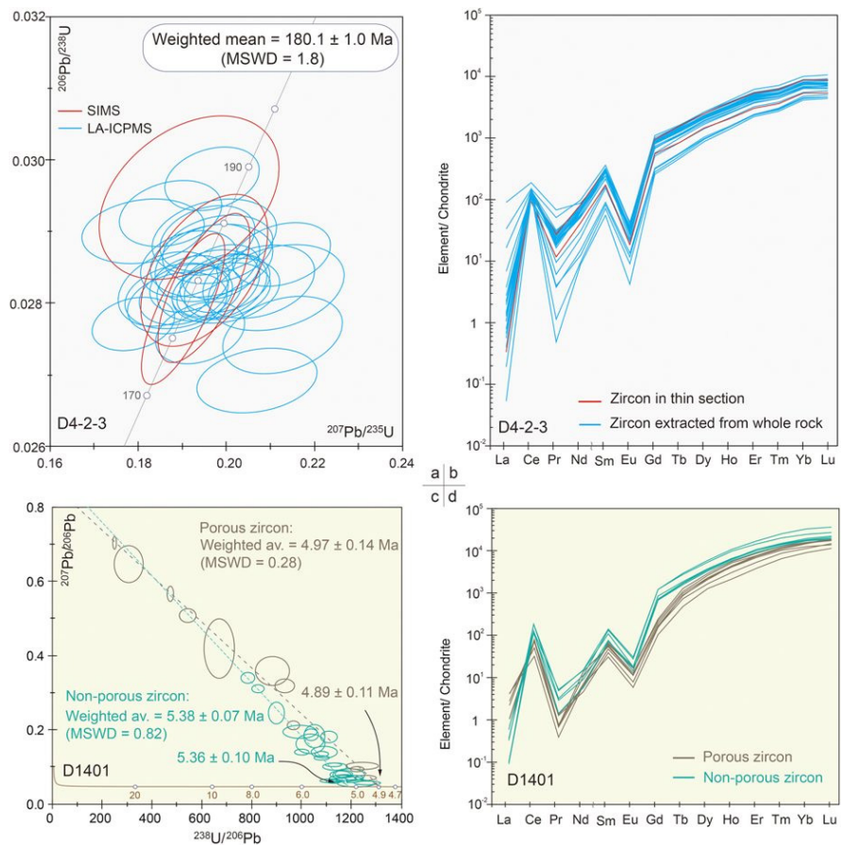
大洋岩石圈演化
Ocean Lithospheric Evolution

Jurassic zircons from the Southwest Indian Ridge

Cheng, H., Zhou, H.Y., Yang, Q.H., Zhang, L.M., Ji, F.W., Dick, H.J.B., Jurassic zircons from the Southwest Indian Ridge. Scientific Reports. 2016, 6: 26260.

Abstract:

The existence of ancient rocks in present mid-ocean ridges have long been observed but received less attention. Here we report the discovery of zircons with both reasonably young ages of about 5 Ma and abnormally old ages of approximate 180 Ma from two evolved gabbroic rocks that were dredged from the Southwest Indian Ridge (SWIR) in the Gallieni fracture zone. U – Pb and Lu – Hf isotope analyses of zircons were made using ion probe and conventional laser abrasion directly in petrographic thin sections. Young zircons and their host oxide gabbro have positive Hf isotope compositions (ε Hf = +15.7 – +12.4), suggesting a highly depleted mantle beneath the SWIR. The spread ε Hf values (from −2.3 to −4.5) of abnormally old zircons, together with the unradiogenic Nd-Hf isotope of the host quartz diorite, appears to suggest an ancient juvenile magmatism along the rifting margin of the southern Gondwana prior to the opening of the Indian Ocean. A convincing explanation for the origin of the unusually old zircons is yet to surface, however, an update of the theory of plate tectonics would be expected with continuing discovery of ancient rocks in the mid-oceanic ridges and abyssal ocean basins.



^{207}Pb-corrected/^{230}Th-disequilibria corrected ages for sample D4-2-3 (a – b) and D1401 (c – d).

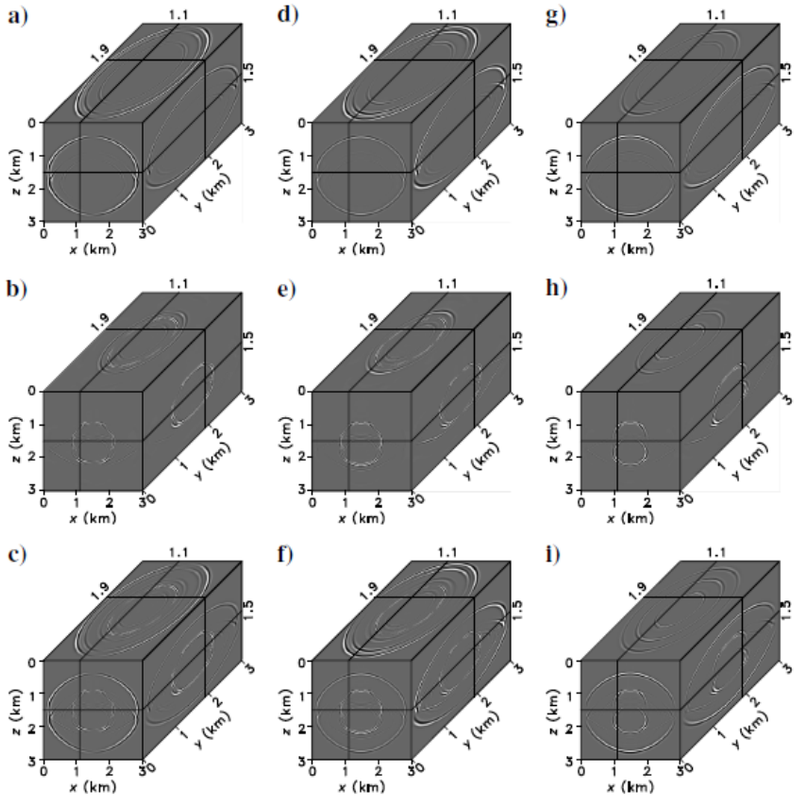
油气地质与地球物理
Petroleum Geology and Geophysics

Simulating propagation of decoupled elastic waves using low–rank approximate mixed–domain integral operators for anisotropic media (4/9 domestic)

Cheng J, Alkhalifah T, Wu Z, et al. Simulating propagation of decoupled elastic waves using low-rank approximate mixed-domain integral operators for anisotropic media. Geophysics, 2016, 81(2):T63-T77.

Abstract:

In elastic imaging, the extrapolated vector fields are decoupled into pure wave modes, such that the imaging condition produces interpretable images. Conventionally, mode decoupling in anisotropic media is costly because the operators involved are dependent on the velocity, and thus they are not stationary. We have developed an efficient pseudo-spectral approach to directly extrapolate the decoupled elastic waves using low-rank approximate mixed-domain integral operators on the basis of the elastic displacement wave equation. We have applied k-space adjustment to the pseudospectral solution to allow for a relatively large extrapolation time step. The low-rank approximation was, thus, applied to the spectral operators that simultaneously extrapolate and decompose the elastic wavefields. Synthetic examples on transversely isotropic and orthorhombic models showed that our approach has the potential to efficiently and accurately simulate the propagations of the decoupled quasi-P and quasi-S modes as well as the total wavefields for elastic wave modeling, imaging, and inversion.



Synthesized decomposed and total elastic wavefields for a orthorhombic model with a VTI overburden: qP (top), qS (mid), and total (bottom) elastic displacement fields (left, x-component; mid, y-component; and right, z-component).

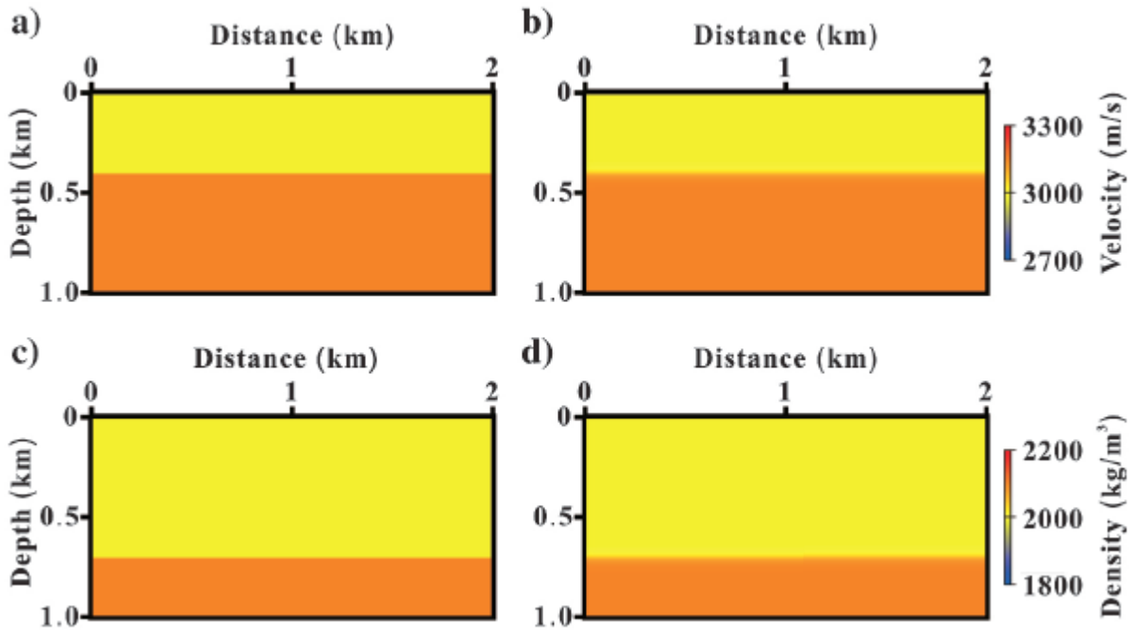
油气地质与地球物理
Petroleum Geology and Geophysics

Least-squares reverse time migration in the presence of density variations

Yang J, Liu Y, Dong L. Least-squares reverse time migration in the presence of density variations. Geophysics, 2016, 81(6):S497-S509.

Abstract:

Least-squares migration (LSM) is commonly regarded as an amplitude-preserving or true amplitude migration algorithm that, compared with conventional migration, can provide migrated images with reduced migration artifacts, balanced amplitudes, and enhanced spatial resolution. Most applications of LSM are based on the constant-density assumption, which is not the case in the real earth. Consequently, the amplitude performance of LSM is not appropriate. To partially remedy this problem, we have developed a least-squares reverse time migration (LSRTM) scheme suitable for density variations in the acoustic approximation. An improved scattering-integral approach is adopted for implementation of LSRTM in the frequency domain. LSRTM images associated with velocity and density perturbations are simultaneously used to generate the simulated data, which better matches the recorded data in amplitudes. Summation of these two images provides a reflectivity model related to impedance perturbation that is in better accordance with the true one, than are the velocity and density images separately. Numerical examples based on a two-layer model and a small part of the Sigsbee2A model verify the effectiveness of our method.



A two-layer model: (a) true velocity model, (b) migration velocity model,(c) true density model, and (d) migration density model.

主要科研论文
Main research papers

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发明专利
Invention Patents

2016 年度共授权 10 项发明专利，其中三项发明专利，七项实用新型专利。

In 2016, a total of 10 invention patents were granted, among which three have already achieved technology transfer.

发明专利 Patent	发明人（按顺序） Inventor (in order)	发明类型 Type	专利号 Patent No.
一种具备自清洗功能可用于原位海水过滤的装置及其使用方法 Device with self-cleaning function for in-situ seawater filtration and use method	季福武; 米智楠; 杨群慧; 周怀阳; 王虎; 杨标; 韦婧; 金璐 Fuwu Ji; Zhinan Mi; Qunhui Yang; Huaiyang Zhou; Hu Wang; Biao Yang; Jing Wei; Lu Jin	发明 Invention	ZL201410675652.5
一种柱塞式高温高压热液实验装置 Plunger type high temperature and high pressure hot liquid experiment device	季福武; 周怀阳; 杨群慧; 王虎; 孙宝石; 韦婧 Fuwu Ji; Huaiyang Zhou; Qunhui Yang; Hu Wang; Baoshi Sun; Jing Wei	发明 Invention	ZL201410676211.7
拟饱含水核磁共振自旋回波信号的分解与合成方法 Decomposition and synthesis of quasi-brine saturated NMR spin-echo signals	刘堂晏，邬龙，薛苗苗，王红涛 Liu Tangyan, Wu Long, Xue Miaomiao, Wang Hongtao	发明 Invention	ZL201310418890.3

论文与专利
Publications and Patents

海底高压直流变电装置 An undersea high-voltage direct-current convertor	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620196646.6
海底观测设备集成适配器 An undersea integration adaptor for observing instruments	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620198968.4
海洋装备配电线路接地故障监测系统 A ground fault monitoring system for marine equipment power distribution lines	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620200392.0
海底中压直流配电装置 An undersea medium power distribution equipment	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620199212.1
海缆终端光电分离转换器 A cable termination assembly with optic-electric spliting and conversion	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620199884.2
组合式直流变换器 A combined DC-DC converter	吕枫，周怀阳 Feng L ü ，Huaiyang Zhou	实用新型 Utility model	ZL201620363607.0
海底观测网水下主基站 An undersea station of seafloor observatory networks	吕枫，周怀阳，吴正伟 Feng L ü ，Huaiyang Zhou， Zhengwei Wu	实用新型 Utility model	ZL201620363338.8

交流与合作
Academic Exchange and Cooperation

实验室通过积极联系和邀请海外优秀学者来访，开展了众多实质性的国际合作，进一步帮助学科发展、科学研究以及人才队伍的建设。本年度继续加强中德（与卡尔大学、不莱梅大学）、中法（巴黎南部第 11 大学、法国国家研究中心气候与环境科学实验室）、中美（德克萨斯农工大学、伍兹霍尔海洋研究所、加州大学）、中加（卡尔加里大学）、中越（越南科学院、越南河内矿业与地质大学）等双边合作，同时拓展新的学生联合培养模式，为学生提供更好的国际视野。2016 年度，在读留学生 11 人。师生年度出国境人数约 80 人次，引进外国专家学者约 80 人次。

Through active contact and invitation to outstanding overseas scholars, the laboratory has carried out numerous substantive international cooperation to further help the development of disciplines, scientific research and the construction of a talent team. This year, we continued to strengthen Sino-German (with the University of Karl, Bremen University), China and France (11th University of Southern Paris, French National Research Center Climate and Environmental Science Laboratory), China and the United States (Texas A&M University, Woods Hall Ocean Research Institute, University of California), China-Canada (University of Calgary), China-Vietnam (Vietnam Academy of Sciences, Hanoi University of Mines and Geology, Vietnam) and other bilateral cooperation, and also expanded the new joint training model to provide students with a better international perspective. In 2016, there were 11 international students studying. The number of teachers and students who went overseas during the year was about 80, and about 80 foreign experts and scholars were introduced to the lab.

第四届“地球系统科学大会”
The 4th "Earth System Science Conference"

由实验室和中国大洋发现计划专家咨询委员会、国家自然科学基金委员会地球科学部及国际中国地球科学促进会共同主办的第四届“地球系统科学大会”在顺利举行，来自大气、海洋、行星、地质、化学、生物科学等多学科领域的千余名华人学者齐聚一堂，共话季风降水、载人深潜、人类演化、生态系统与气候协同演化、海洋储碳机制、南海构造成因、寻找宜居行星等诸多地球科学热点议题。

The 4th "Earth System Science Conference" co-sponsored by the laboratory and the China Ocean Discovery Program Expert Advisory Committee, the National Natural Science Foundation Committee Earth Science Department and the International China Earth Science Promotion Association was successfully held. More than a thousand Chinese scholars from various disciplines such as atmosphere, oceans, planets, geology, chemistry, and biological sciences gathered together to discuss monsoon precipitation, manned deep dive, human evolution, co-evolution of ecosystems and climate, marine carbon storage mechanism, South China Sea structural genesis, searching for livable planets and many other earth science hot topics.

交流与合作
Academic Exchange and Cooperation

同济大学第二届国际青年学者论坛海洋分论坛
Second International Young Scholars Forum Ocean Sub-forum of Tongji University

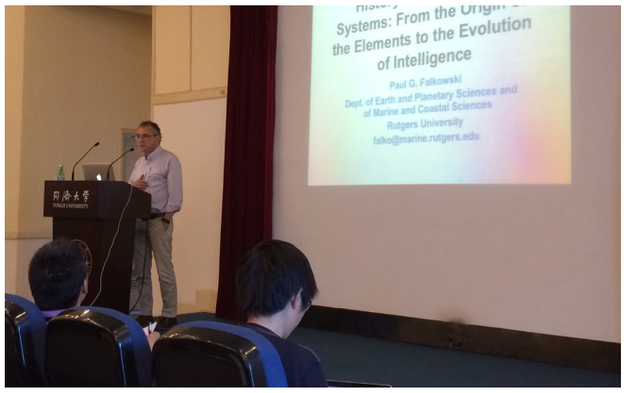
海洋与地球科学学院于 4 月 29 日举办第二届国际青年学者论坛，来自海内外的十余名青年才俊参与交流。

The School of Ocean and Earth Science held the 2nd International Forum of Young Scholars on April 29th. More than ten young talents from home and abroad participated in the exchange.

" 地球系统史：从元素起源到智能演化 " 讲习班
Workshop on "The History of the Earth System: From Elemental Origin to Intelligent Evolution"

由实验室和 IODP 中国办公室联合主办的 " 地球系统史：从元素起源到智能演化 " 讲习班顺利举行，五天的课程由美国科学院院士 Paul Falkowski 教授主讲，涉及星球形成与元素演化、生命的化学组成和复杂性演化、地球宜居性变化、人类智力演化及其对地球改造能力等内容。来自 39 个单位（包括香港和海外）150 余位研究人员和学生参加了本次讲习班。

The "Earth System History: From Elemental Origin to Intelligent Evolution" workshop, co-sponsored by the laboratory and the IODP China Office, was successfully held. The five-day course was taught by Professor Paul Falkowski, a member of the American Academy of Sciences, on the formation of stars and the evolution of elements, the chemistry of life. Composition and complexity evolution, changes in the livability of the Earth, the evolution of human intelligence and its ability to transform the Earth. More than 150 researchers and students from 39 institutions (including Hong Kong and overseas) participated in the workshop.



“海洋地球化学”研究方法培训班
“Marine Geochemistry” research method training course

国际著名海洋地球化学家、《Marine Geology》杂志主编，荷兰乌特列支大学 Gert J. de Lange 教授在同济大学临港基地举办了主要面向海洋学院青年教师和研究生的海洋地球化学研究方法培训班。

Internationally renowned marine geochemist and editor of Marine Geology magazine, Professor Gert J. de Lange of Utrecht University in the Netherlands held a training course on marine geochemistry research methods for young teachers and graduate students of Ocean College at the Lingang Base of Tongji University.

沉积物“从源到汇”过程研究国际短训班暨研讨会
Sediment “From Source to Sink” Process Research International Short Course and Seminar

2016 年 10 月 13-16 日在上海（同济大学）举办沉积物“从源到汇”过程研究国际短训班暨长江 - 东海源汇过程与环境响应研究研讨会。会议特别邀请执行和参与美国 S2S 计划的知名学者，总结 NSF-MARGINS 的 S2S 计划取得的学术成果，分享国际大陆边缘研究的经验与工作思路。海峡两岸学者一起研讨东亚大陆边缘地区源汇过程与环境演变研究的主要进展、关键科学问题与未来主要研究方向，推动国内与国际学术合作。结合国家海底长期观测系统科学大工程，讨论东海海底观测网和观测塔建设带来的海洋科学研究重大机遇。

On October 13-16, 2016, Shanghai (Tongji University) held an international short training course on sediments from source to sink process and a seminar on Yangtze River-Donghai source to sink process and environmental response research. The conference specially invited well-known scholars who participated in the US S2S program to summarize the academic achievements of the S2S program of NSF-MARGINS and share the experience and working ideas of the international continental margin research. Scholars on both sides of the strait discussed the main progress, key scientific issues and future research directions of the source and sink processes and environmental evolution in the marginal regions of the East Asian continent, to promote domestic and international academic cooperation. In conjunction with the National Submarine Long-Term Observation System Science and Engineering, the major opportunities for marine scientific research brought about by the construction of the East China Sea submarine observation network and observation tower were also discussed.

第四届生物 – 有机地球化学研讨会
The 4th Bio–Organic Geochemistry Symposium

实验室协办的第四届生物 - 有机地球化学研讨会获得圆满成功。来自全国各地约四十个院校、超过两百人参加了本次研讨会，另外还有来自美国、德国，尼日利亚和塔吉克斯坦等国际合作单位的代表参加了本次会议。

The 4th Bio-Organic Geochemistry Symposium co-organized by the laboratory was a complete success. About 40 colleges and universities from all over the country and more than 200 people attended the seminar. Representatives from international cooperation units such as the United States, Germany, Nigeria and Tajikistan participated in the conference.

巽他陆架碳循环与植被演变讨论会
Seminar on Carbon Cycle and Vegetation Evolution of the Sunda Shelf

为推动巽他陆架大洋钻探计划实施，实验室于 2016 年 12 月 6 日组织巽他陆架碳循环与植被演变讨论会。从孢粉、有机地化和沉积三个方面，深入研讨巽他陆架碳循环和植被演变的关键科学问题与研究方法。

交流与合作
Academic Exchange and Cooperation

In order to promote the implementation of the Sunda Shelf drilling, the laboratory organized a seminar on the carbon cycle and vegetation evolution of the Sunda Shelf on December 6, 2016. From the aspects of sporopollen, organic geochemistry and sedimentation, the key scientific issues and research methods of carbon cycle and vegetation evolution in the continental shelf were discussed in depth.

美国 AGU 年会南海专题及推介会
US AGU Annual Meeting Nanhai Special Topic and Promotion Conference

美国 AGU 年会期间，国重室与南海深部计划办公室和中国 IODP 办公室联合举办了南海研究推介会，吸引了 100 多位海内外专家学者参加，为中国的南海研究赢得了更多国际学术界的认可和合作机会。

During the AGU annual meeting in the United States, State Key Laboratory and the South China Sea Deep Program Office and the China IODP Office jointly organized the South China Sea Research Promotion Conference, which attracted more than 100 experts and scholars from home and abroad to participate in the study of South China Sea, which won more recognition and cooperation opportunities.

与亨通光电签约成立联合研发中心
Signed a joint R&D center with Hengtong Optoelectronics

9 月 14 日下午，为推进海底观测网大科学工程建设，同济大学与江苏亨通光电股份有限公司合作成立“海洋工程技术研发中心”签约，开展产学研合作。

On the afternoon of September 14, in order to promote the construction of the large-scale scientific project of the seabed observation network, Tongji University and Jiangsu Hengtong Optoelectronics Co., Ltd. jointly established the “Ocean Engineering Technology R&D Center” to sign the cooperation between industry, university and research institute.

专家来访
Visitors

● 1 月及 11 月，国际综合大洋钻探计划国际管理公司前副总裁 Hans Christian Larsen 来访两个月，推动南海深海大洋钻探航次及研究。

In January and November, Hans Christian Larsen, former vice president of the International Integrated Ocean Drilling Program International Management Company, visited for two months to promote the deep sea ocean drilling and research in the South China Sea.

● 3 月及 11 月，美国伍兹霍尔海洋研究所 Henry Dick 教授来访。

In March and November, Professor Henry Dick of the Woods Hole Oceanographic Institute of the United States visited.

● 9 月，国际过去全球变化组织（PAGES）执行秘书长 Marie-France Loutre 到访进一步探讨未来的合作。

In September, Marie-France Loutre, Executive Secretary of the International Past Change Organization (PAGES) visited to explore future cooperation.

● 10 月，美国蒙特里贝海洋研究所 Charles K. Paull 教授来访，介绍美国蒙特雷湾峡谷浊流的最新观测结果。

In October, Professor Charles K. Paull of the Monterey Bay Institute of Oceanography of the United States visited to present the latest turbidity observation results in the Monterey Bay Canyon.

● 11 月，日本海洋科技厅首席科学家 Kiyoshi Suyehiro 教授来访，就未来在海洋地质研究、海底观测网的技术研发等方面的合作达成意向。

In November, Prof. Kiyoshi Suyehiro, chief scientist of the Japan Ocean Science and Technology Department, visited and expressed his intention to cooperate in the future of marine geological research and technology research and development of the seabed observation network.

● 2016 年，加拿大卡尔加里大学两次来访，就本科生双学位项目的推进进行洽商。

In 2016, members of Calgary University of Canada visited twice to discuss the possibility of undergraduate dual degree programs.

开放课题基金
Open Project Fund

实验室自 2010 年起设立“开放课题基金”，支持与我室目前主要研究方向相关的基础研究项目，鼓励国内外高等院校、科研机构研究人员，前来开展合作研究工作。2016 年度共有 11 项开放课题基金获批。

Since 2010, the laboratory has established the "Open Project Fund" to support the basic research projects related to the current research direction of our laboratory and encourage researchers from domestic and foreign higher learning and scientific research institutions to apply and carry out cooperative research in the lab. In 2016, a total of 11 open projects were approved.

交流与合作
Academic Exchange and Cooperation

2016 年度开放课题资助清单
2016 open project funding list

课题编号 Project No.	项目名称 Project title	负责人 Principal	单位 Institution
MGK1601	Deep-Sea Circulation Induced by Near- Surface Flows	Christian Buckingham	University of Southampton
MGK1602	Dynamics of the Intertropical Convergence Zone during the last 1.6 Ma(DITCZ)	Cristiano Chiessi	University of São Paulo
MGK1603	Last centenial environmental change in West Indonesia based on marine, coastal and lake sediment	Wahyoe S Hantoro	Indonesian Institute of Sciences
MGK1604	南海北部麻坑地貌硫酸盐—甲烷产消体系及其成因气体类型研究	曹超 Chao Cao	国家海洋局第三海洋研究所 Third Institute of Oceanography, Ministry of Natural Resources
MGK1605	Ecological Genomics of Phototrophic Gemmatimonadetes Bacteria in Coastal Marine Sediments	曾永辉 Yonghui Zeng	University of Southern Denmark
MGK1606	南海渐新统成岩作用研究	房殿勇 Dianyong Fang	中国海洋石油国际有限公司 China National Offshore Oil Corporation
MGK1607	针对海底情况的三维大地电磁反演问题中的关键技术研究	关晓飞 Xiaofei Guan	同济大学数学系 Department of Mathematics, Tongji University
MGK1608	深海沉积过程实时观测网的研究及其管理平台建设	陆慧敏 Huimin Lu	九州工业大学 Kyushu Institute of Technology
MGK1609	含天然气水合物沉积物的地震波 / 声波衰减特征及衰减机制研究	王吉亮 Jiliang Wang	三亚深海科学与工程研究所 Sanya Deep Sea Science and Engineering Research Institute
MGK1610	利用 GOCE 卫星全张量重力梯度数据研究南海深部构造特征	袁园 Yuan Yuan	国家海洋局第二海洋研究所 Second Institute of Oceanography, Ministry of Natural Resources
MGK1611	东亚季风系统在不同气候背景以及外界强迫下的时空变化特征	张旭 Xu Zhang	德国阿尔弗雷德魏格纳极地海洋研究所（AWI） Alfred Wegner Institute of Polar Oceanography (AWI), Germany

周五论坛
Friday forum

2016 年周五学术报告邀请海内外相关领域专家围绕实验室主要研究方向，面向全体师生共举办 8 场报告，促进了双方的学术交流，加强国际合作。

The academic Friday Forum in 2016 invited experts from relevant fields at home and abroad to focus on the main research directions of the laboratory, and held 8 reports to promote academic exchanges and international cooperation.

报告人 Reporter	报告题目 Topic	报告人单位 Institution	邀请人 Inviter
张旭 Xu Zhang	Understanding abrupt climate shifts during glacials: modeling perspectives	Alfred-Wegener Institute for Polar and Marine Research	王汝建 Rujian Wang
黄奇瑜 Qiyu Huang	北吕宋海槽弧前盆地的沉积层序及构造变形的时空动态变化特征	中科院广州地化所 Guangzhou Institute of Geochemistry, Chinese Academy of Sciences	赵西西 Xixi Zhao
Edward T. Baker	How leaky are oceanic ridge axes? A new assessment of the spatial density of submarine hydrothermal discharge	University of Washington	王虎 Hu Wang
陆尊礼 Zunli Lu	I/Ca as an oxygenation proxy: Precambrian to Pleistocene	Syracuse University	张传伦 Chuanlun Zhang
Gert J. de Lange	The Messinian Salinity Crisis (MSC): a brief introduction to one of the most spectacular marine geological findings of the last 50-years	Utrecht University	刘志飞 Zhifei Liu
张一歌 Yige Zhang	What’s wrong with the alkenone method for ancient pCO2 and how can we fix it?	Texas A&M University	张传伦 Chuanlun Zhang
杨涛 Tao Yang	Strain state and seismic heating signatures in the Japan Trench subduction plate-boundary fault zone: evidence from rock magnetic studies of IODP Expedition 343	中国地震局地球物理研究所 Institute of Geophysics, China Earthquake Administration	赵西西 Xixi Zhao
Cristiano M. Chiessi	Deglacial changes in strength of the Atlantic Meridional Overturning Circulation and its impacts over tropical South America and the adjacent ocean: a high temporal resolution assessment	巴西圣保罗大学 University of Sao Paulo, Brazil	田军 Jun Tian

研究生教育与奖学金
Graduate Education and Scholarships

留学生奖学金
International Student Scholarship

2016 年度获得资助的留学生共有 12 人，9 人攻读博士学位，3 人攻读硕士学位。1 名来自法国的博士学位攻读生顺利毕业，并拿到海洋科学博士学位。

In 2016, 12 international students were studying in the laboratory, 9 of whom are for a doctorate and 3 for a master degree. 1 student from France graduated with PhD degree in Ocean Science.

海洋地质奖学金
Marine Geological Scholarship

2016 年，共有 6 名学生获得了“海洋地质”奖学金，其中本科生 4 人，研究生 2 人。

In order to encourage students to study hard and help them grow into talents, the State Key Laboratory of Marine Geology has established a “Marine Geology” scholarship available to all undergraduate and graduate students in the school. In 2016, 6 students won the scholarship, including 4 undergraduate and 2 graduate students.

学生教育
Student Education

暑期学校 Summer School

实验室每年举行“全国优秀大学生暑期学校”，自 2012 年至今，已成功举办 5 届暑期学校。2016 年，实验室招收来自全国各大高校的优秀学员近 30 人。

Each year, the laboratory holds the National Summer Student Program for Outstanding Undergraduate Students, which is conducted in various forms such as visits to deep sea science museums and key laboratories, subject introductions, professional tests, and interviews and exchanges, in order to strengthen the understanding of outstanding university students about lab-related disciplines and scientific research progress in our laboratory. The program has attracted more and more outstanding national undergraduates to apply for marine graduate studies in the lab. Since 2012, five summer schools have been successfully held. In 2016, the laboratory accepted 30 outstanding students from elite domestic universities to participate in the program.

研究生学术论坛
Graduate Academic Forum

博思论坛 Booz Forum

2016 年 5 月及 12 月，实验室举办了两次研究生论坛，主题分别为“构造与沉积的耦合关系”和“地学领域的进展及测绘技术的应用”。

In May and December of 2016, the laboratories held two postgraduate forums, respectively themed "Coupling relationship between tectonics and sedimentation” and "The progress of Geoscience and the application of Surveying and Mapping Technology." The Booz Forum provided a platform for graduate students to exchange academic knowledge, display scientific research results, broaden their academic horizons, inspire enthusiasm for academic innovation and devotion to research.

科普教育
Popular Science Education

2016 年“深海探索馆”I-III 期共接待海内外参观者超过 36143 人次，其中团体参观达 200 多团次。举办科普展等活动十余场。以全国科技周、地球日、国际海洋节等公共节日为契机，开展科普讲座、参观、互动活动等一系列科普文化活动十余场。

The "Deep Sea Exploration Hall" phases I-III built in the laboratory were open to the public throughout the year. In 2016, more than 36,143 visitors from home and abroad attended the exhibition, among them, more than 200 as groups visits. Over a dozen events such as popular science exhibitions were also held. Taking the public awareness days such as the National Science and Technology Week, Earth Day, and International Ocean Festival as opportunities, we launched a series of popular science and cultural activities including as popular science lectures, visits and interactive adventural activities.

分析室
Laboratories

新开放分析室
Newly Open Analysis Labs

2016 年实验室建成电子探针分析室和岩石物理分析室。

In 2016, the Electron Probe Lab and the Rock Physics Lab are open.

● 电子探针分析室主要功能是可以实现矿物、岩石和材料等各类固体样品的微区形貌和结构观察，以及高精度的原位微区无损的元素成份定性分析、定量分析、线分析和面分析。

The Electron Probe lab is equipped with an Electron Probe Microanalyzer JEOL JXA-8230, with LaB6 and W electron gun, 5 X-ray spectrometers, 10 analytical crystals, and an Oxford X-MaxN 20 IE250, as well as Panchromatic Cathodoluminessence System, PHI-RHO-Z Quantitative Analysis Program and CHIME Dating Program.

● 岩石物理分析室主要功能是固结以及非固结岩芯超声波速度、孔隙度、电阻率及渗透率等岩石物理参数的测试、分析工作。

The rock physics lab has been built since 2015 and by now there is a SCMS-F multi-parameter measure system with several auxiliary apparatuses. In this lab, the main works are focus on the measurement and analyses of ultra-elastic velocities, porosity, resistivity and permeability in well-consolidate and unconsolidated rock samples.

人员情况
Staff

基本情况
General Information

至2016年底，实验室共有固定人员75人，其中专职科研人员61人，实验和工程技术人员13人，以及行政管理人员1人。目前实验室在读硕士生177人、博士生134人，博士后在站10人。

实验室在2016年度的人才引进和培养上有较大突破，取得了丰硕的成果。杨风丽入选国家重点研发计划首席科学家，杨守业入选科技部“中青年科技创新领军人才”。引进了中国海洋石油总公司总地质师朱伟林，其为我国海洋油气勘探领军人物，他的加盟，有力推动实验室在海洋石油勘探方向的研究。马文涛、谢伟、黄恩情、袁伟、王跃和易亮等青年人才入职，以及朱晓军等博士后加入海洋科学/地球物理学博士后流动站，显著提高了实验室的学术研究活力。此外，新进实验技术员李绘，进一步完善了科研支撑体系。

为促进国际交流与合作，吸引优秀外国留学生攻读海洋与地球科学学院相关研究生专业的学历和学位，由重点实验室出资设立了外国留学生奖助金，用于资助攻读学位的外国留学生。2016年度获得资助的留学生共有10人，分别来自越南、莫桑比克、巴基斯坦、马来西亚、泰国、法国等。

实验室还积极支持本学科的研究生出国短期学术交流。这些研究生通过国外的学习交流，不仅取得了较好的科研数据，还锻炼和培养了独立科研和国际学术交流能力，进一步促进本实验室的人才培养和队伍建设。

实验室每年举办大学生暑期学校，通过深海科普馆与重点实验室参观、学科介绍、专业测试、面试交流等多种形式开展，加强各高校优秀在校大学生对实验室相关学科及科研状况的了解，吸引更多全国优秀本科毕业生报考海洋研究生。

学位授予方面，目前设有2个博士点，4个硕士点。以重点实验室研究人员为第一导师，2016年毕业博士研究生为24人，毕业硕士研究生为51人。

By the end of 2016, the laboratory had a total of 75 staff member, including 61 full-time researchers, 13 analytical and engineering supporting staff, and one administrative staff. There were 175 master students, 134 doctoral students, and 10 post-doctoral fellows.

The laboratory made major breakthroughs in the introduction and cultivation of talents in 2016 and achieved fruitful results. Prof. Feng-li Yang was awarded with the “Chief scientist of National key research and development plan”, Prof. Shou-ye Yang was awarded with the” Youth Science and technology innovation leader”. Professor Wei-lin Zhu, an expert on Marine oil and gas exploration, was introduced during the year. His joining will greatly advance research on the direction of Marine oil and gas exploration in the laboratory. Young scholars Dr En-qing Huang and others took up their positions, and seven postdoctoral fellows including Xiao-jun Zhu also joined the postdoctoral station for marine science/geophysics, which helps significantly improve the vitality of academic research in the laboratory. In addition, new researcher Hui Li also brought in rich knowledge into the Marine Chemistry research team.

To promote international exchanges and cooperation and attract outstanding foreign students to study diplomas and degrees related to postgraduate majors of the School of Ocean and Earth Sciences, the key laboratory established foreign students’ scholarships fund for foreign students studying for degrees. In 2016, 10 international students from Vietnam, Mozambique, Pakistan, Malaysia, Thailand and France, respectively, received the funding.

The laboratory also actively supports short-term academic exchanges for postgraduate students going abroad. These graduate students have obtained good scientific research data, and cultivated independent scientific research and international academic exchange capabilities through foreign learning experiences, further promoting the laboratory’s personnel training and team building program.

Each year, the laboratory organized summer schools for students to visit the deep-sea popular science museums and key lab facilities. Through subject introduction, professional testing, interviews, and other forms of communication to help the outstanding university students in various domestic universities and colleges to better understand the various disciplines and current scientific research statues in order to attract more and more outstanding undergraduates to apply for marine graduate studies in our lab.

For degree conferment, the lab hosted 2 doctoral programs and 4 master programs. Taking the key laboratory researchers as the first mentor, 24 students were awarded the doctoral degree and 51 students the master degree in 2016.

新近入选的人才计划
New Talent Plan

周怀阳荣获“全国五一劳动奖章”

National May Day labor medal: Huai-yang Zhou

杨风丽入选国家重点研发计划首席科学家

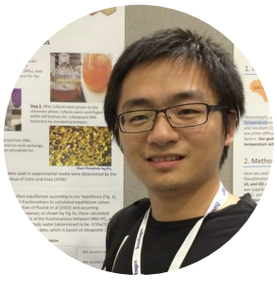
Chief scientist of National key research and development plan: Feng-li Yang

刘志飞获法国国家棕榈教育骑士勋章

French national palm education knighthood: Zhi-fei Liu

杨守业入选科技部“中青年科技创新领军人才”

Youth Science and technology innovation leader: Shou-ye Yang



俞恂入选“上海市青年科技英才扬帆计划”

Shanghai youth scientific and technological talent: Xun Yu

赵峦啸入选“上海晨光计划”

Shanghai morning light program: Luan-xiao Zhao

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