近海海洋环境科学国家重点实验室（厦门大学）

State Key Laboratory of Marine Environmental Science
(Xiamen University)

2017年度报告
ANNUAL REPORT

MEL INTRODUCTION

近海海洋环境科学国家重点实验室（厦门大学）（英文缩写MEL）启动建设于2005年3月，2007年6月通过科技部验收，2010、2015年连续被评为优秀国家重点实验室。实验室瞄准与全球变化有关的重大科学问题，直面国家对海洋环境保护和生态安全的重大需求，立足基础研究，以多学科交叉为基础、以技术创新为动力、主攻海洋生物地球化学过程及其与海洋生态系统相互作用，关注在自然变化和人类活动影响下的海洋生态系统对环境变化的响应和反馈。实验室坚持走国际化发展道路，科学研究力求具备国际视野，管理体系参比国际标准，文化建设崇尚自由宽松，努力建设成为具有重要国际影响力的海洋环境科学研究和创新性人才聚集的基地。

Founded in 1995, the Laboratory of Marine Environmental Science (MEL) was formally promoted to a state key laboratory in March, 2005. MEL consists of 60 scientists and 93 technicians. It is dedicated to cutting-edge and interdisciplinary research related to global and regional environmental changes. MEL's focus is on marine biogeochemistry and its interactions with the marine ecosystem.

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序言

酉鸡为有吉，十二一轮回。MEL在2005年启动了她的建设，而刚刚翻过的2017年正好是实验室建设的第十二个年头。在轮回句点，回望盘点、凝聚自信。在轮回起点，思考短板、谋划发展。

2005年，通过科技部论证获批启动建设。

2006年，获批首个“创新研究群体”科学基金；荣获首个国家自然科学二等奖；获批“111”创新引智基地。

2007年，通过科技部验收。

2008年，启动建设“大型仪器与技术服务中心”（COMET）。

2009年，首次主持“973”项目；获批科技部“国际科技合作基地”。

2010年，获评为优秀国家重点实验室。

2011年，焦念志教授当选为中国科学院院士。

2012年，主持国家重大科学研究计划；举办首届厦门大学海洋科学开放日。

2013年，启用翔安新校区海洋科研平台楼。

2014年，创办厦门海洋环境开放科学大会。

2015年，再度获评为优秀国家重点实验室；再度获国家自然科学二等奖；研究成果发表于《科学》期刊。

2016年，获首批国家重点研发计划“全球变化及应对”重点专项资助2项。

2017年，收获了诸多的“双喜”：产生了MEL平台孕育的第二个中国科学院院士、获批第二个创新研究群体、研究成果再度发表于《科学》期刊；“嘉庚”号科考船、东山太古海洋观测与实验站双双交付使用；所依托的海洋科学学科入选“双一流”建设学科名册，在全国高校学科评估中获得A+的评估结果。

经过12年的发展，MEL坚持走国际化发展道路，科学研究力求具备国际视野、管理体系参比国际标准、文化建设崇尚自由宽松，业已成为我国海洋科学研究、人才聚集与培育、学术交流与合作的重要平台，在国际海洋生物地球化学界已享有些许嘉誉，也为提升中国海洋科学的国际地位做出了贡献。2017年的丰收年为MEL第一个轮回画上了圆满的句号。

过去的12年，中国不断崛起，全球化推动着中国的发展，中国也正在引领新一轮全球化进程。2017年9月，金砖国家领导人第九次会晤在厦门举行，美丽的鹭岛见证《厦门宣言》的诞生，除了凸显经济合作这一主线，也强调环境合作对人类可持续发展的重要性以及共同应对气候变化挑战的决心。2017年10月，十九大报告更是提出加快建设海洋强国的呼吁，正在深层次地激发海洋人的责任感和使命感。

庄子说：“道隐于小成，言隐于荣华。”止步于小小成功，就不可能亲证大道，陶醉于“荣华富贵”，就不可能领悟至言。MEL发展至今，我们也不得不思考如何保持MEL下一轮持续健康发展？如何使MEL顺利避开“中等收入陷阱”？下一轮MEL变革的支点会是什么？

过去几年，我们一直在讨论什么是“国际一流”。显然，国际一流就是一流的师资队伍（每一位教授均能同台竞技于国际舞台）、一流的产出（包括卓越的创新人才和科研成果）以及孕育先进的学术和文化的土壤，诚如嘉庚先生创办厦门大学的宗旨：“研究高深学问，养成专门人才，阐扬世界文化”。国际一流非为一流而一流，她内涵着一个群体及其每位成员的中心思想及价值追求。

以大数据、互联网、人工智能等新技术为典型特征的第四次工业革命业已到来，它将从速度、深度和广度上深刻地影响政治、经济、社会和文化的方方面面，也包括海洋科技。MEL如何客观地审视自身的发展历史和现状、审视新时代海洋强国战略的发展使命和机遇、审视国际海洋科技的发展趋势及挑战，借力新技术革命，顺势而为、乘势而上？这些都是我和同事们今后很长一段时间内需要共同思考的问题。

最后，值此新年来临之际，谨代表实验室全体同仁，向所有关心、支持实验室成长的海内外同仁、朋友表示衷心的感谢，并致以最美好的新年祝福。

戴民汉主任
于2018年1月2日

Message from the Director

2017 is the Year of Rooster and like the Lunar Calendar, which operates in 12 year cycles, this year marks the 12th anniversary of MEL. As one cycle ends and another begins, we must reflect on the achievements and failures of the past and plan for the future.

In 2005, MEL designated a State Key Lab by the Ministry of Science and Technology (MOST).

In 2006, 1st Group of Excellence supported by NSFC Science Fund for Creative Research Groups; 1st National Natural Science Award (2nd prize), and support from the “111” International Exchange Program.

In 2007, MEL officially recognized by MOST following a 2 year test phase.

In 2008, Center of Major Equipment and Technology (COMET) established.

In 2009, support from the National Basic Research (“973) Program.

In 2010, MEL designated an excellent State Key Laboratory during MOST sponsored national review.

In 2011, Nianzhi Jiao elected an academician of the Chinese Academy of Sciences.

In 2012, another project funded by the National Basic Research Program; and 1st Xiamen University Ocean Sciences Open Day.

In 2013, MEL moved to Zhou Long Quan Building on Xiang'an Campus.

In 2014, 1st Xiamen Symposium on Marine Environmental Sciences.

In 2015, MEL again designated an excellent State Key Laboratory during the 2nd national review; another Prize in National Natural Science Award; publications in Science.

In 2016, funding for the National Key Research and Development Program.

The Chinese idiom 双喜 literally translates as “Double Happiness.” In the West, “Good things come in pairs” is a close equivalent. As for us in 2017, we had many moments of 双喜. We had 2 major facilities launched (our new RV, the Tan Kah Kee, and the Dongshan Swire Marine Station); the publication of the 2nd article in *Science*; the 2nd NSFC Group of Excellence; XMU’s marine science program enlisted in the Ministry of Education “Double First-Class Initiative”; and ranked category “A+” in the national review among universities. And, I was awarded the distinction of becoming MEL’s 2nd Academician in the Chinese Academy of Sciences.

We have grown into a primary research institution in China, in marine environmental science. We strive to have an international perspective and management system and hope to be world renowned.

Our corporate culture is a relaxed one which has allowed us to attract and cultivate talent and promote academics and collaboration, thus becoming a leader in marine sciences. We are a key player in global marine biogeochemical research and contributed to the elevation of China's marine science program. Indeed, one reaps what one sows, and 2017 has been a bountiful year for us.

As China continues to rise, we have seen a shift in roles: from globalization boosting China to China now taking the lead on the global stage. In September 2017, the 9th BRICS summit was held in Xiamen, which resulted in the Xiamen Declaration. This calls upon all nations to work towards peace, continued economic cooperation, and tackling climate change and sustainable development, within both the economic and environmental realms. Two months later, the 19th National Congress reiterated the need to become a strong maritime nation, inspiring marine scientists with a sense of responsibility.

As the Chinese philosopher Zhuangzi said, "The path is confused by small successes and meaning is lost by reveling in them." So, it's time for us to consider the next 12 year cycle for MEL. How do we avoid becoming complacent in our achievements and continue to challenge ourselves? What will be impetus for our next cycle of development?

In the past few years, we have been discussing what it means to be "world-class". Obviously, world-class includes a group of competitive faculty members (each professor can compete in the international science community), first-rate output (including innovative talents and research), and a foundation that nurtures advanced science and culture. This lies in accordance with our founder's stated purpose for Xiamen University - to study advanced science, cultivate specialized personnel and welcome the world's culture. Thus, "world-class" is more than just mere words; it houses the spirit and pursuit of value among groups and individuals.

The world is at the start of the 4th industrial revolution, featuring new technologies such as big data, the internet, and artificial intelligence. These technologies and much more will profoundly affect all aspects of politics, economy, society, and culture, as well as marine science and technology. How can we use our past and present to examine the missions and opportunities in the new era? How do we examine development trends and challenges of global marine science and technology? How to leverage the new technological revolution? These are issues that my colleagues and I must consider in depth and detail in the future.

Finally, on the occasion of the New Year, I would like to extend my heart-felt thanks and best wishes of the New Year to all my colleagues and friends from home and abroad who are concerned about and supporting MEL!

Minhan Dai, Director
January 2, 2018

一月 January

第三届厦门海洋环境开放科学大会在厦门大学科学艺术中心举办。
The Third Xiamen Symposium on Marine Environmental Sciences (XMAS-III) took place in Xiamen.

由吴立新院士担任主任的MEL第三届学术委员会第一次会议在厦门召开。
The MEL Academic Committee Meeting was held in Xiamen, attended by the new panel led by Prof. Lixin Wu.

党宏月团队的研究成果“海洋附着微生物的生态过程和生物地球化学作用”、林森杰团队的研究成果“虫黄藻全基因组测序完成”入选2016年度中国海洋与湖沼十大科技进展。
Research achievements related to "Ecological processes and biogeochemical functions of marine surface-associated microorganisms" by Hongyue Dang, and "Whole genome sequencing of *Symbiodinium kawagutii*" by Senjie Lin were listed as two of the "Top 10 Science and Technology Advances of China in Oceanology and Limnology in 2016" by the Chinese Society for Oceanology and Limnology.

四月 April

“嘉庚”号科考船交付使用，并举行首次公众开放日暨科考航次研讨与信息发布活动。
Along with its first public open day, R/V Tan Kah Kee was delivered to Xiamen University and officially launched.

《科学》刊登了史大林团队的研究论文，该成果发现因大气CO_2上升而引起的海洋酸化抑制束毛藻的固氮作用，且该负效应随着海水中铁浓度的下降而加剧。
Dalin Shi's research group published a research article in *Science* entitled "The complex effects of ocean acidification on the prominent N_2-fixing cyanobacterium *Trichodesmium*".

五月 May

汪冰冰、王杉霖入选国家高层次人才。
Bingbing Wang and Shanlin Wang were awarded the National Recruitment Program for Young Professionals.

六月 June

厦门大学东山太古海洋观测与实验站落成。
The Dongshan Swire Marine Station was launched.

焦念志获人力资源和社会保障部、中国科协、科技部、国务院国资委颁发的“首届全国创新争先奖”。
Nianzhi Jiao was named a recipient of the prestigious National Innovation Pioneer Award.

八月 August

高树基为学术带头人的“海洋氮循环与全球变化”研究群体获国家自然科学基金创新研究群体项目资助。
The Ocean Nitrogen Cycle and Global Change Research Group led by Shuh-Ji Kao was awarded the NSFC Science Fund for Innovative Research Groups.

九月 September

由焦念志发起的首届雁栖湖会议国际论坛——陆海统筹论碳汇在北京举行。
Convened by Nianzhi Jiao, the 1st Yan-Qi Lake International Conference on Climate Change and Biologically-driven Ocean Carbon Sequestration was held in Beijing.

《自然•通讯》刊登了高树基团队的研究论文，阐述大气沉降对海洋溶解黑碳的贡献。
Shuh-Ji Kao's research group published a research article in *Nature Communications* entitled "Aerosols as a source of dissolved black carbon to the ocean".

教育部、财政部、国家发展改革委公布世界一流大学和一流学科（简称“双一流”）建设高校及建设学科名单，实验室所依托的海洋科学学科入选“双一流”建设学科名单。
The Ministry of Education , Ministry of Finance, and National Development and Reform Commission released a selected list of universities and disciplines sponsored by the "Double First-Class Initiative". The marine science program of Xiamen University was listed among the First-Class disciplines.

高坤山团队的研究成果“海洋酸化对初级生产过程的影响、机制及其生态效应”获福建省科学技术奖自然科学一等奖。
Research by Kunshan Gao's team on "The impact of ocean acidification on primary production, its mechanism and ecological effect" won 1st prize of the Fujian Provincial Science and Technology Award (Natural Science).

十一月 November

戴民汉入选中国科学院院士。
Minhan Dai was elected as an academician of the Chinese Academy of Sciences.

第十七届中国水色遥感大会在厦门举办。
The 17th China Ocean Color Remote Sensing Conference was held in Xiamen.

厦门大学第六届海洋科学开放日在翔安校区举办，吸引约6500名公众前来参加。
The 6th Xiamen University Annual Ocean Sciences Day was held and attended by about 6500 visitors.

十二月 December

实验室所依托的厦门大学海洋科学学科在全国高校学科评估中获得“A+”的评估结果。
During the 4th national disciplines review among Chinese universities, Xiamen University was ranked in category "A+" in the field of Marine Science.

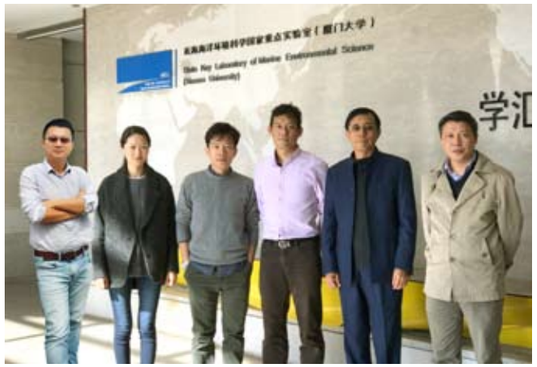
科研课题 / RESEARCH PROJECTS

2017年度，实验室新增科研课题36项，合同经费约4400万元，其中包括国家自然科学基金创新研究群体项目1项、重大研究计划重点支持项目1项、重点项目1项、重点国际（地区）合作交流项目1项、联合基金1项、面上项目11项、青年科学基金7项、重点研发计划“海洋环境安全保障”重点专项项目1项、课题2项，以及其他省部级项目10项。

In 2017, MEL faculties were awarded 44 million RMB for 36 projects in competitive research grants mainly from the National Natural Science Foundation (NSFC), Ministry of Science and Technology (MOST) and State Oceanic Administration (SOA).

国家自然科学基金创新研究群体 NSFC Innovative Research Group

海洋氮循环与全球变化 （首席科学家：高树基）
Nitrogen Cycle under Global Change (Leading PI: Shuh-Ji Kao)



以高树基为学术带头人的“海洋氮循环与全球变化”研究群体获得国家自然科学基金2017年度创新研究群体项目资助，主要成员包括史大林、张瑶、陈敏、高坤山以及刘志宇。

该群体长期从事同位素生物地球化学、微生物生态学和分子生态学、海洋环境变化生理学及海洋流体动力学研究。群体在前期工作中发展出独创的稳定同位素示踪技术，可量化同时发生的多个微生物介导的氮循环过程速率，将用于探索氮循环对于全球变化的响应。在海洋碳、氮循环以及海洋酸化等全球变化对海洋生物的生理生态效应及其机理方面取得多项标志性成果，更成功地耦合海洋动力与关键生物地球化学过程。

本研究群体将侧重上层海洋，拟在三个方向上实现科学突破：1）以氮素为视角、同位素先进技术为手段、以全球变化为研究主线、规划从海洋现场到中尺度生态系统再到室内实验，从不同时空尺度深入探究在不同物理化学环境条件下，以微生物为媒介驱动的氮过程与氮碳耦合机理。2）拟在单细胞、种群、群落以及生态系统水平上，逐步架构氮、碳与能量流转及传递效率的函数，揭示海洋生物泵功能（生态与气候调节）与环境控制因子之间的定量化关系。3）深入了解海洋生态系统对气候变化响应和反馈的机制，建立具备预测能力的海洋生态模型。

Led by Shuh-Ji Kao, the group on “Nitrogen cycle under global change” was funded in 2017 by the NSFC Foundation for Innovative Research Groups. Other key members include Min Chen, Kunshan Gao, Zhiyu Liu, Dalin Shi and Yao Zhang.

The group has long been engaged in marine microbial physiology/ecology and molecular ecology, isotope biogeochemistry and marine hydrodynamics. The group exclusively developed cutting-edge stable isotope tracer technology to simultaneously quantify the rates of multiple microbial-mediated processes in nitrogen cycles. The innovative technique advances our capability to explore the responses of the nitrogen cycle to global changes. A series of outstanding scientific stories in the marine carbon and nitrogen cycle, and physiological and ecological response of marine microorganism to global change have been achieved. Various in-depth mechanisms down to the molecular level have also been uncovered. More importantly, the ocean dynamics and key biogeochemical processes have recently been coupled successfully.

With the support from the NSFC grant, scientific breakthroughs are possible in the following aspects: (1) by considering different scales from manipulated laboratory experiments to mesoscale ecosystems, then to ocean cruise, we explore nitrogen cycle processes driven by microorganisms' enzymatic activities and the mechanism of C/N coupling under the scenarios of global change; (2) to establish theoretical and empirical functions of nitrogen, carbon, energy transfer and transfer efficiency at the single cell, population, community and ecosystem levels to reveal the quantitative relationship between marine biological pump functions (ecological and climate regulation) and environmental factors; (3) in-depth understanding of mechanisms of response and feedback of the marine ecosystem to climate change to construct a marine ecological model with predictive capability.

科研课题 RESEARCH PROJECTS
重点项目介绍 PROJECT HIGHLIGHT

国家自然科学基金重大研究计划重点支持项目 NSFC Major Program

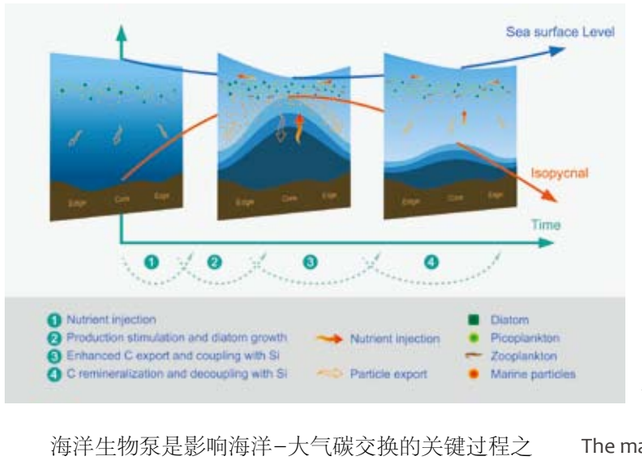
微生物对近海典型海域碳源汇的调节机制及其环境效应（首席科学家：焦念志）
The role of microbial regulating mechanisms of carbon sequestration in typical coastal waters in China (Leading PI: Nianzhi Jiao)

海洋是地球上巨大的溶解性有机碳库，其储碳量与大气二氧化碳相当。“微型生物碳泵”（Microbial carbon pump, MCP）是生物储碳的重要机制，微生物活动（细菌的代谢、病毒裂解、原生动物捕食等）把溶解有机碳从活性向惰性转化，是“巨大碳库的幕后推手”，奠定了海洋有机碳库的基础。近海海域是复杂而重要的生态区，河口海区常常是大气CO_2的“源”而非“汇”。本项目遵循“水圈微生物计划”总体设计，以碳氮硫循环为主线，以MCP为抓手，针对微型生物对碳“源”或“汇”调节的关键生态过程和主要机制开展研究。通过现场调查、生态模拟实验与室内研究相结合，以及海洋微生物与海洋化学的研究手段相结合，搭建微生物微观过程与海洋碳循环宏观效应之间的桥梁，为重大研究计划的科学目标“水圈微生物参与碳氮硫等元素生物地球化学循环的宏观机制与生态效应”提供支撑。

The Earth’s oceans harbor a tremendous dissolved organic carbon (DOC) pool that is equivalent in amount to the total inventory of atmospheric CO_2. The microbial carbon pump (MCP) framework encompasses the processes (bacterial metabolism, grazing, virus lysis, etc.) whereby DOC is transformed from labile to recalcitrant states, contributing to carbon sequestration in the ocean. Estuaries are often observed as “sources” rather than “sinks” of CO_2 to the atmosphere, but the mechanisms behind are not fully understood yet. With the MCP as the main theme, the present project follows the overall guidance of the "Hydrosphere Microbiology Program", and employs biological and chemical approaches to investigate the relevant microbial processes and regulating mechanisms in carbon, nitrogen, and sulfur cycles so as to address the “source” and “sink” issues from comprehensive perspectives.

国家自然科学基金重点项目 NSFC Key Program

中尺度气旋式涡旋作用下有机碳与生源硅输出通量的动态变化与耦合：涡旋演化与亚中尺度过程的重要性（首席科学家：戴民汉）
Transient enhancement and decoupling of carbon export vs opal in cyclonic eddies: overprints of submesoscale interactions and eddy evolution (Leading PI: Minhan Dai)



气旋式涡旋的时空演化及其生物地球化学响应概念模型

海洋生物泵是影响海洋–大气碳交换的关键过程之一，调控着海洋碳储量和大气CO_2浓度，影响全球气候系统。虽然中尺度涡的三维环流结构的观测及其动力解析仍尚待深入，但其物理动力场的基本结构却相对明确。而且，中尺度涡所驱动的生物地球化学响应信号在时间和空间尺度上均易为现代观测手段所获取，例如，在中尺度涡的驱动下，深层营养盐进入真光层可导致浮游植物快速响应，海洋生物泵的结构与效率随之也发生快速改变，因此，中尺度涡是研究海洋生物泵过程和机理的绝佳试验场。本项目执行时间为2018–2022年，将以中尺度冷涡为案例解剖“麻雀”，围绕表征生物泵效率的有机物输出通量的时空格局这一主线，探讨冷涡的时空演变，特别是冷涡的演化以及冷涡系统在亚中尺度水平上的变异及其与有机碳、生源硅输出通量之间的动态变化关系，揭示其中的生物泵的关键过程与机制，拟解决如下关键科学问题：1）亚中尺度过程如何调节中尺度涡中颗粒有机碳与生源硅的输出？2）冷涡动力场随时间的演变如何影响颗粒有机碳和生源硅的输出？3）中尺度涡的时空变异如何影响颗粒有机碳与生源硅输出的耦合或非耦合？这些过程如何调控海–气界面CO_2的源汇格局？项目的实施可为全面认识、定量解析海洋生物泵及其在碳循环中的作用奠定基础。

The marine biological pump is one of the key processes controlling air-sea carbon exchange, which modulates both carbon storage in the ocean and CO_2 concentration in the atmosphere. Mesoscale eddies induce extensive spatial variability in biological production and are critical to the biologically mediated downward transport known as the biological pump and sequestration of carbon in the ocean interior. This proposal will try to examine the eddy's evolution and its submesoscale variability and how spatial-temporal variability modulate the exports of carbon and opal and their coupling by tracking a prominent cyclonic eddy in the North Pacific Ocean. Through intensive and highly spatial-temporal resolved field observations and numerical modeling, we are to answer the following critical questions: (1) How do submesoscale processes of a cyclonic eddy modulates the spatial variability of carbon and opal exports? (2) how does eddy evolution affect carbon and opal exports? (3) Are the exports of carbon and opal coupled or decoupled on the spatial scale during the submesoscale variability and on the temporal scale during eddy evolution? We contend that the proposed research is crucial in better understanding the biological carbon pump and its role in the global carbon cycle.

国家重点研发计划“海洋环境安全保障”重点专项 National Key Research and Development Program

海水总碱度在线监测仪器的研制及产业化（首席科学家：陈进顺/李权龙）
Development and production of online instruments for the measurement of sea water total alkalinity (Leading PIs: Jinshun Chen / Quanlong Li)

海水总碱度（Total alkalinity, TA）是海水碳酸盐系统的四大参数之一，是海洋碳循环和海洋酸化研究的常用参数。TA在线监测仪器是获取高时空分辨率海水TA数据的最佳手段。本项目执行时间为2017–2020年，将在原有的工作基础上，研制两种海水TA在线监测仪器：1）全自动的既可用于离散样品测定也可用于走航测定的船载走航TA测定仪；2）可安装于浮标等固定平台上、用于长期观测的原位TA测定仪。同时，和企业紧密合作，对所研制的仪器进行标准化定型，实现批量生产，并建立海水TA在线监测仪器的产业化基地。两种仪器的性能将达到国际先进甚至领先水平，可望实现海水TA的高时空分辨率观测，进而推动相关科学研究的发展。

Total alkalinity (TA) is one of the four parameters of the ocean carbonate system and is a common parameter for ocean carbon cycle and ocean acidification studies. The best means to obtain TA data in high temporal and spatial resolution is the application of online TA instruments. Based on previous work, this project aims to develop two instruments for online TA monitoring: (1) automatic shipboard TA analyzer for both discrete sample measurement and underway measurement; (2) *in situ* TA analyzer which can be installed on fixed platforms such as buoys, for long-term observations. At the same time, the project will cooperate closely with businesses to standardize the instruments and establish an industrial base for mass production. These instruments are expected to realize a high spatio-temporal resolution observation of seawater TA and promote the development of relevant scientific research.

交流与合作
EXCHANGES AND COOPERATION

第三届厦门海洋环境开放科学大会
The Third Xiamen Symposium on Marine Environmental Sciences (XMAS-III)

XMAS系列会议是由实验室发起和组织的系列国际会议，主题为“多学科交叉研究海洋环境”。第三届XMAS大会于2017年1月9-11日在厦门大学科学艺术中心召开。大会设4个专场、9个特别专场和2个研讨会。来自海内外150个学术机构的620余名学者参加了大会，其中来自美国等21个国家和地区的境外专家占比30%。

美国蒙特利湾海洋研究所Peter Brewer、美国国家海洋与大气管理局太平洋海洋环境实验室Richard Feely、伍兹霍尔海洋研究所Dennis McGillicuddy、缅因大学Mary Jane Perry以及加州大学圣克鲁兹分校Jonathan Zehr等5名海洋科学领域的著名学者，分别在海洋生物地球化学、海洋酸化、海洋动力过程与生物过程的耦合、海洋遥感以及海洋微生物地球化学等领域做大会主题报告。

大会共安排口头报告211个及展板报告308个。此外，还组织了一系列交流与研讨活动：

学术论文撰写与投稿经验分享会：面向年轻的科学工作者，由地学重要期刊*Journal of Geophysical Research-Oceans*主编Peter Brewer主讲。

学生交流活动：邀请数名科学家分享学术研究和职业发展经历；组织参会科学家组成评审委员会对学生展板进行评议，从中选出5位最佳展板报告，由MEL与香港大学太古海洋科学研究所共同为获奖者提供交流学习资助。

女性科学家沙龙：大会邀请7名杰出女性科学家分享其在科学研究中面临的问题与挑战，许多参加沙龙的女性科研工作者从中产生共鸣并获得鼓舞。

第四届厦门海洋环境开放科学大会将于2019年1月举办，欢迎关注更多资讯：
http://mel.xmu.edu.cn/conference/4xmas.




(From left to right starting at the top) Keynote speakers: Dr. Peter G. Brewer, Dr. Richard A. Feely, Dr. Dennis McGillicuddy, Dr. Mary Jane Perry and Dr. Jonathan Zehr.

The Xiamen Symposium on Marine Environmental Sciences (XMAS) is a serial international conference convened and organized by MEL, with the overarching theme "The Changing Ocean Environment: From a Multidisciplinary Perspective". The third XMAS was held at XMU on January 9-11, 2017.

The symposium consisted of 4 general sessions, 9 special sessions and 2 workshops, covering physical oceanography, marine biogeochemistry, biological oceanography, marine ecotoxicology and public education along with workshops for emerging topics in marine environmental sciences.

Five outstanding scientists delivered keynote speeches. They were Dr. Peter G. Brewer from the Monterey Bay Aquarium Research Institute, Dr. Richard A. Feely from the NOAA's Pacific Marine Environmental Laboratory, Dr. Dennis McGillicuddy from the Woods Hole Oceanographic Institution, Dr. Mary Jane Perry from the University of Maine, and Dr. Jonathan Zehr from the University of California, Santa Cruz.

The XMAS-III attracted more than 620 scientists and students from 150 institutions covering 21 countries and regions, including the USA, South Korea, Japan, Malaysia, Hong Kong, and Taiwan. A total of 211 oral talks and 308 posters were presented during the conference.

In addition, the conference organized several special activities, including:

Open Discussion Session on Publication Practice in JGR-Oceans: Dr. Peter Brewer held an open discussion for young researchers. He shared his experience as Editor-in chief of JGR-Oceans and talked about how to write a paper and get it published in a scientific journal.

Student Activities: Several invited scientists shared their lives and career experiences with students. The Student Poster Review Committee evaluated more than 160 student posters and there were 5 winners who were awarded a small scholarship jointly sponsored by MEL (XMU) and SWIMS (HKU).

Women in Science Salon: While the ratio of female to male students in ocean and environmental sciences fields have steadily increased over the years, the number of female scientists within the higher tiers of science remains disappointingly low. 7 leading women in the field held an open discussion about the opportunities and challenges specific to women in science.

The next iteration XMAS-IV (http://mel.xmu.edu.cn/conference/4xmas) will be held in January 2019. We are looking forward to hosting you in Xiamen.

Discussion on publication practice.

Student discussions.

Women in Science Salon.

首届雁栖湖会议国际论坛
The First Yan-Qi Lake International Conference

9月19-22日，首届雁栖湖会议国际论坛在北京雁栖湖国际会议中心举办。雁栖湖会议国际论坛是中国科学院搭建的跨学部高水平国际学术交流平台，面向科学前沿并兼顾学科发展战略。此次论坛由中国科学院学部主办、厦门大学承办、北京市政府协办。中国科学院焦念志院士发起并担任主席、美国人文与科学院Farooq Azam院士、欧洲科学院Louis Legendre院士、加拿大皇家科学院Curtis Sutle院士、以及中国科学院郭正堂院士等担任共同主席。共90人（包括24位海外学者）参加了论坛，围绕"海洋碳汇过程与机制"、"海洋碳汇模型与预测"、"海洋碳汇标准与体系"等中心议题进行了讨论。

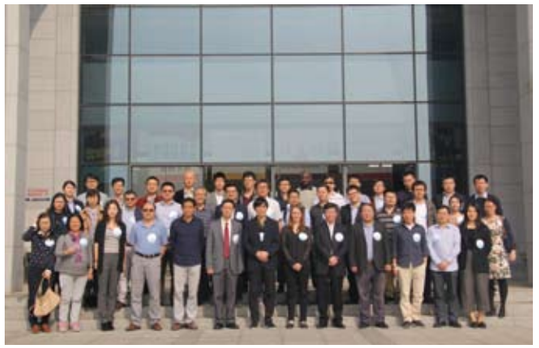
The Yan-Qi Lake International Conference (YC) is a high-end academic forum initiated by the Chinese Academy of Sciences (CAS). It aims to establish a top-level platform for international academic exchange and communication, and promoting disciplinary construction and development.

The 1st YC was held on September 19-22 in Beijing. It was convened and chaired by CAS Academician Prof. Nianzhi Jiao, co-chaired by CAS Academician Prof. Zhengtang Guo, Fellow of the American Academy of Arts and Sciences Prof. Farooq Azam, Fellow of the European Academy of Sciences Prof. Louis Legendre, and Fellow of the Royal Society of Canada Prof. Curtis Suttle.

The major theme of this conference was Climate Change and Biologically-Driven Ocean Carbon Sequestration. There were three themetic topics including marine carbon sequestration mechanisms and processes, numerical modeling for forecasting marine carbon sequestration, and marine carbon protocols. 90 scientists and students (including 24 international scholars) attended the conference.

More on http://ime.xmu.edu.cn/yanqilake/

组织或承办的会议 MEL ORGANIZED SYMPOSIA / CONFERENCES



2017 Xiamen University Marine Environmental Science Forum for Young Scholars was attended by 21 young scientists on January 8. The forum was organized by XMU Office of Human Resources and Faculty of Earth Science and Technology and hosted by MEL.

The World Harbor Project (WHP) 2nd Global Partners Meeting took place on September 26-28 in Xiamen. 45 participants from 13 partner cities across 6 continents attended the meeting. Discussions were based on the four themes: 1) water and sediment quality, 2) green engineering, 3) multiple uses and users, and 4) education. Initiated by the Sydney Institute of Marine Science in 2014, WHP aims to develop resilient urban ports and harbors through a global network of collaborating cities. Xiamen (represented by Yunwei Dong) joined the Project in 2016.

The 17th China Ocean Color Remote Sensing Conference was held at XMU on November 1-3. The attendees included more than 250 scientists and students from over 50 research and education institutes, who presented and discussed their latest achievements in radioactive transfer modeling, remote sensing algorithms, applications, LIDAR, and new technologies in water color remote sensing for land and oceans.

凌峰论坛 Lingfeng Forum

凌峰论坛自2004年开展以来，持续发挥“启迪新思想，促进学术融合”的重要作用，对实验室的研究方向与学术交流产生深远的影响。2017年，实验室举办了7讲凌峰论坛。
Initiated in 2004, the Lingfeng Forum continues to play an important role as a platform to foster new ideas and promote academic fusion for MEL faculty and students. Seven forums were organized in 2017.

No.	Theme	Conveners
#59	Sea level change	Jianyu Hu, Shaoping Shang, Xuebin Zhang and John A. Church
#60	GEOTRACES - Opportunities and challenges	Yihua Cai and Zhimian Cao
#61	Online monitoring technology of marine environment	Jian Ma and Xi Chen
#62	The turbulent ocean - dynamics and modeling	Zhiyu Liu and Xiao-Hai Yan
#63	D-SMART based collaborations and interdisciplinary observations between XMU and HKUST	Yuwu Jiang , Guizhi Wang, Xiaolin Li, Fengling Yu and Xin Liu
#64	Coral responses to environmental change	Senjie Lin and Tuo Shi
#65	The physical and biogeochemical research and observation on mesoscale eddies	Kuanbo Zhou and Hongyang Lin

The 64th Lingfeng Forum

(http://mel.xmu.edu.cn/article_lingfeng.asp?id=13)

午餐交流会及学术沙龙 Luncheon Seminar & Academic Salon

自2014年起启动的“周一午餐交流会”，内容涵盖学术探讨、运行管理、平台建设等方面，2017年共进行了23讲。同时，自2017年11月起，MEL重新组织学术沙龙活动，使实验室成员在紧张的工作之余，建立友谊、交流思想、碰撞学术火花。

The MEL Weekly Luncheon Seminar Series was launched in 2014 to facilitate interactions among faculty, staffs, students and visitors. A total of 23 luncheon seminars were held in 2017. The MEL Academic Salon was re-launched since this November. We welcome all MEL members, new employees and visiting scholars.

No.	Title	Speaker
#68	Analytical approach for determining the mean water level profile in an estuary with substantial fresh water discharge	Huayang Cai Sun Yat-sen University (Guangzhou)
#69	Dating a ubiquitous marine bacterial lineage using genomic mutation rate	Haiwei Luo The Chinese University of Hong Kong
#70	Dust, iron and marine biology	Ying Ye Alfred Wegener Institute, Germany
#71	How siderophores really work in natural matrices?	Jean-Philippe Bellenger University of Sherbrooke, Canada
#72	走进西沙	Weidi Yang Xiamen University
#73	海底上升泉与地下水深循环	Jiansheng Chen Hohai University
#74	全球暖化与海岸变迁	James T. Liu National Sun Yat-sen University (Kaohsiung)
#75	Studies of sedimentary organic matter and phosphorus in lakes, rivers and coastal zones	Loh Pei Sun Zhejiang University
#76	The level of phosphate controls decomposition rate of labile organic matter in hypoxic coastal waters	Zhanfei Liu The University of Texas at Austin, USA
#77	Autonomous observations of ocean carbon uptake: Three stories from the underside of Earth	Thomas William Trull Commonwealth Scientific and Industrial Research Organization, Australia
#78	Light and photosynthesis in the ocean: Primary production in the deep blue sea	Edward Laws Louisiana State University, USA
#79	The cycling of essential and toxic trace metals in oxygen minimum zones	Gregory Cutter Old Dominion University, USA
#80	Observed submesoscale characteristics in the upper northern South China Sea	Hongyang Lin Xiamen University
#81	Disproportionate nutrient loads and resulting stoichiometry impacts food webs, from toxic algae to higher trophic levels	Patricia M. Glibert University of Maryland, USA
#82	Molecular ecological adaptation and growth regulated gene of dinoflagellate *Prorocentrum donghaiense*	Xinguo Shi Xiamen University
#83	Parasites of marine plankton	Fernando Gomez University of Sao Paulo, Brazil
#84	Sedimentary processes of altered Korean estuaries	Guan-hong Lee Inha University, Korea
#85	末次冰期以来北太平洋生物泵演化与有机碳埋藏	Dawei Li Xiamen University
#86	The role of the ocean as a source of airborne organic matter and its impact on cloud formation	Daniel A. Knopf Stony Brook University, USA
#87	^{129}I as a marine tracer	George S. Burr CAS Institute for Earth Environment
#88	Genome sequencing of the marine diatom Skeletonema marinoi	Mats Töpel University of Gothenburg, Sweden
#89	生物帮浦之储碳角色与可能机制	Chin-Chang Hung National Sun Yat-sen University (Kaohsiung)
#90	高灵敏光电信号检测模块研究及在海水分析中的应用	Jintao Liang Guilin University of Electronic Technology

#74 Luncheon Seminar by Dr. James Liu.

#86 Luncheon Seminar by Dr. Daniel Knopf.

#78 Luncheon Seminar by Dr. Edward Laws.

Professor John Hodgkiss and Mrs Margaret Hodgkiss with Minhan Dai at the Academic Salon. MEL appreciates their dedication as MEL's English editors since 2005.

访问学者与开放课题基金 Visiting Fellowship Program

实验室访问学者基金（分为‘郑重’杰出/杰出、高级和青年3类）支持国内外知名专家及青年学者到实验室开展1至6个月的学术交流与合作。2017年度共有29名学者获批该项基金，其中，杰出访问学者7名（包括“郑重”杰出学者1名）、高级访问学者17名、青年访问学者5名。

The MEL Visiting Fellowship Program was launched in 2009. The program has supported visiting fellows to conduct collaborative studies with MEL scientists for durations of 1 to 6 months, providing research funds, travel and living expenses. 29 fellows were sponsored in 2017.

Recipients of the 2017 MEL Visiting Fellowship Program

Zhengzhong Distinguished Visiting Fellow		
James Murray	Professor Emeritus	University of Washington, USA
Distinguished Visiting Fellow		
Kuoping Chiang	Professor	National Taiwan Ocean University (Keelung)
Gregory Cutter	Professor	Old Dominion University, USA
Edward A. Laws	Professor	Louisiana State University, USA
Xiangsan Liang	Professor	Nanjing University of Information Science & Technology
William D. Smyth	Professor	Oregon State University, USA
Thomas W. Trull	Senior Principal Research Scientist	Commonwealth Scientific and Industrial Research Organization, Australia
Senior Visiting Fellow		
Punyasloke Bhadury	Associate Professor	Indian Institute of Science Education and Research Kolkata, India
Huayang Cai	Associate Professor	Sun Yat-Sen University (Guangzhou)
Keping Du	Associate Professor	Beijing Normal University
Fernando Gomez	Researcher	University of Sao Paulo, Brazil
Walter Geibert	Senior Scientist	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Germany
Yiguo Hong	Research Professor	South China Sea Institute of Oceanology, CAS
Chuanmin Hu	Professor	University of South Florida, USA
Chin-Chang Hung	Distinguished Professor	National Sun Yat-sen University (Kaohsiung)
Ikramul Pablo Huq	Professor	University of Delaware, USA
Mingshun Jiang	Associate Research Professor	Florida Atlantic University, USA
Jintao Liang	Professor	Guilin University of Electronic Technology

Senior Visiting Fellow		
Tullio Rossi	Science Communicator	Animate Your Science
Mats Töpel	Researcher	University of Gothenburg, Sweden
Zhengrong Wang	Associate Professor	City College of New York, USA
Andrew Whitehead	Associate Professor	University of California Davis, USA
Jie Xu	Research Professor	South China Sea Institute of Oceanology, CAS
Weidong Zhai	Professor	Shandong University
Young Scientist Visiting Fellow		
Amber Annett	Senior Research Fellow	University of Southampton, UK
Yuanyuan Feng	Assistant Professor	Tianjin University of Science & Technology
Bingyi Liu	Associate Professor	Ocean University of China
Wenhui Wang	Associate Professor	Central South University
Ying Ye	Postdoctoral Researcher	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Germany

Left to right:

MEL Senior Visiting Fellow Dr. Zhanfei Liu from the University of Texas at Austin.

MEL Senior Visiting Fellow Dr. Andrew Whitehead from the University of California Davis.

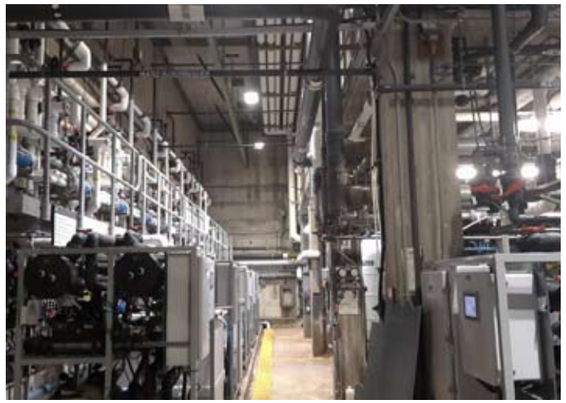
MEL Senior Visiting Fellow Dr. Chin-Chang Hung from National Sun Yat-sen University (Kaohsiung).

MEL Distinguished Visiting Fellow Dr. Gregory Cutter from Old Dominion University working at R/V TKK.

MEL Senior Visiting Fellow Dr. Gomez Fernando from University of Sao Paulo, visiting MEL for 3 months.

(http://mel.xmu.edu.cn/Visiting_Fellowships.asp?id=1)

院际合作 Institutional Partnership

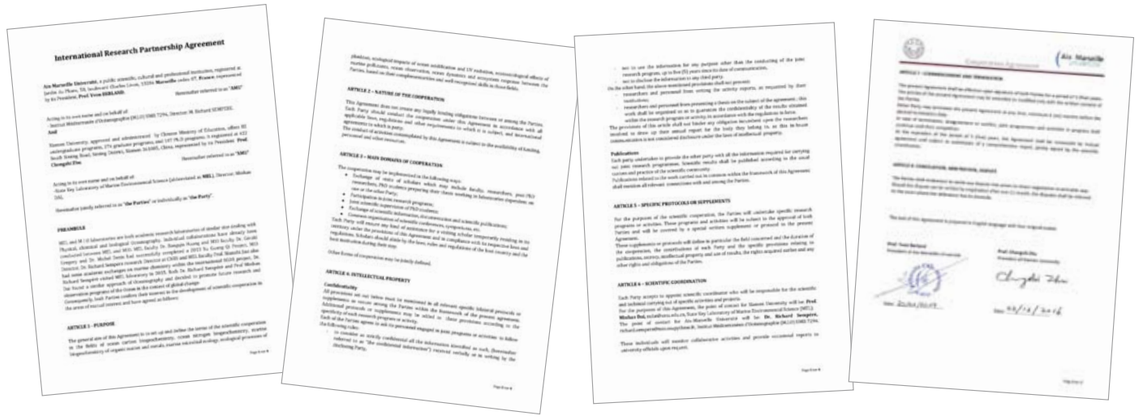


在厦门大学和加拿大戴尔豪斯大学的校级合作协议框架下，焦念志研究团队与戴尔豪斯大学海洋学院展开实质性合作研究，使用其Aquatron实验体系进行垂直过程的微型生物碳代谢过程与碳循环研究。Aquatron大型水体设施高达12米，水体数百吨，被认为是世界上现行运转最好的陆基可控垂直水体研究设施。2017年，共派出6名师生赴戴尔豪斯大学开展合作研究。

Under the collaboration framework between Xiamen University and Dalhousie University, Nianzhi Jiao's research group continued the collaborative study with the Department of Oceanography at Dalhousie University on the role of microbial processes in carbon cycling in the ocean using the unique Aquatron water column experimental facility at the university. 6 faculty and students have visited Dalhousie for the collaborative experiments.

合作备忘录 MOU

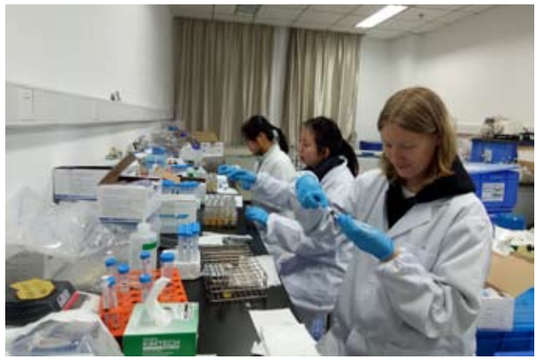
1月20日，实验室与法国艾克斯–马赛大学地中海海洋学研究所签署《国际科研伙伴关系意向书》。
The International Research Partnership Agreement concerning the collaborative activities between Aix-Marseille University, Institut Méditerranée d'Océanographie (M.I.O) and MEL was signed on January 20.



其它交流与合作 Other Exchange Highlights

实验室通过访问学者基金与开放课题、“111”引智计划、“凌峰论坛”、“周一午餐交流会”等形式为实验室成员提供与海内外学者交流的平台。2017年度，共有70余名国内外学者通过学术报告、讲授课程、合作研究等多种形式来实验室开展合作交流。此外，科研、技术人员和研究生共计150余人次出访，参加国内外学术研讨会、合作研究、联合航次或技术培训等。

International exchange and collaborations are supported by several programs, for example, the MEL Visiting Fellowship Program, Lingfeng Forum, Luncheon Seminar and the “111” Collaborative Program. In 2017, more than 70 visitors came to MEL and more than 150 MEL members and students went out for academic exchanges, joint research, cruise surveys and trainings.



Naomi Geeraert and Yvonne Yau from The University of Hong Kong working in Shuh-Ji Kao's lab in December.

Prof. Ruixin Huang from Woods Hole Oceanographic Institution delivered a Nanqiang Lecture on “The road to a creative scientist -- a personal reflection” in April.

Prof. Dong-Ping Wang from Stony Brook University giving a talk in June.

The CAS Academician, Prof. Yuntai Chen from Institute of Geophysics, China Earthquake Administration giving a seminar on Tsunami and Earthquakes in December.

Prof. Mark Moline from University of Delaware visited the Joint Receiving Station for Remote Sensing in November.

Nianzhi Jiao giving a talk entitled "Biological mediated carbon cycling and sequestration in the ocean and climate change: A new dimension and perspective" at Session 13, North Pacific Scientific Organization Annual Meeting, September 23-26, Vladivostok, Russia. Jiao was one of the session co-conveners together with Richard Rivkin, Louis Legendre and Robin Anderson.

Hongyue Dang at the 5th International Conference on Nitrification and Related Processes (ICoN5), July 22-29, Vienna, Austria.

Minhan Dai taught a lecture for the Training Course on Marine Radioactivity held on August 13. The workshop was convened by Ken Buesseler, Minhan Dai and Claudia Benitez-Nelson during the Goldschmidt 2017 in Paris, France.

Nianzhi Jiao presented a keynote speech on "Blue carbon in the open ocean: From science to practice" at the 2017 International Blue Carbon Forum, World Ocean Week, November 4, in Xiamen.

Tuo Shi and Senjie Lin were invited to give talks at The 7th Cross-Strait Coral Reef Conference held in Kenting on June 19-23.

Nianzhi Jiao, as one of the lead authors, participated in the 1st Writing Meeting of the Intergovernmental Panel on Climate Change 6th Assessment Special Report on Ocean and Cryosphere in a Changing Climate at Tanoa International, September 30-October 7, Nadi, Fiji.

Minhan Dai with the SOLAS-IMBeR Ocean Acidification Working Group in Villefranche, France, on September 26-27.

Fengling Yu giving a talk at the IGCP (The International Geoscience Programme) Meeting in South Africa on September 17-23. Yu is one of the project leaders of the IGCP Project 639: Sea Level Change from Minutes to Millennia.

Rui Zhang attended the Marine Molecular Ecology Gordon Research Conference at the Hong Kong University of Science and Technology, Hong Kong, July 23-28.

Kunshan Gao presenting a talk at the AQUAFLUO II: Chlorophyll fluorescence in Aquatic Sciences Meeting 2017 in Sydney, Australia on December 4-8.

奖学金与学生教育
FELLOWSHIPS & EDUCATION PROGRAMS

2017年实验室继续开展多样化人才培养计划，如实施优秀博士生奖学金、本科生暑期科研奖学金等，举办“绝热运动、起伏模态及等密度层分析”讲习班、第一届“中国水色理论及遥感”暑期班，为学生提供系统学习理论基础和科学前沿热点的机会；鼓励学生发起、组织第二届MEL研究生学术论坛、“水环境科学高校联盟（UCAS）”第九届研讨会（香港）等，继续为学生的成长、领导力训练与学术交流提供多样化的平台。

MEL contitues to sponsor and organize multi-tiered programs to inspire students to pursue excellence in science, such as the PhD Fellowship and Undergraduate Research Fellowship. MEL also hosted or supported diverse exchange programs to foster students' leadership and academic development. The programs include the Training Workshop on Adiabatic Motions, Heaving Modes and Isopycnal Layer Analysis, the 9th UCAS Symposium, the 2nd Graduate Student Forum, and the Summer School on China Ocean Color and Remote Sensing Study.

The Training Course on Adiabatic Motions, Heaving Modes and Isopycnal Layer Analysis was organized on April 24-28 in Xiamen. Prof. Ruixin Huang from Woods Hole Oceanographic Institution was the main lecturer.

The 1st Summer School on China Ocean Color and Remote Sensing Study was held in Hulun Lake National Reserve on July 31 - August 10.

The 2nd MEL Graduate Forum, took place on June 22-23, was attended by 35 graduates, with 25 oral presentations and 17 posters.

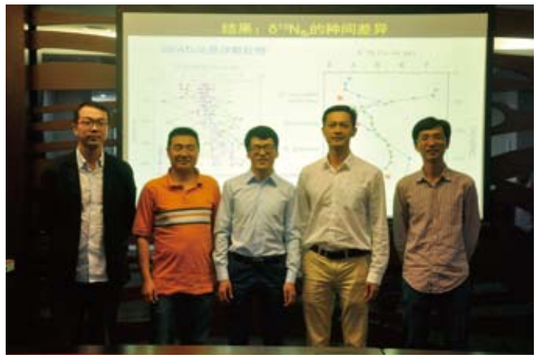
The 9th UCAS Postgraduate Symposium on “Understanding the aquatic environment from a multidisciplinary perspective: What can young scientists do?” was held at The University of Hong Kong on March 27-31. (http://ucas.xmu.edu.cn)

杰出博士后基金 MEL Outstanding Postdoctoral Fellowship

实验室于2014年设立“杰出博士后基金”，吸引国内外优秀的博士毕业生开展博士后研究，以此促进学科交叉，同时提高人才培养能力。该基金常年接受申请，每年审批的申请截止时间为5月31日及10月31日。2017年共资助2人，分别是山东大学的戴溪博士和中国科学院海洋研究所的宋希坤博士。此外，本年度有3名博士后顺利出站。同时，在站博士后谢聿原获批国家自然科学基金青年科学基金项目1项，刘迟迟获得中国博士后科学基金面上项目一等资助。

Aiming to foster innovative research and interdisciplinary collaborations, MEL initiated the Outstanding Postdoctoral Fellowship Program in 2014. The Fellowship funds innovative, ground-breaking projects that have the potential to advance knowledge in marine environmental sciences and other interdisciplinary research that fits into MEL's research scopes.

The application review occurs twice a year, May 31 and October 31. Two applicants were funded in 2017 and expected to start their postdoc research in 2018. They are Dr. Xi Dai from Shandong University, and Dr. Xikun Song from CAS Institute of Oceanology. Among all postdocs, Dr. Yuyuan Xie were granted an NSFC Young Scientists Fund, and Dr. Chichi Liu received the support from China Postdoctoral Science Foundation for a General Project. In addition, 3 postdoctoral fellows completed their research work in 2017.



Dr. Dawei Li presented his research on November 6. He is now appointed as an Associate Professor in Ocean University of China with the "Young Talent Program" support.

Dr. Xinguo Shi gave a presentation on September 25. He joined Fuzhou University as an Associate Professor after he completed his postdoctoral work at MEL.

Dr. Hongyang Lin gave a talk on August 7. He is now an Associate Research Scientist at MEL.

(http://mel.xmu.edu.cn/postdoc)

博士生奖学金 MEL PhD Fellowship

为吸引国内外优秀生源，实验室于2016年12月设立“博士生奖学金”，每年9月开放申请，面向国内外高校招收博士研究生，资助海洋环境科学相关领域及与实验室主攻方向相关的其他学科领域。第一批申请共有4名学生入选，已于2017年9月入学。

Aiming to attract and encourage academically outstanding PhD students, MEL initiated the MEL PhD Fellowship in December of 2016. The Fellowship is offered in marine environmental sciences and other interdisciplinary research that fits into MEL's research scopes. Applicants must have already obtained or been currently working towards a master degree and all candidates who are seeking admission as new full time PhD students. The first 4 awardees joined MEL in September 2017.

陈卓宇 Zhuoyu Chen
海洋微型生物生态学
Marine microbial ecology

马轶凡 Yifan Ma
用Th-U不平衡法示踪上层水体颗粒有机碳的输出
Using the U-Th disequilibrium to trace the processes of particulate organic carbons export to the deep ocean

万茹 Ru Wan
中国近岸富营养化及低氧海区微生物生物地球化学循环
Microbial biogeochemical cycles in eutrophication and oxygen deficient coastal water in China

叶幼亭 Youting Ye
海洋环境生物学
Marine environmental biology

(http://mel.xmu.edu.cn/education_type.asp?id=23)

海洋环境科学本科生暑期科研奖学金项目
MEL Summer Undergraduate Research Fellowship

为鼓励本科生尽早开展科研训练，更好地培养本科生的创新能力和学术精神，激发优秀学生的科学兴趣，并为其提供继续深造的平台和机会，实验室自2014年起启动“MEL海洋环境科学本科生暑期科研奖学金”。2017年录取了来自台湾成功大学、台湾中兴大学、中国海洋大学、福州大学、厦门大学等10所高校共18名本科生。项目以科研课题为导向，本科生在导师的指导下进行开展实验研究。组委会还为本科生组织了系列学术讲座、技术安全讲座和野外调查，并定期开展学术沙龙，以期全方位培养学生的科研能力、科学表达与交流能力。

Initiated in 2014, the MEL Summer Undergraduate Research Fellowship in Marine Environmental Science (URF) encourages undergraduates to pursue science and technology careers by providing research experiences at MEL. 18 undergraduate students from 10 universities joined the program in 2017, working on mini research projects with individual supervisors. They also received training on lab safety and facility operations. Several interactive seminars and field studies were also organized for participants.

1/ The URF Student Salon.
2/ Li Wang working on her project in Dr. Haizheng Hong's lab.
3/ Participants during a field trip to an abalone farm.
4/ Caixia Yue received her URF certificate from the advisor Dr. Weidong Guo.

(More at http://mel.xmu.edu.cn/URF)

公众教育
OUTREACH

公众教育 Outreach Programs

中国海洋科学卓越教育伙伴计划（COSEE China）于2010年8月建立，旨在通过科学家和教育工作者之间的密切合作，推广海洋科学与文化教育，向公众普及海洋科学知识，提高全民海洋意识，进而推动海洋科学研究和教育的发展，提升海洋科学在国家发展战略中的地位，并促进国际海洋科学与文化的交流合作。

2017年度，实验室以COSEE China办公室为依托，开展了一系列公众开放活动，例如：1月9-11日，与香港大学Bayden Russel博士在第三届厦门海洋环境开放科学大会上组织“海洋公众教育分会”；1月12日，邀请美国马萨诸塞大学波士顿分校的Robert Chen组织“海洋科学教育与普及：拓展你的科学传播”小型研讨会，帮助参会者开发有效的教育与科普活动方案；6月18日–7月31日，邀请澳大利亚阿德莱德大学的Tullio Rossi博士分别为本科生、研究生开设选修课《科学传播——讲故事与新媒体》；7月25-28日，举办水生科学暑期生态营；7月31日–8月1日，举办厦大–太古红树林夏令营；11月5日，举办第六届厦门大学海洋科学开放日；同时，利用海洋日、地球日等纪念日组织学者为中小学开设科普讲座与调研。

Tullio Rossi taking questions from studnts after class.

The Center for Ocean Sciences Education Excellence China (COSEE China) was established in 2010. It aims to bridge the gap between scientists and educators. By forging links between these groups, it aims to enhance public awareness about the ocean and cultivate the next generation of ocean scientists and a scientifically literate citizenry. Several ongoing programs were conducted by COSEE China throughout the year that enables these goals to be met. A special session on “Marine public education” was held, co-chaired by Emily King and Dr. Bayden Russell from the University of Hong Kong at the Third Xiamen Symposium on Marine Environmental Sciences on January 9-11; Dr. Robert Chen from the University of Massachusetts Boston was invited to organize a workshop on “Ocean Science Education and Outreach: Broadening the Reach of Your Science” on January 12; Dr. Tullio Rossi from Animate Your Science was invited to teach two courses on “Connection: Storytelling and new media for science communication” during the summer semester; the 6th Aquatic Sciences Eco-Learning Program in July, the MEL-HAECO Mangrove Summer Camp in Auguest were conducted, and Ocean Sciences Day held in November. In addition, school visits by several scientists and staff broadened our public impact.

Robert Chen leading the activity at the workshop.

Guodong Han (PhD student) giving a talk on intertidal ecosystem to students at the Binglang Middle School.

20 middle school students from around Xiamen and COSEE China counselors joined the 6th Aquatic Sciences Eco-Learning Program on July 25-28. Several local aquatic ecosystems such as mangroves and the intertidal zone were introduced, overfishing and ocean pollution were discussed, and basic science and engineering skills were taught throughout the camp activities.

The 2nd XMU-HAECO Mangrove Summer Camp was held on July 31 - August 1. 16 middle school students from HAECO Xiamen (Hong Kong Aircraft Engineering Co. Ltd.) employee families joined the camp and explored the HAECO-XMU Mangrove Restoration Site.

海洋科学开放日 Ocean Sciences Day — Our Ocean, Our Future

11月5日，“我们的海洋，我们的未来”—第六届厦门大学海洋科学开放日在翔安校区周隆泉楼、希平楼、金泉楼举行，短短七小时内共吸引约6500名公众参与。共有400余名师生投入工作，50余个实验室和学生展览摊位开放，内容涉及海洋观测技术与仪器设施、海洋化学实验演示、海洋生态、海洋酸化、海洋污染等主题。活动不仅邀请袁东星、游伟伟、陈鹭真、夏光远、贾语嫣、Sam Smith等六位讲者以海龟、海绵、红树林、海洋生物多样性、食品安全、保护地球的几种方式等为主题做讲座，还开设了“鱼类解剖”、“红螯螯虾解剖”、“磷酸盐的神奇显色反应”及“现场制作浮标”等4个趣味课堂，让访客在现场参观之余，还能进入实验室动手实验。此外，孩子们可以通过观看视频、图片、实物、参与游戏等方式全方位地学习海洋科学。海洋科学开放日已成为厦门国际海洋周重要组成部分，为市民提供了一场海洋科学的知识盛宴。

On November 5, over 6500 visitors flooded the Zhou Long Quan Building, Xiping Building, and Jinquan Building during the 6th Xiamen University Ocean Sciences Day. Over 50 laboratories and specially designed interactive booths covering a wide range of ocean science and marine environmental topics were available. The goal of all these exhibits was to promote public ocean literacy. Over 400 faculty, staff, students, and volunteers were involved in the day.

Guests were able to conduct experiments which explained the impact of increased nutrients in our waterways, examine key local coastal and near-shore ecosystems, discover the wide diversity of marine life that exists, as well as learn about new technologies used in ocean research. Each exhibit also highlighted the importance of their own behaviors and taught visitors how they too can be better stewards of the ocean.

In addition to the exhibits and labs, 6 speakers gave talks throughout the day. Some were scientific in nature – sea turtle conservation, sea sponges, mangroves and their ecology; while others had a more socio-economic angle, such as the state of global and domestic fisheries development and seafood safety, and several ways that individuals can do to protect the ocean.

In its 6th iteration, Xiamen University's Ocean Sciences Day is an integral part of Xiamen's World Ocean Week and a highlight among Xiamen's annual list of events.


1


2


3


4

1/ Participants conducting the phosphate test to determine the water pollution level.
2/ A demonstration on biofouling.
3/ What is ocean acidification? Look at the shells in an acid environment.
4/ The microscope is always a good way to know more about the microworld.

科研设施与实验观测
FACILITIES AND FIELD OBSERVATION

大型仪器与技术服务中心 COMET

实验室共有五个中心平台和十四个功能实验室，并于2008年建立COMET中心平台。COMET整合了所有大型装备，全面向科研人员提供开放服务，并建成良好的仪器运行管理体系，解决创新性科研发展过程中使用大型仪器难、维修费和运行费过高等障碍，使实验室仪器得以顺利运转，为科学研究提供了更好的技术服务与支撑。2017年，实验室获得国家财政部7581万元的仪器专项经费支持，申购了13套百万元以上的设备及集成系统，将陆续加入共享平台，对外提供科研服务。

The Center of Major Equipment and Technology (COMET) was established in 2008 to better maintain MEL's scientific instruments with higher efficiency and lower operating costs. COMET continues to strive for excellence as an infrastructure for research and teaching and to inspire innovative research discoveries. In 2017, MEL has received a special funding of 75.81 million RMB from the Ministry of Finance for equipment and infrastructure construction. 13 major facilities (> 1 million RMB) have been purchased with the funding and will be in place for use soon.

实验室2017年到位的主要科研设施（百万元以上）
Newly installed major instruments in 2017 (>1 Million RMB)

仪器名称 Facilities	型号 Model
联合遥感接收站 Joint Receiving Station for Remote Sensing	SC75LX-XY
海水CO_2分压自动测量系统 Autonomous pCO_2 Measuring System	8050
场发射环境扫描电镜 Environmental Scanning Electron Microscopy	FEI Quanta 650
浮游生物连续采样网 Multiple Plankton Nets	Multinet/Maxi
海洋小分子溶解有机物质谱表征系统 Characterization System of Marine Dissolved Organic Matter	Xevo G2-XS QTOF
长岩芯重力活塞取样系统 Calypso Piston Corer	KF-3t/18m
环境监测及处理系统（东山站）Environmental Sample Processor (D-SMART)	ESP
珊瑚礁在线监测系统（东山站）Coral Community Observation System (D-SMART)	集成系统
海洋生态环境室内模拟系统（东山站） Marine Ecosystem Indoor Seawater Facilities (D-SMART)	集成系统
水文观测系统 Hydrological Observatory System	String Buoy System
超速流式细胞分析分选平台 BD Influx High-Speed Cell Sorter	Influx
高分辨扇形磁场电感耦合等离子质谱仪 High Resolution Sector Field Inductively Coupled Plasma Mass Spectrometry	ELEMENT XR
流式细胞成像仪 Imaging FlowCytobot	FluoSieve
船载多普勒天气雷达系统 Shipborne Polarimetric Weather Radar	SCR-CPD

大型仪器与技术服务中心 COMET

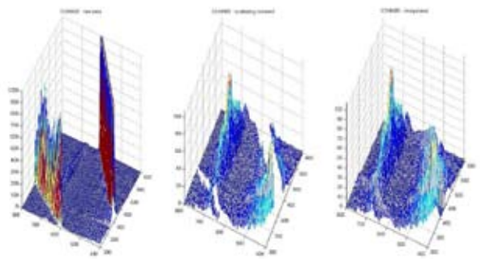
技术人员开放基金
MEL Technology and Innovation Fund

实验室长期关注技术队伍素质建设，为有效提升科研工作效率，鼓励技术创新，COMET每年资助2–4项技术开放基金项目，资助期限两年。2017年共资助了三个项目，分别为优化船载高精度pH观测系统（郭利果）、流动注射–化学发光法检测海水中痕量铁的标准化研究（黄勇明）、中国南海北部的季节水团系统划分及T-S水体相似度法在水团细分中的应用（朱佳）。

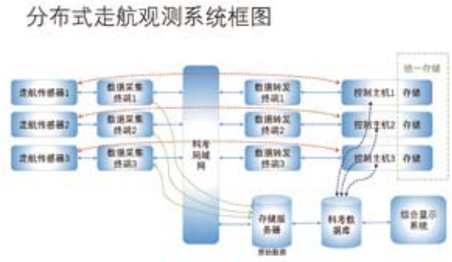
COMET is dedicated to the capacity building of the technical supportteam and encourages technicians to apply for the Technology and Innovation Fund. Three projects were funded in 2017 for a 2-year term. The projects include: Optimization of shipboard high-resolution pH observation system (Liguo Guo), Flow injection-chemiluminescence detection of trace iron in seawater (Dr. Yongming Huang), and Classification of upper layer water masses and application of T-S Similarity Number in the Northern South China Sea (Jia Zhu).

On-going projects

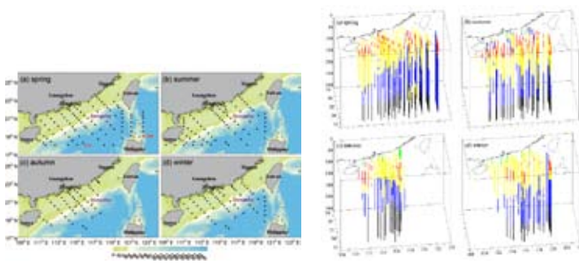
Reconstruction and development of R/V *in situ* observation information system (Liyan Li, 2016-2018). The system integrates cruise planning with operation planning, bridge control, onsite observation and sampling schedule planning. It has functioned very well during the R/V TKK's test cruise and scientific cruises so far.



Construction of bio-optical dataset of phytoplankton (Dr. Jixin Chen, 2016-2018). The project has obtained the flow optical signal characterizations and microscopic images of 77 algae samples by using flow cytometry (CytoSUB), acquired standard fluorescence spectra of 60 algae species with the scanning fluorescence spectrophotometer, and collected photosynthetic pigment composition data of 77 strains of algae by reversed-phase high-performance liquid chromatography (HPLC).



R/V distributed continuous data acquisition system (Junwei Dai, 2016-2018). The system is designed to collect and store data from facility sensors distributed on the vessel into the server terminal utilizing the high-speed built-in LAN on the R/V, to provide an integrated data base for *in situ* observation. The system is partially functioning now.



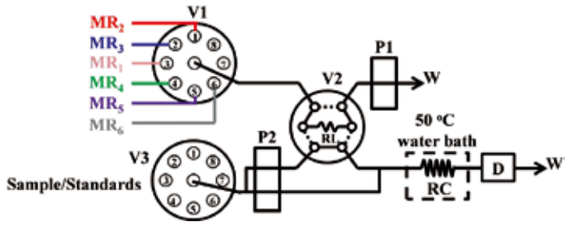
Classification of upper layer water masses and application of T-S Similarity Number in the northern South China Sea (Jia Zhu, 2017-2019). The figures show the map of sampling stations and preliminary classification results in four seasons (Green: river plume; Red: surface water; Yellow: surface mixed layer; Blue: subsurface water; Black: subsurface-intermediate water mass).

大型仪器与技术服务中心 COMET

仪器研制与改造
Instrumentation

为满足现场观测的需求，海洋仪器研发中心利用已开发的多功能流动分析仪，研发出顺序测定水样中多种营养元素的反相流动注射–分光光度法，对NO_2^-、NO_3^-、PO_4^{3-}、Fe^{2+}、Fe^{3+}和Mn^{2+}进行同时测定，对各个要素检测范围分别为0.03-20，0.7-200，0.3-12，0.03-5，0.03-5，0.2-9 μM，测定结果的相对标准偏差小于5%，每小时可检测20个样品，今后有望发展成为近海海水中多种营养要素的在线连续观测仪器。

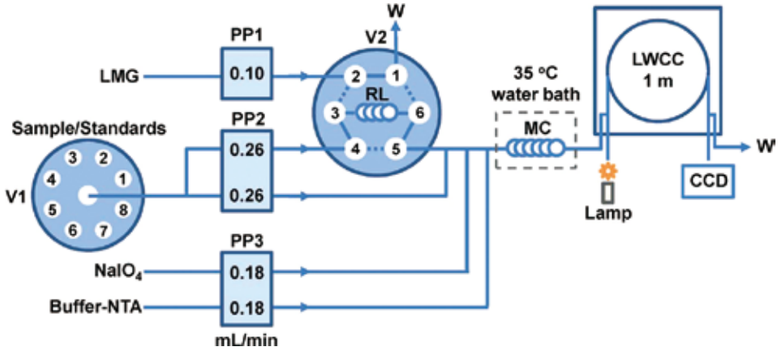
An integrated system was developed for automatic and sequential determination of NO_2^-, NO_3^-, PO_4^{3-}, Fe^{2+}, Fe^{3+} and Mn^{2+} in natural waters based on reverse flow injection analysis combined with spectrophotometric detection. The upper limits of the linear range (along with detection limit, μM) of the proposed method was 20 (0.03), 200 (0.7), 12 (0.3), 5 (0.03), 5 (0.03), 9 (0.2) for NO_2^-, NO_3^-, PO_4^{3-}, Fe^{2+}, Fe^{3+} and Mn^{2+}, respectively. The relative standard deviations were below 5% (n=9–13) and the sample throughput was about 20 h per hour.



Manifold of rFIA for multi-nutrient elements determination. P1 and P2, peristaltic pumps; V1 and V3, 8-position selector valve; V2, 6-port valve; RC, reaction coil; RL, reagent loop; D, variable wavelength spectrophotometer; MR1–6, mixing reagents for NO_2^-, NO_3^-, PO_4^{3-}, Fe^{2+}, Fe^{3+} and Mn^{2+} determination, respectively; W, waste.

基于Mn催化高碘酸钠（$NaIO_4$）氧化隐色孔雀绿的显色体系，研发了适用于海水中痕量溶解态Mn的反相流动注射–长光程–催化分光光度测定法，方法检出限达0.2 nM，定量范围为0.5-10.0 nM，基本适用于大洋海水的分析，对标准参考海水NASS-6的测定结果符合参考值。

A sensitive and precise method for determination of nanomolar manganese in seawater was developed, based on the reaction of manganese catalyzed oxidation of leucomalachite green (LMG) with sodium periodate. The method detection limit was 0.20 nM, and the quantification range was 0.50–10.00 nM, which should be sensitive enough and suitable for open ocean seawater analysis. The seawater certified reference material NASS-6 was used to test the accuracy, and good agreement was reached.



Manifold of rFIA-LWCC-LMG method for determination of trace dissolved Mn in seawater. PP1-3, peristaltic pumps; V1, 8-position selector valve; V2, 6-port-2-position injection valve; MC, mixing coil; RL, reagent loop; W, waste; CCD, variable wavelength spectrophotometer.

海洋现场观测 MEL at Sea

2017年实验室组织和参与37个科考航次，246人次在南海、东海、黄海、台湾海峡、西北太平洋、长江口、珠江口等海域开展了共计540天的海上调查。
In 2017, MEL organized and participated in 37 cruises. A total of 246 scientists, technicians and students spent 540 days at sea. The investigation areas ranged from the South China Sea to East China Sea, the Taiwan Strait, Northeast Pacific and several estuaries.

厦门大学“嘉庚”号海洋科学考察船 R/V Tan Kah Kee

2017年，厦门大学3000吨级海洋科考船“嘉庚”号投入使用。3月28日，由广船国际有限公司正式交付厦门大学，4月1日科考船顺利抵达厦门。4月15日举行“嘉庚”号首次公众开放日，吸引超过1500名厦门市民登船参观。同时，“嘉庚”号科考船正式入列国家海洋调查船队。

10月23日，“嘉庚”号科考船水下辐射噪声SILENT证书交付仪式在挪威船级社（DNV GL）中国区总部上海举行。“嘉庚”号成为我国第一艘通过DNV船舶噪声船级符号Silent A+S指标的船舶。此外，“嘉庚”号是国内科考船中首个在升降鳍上设置走航超洁净（痕量金属无玷污）海水采集系统的船舶，首次实现了集成采水器、绞车和集装箱式实验室的可移式船载痕量金属洁净水样采集及分析测试系统。

2017年，“嘉庚”号共执行了6个科考航次，在航114天。在KK1701航次中，“嘉庚”号用CTD在南海采到5500米水深的水样。在KK1702航次中，“嘉庚”号在南海SEATS站连续作业96小时，创造了CTD连续采水39次，甲板连续作业99次，累计采水量11232升的佳绩。

2017 was the first year XMU‘s new research vessel- ‘Tan Kah Kee’ (R/V TKK) came into service. The TKK was officially delivered to XMU on March 28 and back to Xiamen Port on April 1. On April 15, an open house of the TKK was held in Xiamen Dongdu International Cruise Terminal. More than 1500 visitors participated the event. The TKK had officially become a member of China Marine Research Vessels (CMRV) on the same day.

On October 23, the TKK obtained the Underwater Radiation Noise SILENT Certificate from DNV GL in Shanghai which is the first of such certificate awarded to a China-made vessel. In addition, the TKK is also the first R/V in China with a super-clean (Trace Metal-free) seawater collection system on its drop keel, which allows researchers to collect the cleanest seawater with the two removable Trace Metal Clean Labs on vessel.

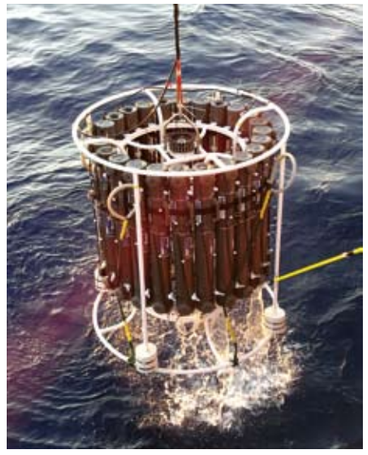
The TKK has undertaken 6 research cruises (114 days) since its delivery in 2017. Some remarkable achievements have been made. During the cruise KK1701, with the help of-the CTD system, the TKK collected seawaters from 5500 m deep below sea surface. On cruise KK1702, 11232 liters of water sample was collected after a 96 hours of continuous sampling at SEATS Station in the South China Sea.

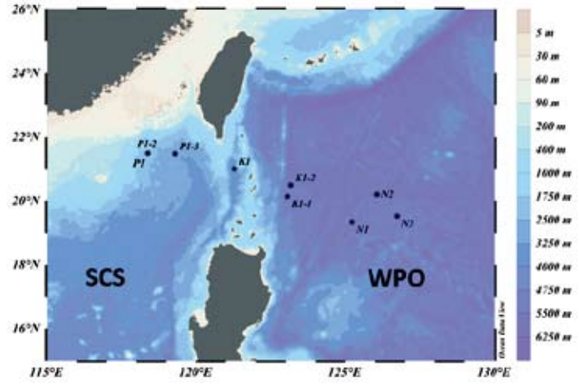
Captain Long Yin of the R/V TKK touring the public with boat facilities.

厦门大学“嘉庚”号海洋科学考察船 R/V Tan Kah Kee

The SILENT Underwater Noise Certificate was delivered to R/V TKK by DNV GL.

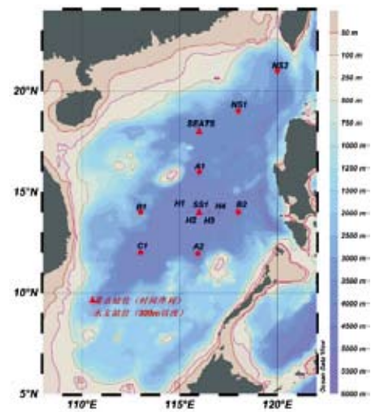
The removable Trace Metal Clean Lab.





Map of sampling stations during the trace metal test cruise I on August 2-14.

On cruise KK1703, R/V TKK collected the clean seawater for the first time through the trace metal seawater sampling system, which means scientists in China can conduct trace metal research more easily in the future.



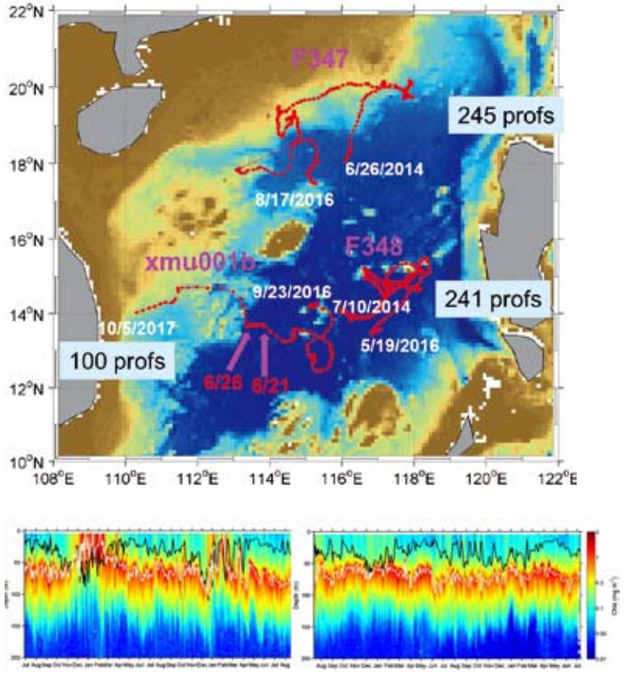
Subsurface moorings for the deep ocean were developed by Jianyu Hu and Zhenyu Sun's group to obtain stable and reliable data for long-term continuous observation in the South China Sea. It is MEL's first subsurface mooring at a deep basin. It was deployed in the middle-southern South China Sea by the R/V TKK in June 2017, and scheduled to be recovered in summer or fall 2018.

Scientists are retrieving the floating sediment trap in the SCS basin at the SEATS Station.

海洋生物光学自主式漂流剖面仪　BIO-ARGO

实验室目前已投放3套生物地球化学自主漂流浮标BGC-Argo。其中两套SeaBird BGC-Argo（型号Navis BGCi），搭载有CTD (SBE41 CP)，溶解氧 (SBE 63) 三通道荧光后向散射传感器（WetLabs MCOMS，可测量Chlα荧光，CDOM荧光，和700 nm后向散射bb(700)），于2014年7月投放到了南海北部海盆和中央海盆，到2016年8月寿命终止。分别观测了245和241个剖面数据，得到了2年长时间序列的高垂直分辨率数据，很好地揭示了南海浮游植物季节变化特征。另外一套NKE BGC-Argo（型号 PROVOR CTS4）搭载有更多传感器，包括CTD (SBE 41CP)、溶解氧（AANDERAA Optode 4330)、三通道荧光后向散射传感器（WetLabs FLBBCD）、透射仪（C-Rover，测量660 nm颗粒物后向散射系数cp(660)），以及四通道水下光谱仪（Satlantic OCR-504，可测量380，412，490 nm向下辐照度和光合有效辐射PAR），于2016年9月投放到南海中央海盆。截至2017年12月31日，共观测到110个剖面数据，已得到1.5年时间序列数据。3套BGC-Argo观测站位及剖面数据均可在实验室的BGC-Argo在线数据系统（http://odc.xmu.edu.cn/BioArgo）查看。

Three Bio-Argo floats have been deployed by MEL. Two Sea-Bird BCG-Argos (Navis BGCi) with CTD (SBE41 CP) and Dissolved Oxygen sensor (SBE 63) integrated WET Labs MCOMS fluorometer/backscattering sensor, were deployed in the northern South China Sea (SCS) and central SCS basin from July 2014 to August 2016, transmitted 245 and 241 profiling via satellite. The third NKE BGC-Argo (PROVOR CTS4) with SBE 41CP, AANDERAA Optode 4330, integrated with Wet Labs FLBBCD, C-Rover and Satlantic OCR-504, was deployed in central SCS basin in September 2016. Till December 2017, a series of 110 profiling data have been recorded. All the data are available at http://odc.xmu.edu.cn/bioargo.



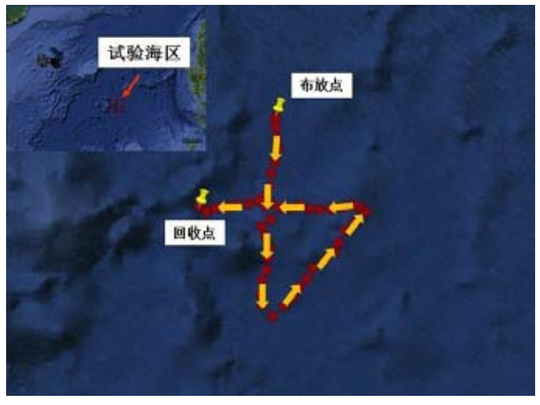
Map showing deployed locations the 3 Bio-Argo floats and their floating track.

生物地球化学水下滑翔机 BGC SEA GLIDER

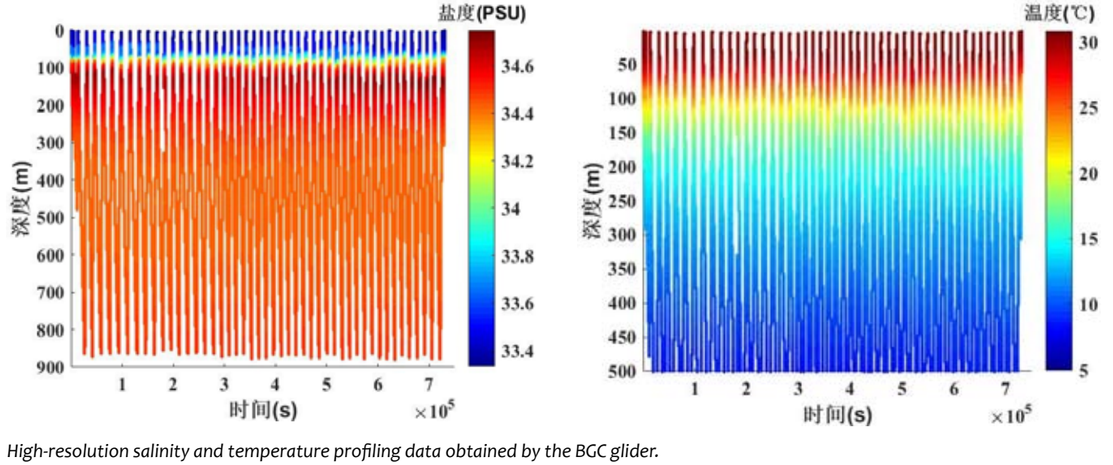
实验室已购置两台海燕II水下滑翔机（最大运行深度1000米），并与天津大学开展了密切的合作，集成多种生物地球化学传感器，构建生物地球化学滑翔机（BGC-Glider），携带有CTD、溶解氧、三通道光学传感器、叶绿素荧光、CDOM（黄色物质荧光）、BB700（后向散射）、三通道后向散射光学传感器、硝酸盐传感器等，已于2017年6月在“嘉庚”号KK1701航次中投入使用，连续工作9.5天获取50个连续深水（1000米）剖面数据，取得了高质量、高精度的现场观测数据。

The two Petrel II Sea Gliders were developed by Tianjin University. The glider is integrated with multiple biogeochemical sensors such as CTD, dissolved oxygen, optical fluorescence/backscatter, nitrates, CDOM and BB700. The gliders are capable of adjusting buoyancy and perform transectional profiling continuously from the surface down to 1000m for up to two months. In June 2017, the glider was deployed during the cruise KK1701 for a 9.5-day continuous sampling in SCS. A series of 50 high resolution profiling data were obtained real time via the satellite.

Engineers preparing for the glider deployment on R/V TKK.



Floating track of the BGC-Glider in the South China Sea in June 2017.



High-resolution salinity and temperature profiling data obtained by the BGC glider.

东山太古海洋观测与实验站 Dongshan Swire Marine Station

作为国内首个获跨国企业（太古集团慈善信托基金）捐资的海洋科研设施，厦门大学东山太古海洋观测与实验站（以下简称“东山站”）自2011年在福建省东山县西埔镇苏峰山启动建设。东山站距厦门市约173公里，占地87.59亩，面向台湾海峡开阔水域，位于省级珊瑚自然保护区的南缘。

2017年5月31日，一期主体建筑碧海楼完工，标志着东山站的正式落成。6月1日，东山站举行战略合作研讨会。会上，厦门大学与福建省海洋与渔业厅、东山县人民政府分别签署了合作建设东山站战略合作框架协议，实验室与香港大学太古海洋研究所、美国东北大学可持续发展研究中心、浙江大学流体动力与机电系统国家重点实验室、中天海洋系统有限公司、斯坦道仪器公司等机构签署了战略合作备忘录。6月2-3日，东山站第二届国际咨询委员会会议召开，就东山站未来的运行管理提出了可行性建议及工作规划。

东山站将以监测全球气候及由人类活动引起的环境变化对海洋生态系统造成的影响为研究方向，希望建成长期稳定的海–陆–气界面环境要素观测平台、开放的海洋科学与技术实验基地、海洋观测仪器研究与测试基地以及科普及教学实习基地，并希望成为海洋观测与实验的国际合作基地。自东山站落成以来，已开展多次交流与研讨，如举办“南海碳循环过程、机理及其全球意义”国家重大科学计划项目年度学术交流会、厦门大学与香港科技大学“基于东山站的多学科观测研究与展望”凌峰论坛。与此同时，围绕东山站的科研工作也在陆续开展，地下河口监测平台首次开展时间序列采样，拟初步探究地下河口微生物群落结构和丰度以及潮汐驱动下地下河口各生化参数响应，以期为日后地下河口监测平台的正式使用提供实验基础和数据支持。

The D-SMART Birdview.

Engineer Qing Li sampling in the D-SMART underground water monitoring well.

As the first marine scientific research facility in China that has been funded by a multinational corporations (Swire Group), the Dongshan Swire Marine Station of Xiamen University (D-SMART) started construction in 2011 and was jointly supported by the Swire Group Charitable Trust and Dongshan County government. The station is located at Sufeng Mountain, Xipu Town, Dongshan County, about 173 km away from Xiamen. It covers an area of 87.59 mu and faces the open waters of the Taiwan Strait. It is located on the southern margin of the provincial coral nature reserve.

On May 31, 2017, the first phase of D-SMART (Aqua Building) was completed. On June 1, D-SMART held a strategic cooperation seminar marking the formal completion of D-SMART, and the Second International Advisory Committee Meeting of D-SMART was held during June 2-3. The meeting put forward feasible suggestions and work plans for the future operation and management of D-SMART.

In the strategic cooperation seminar, strategic cooperation framework agreements for D-SMART development were signed by Xiamen University with Department of Ocean and Fishery of Fujian Province and Dongshan County Government. MEL signed a host of memorandums on strategic cooperation on specific exchange and cooperation with The Swire Institute of Marine Science (SWIMS) of The University of Hong Kong, the Sustainable Development Research Center of Northeast University (USA) , the State Key Laboratory of Fluid Power & Mechatronic Systems of Zhejiang University, ZTT Ocean System Co., Ltd. and Standards Instruments Company.

Since the completion of D-SMART, several academic conferences have been held at D-SMART, including the annual academic meeting of CHOICEC-II (Major National Science Research Program) held on October 18-21. At the same time, research work based at D-SMART started. During June 24-25, MEL and the Hong Kong University of Science and Technology jointly held the Lingfeng Forum based on the multi-disciplinary observations and prospects of D-SMART; During October 21-22, for the first time, time-series sampling were carried out in the underground water monitoring platform of D-SMART, intended to tentatively study the structure and abundance of underground microbial communities, as well as biochemical parameters of tide-driven underground water, furtherly to provide experimental basis and data support for formal operations of the underground water monitoring platform.

In addition, to further promote the construction of the second phase of D-SMART, the construction plans were refined and adjusted, and a new general layout plan and visual renderings were released.

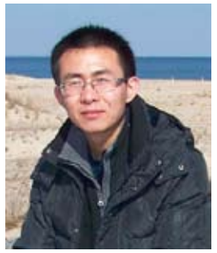
Website: http://mel.xmu.edu.cn/dsmart/

Representatives from Swire Trust, Fujian Department of Ocean and Fishery and Xiamen University inaugurated D-SMART.

The Annual Meeting CHOIC-C II Project was held at D-SMART in October.

科研进展
RESEARCH HIGHLIGHTS

海洋生物地球化学 Marine Biogeochemistry



Chuanjun Du (First Author)

南海海盆上层生源要素跨等密度面通量的准确量化
Diapycnal fluxes of nutrients in an oligotrophic oceanic regime: The South China Sea

Du, CJ; Liu, ZY; Kao, S-J; Dai, MH*. ***GEOPHYSICAL RESEARCH LETTERS***, 2017. 44, DOI:10.1002/2017GL074921.

Minhan Dai (Reprint Author)

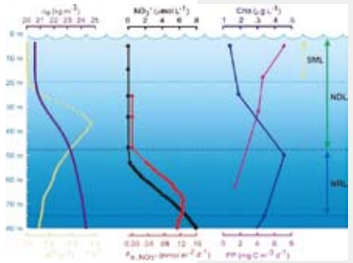
在寡营养盐海区，由海洋动力过程所驱动的跨等密度面营养盐输入是维持上层海洋新生产力的重要基础。由于缺乏营养盐与湍流混合过程的同步观测，准确量化相关通量非常困难。特别是由于对相关物理过程认识的不足，在此之前发表的跨等密度面营养盐通量研究普遍忽略了由湍流混合过程所导致的跨等密度面平流输运，使得其结果具有很大的不确定性，亟待准确评估。

戴民汉、刘志宇、高树基等基于2012年夏季在南海海盆SEATS站湍流微结构与营养盐的高分辨率观测，首次同时定量了硝酸盐等生源要素跨密度面的扩散通量与平流通量。结果显示，在真光层底部硝酸盐的跨等密度面平流通量为有效通量的16%，而当水深增加到500 m时这一比例可达70%。这表明忽略跨等密度面平流输运将显著误估跨等密度面通量。该研究从营养盐通量垂向结构的角度揭示了真光层的双层结构。在营养盐跃层上部的营养盐耗尽层（Nutrient-depleted Layer, NDL），溶解无机氮（DIN）的有效通量极低，而其它新生氮（如表层固氮和大气沉降）是支持新生产力与输出生产力的主要营养盐来源。在NDL内，相较于Redfield比值，磷酸盐、硅酸盐通量与DIN通量的比值较高，表明此处生产力受到氮限制且有额外的DIN被硅藻去除。从NDL以下到真光层底部称为富营养盐层（Nutrient-replete layer, NRL）。该层内，DIN浓度及其有效通量快速增加，其底部通量比NDL内大3个数量级，足以支持该层内的输出生产力。相较于Redfield比值，溶解无机碳（DIC）的有效通量与DIN的有效通量的比值较高，表明南海上层存在着过量的DIC，这与南海海盆是大气二氧化碳弱源的既有认知是一致的。该成果是物理海洋学与生物地球化学交叉研究、“无缝”合作的一个漂亮案例，对深入认识寡营养盐海区上层生物地球化学过程具有重要意义。

Abstract: Nutrients from depth have been hypothesized as a primary source of new nutrients that sustain new productivity in oligotrophic oceans; however, the flux is challenging to quantify. Here we show for a first time in the oligotrophic South China Sea an extremely low diapycnal dissolved inorganic nitrogen (DIN) flux as 1.8 × 10^{-4} mmol $m^{-2}d^{-1}$ in the nutrient-depleted layer (NDL) above the nutricline, where other nutrient supplies sustain the new production. Here higher phosphate and silicate fluxes relative to DIN than Redfield stoichiometry further indicate N-limited biological productivity and additional removal of DIN by diatoms. Below the NDL across the nutricline to the base of euphotic zone, termed as nutrient replete layer, the DIN flux is three orders of magnitude larger and sufficient in supporting the export production therein. Here higher DIC flux relative to DIN than Redfield stoichiometry further infers DIC excess in the upper ocean.

Key Points:

- The commonly ignored diapycnal advection induced by turbulent mixing is important in calculation of diapycnal nutrient fluxes
- The euphotic zone should be categorized into two distinct layers in terms of vertical nutrient fluxes in oligotrophic oceanic regimes
- The modulation of diapycnal nutrient fluxes on biological carbon pump in the upper ocean and air-sea CO_2 exchange was inferred



Profiles of the potential density (σ_θ), squared buoyancy frequency (N^2), NO_3^-, effective diapycnal flux of NO_3^- ($Fe_{\_NO_3^-}$), PP, and Chl α within the euphotic zone. In the upper 47 m, NO_3^- and $Fe_{\_NO_3^-}$ were estimated from discrete water samples with nanomolar level sensitivity, while those below 53 m were estimated from continuous sensor measurements. Also shown are the surface mixed layer (SML), the nutrient-depleted layer (NDL), and the nutrient replete layer (NRL).

海洋生物地球化学 Marine Biogeochemistry

大气沉降贡献海洋溶解黑碳碳库
Aerosols as a source of dissolved black carbon to the ocean

Bao, HY; Niggemann, J; **Luo, L**; Dittmar, T; **Kao, SJ***. ***NATURE COMMUNICATIONS***, 2017. 8, 510, DOI:10.1038/s41467-017-00437-3

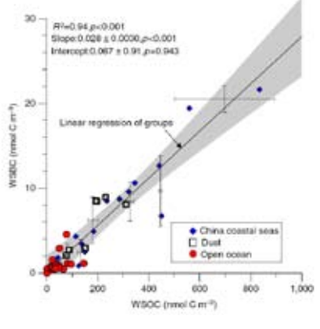
Hongyan Bao (First Author)

Shuh-Ji Kao (Reprint Author)

溶解黑碳在开阔大洋的年龄可达上万年，是海洋中到目前为止已知的年龄最老、最大的惰性溶解有机碳。因此海洋溶解黑碳的源汇问题是全球碳循环研究的重要部分。通过河流向海洋输送是目前已知的最大的海洋溶解黑碳来源。与河流输送相比，大气输送具有快速和高效的特点。近期研究表明大气输送是海洋中黑碳的主要来源之一，而黑碳在传输过程中的氧化可以增加其水溶性，成为溶解黑碳；此外沙尘中的土壤有机质也可能包含溶解黑碳。考虑每年燃烧产生的大量黑碳以及沙尘向海传输，大气沉降也可能显著贡献海洋溶解黑碳碳库，但相关的信息非常有限。

高树基研究团队通过测定2015年春季东、黄海以及西北太平洋的气溶胶中水溶性有机碳、水溶性黑碳的含量，并结合超高分辨质谱---傅里叶变换离子回旋共振质谱 (FT-ICR-MS)，解析了海洋气溶胶中溶解黑碳的浓度以及分子组成。结果表明在沙尘爆发期间，大气干沉降对东、黄海溶解黑碳的贡献是河流输入的约40%；气溶胶与河流中溶解黑碳的分子组成比对表明气溶胶中溶解黑碳的主要来源与河流相近。进一步分析发现气溶胶中溶解黑碳的浓度与水溶性有机碳浓度显著高度相关，溶解黑碳占水溶性有机碳的比例平均为2.8 ± 0.65%。基于该相关关系，团队首次估算出全球海洋大气沉降的溶解黑碳约为1.8 ± 0.83 Tg yr^{-1}，是海洋溶解黑碳的显著来源之一。预测的未来生物质燃烧以及沙尘输送的变化可能增加大气沉降溶解黑碳的通量，影响区域甚至全球碳库。该研究结果将有助于把溶解黑碳纳入到海洋碳循环研究模型中。

Abstract: Dissolved black carbon (DBC) is the largest known slow-cycling organic carbon pool in the world's oceans. Atmospheric deposition could significantly contribute to the oceanic DBC pool, but respective information is lacking. Here we estimate that, during the dust outbreak season, the atmospheric dry deposition of water-soluble black carbon (WSBC) is similar to 40% of the riverine input to the China coastal seas. The molecular composition of atmospheric WSBC determined by ultrahigh-resolution mass spectrometry, reveals similar soil-derived sources as for riverine discharge. WSBC is significantly positively correlated with watersoluble organic carbon (WSOC) in marine aerosols, and water-soluble black carbon contributes on average 2.8 ± 0.65% to the total WSOC. Based on this relationship, the global atmospheric deposition of DBC to the ocean is estimated to be 1.8 ± 0.83 Tg yr^{-1}. Anticipated future changes in biomass burning and dust mobilization might increase these numbers, with consequences for regional ecosystems and global carbon reservoirs.



Relationship between water soluble black carbon and water soluble organic carbon. Error bars show the 1 s.d. of the average values for each concentration group. The statistics are for the regression of the average values. The grey area shows the 95% confidence interval of the linear regression.

定量珠江口下游缺氧区耗氧有机物的来源
Tracing the origin of the oxygen-consuming organic matter in the hypoxic zone in a large eutrophic estuary: the lower reach of the Pearl River Estuary, China

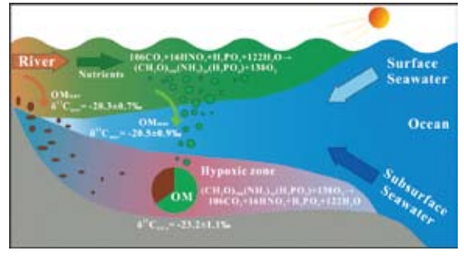
Su, JZ; Dai, MH*; He, BY; Wang, LF; Gan, JP; **Guo, XH; Zhao, HD**; **Yu, FL.** ***BIOGEOSCIENCES,*** 2017. 14: 4087-4099.

Jianzhong Su (First Author)

Minhan Dai (Reprint Author)

20世纪50年代以来，有关河口和近岸水体缺氧现象的报道持续增长，至2008年，已报道的缺氧区超过了400个，主要分布在受人类活动干扰严重的近海水域，例如：中国的长江口和珠江口、美国的切萨皮克湾、墨西哥湾北部、欧洲的波罗的海和亚得里亚海北部。水体缺氧已经发展成为一个全球性的重大环境问题，引起科学界和大众的广泛关注。缺氧区的出现会使水栖环境恶化，减少水生动植物的多样性，产生CO_2、N_2O、CH_4等温室气体，加剧近岸水体酸化和全球变暖。科学调查数据揭示导致河口与近岸缺氧区的两个主要因素是水体的层化和有机物的耗氧降解。尽管我们已经认识到有机物的耗氧降解是造成河口缺氧的重要原因，但目前对河口耗氧有机物来源的定量研究还非常缺乏。传统观点认为，河口耗氧有机物主要来源于营养盐（农业化肥、洗涤剂等的使用）刺激下藻类的过度生产；但也有观点认为来自河流输入的陆源有机物（土壤、植物碎屑、生活污水、工业废水等）对缺氧区的形成有所贡献。厘清河口耗氧有机物的来源，即来自海源或者陆源，可以为制定相关的预防治理政策和管理措施提供科学依据。近30年来，珠江三角洲是中国经济发展最迅猛的区域之一，与发展相伴随的是珠江口水体环境的恶化。珠江口的富营养化驱动了其近海水域季节性底层缺氧区的出现。通过无机碳及其稳定同位素的质量守恒，戴民汉研究团队得出有机物的有氧呼吸主导了水柱的耗氧过程，被降解的有机物有65±16%来自海源，另外35±16%来自陆源。该研究结论对珠江口区域富营养化和缺氧的治理，特别是对香港附近水质的改善，具有现实的指导意义，对由香港政府主导的海湾区净化计划（Harbour Area Treatment Scheme）亦有参考意义。

Abstract: We assess the relative contributions of different sources of organic matter, marine vs. terrestrial, to oxygen consumption in an emerging hypoxic zone in the lower Pearl River Estuary (PRE), a large eutrophic estuary located in Southern China. Our cruise, conducted in July 2014, consisted of two legs before and after the passing of Typhoon Rammasun, which completely de-stratified the water column. The stratification recovered rapidly, within 1 day after the typhoon. We observed algal blooms in the upper layer of the water column and hypoxia underneath in bottom water during both legs. Repeat sampling at the initial hypoxic station showed severe oxygen depletion down to 30 μmol kg^{-1} before the typhoon and a clear drawdown of dissolved oxygen after the typhoon. Based on a three endmember mixing model and the mass balance of dissolved inorganic carbon and its isotopic composition, the $\delta^{13}C$ of organic carbon remineralized in the hypoxic zone was -23.2 ± 1.1 ‰. We estimated that 65 ±16% of the oxygen-consuming organic matter was derived from marine sources, and the rest (35 ± 16 %) was derived from the continent. In contrast to a recently studied hypoxic zone in the East China Sea off the Changjiang Estuary where marine organic matter dominated oxygen consumption, here terrestrial organic matter significantly contributed to the formation and maintenance of hypoxia. How varying amounts of these organic matter sources drive oxygen consumption has important implications for better understanding hypoxia and its mitigation in bottom waters.



A conceptual diagram illustrating the partitioning of oxygen-consuming organic matter (OCmar vs. OCterr) within the hypoxic zone in the lower PRE and the adjacent coastal area.

海洋生物地球化学 Marine Biogeochemistry

Dawei Li (First Author)

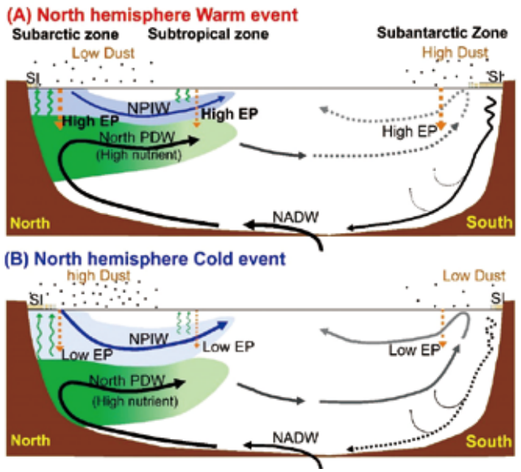
海洋动力过程控制末次冰期北太平洋输出生产力

Millennial-scale ocean dynamics controlled export productivity in the subtropical North Pacific

Li, DW; Zheng, LW; Jaccard, SL; Fang, TH; Paytan, A; Zheng, XF; Chang, YP; **Kao, SJ***. ***GEOLOGY,*** 2017. 45: 651-654.

Shuh-Ji Kao (Reprint Author)

研究地质历史时期（非人为干扰的自然规律）生物泵强度变化的控制机理是当今的研究热点之一。在末次冰期快速的千年气候振荡旋回中，铁沉降主导南大洋亚南极海区初级生产力的输出通量；与之相反，李大伟与高树基团队发现冲绳海槽区域上层水体输出生产力记录与北半球高纬度的沙尘（铁）沉降记录呈现了反相对应关系：即输出生产力高值对应沙尘（铁）沉降低值。通过进一步集成之前的研究结果，该团队提出北太平洋中层水强度的演化（即：该水层在冷期变深，在暖期变浅）是控制北太平洋输出生产力的主控因子。该研究结果首次提出了末次冰期千年气候振荡旋回中海洋生物泵控制机理的南–北半球空间差异性。在此基础之上，结合南北两极高分辨率的冰芯记录（包括温度、大气沙尘沉降记录），团队提出：在末次冰期南北半球气候的不对称变化阶段—“两极跷跷板模式（bipolar seesaw，南极和北半球之间气候不同步变化模式）”，北太平洋和南大洋亚南极海区输出生产力呈现同步变化，但受控于不同的环境因子。



Schematic diagram for the teleconnection between high and low-latitude regions on millennial climate events during bipolar seesaw.

Abstract: The integrated effects of ocean-climate dynamics on export production in the North Pacific have remained elusive. We present a 91 k.y. export productivity (EP) record based on sedimentary reactive phosphorus from the western subtropical North Pacific. On a millennial time scale, EP decreased during Northern Hemisphere cold events when atmospheric dust loading was high, and increased during warm episodes. The inferred antiphase relation between dust and EP suggests that the supply of macronutrients to the sunlit surface ocean, modulated by the penetration depth of North Pacific Intermediate Water and not eolian Fe, exerted a major control on EP in the subtropical North Pacific. A compilation of global EP records suggests that eolian Fe most likely played a role in stimulating EP regionally only in the Subantarctic zone of the Southern Ocean. Over the past 91 k.y., during the cold-south-warm-north phase of the bipolar seesaw, the biological pump in both hemispheres was enhanced synchronously, yet by different drivers; atmospheric Fe input for the Subantarctic and subsurface macronutrient supply for the North Pacific, including the tropical and/or subtropical Pacific, and the Antarctic zone of the Southern Ocean.

Qingquan Hong (First Author)

九龙江口孔隙水交换和海底地下水排放的溶解物质：基于^{224}Ra/^{228}Th不平衡法的新认识

Solute transport into the Jiulong River estuary via pore water exchange and submarine groundwater discharge: New insights from ^{224}Ra-/^{228}Th-disequilibrium

Hong, QQ; Cai, PH*; Shi, XM; Li, Q; Wang, ***GZ. GEOCHIMICA ET COSMOCHIMICA ACTA,*** 2017. 198: 338-359.

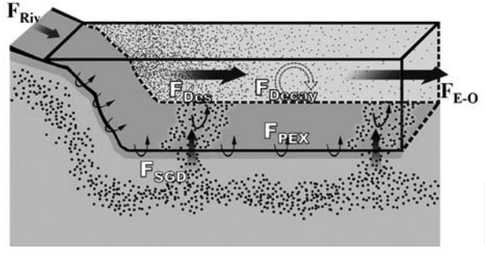
Pinghe Cai (Reprint Author)

孔隙水交换（Pore water EXchange, PEX）和海底地下水排放（Submarine Groundwater Discharge, SGD）是河口和近岸区域海底与水体生态系统之间溶解物质（如溶解无机碳、营养盐和痕量金属等）交换的两个主要过程。两者发生的尺度分别为“毫米到米”和“米到几十千米”，其输送的物质分别代表再生成分和外源成分。准确定量这两个过程对水体生态系统的相对重要性将有助于理解河口和近岸区域元素的生物地球化学。但是，目前对这两个过程的相对贡献仍没有准确的评估，PEX甚至经常成为被忽视的一环。

蔡平河课题组以九龙江河口为研究对象，采用^{224}Ra/^{228}Th不平衡方法结合水体中^{224}Ra的质量平衡，首次直接、清晰地同时估算了PEX和SGD两个过程的溶解物质通量的季节变化。在整个河口尺度上，PEX输送的溶解物质通量与SGD的相当，两者均与河流输入相当甚至高于河流输入通量，并且具有明显的季节变化。此外，浸灌作用是控制PEX输送的主要过程，并且其强度主要受沉积物混合速率的影响。

该成果展示了PEX对溶解物质输送的重要性，是河口区溶解物质交换不可忽视的一环，对深入认识底部沉积物输送在海洋物质源汇格局中的作用具有重要意义。

Abstract: Pore water exchange (PEX) and submarine groundwater discharge (SGD) represent two mechanisms for solute transport from the seabed into the coastal ocean. However, their relative importance remains to be assessed. In this study, we pursued the recently developed ^{224}Ra/^{228}Th disequilibrium approach to quantify PEX fluxes of ^{224}Ra into the Jiulong River estuary, China. By constructing a full mass balance of water column ^{224}Ra, we were allowed to put various source terms, i. e., SGD, diffusive and advective pore water flow (PEX), and river input in a single context. This led to the first quantitative assessment of the relative importance of PEX vs. SGD in the delivery of solutes into an estuary. We carried out two surveys in the Jiulong River estuary: one in January 2014 (winter survey), the other in August 2014 (summer survey). By virtue of a 1-D mass balance model of ^{224}Ra in the sediment column, we demonstrated that PEX fluxes of ^{224}Ra were highly variable, both temporally and spatially, and can change by 1-2 orders of magnitude in our study area. Moreover, we identified a strong correlation between ^{224}Ra -based irrigation rate and ^{234}Th-based sediment mixing rate. Our results highlighted irrigation as the predominant PEX process for solute transfer across the sediment-water interface. Total PEX flux of ^{224}Ra (in 1010 dpm d^{-1}) into the Jiulong River estuary was estimated to be 22.3 ± 3.0 and 33.7 ± 5.5 during the winter and summer surveys, respectively. In comparison, total SGD flux of ^{224}Ra (in 1010 dpm d-1) was 11.3 ± 8.6 and 49.5 ± 16.3 in the respective seasons. By multiplying the PEX fluxes of ^{224}Ra by the ratio of the concentration gradients of component/^{224}Ra at the sediment-water interface, we quantified the total PEX fluxes of dissolved inorganic carbon (DIC) and nutrients (NH_4^+, NO_3^-, and H_4SiO_4) into the Jiulong River estuary. In the meantime, net export of DIC and nutrients via SGD were estimated by multiplying the SGD fluxes of ^{224}Ra by the DIC (nutrients)/ ^{224}Ra ratios in the SGD end-members around this area. Our results revealed that PEX-driven fluxes of solutes rival net SGD input and river input in an estuary. An additional new finding is that water column NO_3^- in the surface estuary was effectively sequestered due to SGD, probably as a result of intense denitrification occurring in the anoxic subterranean estuary.



Schematic diagram of the Ra budget in an estuary.

海洋生物地球化学 Marine Biogeochemistry

西南季风时节南海西部溶解黑碳的源与汇

Source and fate of dissolved black carbon in the western South China Sea during the southwest monsoon prevailing season

Fang, ZM; Yang, WF*; Chen, M; Ma HY. ***JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES,*** 2017. 122, DOI:10.1002/2017JG004014.

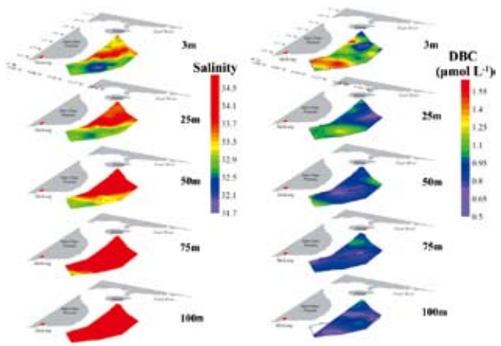
Ziming Fang (First Author)

Weifeng Yang (Reprint Author)

为了提升人们对海洋中黑碳循环的认识，杨伟锋研究团队在西南季风盛行季节（该季节亚洲季风会为该地区带来大量降水）采集并分析了南海西部海水中的黑碳，深入研究了其中溶解态黑碳的来源与归宿。该研究应用了一种从土壤或水样中分离黑碳的方法，将海水样品氧化，把溶解态黑碳转化为苯多羧酸化合物，然后测量了该化合物。发现样品中溶解态黑碳的浓度从每升0.49 μmol变化到1.6 μmol（平均每升约0.95 μmol）。研究人员也注意到，湄公河羽状流区域的混合层（指海洋表层温度，盐度和密度分布均匀的水层）中溶解态黑碳浓度比周围其它海域及中深层海水更高。

海洋碳循环对人类非常重要，因为海洋吸收了大约一半人类活动排放到大气中的碳，我们呼吸的氧气至少有一半由海洋植物产生。该研究通过有效的方法测量溶解态黑碳，并从中探寻规律，在了解海洋和全球碳循环方面迈出了重要一步。地球与空间科学新闻杂志（Earth & Space Science News, EOS）刊登科学热点介绍，报道了这一研究论文。

Abstract: Dissolved black carbon (DBC) is of importance for understanding the marine carbon cycle especially on long time scales owing to its refractory nature in the dissolved organic carbon pool. However, its geochemical behavior is poorly understood in the open oceans due to limited DBC data. Here 86 seawater samples were determined using the benzene-polycarboxylic acid method to investigate the source and fate of DBC in the western South China Sea. The DBC concentration varied from 0.49 to 1.60 μmol L^{-1}, averaging 0.95 μmol L^{-1}. Spatially, the Mekong River plume (i.e., MR plume) showed higher DBC concentrations and (B6CA + B5CA)/(B4CA + B3CA) ratios (i.e., $R_{H/L}$) in the mixed layer than the distal regions. In addition, the DBC concentration positively correlated with salinity in the mixed layer within the MR plume, indicating the important DBC input from the Mekong River. In intermediate water (500–1500 m), DBC varied from 0.70 to 0.85 μmol L^{-1} and the $R_{H/L}$ value continually increased with depth, implying another DBC source with distinct $R_{H/L}$ ratio comparing with the euphotic zone. Based on a conservative mixing model, the Mekong River and atmospheric deposition collectively input 38–100 Gg DBC each year, and over one third of DBC were removed within the euphotic zone, probably via photodegradation and/or adsorption on particles. These results highlighted the different DBC behavior in the euphotic and intermediate zones and lent support to DBC as a proxy for tracing water mixing in the intermediate and deep oceans.



Spatial patterns of (a) salinity and (b) DBC concentration in the western SCS. The distributions were presented at five depths, i.e., surface (3 m), 25 m, 50 m,75 m, and 100 m.

海洋微型生物与浮游生物生态 Marine Microbial and Phytoplanktonic Ecology

海洋超微型蓝细菌产生溶解有机物与海洋荧光溶解有机物具有相似的光学特征

Picocyanobacteria and deep-ocean fluorescent dissolved organic matter share similar optical properties

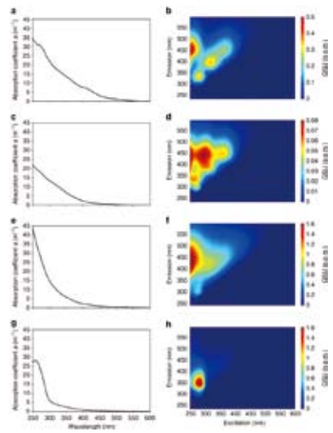
Zhao, Z; Gonsior, M*; Luek, J; Timko, S; Ianiri, H; Hertkorn, N; Schmitt-Kopplin, P; Fang, XT; Zeng, QL; **Jiao, NZ**; Chen, F. NATURE COMMUNICATIONS, 2017, 8: 15284, doi: 10.1038/ncomms15284.

Zhao Zhao (First Author)

以聚球藻与原绿球藻为主要类群的海洋超微型蓝细菌（picocyanobacteria），是世界大洋初级生产力的重要贡献者。它们固定二氧化碳转化为有机物，而其细胞死亡所释放的有机物贡献于海洋溶解有机碳库。海洋溶解有机物中特殊的荧光溶解有机物成分（fluorescent dissolved organic matter, FDOM）在真光层以下的深海得以稳定存在，但对于这类特殊荧光信号来源的解释至今尚存在争议。

焦念志课题组与美国马里兰大学团队合作，通过比较代表超微型蓝细菌培养株（聚球藻和原绿球藻）所释放的荧光溶解有机物与典型海洋荧光溶解有机物的信号，发现二者具有极其相似的光学特性。除三维荧光光谱分析外，这种相似性得到了荧光量子产率和光降解行为相似性的佐证。从聚球藻释放溶解有机物的超高分辨质谱与核磁共振的表征结果中，可推断这一特殊荧光信号来源于聚球藻的特征荧光色素（藻胆素）的降解产物。而由于细胞体积小、胞内缺乏营养物质等特点，微型蓝细菌会随垂直混合及原生动物粪便打包沉降等作用进入深层海洋并保持细胞及荧光色素信号的完整。因此，除了表层荧光溶解有机物向深层海洋的输出外，进入深层海洋的超微型蓝细菌细胞，死亡破裂之后的降解产物也可能成为深海荧光溶解有机物的来源。基于超微型蓝细菌在全球海洋生态系统中的重要作用，该研究成果揭示超微型蓝细菌可能是海洋荧光溶解有机物的重要贡献者之一。

Abstract: Marine chromophoric dissolved organic matter (CDOM) and its related fluorescent components (FDOM), which are widely distributed but highly photobleached in the surface ocean, are critical in regulating light attenuation in the ocean. However, the origins of marine FDOM are still under investigation. Here we show that cultured picocyanobacteria, *Synechococcus* and *Prochlorococcus*, release FDOM that closely match the typical fluorescent signals found in oceanic environments. *Picocyanobacterial* FDOM also shows comparable apparent fluorescent quantum yields and undergoes similar photo-degradation behaviour when compared with deep-ocean FDOM, further strengthening the similarity between them. Ultrahigh-resolution mass spectrometry (MS) and nuclear magnetic resonance spectroscopy reveal abundant nitrogen-containing compounds in *Synechococcus* DOM, which may originate from degradation products of the fluorescent phycobilin pigments. Given the importance of picocyanobacteria in the global carbon cycle, our results indicate that picocyanobacteria are likely to be important sources of marine autochthonous FDOM, which may accumulate in the deep ocean.



Optical properties of picocyanobacteria, marine and heterotrophic bacteria DOM. Ultraviolet–Vis absorption and EEM fluorescence spectra of (a,b) *Synechococcus*-derived SPE-DOM, (c,d) *Prochlorococcus*-derived SPE-DOM, (e,f) SPE-DOM collected from the Sargasso Sea (BATS at 4,530m depth) in August 2013 and (g,h) heterotrophic bacterium R. pomeroyi-derived SPE-DOM. Note: cell density was different in each culture and preclude a direct comparison of fluorescence intensity, and hence the given ultraviolet–Vis and EEM data are only intended to compare peak shapes and not intensities.

海洋微型生物与浮游生物生态 Marine Microbial and Phytoplanktonic Ecology

Wupeng Xiao
(Co-first Author)

Xin Liu
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升温和富营养化改变硅藻和甲藻演替格局

Warming and eutrophication combine to restructure diatoms and dinoflagellates

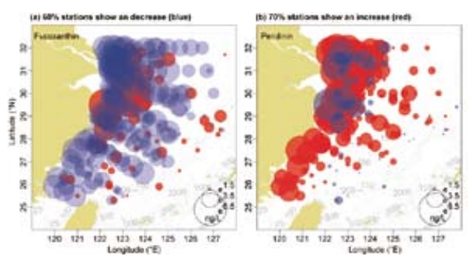
Xiao, WP; Liu, X; Irwin, AJ; Laws, EA; **Wang, L**; Chen, BZ; **Zeng, Y; Huang, BQ***. ***WATER RESEARCH***, 2018. 1: 206-216.

Bangqin Huang
(Reprint Author)

海水变暖和富营养化是近海生态系统面临的两大主要环境问题，硅藻和甲藻是近海生态系统的两大优势浮游植物类群，且是近海藻华发生频率最高的类群。因此，研究硅藻和甲藻对海水变暖和富营养化的响应对了解未来环境变化对近海生态系统结构和功能的影响至关重要。

黄邦钦研究团队收集了东海14年（2002-2015年）累积23个现场航次的2816个浮游植物光合色素样本，分别以硅藻和甲藻的特征色素岩藻黄素（Fucoxanthin）和多甲藻素（Peridinin）为研究对象，通过广义线性模型（GLMs）、广义相加混合模型（GAMMs）等多种统计学手段，建立了东海硅藻和甲藻对主要环境因子的响应模式，对硅藻和甲藻时空演替的环境驱动因子做了细致探讨。结果表明，硅藻和甲藻对温度和营养盐（氮、磷及其比值）变化的响应模式不同：硅藻偏好低温和高营养盐，而甲藻对温度和营养盐相对不敏感，但倾向于低磷和高氮磷比的环境。硅藻和甲藻的这些生态位特性差异决定了升温导致的低营养盐及富营养化引起的高氮磷比值都会促进甲藻的快速生长。基于GAMMs模型，该研究进一步对硅、甲藻在未来全球变暖和富营养化双重压力下的响应动态做了定量预测。结果显示，假设温度和氮磷比（取对数）各升高两个单位，东海约60%的区域将出现硅藻生物量的下降，约70%的区域甲藻生物量将升高；变化最大的近岸区域硅藻生物量将降低19%，甲藻生物量将升高60%。

Abstract: Temperature change and eutrophication are known to affect phytoplankton communities, but relatively little is known about the effects of interactions between simultaneous changes of temperature and nutrient loading in coastal ecosystems. Here we show that such interaction is key in driving diatom-dinoflagellate dynamics in the East China Sea. Diatoms and dinoflagellates responded differently to temperature, nutrient concentrations and ratios, and their interactions. Diatoms preferred lower temperature and higher nutrient concentrations, while dinoflagellates were less sensitive to temperature and nutrient concentrations, but tended to prevail at low phosphorus and high N:P ratio conditions. These different traits of diatoms and dinoflagellates resulted in the fact that both the effect of warming resulting in nutrients decline as a consequence of increasing stratification and the effect of increasing terrestrial nutrient input as a result of eutrophication might promote dinoflagellates over diatoms. We predict that conservative forecasts of environmental change by the year 2100 are likely to result in the decrease of diatoms in 60% and the increase of dinoflagellates in 70% of the surface water of the East China Sea, and project that mean diatoms should decrease by 19% while mean dinoflagellates should increase by 60% in the surface water of the coastal East China Sea. This analysis is based on a series of statistical niche models of the consequences of multiple environmental changes on diatom and dinoflagellate biomass in the East China Sea based on 2815 samples randomly collected from 23 cruises spanning 14 years (2002–2015). Our findings reveal that dinoflagellate blooms will be more frequent and intense, which will affect coastal ecosystem functioning.



Distribution of predicted changes in pigment concentrations assuming surface temperatures increases of 2℃ and N:P ratio increases of e^2=7.4. Red circles represent increases and blue circles decreases compared to present concentrations. a. fucoxanthin. b. peridinin.

Rui Zhang (Reprint Author)

火山灰刺激海洋自养和异养微生物的生长

Volcanic ash stimulates growth of marine autotrophic and heterotrophic microorganisms

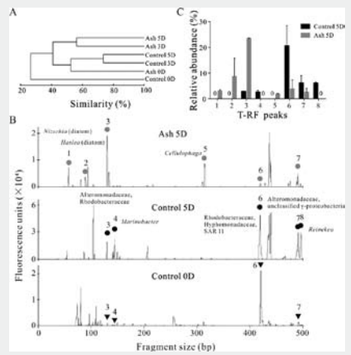
Zhang, R*; **Jiang, T; Tian, Y;** Xie, SC; Zhou, L; **Li, Q; Jiao, NZ***. ***GEOLOGY,*** 2017. 45: 679-682.

Nianzhi Jiao (Reprint Author)

地球历史上有大量的火山喷发记录。无论是地质历史时期还是现代的火山喷发，都被认为是影响当地甚至全球生态系统和气候的主要事件之一。越来越多的研究开始致力于探明火山喷发物火山灰对海洋生态系统的影响。然而，关于海洋微生物对火山灰的响应的研究还比较少。张锐、焦念志研究团队在低营养盐低叶绿素的西太平洋海域开展了两个船载现场培养实验，结果发现火山灰添加首先会刺激海洋异养细菌的大量生长，然后引起浮游植物的爆发（包括微微型真核藻类和较大型的真核藻类，如硅藻）。火山灰溶出的铵盐、硝酸盐、磷酸盐被迅速消耗降低后逐渐升高，硅酸盐浓度在培养后期有明显的下降趋势。异养细菌丰度在培养初期迅速增加，说明异养细菌相对于自养浮游植物可以优先利用环境中营养盐（如氮、磷）。之后，自养浮游植物利用培养体系中硅酸盐和异养细菌死亡所释放的营养盐得以爆发。团队发现火山灰的添加导致了细菌多样性降低及细菌群落结构改变。例如，火山灰添加刺激了红杆菌科和交替单胞菌科类群的生长，而对现代海洋中最丰富细菌类群SAR 11具有抑制作用。微生物群落结构的变化及主要的微生物类群对火山灰的不同响应可能对海洋中生物地球化学循环和全球气候变化产生重要的影响。

二叠纪–三叠纪之交，大规模的火山活动与海洋宏体生物大灭绝和微生物变化相耦合。中国浙江煤山剖面中，大灭绝事件主幕发生在第25层火山灰层，之后，生物标志物指示的蓝细菌在26层迅速爆发。第二幕大灭绝位于28层火山灰层，与之相应地，在第29层出现了蓝细菌的第二次爆发。同时，疑源类和青绿藻在大灭绝后也开始繁盛。火山灰添加实验中，蓝细菌和真核生物丰度的升高可能在一定程度上解释了大灭绝后微生物繁盛的现象。我们认为，强烈的火山活动不仅与宏体生物灭绝有关，其产生的火山灰进入海水中溶出数量可观的营养盐，可能促进了微生物繁盛。因此，火山灰对海洋生态系统中微生物群落的影响可能产生重要的生态环境效应，这一点是过去研究地质历史时期和现代火山喷发事件中所忽视的重要部分。

Abstract: Volcanic eruptions are considered to be some of the most important events affecting local and global ecosystems and climate. An increasing body of research has been concerned with discerning the influence of volcanic ash on marine ecosystems. However, studies on the responses of autotrophic and heterotrophic microorganisms to volcanic ash are rare. In this study we conducted two microcosm experiments in the low-nutrient and low-chlorophyll western Pacific Ocean and found that volcanic ash first stimulated the abundance of heterotrophic bacterioplankton, followed by phytoplankton bloom that included both picoeukaryotes and larger eukaryotes such as diatoms. Using terminal restriction fragment length polymorphism and clone library analyses, we observed an altered bacterial diversity and community structure with volcanic ash addition. Our study showed that volcanic ash affects the community composition of both heterotrophic bacterioplankton and phytoplankton in the surface ocean. These results elucidate the overlooked impacts of natural volcanic eruption events on microbial communities, which play important ecological and biogeochemical roles in the marine ecosystem.



Microbial community structure altered by volcanic ash manipulation. A: The clustering dendrograms based on DNA fingerprinting analysis (terminal restriction fragment length polymorphism, T-RFLP) showing similarity of microbial community structure during 5-day incubation of volcanic ash treatments and control. B: Typical microbial community structure as revealed by T-RFLP analysis of polymerase chain reaction (PCR)–amplified 16S rRNA genes (bp—base pair). Eight peaks affected by volcanic ash manipulation are highlighted on T-RFLP profiling. Microbial groups that may generate these peaks are shown. C: Relative abundance of 8 T-RFLP peaks after 5-day incubation with volcanic ash manipulation.

海洋微型生物与浮游生物生态 Marine Microbial and Phytoplanktonic Ecology

通过转录组学与小RNA组学分析揭示甲藻应对磷酸盐胁迫的多层次调控机制

Transcriptomic and microRNAomic profiling reveals multi-faceted mechanisms to cope with phosphate stress in a dinoflagellate

Shi, XG; Lin, X; Li, L; Li, MZ; Palenik, B; **Lin, SJ***. ***THE ISME JOURNAL,*** 2017. 11: 2209-2218.

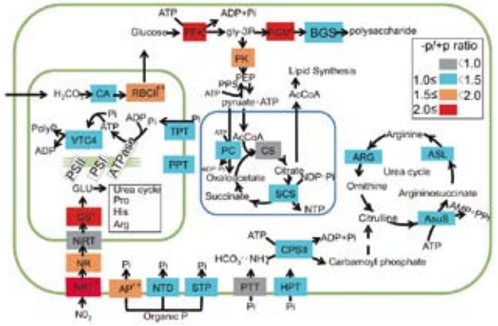
Xinguo Shi (First Author) **Senjie Lin (Reprint Author)**

原甲藻是广分布的典型甲藻代表，而东海原甲藻在我国近海海域广泛存在，是赤潮主导物种，每年都爆发大规模赤潮，对我国海洋生态系统影响大，且易于室内培养、同步化效率高（室内培养和现场分别可达75%和60%以上），非常适合研究赤潮甲藻对环境因子的分子响应机制。

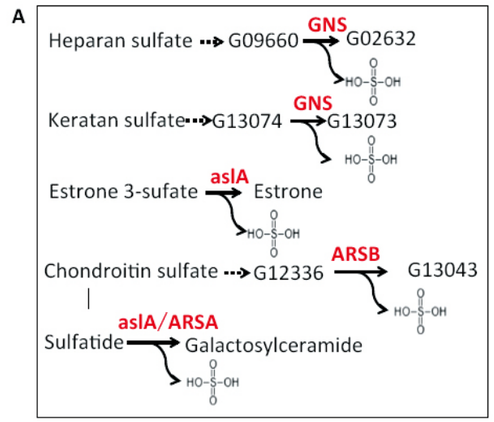
多年的海洋生态调查结果显示，东海原甲藻往往在磷胁迫条件下获取生态位优势从而形成赤潮。石新国、林森杰课题组以东海原甲藻为例，首次综合利用生理学、转录组学、转录后调控、蛋白质印迹杂交、荧光定量PCR、以及高效液相质谱（HPLC-MS）等研究方法，探讨该甲藻在磷胁迫条件下转录水平、转录后水平以及代谢水平上的应答机制，有效地推进了东海原甲藻成为甲藻研究模式种的进程。

在低磷条件下，东海原甲藻对磷胁迫产生一系列的生理学响应，细胞快速进入平台期、细胞增大、光合效率降低、单细胞RNA含量降低、细胞周期停滞在G1期。研究团队通过转录组数据分析发现，在磷限制条件下1657 个基因 (0.86%) 表达量出现显著差异，其中包括596个基因上调，1061个基因下调。被调控的基因通路包括无机氮的吸收代谢、有机磷的同化、糖酵解途径以及ATP分解及合成等。控制细胞分裂的重要基因G1/S细胞周期蛋白在磷胁迫条件下显著下调。鉴于甲藻的基因表达存在大量转录后调控的情况，研究人员又对磷限制条件下东海原甲藻的microRNA进行了测序，来探讨磷胁迫条件下转录后调控的响应。共发现17个microRNA，它们的靶蛋白标定109个和磷应用相关的基因，其功能主要是利用有机磷以及磷酸基团的转运等。这17个miRNA中有12个表达差异显著，这些miRNA靶向3,268个蛋白。对这些蛋白进行富集分析发现富集度最高的通路是硫脂水解酶基因，这最终导致硫脂（sulfatide）在单细胞中的积累。为了验证转录后调控分析所获得的这一结果，团队对磷限制条件下的单细胞硫脂进行了高效液相质谱（HPLC-MS）分析，发现单细胞硫脂显著增加。结合以往的研究结果，团队认为在磷限制条件下东海原甲藻可以用硫脂（sulfatide）代替磷脂以节约利用磷，从而在海区磷限制的条件下获取竞争优势并爆发形成赤潮。

Abstract: Although gene regulation can occur at both transcriptional and epigenetic (microRNA) levels, combined transcriptomic and microRNAomic responses to environmental stress are still largely unexplored for marine plankton. Here, we conducted transcriptome and microRNAome sequencing for Prorocentrum donghaiense to understand the molecular mechanisms by which this dinoflagellate copes with phosphorus (P) deficiency. Under P-depleted conditions, G1/S specific cyclin gene was markedly downregulated, consistent with growth inhibition, and genes related to dissolved organic phosphorus (DOP) hydrolysis, carbon fixation, nitrate assimilation, glycolysis, and cellular motility were upregulated. The elevated expression of ATP-generating genes (for example, rhodopsin) and ATP-consuming genes suggests some metabolic reconfiguration towards accelerated ATP recycling under P deficiency. MicroRNAome sequencing revealed 17 microRNAs, potentially regulating 3268 protein-coding genes. Functional enrichment analysis of these microRNA-targeted genes predicted decreases in sulfatide (sulfolipid) catabolism under P deficiency. Strikingly, we detected a significant increase in sulfolipid sulfatide content (but not in sulphoquinovosyldiacylglycerol content) and its biosynthesis gene expression, indicating a different sulfolipid-substituting-phospholipid mechanism in this dinoflagellate than other phytoplankters studied previously. Taken together, our integrative transcriptomic and microRNAomic analyses show that enhanced DOP utilization, accelerated ATP cycling and repressed sulfolipid degradation constitute a comprehensive strategy to cope with P deficiency in a model dinoflagellate.



P. donghaiense metabolic pathways responding to phosphate limitation. GS, glutamate synthase; CS, citrate synthase; SCS, Succinyl coenzyme A synthetase; NiRT, nitrite transporter; NR, nitrite reductase; NTD, 5'-Nucleotidase; STP, Serine/threonine phosphatase; TPT, plastidic triose-phosphate/phosphate translocator; VTC4, Vacuolar transporter chaperone 4; PPT, phosphoenolpyruvate/ phosphate translocator; PC, pyruvate carboxylase; Acetyl-CoA, Acetyl coenzyme A; CPSII, Carbamoyl phosphate synthetase II; AsuS, argininosuccinate synthase; ASL, argininosuccinate lyase; ARG, arginase; PTT, phosphate transporter; HPT, phosphate transporter; CA, Carbonic anhydrase; RBCII, Form II RuBisCO; NRT, Nitrate transporter; AP, alkaline phosphatase; PFK, Phosphofructokinase; PGM, Phosphoglucomutase; BGS, Callose synthase; PK, Pyruvate kinase; PEP, Phosphoenolpyruvate; PPS, PEP synthetase. Color filling of gene name box depicts the fold change of expression levels of the gene based on RNA-seq data; *Indicates significant up- or downregulation based on RNA-seq data; **Indicating significantly up- or downregulation based on qRT-PCR.



microRNA target genes that regulate sulfate metabolism and cellular sulfatide content in the P-replete and P-depleted P. donghaiense cultures. A. microRNA target genes that regulate sulfate metabolism. Target genes of up-regulated microRNA are shown in red. GNS: N-acetylglucosamine-6-sulfatase; aslA: arylsulfatase; ARSA: arylsulfatase A; ARSB: arylsulfatase B. Dotted arrow indicates multiple steps. G-numbers are glycan number from KEGG. (B) Cellular sulfatide content of P-replete and P-depleted *P. donghaiense* cells on day 3 and day 6.

全球变化及海洋生物响应 Marine Ecosystem Responses to Global Change

Haizheng Hong (First Author)

海洋酸化对优势固氮蓝藻束毛藻的复杂效应

The complex effects of ocean acidification on the prominent N_2-fixing *cyanobacterium Trichodesmium*

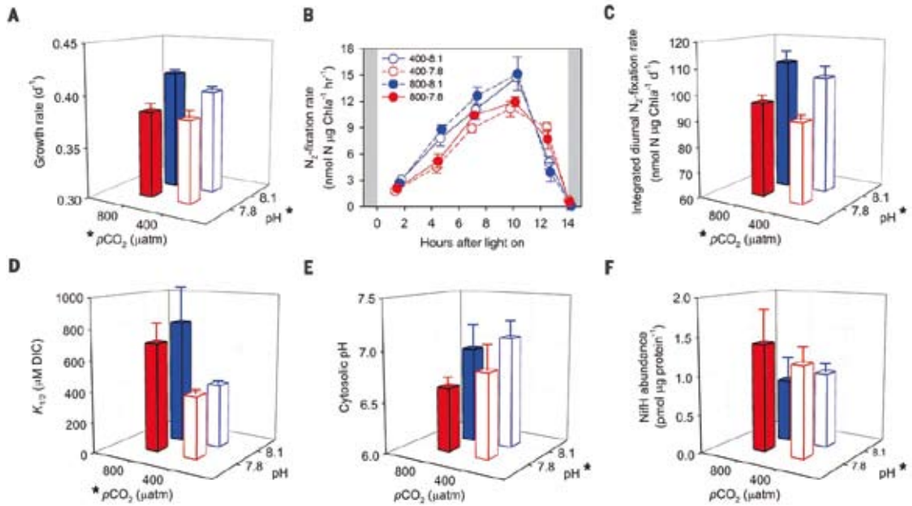
Hong, HZ; Shen, R; Zhang, FT; Wen, ZZ; Chang, SW; Lin, WF; Kranz, SA; **Luo, YW; Kao, SJ;** Morel, FMM; **Shi, DL***. ***SCIENCE,*** 2017. 356: 527-530.

Dalin Shi (Reprint Author)

海洋初级生产者浮游植物在海洋和全球碳循环中扮演着举足轻重的角色，调节着全球气候。氮是浮游植物生长所必需的元素，其缺乏限制了全球面积一半以上海区的初级生产力。束毛藻是海洋生态系统中“新氮”的重要来源之一，可贡献高达50%的全球海洋总固氮量，对海洋初级生产力以及碳、氮生物地球化学循环起着至关重要的影响。工业革命以来，近三分之一人类活动排放的CO_2进入海洋，导致其正以迄今3亿年以来最快的速度酸化。海洋酸化将怎样影响束毛藻的固氮作用，其碳、氮生物地球化学效应和气候效应如何，是国际海洋全球变化研究的热点和焦点。围绕该重大科学问题，近年来国际上开展了一系列的研究，但报道的研究发现却截然相反，有的研究表明海水酸化显著促进了束毛藻生长和固氮，而有的研究则报道酸化起抑制作用。针对这一备受关注却悬而未决的科学问题，史大林研究团队及其合作者开展了系统性的实验室和现场研究工作。

在束毛藻生活的寡营养海区，痕量金属铁是其生长和固氮作用最重要的限制因子之一。然而，先前报道海洋酸化促进束毛藻固氮作用的室内研究，使用的均是富营养的人工海水培养基。研究团队采用痕量金属洁净操作技术，以天然寡营养海水为培养基开展研究，并创新性地从区分海洋酸化过程中CO_2上升和pH下降的双重效应入手，发现CO_2升高对束毛藻固氮的促进作用弱于海水pH下降对其的抑制作用，导致海洋酸化的净效应为抑制束毛藻固氮，且该负效应随着海水中铁浓度的下降而增强。实验表明，藻细胞内的pH随着海水pH的下降而下降，束毛藻上调固氮酶的表达以应对由此引起的固氮速率降低，同时加大能量生产用以维持细胞内的pH稳态（pH homeostasis）。鉴于固氮酶合成和能量生产过程对铁的高度需求，铁限制条件加剧了酸化的负效应。此外，通过系统的受控培养实验，研究团队发现先前其他研究小组报道的海洋酸化对束毛藻固氮的促进作用，很可能是因人工海水培养基中金属和氨的污染所导致的假象。在室内实验的基础上，团队通过在南海寡营养海区的现场痕量金属洁净受控培养实验，在国际上首次对铁限制下的天然束毛藻群落开展了酸化研究，发现海水酸化在降低固氮速率的同时上调了固氮酶基因的转录，表明酸化导致固氮效率下降，这与实验室的机理研究结果相吻合。该研究成果不仅揭示了海洋酸化对束毛藻的影响及其机制，而且为先前国际上就该科学问题的争议提供了科学解释，对于深入理解全球变化下碳、氮的海洋生物地球化学循环具有重要的意义。

Abstract: Acidification of seawater caused by anthropogenic carbon dioxide (CO_2) is anticipated to influence the growth of dinitrogen (N_2)-fixing phytoplankton, which contribute a large fraction of primary production in the tropical and subtropical ocean. We found that growth and N_2-fixation of the ubiquitous cyanobacterium *Trichodesmium* decreased under acidified conditions, notwithstanding a beneficial effect of high CO_2. Acidification resulted in low cytosolic pH and reduced N_2-fixation rates despite elevated nitrogenase concentrations. Low cytosolic pH required increased proton pumping across the thylakoid membrane and elevated adenosine triphosphate production. These requirements were not satisfied under field or experimental iron-limiting conditions, which greatly amplified the negative effect of acidification.



Separate effects of increasing PCO_2 and decreasing pH on *T. erythraeum*. (A) Specific growth rates, (B) endogenous rhythm of N_2-fixation rate over a diurnal cycle (the gray areas indicate the dark phase), (C) integrated diurnal N_2-fixation rates, (D) half saturation concentrations (K1/2) of photosynthesis, (E) cytosolic pH, and (F) NifH concentration of steady-state growing *T. erythraeum* at high Fe (Fe_T = 1 µM) in Aquil-tricho medium prepared with synthetic ocean water, where PCO_2 and pH were varied independently (table S4) (17). K1/2, cytosolic pH, and NifH concentration were determined at the middle of photoperiod (7 to 9.5 hours). Blue and red denote pH 8.1 and 7.8, respectively; solid bars and circles denote 800 µatm CO_2, and open bars and circles denote 400 µatm CO_2. Error bars represent the SD of biological replicates (n = 4). Significant differences between CO_2 treatments or between pH treatments are denoted by asterisks beside the axis titles of PCO_2 or pH ($P < 0.05$, two-way analysis of variance).

Futian Li (First Author)

适应海水酸化1800代后模式硅藻下调其光合与呼吸作用，生长速率减缓

Decreased photosynthesis and growth with reduced respiration in the model diatom *Phaeodactylum tricornutum* grown under elevated CO_2 over 1800 generations

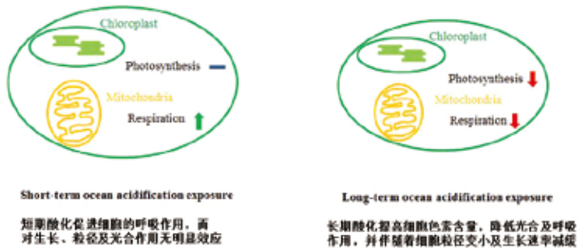
Li, FT; Beardall, J; Collins, S; **Gao, KS***. ***GLOBAL CHANGE BIOLOGY,*** 2017. 23: 127-137.

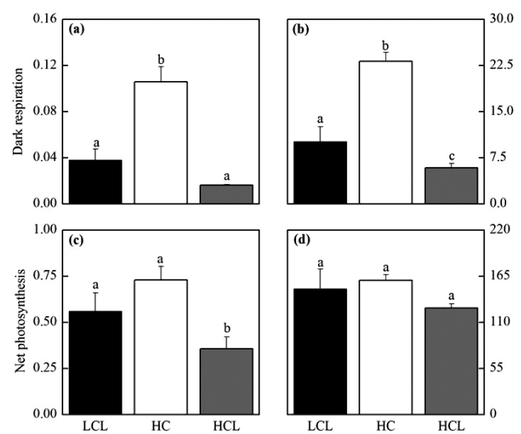
Kunshan Gao (Reprint Author)

硅藻作为水域初级生产力的主要贡献者，在全球碳/硅的生物地球化学循环中发挥着重要作用。迄今，海洋酸化对硅藻及其它浮游植物类群影响的报道，大都基于短期(8-20代)实验。短期酸化研究的结果，对理解细胞响应酸化及相关化学变化的过程与机制非常重要。然而，长期适应酸化胁迫的细胞，也许会产生演化性响应，展示不同的生理学表征。高坤山研究团队以分离于南海的三角褐指藻（*Phaeodactylum tricornutum* CCMA 106）为研究对象，将其长期（1035天，约1860代）暴露于酸化条件下（1000µatm pCO_2, pHT:7.70），探讨了其生长及光合生理的变化，并与对照组（400µatm pCO_2, pHT: 8.02）及短期（10天，约20代）酸化处理（1000µatm pCO_2, pHT:7.70）的细胞，进行了对

比性分析。结果发现，适应海水酸化1860代后，该硅藻细胞粒径变小，生长与光合速率（与对照组相比）明显下降，并伴随着呼吸作用的下调。相反，短期酸化提高了三角褐指藻呼吸速率，对其生长及光合作用无显著影响。该研究表明，硅藻类在长期适应酸化过程中，可能产生进化性的生理学变化；并暗示，不同浮游植物类群生理生态特性不同，长期适应酸化的生理学响应也会不同，且长期适应酸化的机制也会不同。

Abstract: Studies on the long-term responses of marine phytoplankton to ongoing ocean acidification (OA) are appearing rapidly in the literature. However, only a few of these have investigated diatoms, which is disproportionate to their contribution to global primary production. Here we show that a population of the model diatom *Phaeodactylum tricornutum*, after growing under elevated CO_2 (1000 µatm, HCL, pHT: 7.70) for 1860 generations, showed significant differences in photosynthesis and growth from a population maintained in ambient CO_2 and then transferred to elevated CO_2 for 20 generations (HC). The HCL population had lower mitochondrial respiration, than did the control population maintained in ambient CO_2 (400 µatm, LCL, pH(T): 8.02) for 1860 generations. Although the cells had higher respiratory carbon loss within 20 generations under the elevated CO_2, being consistent to previous findings, they downregulated their respiration to sustain their growth in longer duration under the OA condition. Responses of phytoplankton to OA may depend on the timescale for which they are exposed due to fluctuations in physiological traits over time. This study provides the first evidence that populations of the model species, *P. tricornutum*, differ phenotypically from each other after having been grown for differing spans of time under OA conditions, suggesting that long-term changes should be measured to understand responses of primary producers to OA, especially in waters with diatom-dominated phytoplankton assemblages.





Dark respiration (a) and net photosynthesis (c) (µmol O_2 µg chl α^{-1} h^{-1}) per chl α for *Phaeodactylum tricornutum* cells from LCL (black bar), HC (white bar), and HCL (gray bar) populations. Dark respiration (b), and net photosynthesis (d) on a per cell basis (fmol $cell^{-1}$ h^{-1}) for the three populations. LCL, long-term ambient air exposure; HC, short-term elevated CO_2 exposure; HCL, long-term elevated CO_2 exposure. The measurements were determined after 1860 generations (1035 days) for LCL and HCL populations, and 20 generations for HC population. The values are means ± SD of triplicate cultures from each population (n = 3). The different letters indicate significant differences among populations at $p < 0.05$.

全球变化及海洋生物响应 Marine Ecosystem Responses to Global Change

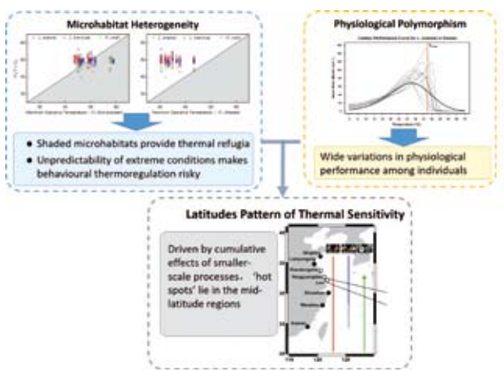
潮间带贝类温度敏感性：微气候和行为及生理多样性的重要作用
Untangling the roles of microclimate, behaviour and physiological polymorphism in governing vulnerability of intertidal snails to heat stress

Dong, YW*; Li, XX; Choi, FMP; Williams, GA; Somero, GN; Helmuth, B. ***PROCEEDINGS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES***, 2017. 284, DOI:10.1098/rspb.2016.2367.

Yunwei Dong (Reprint Author)

生物对于全球气候变化下极端气候条件的响应是当今的研究热点之一。然而针对这个问题，现多采用全球尺度或生物地理尺度模型进行研究，而忽略了小尺度生理和生态过程的生态学意义。董云伟研究团队选取中国沿岸纬度跨度达11.5°的8个地点，以潮间带腹足类（中华滨螺，短滨螺，齿纹蜒螺）为研究对象，系统分析了小尺度环境变化和生理多样性对不同地理种群温度敏感性的影响。研究表明，小尺度温度环境和生理耐受能力的多态性对于种群适合度具有重要影响。与阳面相比，阴面温和的温度环境为生物提供了避难所；自相关分析结果表明，在高温地区，贝类对高温事件的预测能力降低，无法进行有效的行为适应；部分贝类个体较高的温度耐受上限可保证整个种群的存活率。我国温带及亚热带沿岸对未来升温最敏感的潮间带贝类种群可能在扬子大三角洲地区。

Abstract: Biogeographic distributions are driven by cumulative effects of smaller scale processes. Thus, vulnerability of animals to thermal stress is the result of physiological sensitivities to body temperature (T_b), microclimatic conditions, and behavioural thermoregulation. To understand interactions among these variables, we analysed the thermal tolerances of three species of intertidal snails from different latitudes along the Chinese coast, and estimated potential T_b in different microhabitats at each site. We then empirically determined the temperatures at which heart rate decreased sharply with rising temperature (Arrhenius breakpoint temperature, ABT) and at which it fell to zero (flat line temperature, FLT) to calculate thermal safety margins (TSM). Regular exceedance of FLT in sun-exposed microhabitats, a lethal effect, was predicted for only one mid-latitude site. However, ABTs of some individuals were exceeded at sun-exposed microhabitats in most sites, suggesting physiological impairment for snails with poor behavioural thermoregulation and revealing inter-individual variations (physiological polymorphism) of thermal limits. An autocorrelation analysis of T_b showed that predictability of extreme temperatures was lowest at the hottest sites, indicating that the effectiveness of behavioural thermoregulation is potentially lowest at these sites. These results illustrate the critical roles of mechanistic studies at small spatial scales when predicting effects of climate change.



Microhabitat heterogeneity and physiological polymorphism play important roles in forecasting the responses of intertidal animals to climate change. Shaded microhabitats provide thermal refugia to avoid lethal or sublethal heat stress. High physiological variation among individuals within populations is observed which allows some individuals surviving in the maximum habitat temperature and guarantees maintenance of the local population. According to cumulative effects of microhabitat and physiological polymorphism, the thermal sensitivity of intertidal species along the Chinese coastline shows a highly nonlinear relationship with latitude and the most thermally vulnerable population lies in the mid-latitude regions.

海洋污染与生态毒理 Marine Ecotoxicology

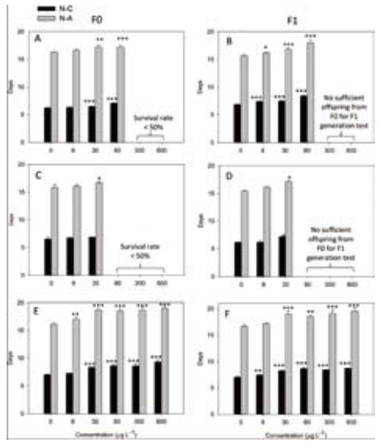
六溴环十二烷三种异构体在海洋桡足类日本虎斑猛水蚤中的生物富集性和毒性
Toxicity and bioaccumulation of three hexabromocyclododecane diastereoisomers in the marine copepod *Tigriopus japonicas*

Hong, HZ*; Lv, DM; Liu, WX; Huang, LM; Chen, LY; Shen, R; Shi, DL. *AQUATIC TOXICOLOGY,* 2017. 188: 1-9.

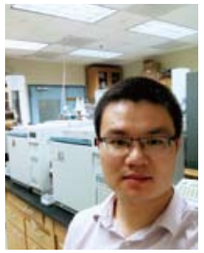
Haizheng Hong (Reprint Author)

六溴环十二烷（HBCD）是全球使用的三大溴代阻燃剂之一，是新型的持久性有机污染物，广泛存在于各种环境生物体内中，包括海洋生物。HBCD包含α, β和γ三种具有不同的物理和化学特性的异构体，很可能呈现不同的生物累积性和毒性效应，但已有的毒理学研究常常忽略这些不同，而仅仅关注HBCD混合物的毒性。洪海征等人以海洋模式浮游生物日本虎斑猛水蚤为研究对象，发现相较于γ异构体，α和β异构体更易诱导产生活性氧化物，导致较高的致死毒性；但这三种异构体在延缓发育方面的毒性相当。而且两个世代的长期暴露实验表明日本虎斑猛水蚤的子代比母代对三种HBCD异构体的毒性均更加敏感。另外，三种异构体在日本虎斑猛水蚤中的生物富集因子排序为α-HBCD > γ-HBCD > β-HBCD，而且它们都显著高于鱼体。这些发现表明为科学地进行HBCD的风险评估需要关注其长期慢性暴露的毒性数据，并且区别三种异构体的生物累积性和毒性，特别需要关注α-HBCD对海洋生态系统的影响。

Abstract: The three major hexabromocyclododecane (HBCD) diastereoisomers, i.e. α-, β- and γ-HBCD, have distinct physical and chemical properties that may potentially result in different levels of bioaccumulation and toxicity in aquatic organisms. To assess the impact of diastereomeric variation in HBCDs, the marine copepod *Tigriopus japonicas* was exposed to α-, β- and γ-HBCD in isolation. Results showed that all the three diastereoisomers had a similar potency to cause growth delay in *T. japonicas*. Variation was observed in the overall survival rate with exposure to α- and β-HBCD, and this resulted in significantly higher lethal toxicity in *T. japonicas* than that with exposure to γ-HBCD. Exposure to α-, β- and γ-HBCD led to the generation of ROS in *T. japonicas*, a possibly toxic mechanism. Both α- and β-HBCD showed a higher potential to induce oxidative stress, which may be a factor in the higher lethal toxicity observed with α- and β-HBCD exposure. It is of note that *T. japonicas* was found to be more sensitive to all three diastereoisomers in the F1 generation than in the F0 generation. The bioconcentration potential of HBCD diastereoisomers can be ranked in the order α-HBCD > γ-HBCD > β-HBCD and was found to be higher in *T. japonicas* than has been reported for fish species.



Effects of α-HBCD (A and B), β-HBCD (C and D) and γ-HBCD (E and F) exposure on the developmental duration of N-C phase (from newly hatched nauplius to C1 copepodid stage) and N-A phase (the whole maturation period, from newly hatched nauplius to adult bearing egg sacs) in *T. japonicas* in the F0 (A, C, E) and F1 generations (B, D,F). α-, β- and γ-HBCD concentrations of 0, 8, 30, 80, 300 and 800 μg L^{-1} were used for exposure. In the exposure groups with concentrations that caused cumulative mortality higher than 50% (i.e., 300 and 800 μg L^{-1}α-HBCD, and 80, 300 and 800 μg L^{-1} β-HBCD), developmental durations were not calculated and exposure was discontinued for the F1 generation. Values are presented as the mean ± SD (n =5), with significant differences from the controls indicated by asterisks (one-way ANOVA, followed by the LSD post hoc test: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).



中国边缘海陆源多环芳烃的季节变化：污染源输入、相态分配与洋流输运
Seasonal variation of terrigenous Polycyclic Aromatic Hydrocarbons along the marginal seas of China: Input, phase partitioning, and ocean-current transport

Ya, ML; Wang, XH*; Wu, YL; Li, YY; Yan, JM; Fang, C; Zhao, YY; Qian, RR; Lin, XL. *ENVIRONMENTAL SCIENCE & TECHNOLOGY,* 2017. 51: 9072-9079.

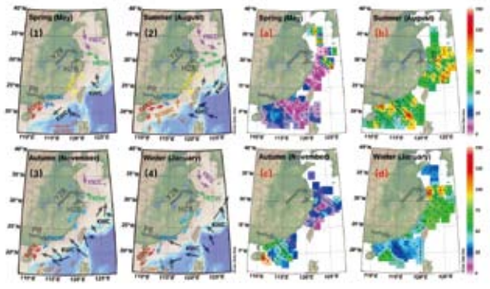
Miaolei Ya (First Author)

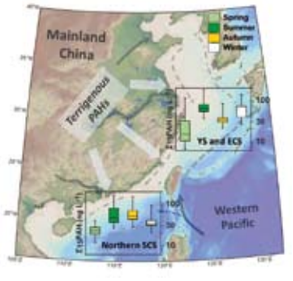
Xinhong Wang (Reprint Author)

王新红课题组首次对中国近海（南海北部、东海和黄海）开展了痕量有机污染物多环芳烃的陆源输入、残留特征及相态分布等的季节变化和近海环流影响研究。

研究发现，中国近海表层海水多环芳烃的组成、含量及来源具有明显的季节差异，其中秋季和夏季海水中多环芳烃的残留浓度和储量均显著高于冬春季。而海水中多环芳烃的季节变化与陆源多环芳烃的排放强度并不一致，陆源和海源（船运和海上石油开采）排放、近海海洋环流主导的扩散和稀释作用等是影响多环芳烃储量、组成及来源等季节变化和空间分布的重要驱动因子，有机碳分配系数的降低反映了陆源输入的超细黑碳粒子可能对多环芳烃在水–颗粒物界面的相态分配有直接影响。该研究为全面评估我国近海海洋环境受人为活动影响输入陆源多环芳烃的污染现状及生态风险提供重要依据。

Abstract: To study the spatial distributions and seasonal differences of concentrations, source identification, and phase partitioning of polycyclic aromatic hydrocarbons (PAHs) in surface water, intensive sampling was carried out along the marginal seas of China in four seasons. In the northern South China Sea (SCS), the highest PAH levels occurred in the summer (July to August) and autumn (October to November). In the East China Sea (ECS) and the Yellow Sea, the highest occurred in the summer (August) and winter (December). In all areas, the lowest PAH levels were found in the spring (May to June). The estimated mass inventory of PAHs in the surface water (0-5 m) of the northern SCS and ECS accounted for less than 8% of PAHs outflow into the offshore environment. That showed the consistent seasonal variation with PAHs levels. Land- and ocean-based emissions, surface runoff, and the open seawater dilution were the most important environmental factors influencing the seasonal heterogeneity and the spatial distributions of PAH in the surface water. The decline of observed organic carbon normalized partition coefficients in the four seasons was probably affected by the presence of submicrometer-sized soot particles accompanying the PAH outflow from China.





多环芳烃在中国近海呈现显著的季节性差异（$p<0.05$）

(1–4) Surface ocean currents along the MC during sampling periods. (a–d) Spatial variation in Σ_{15}PAHs affected by seasonal terrigenous inputs and ocean currents in spring, summer, autumn, and winter, respectively. YZR, Yangtze River; PR, Pearl River; HZB, Hangzhou Bay; SCSWC, South China Sea warm current; PRDW, Pearl River dilute water; GDCC, Guangdong coastal current; YRDW, Yangtze River diluted water; YSCC, Yellow Sea coastal current; MZCC, Min-Zhe coastal current; and TWWC, Taiwan warm current.

物理海洋学与海洋遥感 Physical Oceanography and Remote Sensing

北太平洋低纬度西边界流系的弱跃层混合
Weak thermocline mixing in the North Pacific low-latitude western boundary current system

Liu, ZY*; Lian, Q; Zhang, FT; Wang, L; Li, MM; **Bai, XL;** Wang, JN; Wang F. ***GEOPHYSICAL RESEARCH LETTERS,*** 2017. 44, DOI:10.1002/2017GL075210.

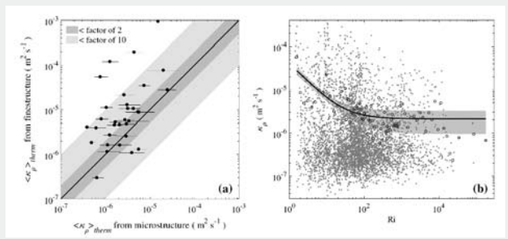
Zhiyu Liu (Reprint Author)

北太平洋低纬度西边界流连接太平洋热带环流与副热带环流，是印尼贯穿流的源头，调控西太平洋暖池与太平洋赤道流系的水团特性，对全球气候系统具有重要的调节作用。不同水团间相互作用与转换的主要途径为沿等密度面混合与跨等密度面混合。其中，跨等密度面混合主要由内波破碎与（或）流动剪切不稳定产生的小尺度湍流所驱动。跨等密度面混合显著影响低纬度西边界流的动力与热力结构。然而，迄今对北太平洋低纬度西边界流系跃层混合的认识还非常不足。基于湍流微结构剖面观测资料，刘志宇团队的研究首次揭示了北太平洋低纬度西边界流系跃层混合的特征与控制机理。观测结果显示，低纬度西边界流系的跃层混合普遍较弱，跨等密度面混合率仅为 $O(10^{-6})$ m^2 s^{-1}，显著低于全球大洋跃层混合的背景值。这与“在低纬度内波破碎受到显著抑制”的理论认识是一致的，但与前人基于温盐与流速观测资料的间接估计结果存在显著差异，相差至少2个量级，表明目前所普遍采用的细尺度参数化方法并不适用于低纬度西边界流区。此外，观测结果显示在棉兰老涡的南北两翼跃层混合显著增强，跨等密度面混合率比该区域的平均值高一个量级。而在涡旋中心，跨等密度面混合率与平均值无显著差异。这表明涡旋边缘处的强地转流速剪切是湍流耗散与混合增强的原因。该研究同时发展了可应用于区域海洋环流与气候模式的跃层混合参数化方案。

Abstract: Despite its potential importance in the global climate system, mixing properties of the North Pacific low-latitude western boundary current system (LLWBC) remained unsampled until very recently. We report here on the first measurements of turbulence microstructure associated with these currents, made in the western boundary region of the tropical North Pacific east of the Philippines. The results suggest that thermocline mixing in the North Pacific LLWBC is generally weak with the diapycnal diffusivity $K\rho \sim O(10^{-6})$ m^2 s^{-1}. This is consistent with predictions from internal wave-wave interaction theory that mixing due to internal wave breaking is significantly reduced at low latitudes. Enhanced mixing is found to be associated with a permanent cyclonic eddy, the Mindanao Eddy, but mainly at its south and north flanks. There, κ_ρ is elevated by an order of magnitude due to eddy-induced geostrophic shear. Mixing in the eddy core is at the background level with no indication of enhancement.

Highlights:

- Thermocline mixing in the North Pacific low-latitude western boundary current system is overall very weak
- Thermocline mixing at the south and north flanks of the Mindanao Eddy was elevated by an order of magnitude due to eddy-induced shear
- The oft-used fine-scale parameterization of turbulence seems to generally overestimate thermocline mixing in the North Pacific LLWBC



(a) Comparison between microstructure measurements and fine-scale parameterization for the thermoclineaveraged diapycnal diffusivity ($< \kappa_\rho >_{therm}$) at all the observation sites. Agreement within factors of 2 and 10 is designated by the gray bands. The 95% bootstrapped confidence intervals for the estimates from microstructure measurements are represented by bars. (b) Original (gray small symbols) and bin-averaged samples (large open symbols) of the diapycnal diffusivity (κ_ρ) versus the gradient Richardson number (Ri) for all the estimates in the thermocline. The bold line shows the analytical approximation discussed in the text with the 95% confidence intervals indicated by gray shading.

Lin Qi (Reprint Author)

2017年东海“金潮”爆发的来龙去脉
Floating algae blooms in the East China Sea

Qi, L; Hu, C*; Wang, MQ; **Shang, SL**; Wilson, C. ***GEOPHYSICAL RESEARCH LETTERS,*** 2017. 44, DOI:10.1002/2017GL075525.

2017年5月18日，利用漂浮藻类遥感反演模型（Alternative Floating Algae Index, AFAI）处理的MODIS卫星遥感影像显示在我国东海分布有大量的漂浮藻类，其面积延伸至十几万平方公里的海域。该区域此前从未出现过如此大规模的藻华爆发，因此，此次爆发藻华的藻种类别，漂移路径以及成因都是需要探究的重要问题。由齐琳、商少凌与美国佛罗里达大学胡传民团队等人开展的此项研究使用不同时空尺度的多源卫星遥感数据，包括MODIS（1km，1-2幅/天），VIIRS（750m，1-2幅/天），GOCI（500m，8幅/天），OLI（30m，1幅/16天），结合数值模型HYCOM与实验室光谱测量，尝试进行该藻华种类的识别并追溯此次藻华发生的源头。结果显示，自2012年以来，这种藻华每年2-3月份开始都会在浙江沿岸的海域出现，之后随黑潮和台湾暖流漂移至韩国济州岛与日本南部，还有部分会随洋流进入我国黄海。通过查阅历史文献与相关新闻报道，这种藻华漂移路径的所覆盖范围恰好是马尾藻大量生长繁殖的区域。同时，利用遥感光谱数据分析显示，该藻华的光谱特征与实验室测量得到的马尾藻藻华光谱特征一致，因此可判断2017春季在东海所爆发的这次大型藻华为马尾藻金潮。

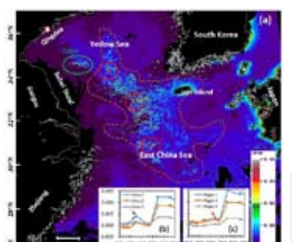
根据遥感反演结果，这次马尾藻金潮的实际总覆盖面积（假设将所有漂浮马尾藻聚拢在一起）约530 km^2，但其分布面积延伸达到~160,000 km^2，大大超过了历史上所能够监测到的黄海浒苔绿潮最大分布面积~40,000km^2（2015年6月21日）。通过处理历史遥感数据发现马尾藻金潮自2012年开始每年春季都会在东海爆发，但其规模与持续时间都较为有限。2015年东海曾出现过较大规模的金潮，但由于其分布范围集中在距离中国比较远的海域，因此受到的关注较少。

2017年春季东海大部分水域海水温度异常偏高、光照条件充足，加之我国东部沿岸不断攀升的水产养殖业导致大量的营养物质被排入海水中，可能是造成此次马尾藻大规模爆发的重要因素。

Abstract: A floating algae bloom in the East China Sea was observed in Moderate Resolution Imaging Spectroradiometer (MODIS) imagery in May 2017. Using satellite imagery from MODIS, Visible Infrared Imaging Radiometer Suite, Geostationary Ocean Color Imager, and Ocean Land Imager, and combined with numerical particle tracing experiments and laboratory experiments, we examined the history of this bloom as well as similar blooms in previous years and attempted to trace the bloom source and identify the algae type. Results suggest that one bloom origin is offshore Zhejiang coast where algae slicks have appeared in satellite imagery almost every February–March since 2012. Following the Kuroshio Current and Taiwan Warm Current, these “initial” algae slicks are first transported to the northeast to reach South Korea (Jeju Island) and Japan coastal waters (up to 135°E) by early April 2017, and then transported to the northwest to enter the Yellow Sea by the end of April. The transport pathway covers an area known to be rich in Sargassum horneri, and spectral analysis suggests that most of the algae slicks may contain large amount of *S. horneri*. The bloom covers a water area of ~160,000 km^2 with pure algae coverage of ~530 km^2, which exceeds the size of most Ulva blooms that occur every May–July in the Yellow Sea. While blooms of smaller size also occurred in previous years and especially in 2015, the 2017 bloom is hypothesized to be a result of record-high water temperature, increased light availability, and continuous expansion of Porphyra aquaculture along the East China Sea coast.

Key Points:

- An unprecedented massive floating algae bloom in the East China Sea is discovered, which appears to be Sargassum horneri
- The bloom is thought to be a result of increased water temperature, light, and expanded seaweed aquaculture along the ECS coast
- Bloom origin is traced back to coastal waters off Zhejiang coast, with a “hotspot” identified, yet other origins cannot be ruled out



MODIS AFAI image on 18 May 2017 covering the East China Sea and Yellow Sea.

物理海洋学与海洋遥感 Physical Oceanography and Remote Sensing

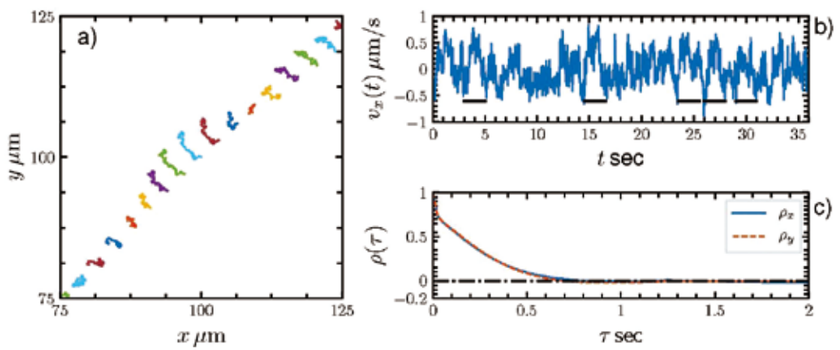
二维细菌湍流中的泰勒扩散
Taylor dispersion in two-dimensional bacterial turbulence

Huang, YX*; Ou, WY; Chen, M; Lu, ZM; Jiang, N; Liu, YL; Qiu, X; Zhou, Q. ***PHYSICS OF FLUIDS,*** 2017. 29, 51901, DOI:10.1063/1.4982898.

Yongxiang Huang (Reprint Author)

由细菌主动运动形成的群体运动展现了湍流特征，即存在不同时间–空间尺度漩涡的相互作用。在准二维溶液中，细菌的群体运动会形成类似于海洋中尺度涡结构(mesoscale turbulence)，从而有效提升细菌对营养物质的获取。黄永祥等人使用实验数据，通过数值求解拉格朗日方程，获取了准二维细菌湍流中虚拟颗粒的拉格朗日轨迹，并分析了单颗粒相对应的泰勒扩散，成功识别了两个扩算区间。发现相应的标度指数均大于正常扩散的标度值1/2，因而呈现超扩散现象。我们进一步检验了高阶统计矩，发现存在较为微弱的间线性修正。超扩散现象的识别证实了细菌主动运动可以更加有效获取营养物质这一假说。

Abstract: In this work, single particle dispersion was analyzed for a bacterial turbulence by retrieving the virtual Lagrangian trajectory via numerical integration of the Lagrangian equation. High-order displacement functions were calculated for cases with and without mean velocity effect. The two-regime power-law behavior for short and long time evolutions was identified experimentally, which was separated by the Lagrangian integral time. For the case with the mean velocity effect, the experimental Hurst numbers were determined to be 0.94 and 0.97 for short and long time evolutions, respectively. For the case without the mean velocity effect, the values were 0.88 and 0.58. Moreover, very weak intermittency correctionwas detected. All measured Hurst numbers were above 1/2, the value of the normal diffusion, which verifies the super-diffusion behavior of living fluid. This behavior increases the efficiency of bacteria to obtain food.



(a) Illustration of Lagrangian trajectories. (b) The Lagrangian velocity vx along the trajectory. The horizontal solid line indicates a time span 2 s. (c) Experimental autocorrelation function ρ(τ) for Lagrangian velocities v_x and v_y. The corresponding zero-crossing based Lagrangian time is ~ 0.75 s.

新技术与分析方法 New Technologies and Analytical Methods

过硫酸钠中性消解法测定天然水体中的总磷
Determination of total phosphorus in natural waters with a simple neutral digestion method using sodium persulfate

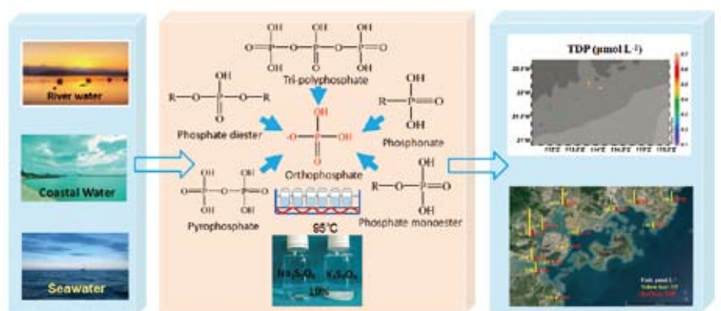
Ma, J*; Yuan, Y; Zhou, TJ; Yuan, DX. ***LIMNOLOGY AND OCEANOGRAPHY-METHODS,*** 2017. 15: 372-380.

Jian Ma (Reprint Author)

总磷浓度是描述海洋环境水质的重要指标，其测定方式是利用消解的方式将所有形态的磷转化为无机磷，之后通过分光光度法进行测定。马剑课题组采用溶解度高的过硫酸钠代替传统使用的过硫酸钾，亚沸水浴代替高压高温消解，建立了水环境中总磷的中性过硫酸钠消解法。本方法的消解时间为3 h，使用5 cm比色皿时检测限为0.02 μM。通过先加入抗坏血酸，再加入钼酸铵混合溶液的方式，可消除海水样品消解过程中产生的余氯影响。四种典型的有机磷实际海水基底加标回收率为88.5%-100.8%。应用本方法和国家标准（GB11893-89）过硫酸钾–高压灭菌法对28个实际水样进行测定，测定结果无显著性差异。

本方法操作简单，实用性强，可批量处理和现场应用，目前已成功实现三种不同类型水样的测定和南海A断面垂直剖面的现场测定。

Abstract: The determination of total phosphorus (TP) in an aqueous sample is based on digestion of the sample to convert phosphorus compounds into orthophosphate, which can then be determined based on spectrophotometry. The widely used oxidant, potassium persulfate, has poor aqueous solubility and requires careful handling with furnace, autoclave, or oven. Here, a very simple method for the determination of TP has been developed, using an inexpensive portable water boiler for neutral digestion and highly water soluble sodium persulfate instead of potassium persulfate. The key experimental factors have been evaluated and optimized. The optimal conditions for efficient TP determination were found to be 3 h of digestion time at sub-boiling temperature, followed by addition of ascorbic acid to eliminate free chlorine generated from the saline sample, and then addition of the ammonium molybdate reagent for detection by UV-Vis spectrophotometry. The detection limit is 0.02 μM using 5-cm cuvette. Under these optimized conditions, both artificial solutions containing model phosphorus compounds (n = 19) and natural water samples (n = 14) were analyzed using both sodium persulfate and potassium persulfate. There is no significant difference between the digestion performances of these two oxidants. This new method was used to analyze natural water samples (n = 28) in comparison with the standard autoclaving method using potassium persulfate. The analytical results using this method agreed very well with the standard method. Samples of different matrix were analyzed, showing the successful application of this method in both environmental monitoring (time series and spatial survey) and marine science (spatial and vertical distribution).



新技术与分析方法 New Technologies and Analytical Methods

制作按比率pH纳米传感器的细胞内成像的共沉淀方法
A co-precipitation strategy for making a ratiometric pH nanosensor for intracellular imaging

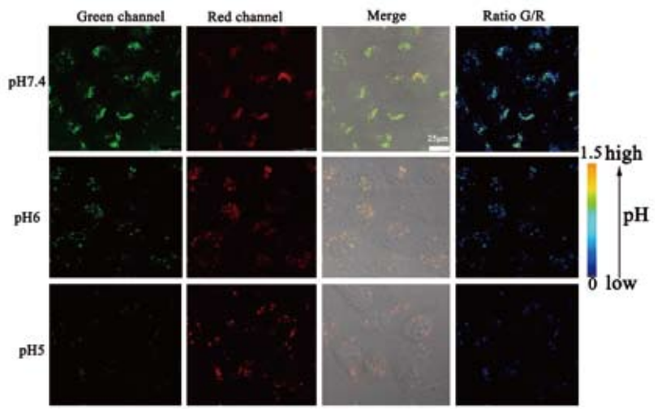
Yao, QH; Lu, SS; Lin, FY; Zhao, TT; Zhao, L*; **Chen, X***. ***SENSORS AND ACTUATORS B-CHEMICAL,*** 2017. 250: 484-490.

Qiuhong Yao (First Author)

Xi Chen (Reprint Author)

陈曦团队研究制备了一种新型的具有核–壳结构的比率式纳米氧传感。体系利用两亲共聚物聚苯乙烯-co-顺丁烯酸酐，将疏水的聚苯乙烯，5,10,15,20-4-(5-氟基)卟啉铂（TFPP）和π-共聚物化合物捆缚成核。通过静电吸附作用，在核外包裹上一层生物大分子多聚赖氨酸壳层，以提高粒子的生物相容性。多聚赖氨酸使粒子带正电，利于提高粒子在细胞内的负载率并协助粒子逃脱溶酶体的束缚。研究以荧光素为pH敏感探针，TFPP为参比染料。经过共沉淀作用，构建得到对溶液pH敏感且生物相容性好的比率式pH纳米传感粒子。该传感粒子具备粒径小，水中分散性好，荧光强，对pH的响应灵敏，可透过细胞膜等特点，与细胞共同孵育后，粒子透过细胞膜后主要分散于细胞质中，实现对细胞质真实pH环境的检测。

Abstract: A core-shell ratiometric pH nanosensor for intracellular imaging was made using a facile co-precipitation strategy. Fluorescein isothiocyanate (FITC), a pH sensitive probe with green fluorescence emission, was first conjugated to amino-terminated polystyrene (PS-NH_2). In the co-precipitation method, the FITCPS-NH_2, polystyrene, amphiphilic poly(styrene-co-maleic anhydride) and the reference fluorochrome, 5,10,15,20-tetrakis (pentafluorophenyl) porphyrin, were used to form nanosize hydrophobic cores in an aqueous phase. Finally, poly-L-lysine was selected and attached to the cores through electrostatic forces to improve the cytoplasmic compatibility of the nanoparticles. The prepared FITC doped polymer nanoparticles exhibited excellent ratiometric luminescence responses to pH change and had exceptional intracellular imaging performance as well. Using the prepared nanosensors, a sensing approach for the semi-quantitative pH detection of living cells was set up, revealing the potential applications in biological and biomedical pH detection.



Confocal microscopy images of FP@PLL NPs in Caski cells at pH 7.4, 6 and 5.

新技术与分析方法 New Technologies and Analytical Methods

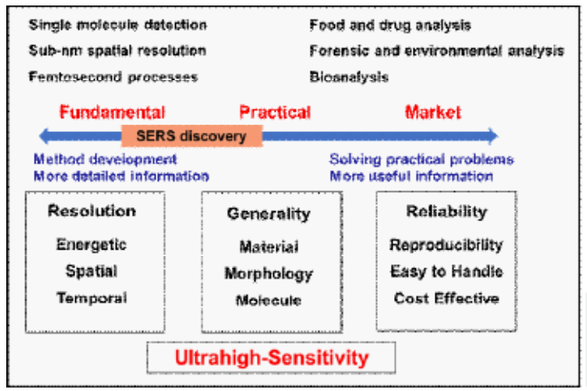
表面增强拉曼光谱：瓶颈与未来的方向
Surface-enhanced Raman spectroscopy: bottlenecks and future directions

Panneerselvam, R; **Liu, GK***; Wang, YH; Liu, JY; Ding, SY; Li, JF; Wu, DY; Tan, ZQ. ***CHEMICAL COMMUNICATIONS,*** 2017, DOI:10.1039/C7CC05979E.

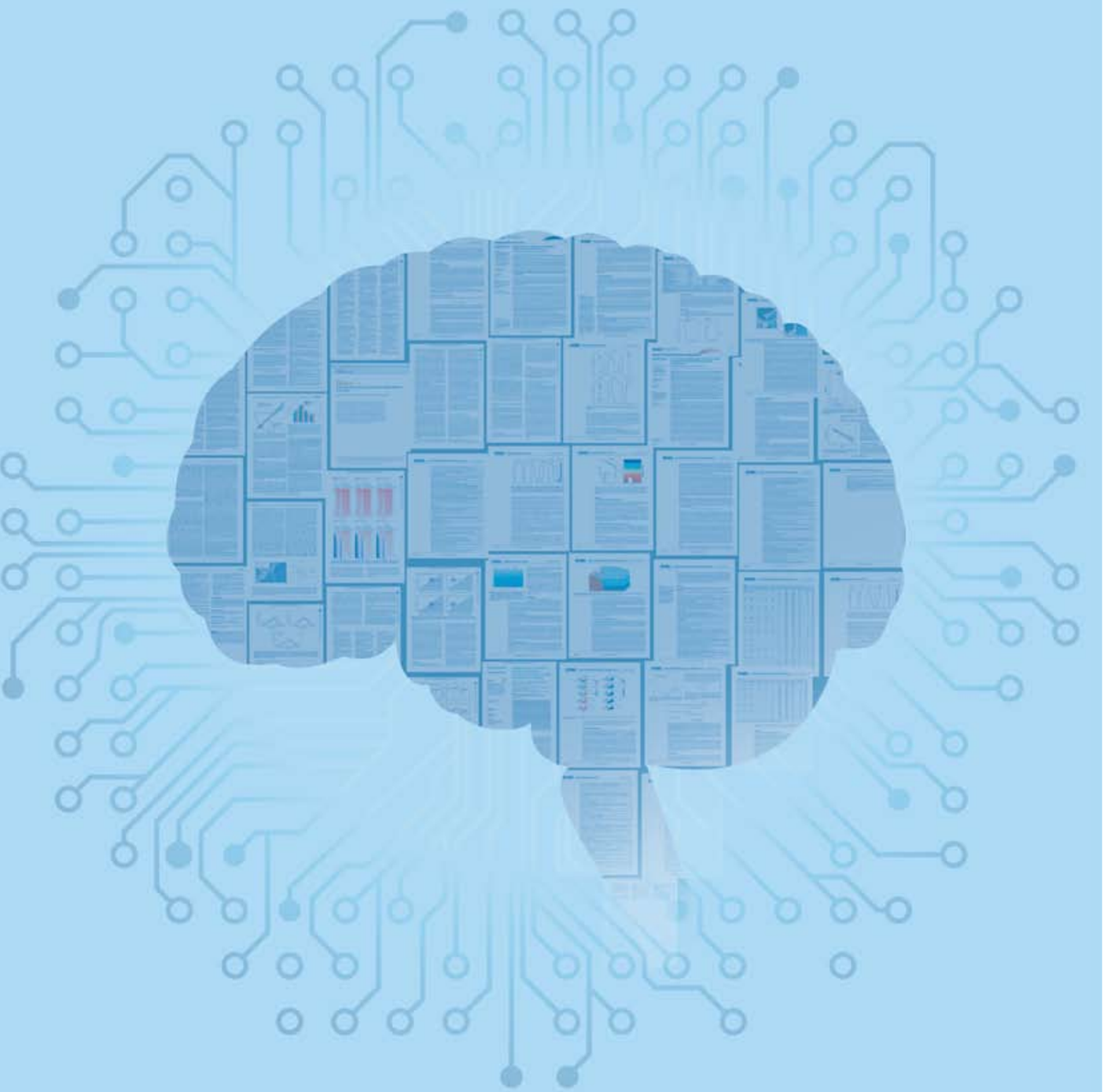
Guokun Liu (Reprint Author)

由刘国坤团队撰写的该文章主要讨论了过去四十年里，表面增强拉曼光谱（SERS）发展的瓶颈问题以及未来的发展趋势。永无止境的追求单分子检测的高灵敏度、亚纳米的高空间分辨尺度以及飞秒动力学的高时间分辨，是SERS基础科研的重点发展方向。如何将SERS技术发展成为一种普适性的检测工具，发挥其指纹图谱的高灵敏度特点，用于解决表面，材料，生命、环境、文物以及食品科学等各领域的实际问题，最终用于民生日常生活，则是SERS技术实际推广用的终极目标。

Abstract: In this feature article, we discuss in detail developmental bottleneck issues in Raman spectroscopy in its early stages and surface-enhanced Raman spectroscopy (SERS) in the past four decades. We divide SERS research into two different directions with different targets. Fundamental research is extending the limits of SERS to single-molecule, sub-nanometer resolution and femtosecond processes. In contrast, practical research is expanding the range of applications with the aim of providing versatile analytical tools for surface, materials, life, environmental, forensic and food sciences and also commercial instruments for use in daily life. In the second direction there have continually been many complex bottlenecks to be overcome. We attempt to enumerate the key issues in detail and also describe the achievements made to overcome the bottlenecks. In the last, but not least important part, we discuss the remaining bottlenecks and possible strategies for overcoming them to enable SERS to be an even more powerful and versatile technique.



Two different research directions of surface-enhanced Raman spectroscopy.



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Zhu, XX; Lin, JJ; Gao, AG; Wang, DH; Zhu, M. Simultaneous determination of rare earth elements in aqueous samples by online preconcentration system and inductively coupled plasma mass spectrometry. ***ATOMIC SPECTROSCOPY,*** 2017. 38: 77-85.

人员情况
PERSONNEL

获奖与人才计划 Awards and Recognition

◆ 戴民汉当选中国科学院院士
Minhan Dai was elected an academician of the Chinese Academy of Sciences.

◆ 焦念志获人力资源和社会保障部、中国科协、科技部、国务院国资委颁发“首届全国创新争先奖”
Nianzhi Jiao was named a recipient of the prestigious National Innovation Pioneer Award that was created by the Central Government in 2017.

◆ 汪冰冰、王杉霖入选国家高层次人才。
Bingbing Wang and Shanlin Wang were granted the National Recruitment Program for Young Professionals.

◆ 洪华生获厦门大学“南强杰出贡献奖”
Huasheng Hong was awarded the Nanqiang Distinguished Contribution Award by Xiamen University.

◆ 史大林获“第二十四届福建运盛青年科技奖”
Dalin Shi received the Science and Technology Award from Fujian Yunsheng Youth Foundation.

◆ 张瑶入选“2016年科技部中青年科技创新领军人才”、“第十四届福建青年科技奖”
Yao Zhang received support from the MOST Science and Technology Innovation Leading Talents Program and the 14th Science and Technology Award for Young Scholars of Fujian Province.

◆ 高坤山研究团队的成果“海洋酸化对初级生产过程的影响、机制及其生态效应”获福建省科学技术奖自然科学一等奖
Research by Kunshan Gao’s team on “The impact of ocean acidification on primary production, its mechanism and ecological effect” won 1st prize of the Fujian Provincial Science and Technology Award (Natural Science).

◆ 党宏月团队的研究成果“海洋附着微生物的生态过程和生物地球化学作用”、林森杰团队的成果“虫黄藻全基因组测序完成”入选2016年度中国海洋与湖沼十大科技进展
Research achievements related to "Ecological processes and biogeochemical functions of marine surface-associated microorganisms" by Hongyue Dang, and “Whole genome sequencing of *Symbiodinium kawagutii*” by Senjie Lin were listed as two of the "Top 10 Science and Technology Advances of China in Oceanology and Limnology in 2016" by the Chinese Society for Oceanology and Limnology.

新进人员 MEL New Members

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华东师范大学博士(2012)
厦门大学博士后（2013-2017）
德国奥尔登堡大学访问学者（2015-2016）
厦门大学助理教授（2017—至今）
PhD, East China Normal University (2012)
Postdoctoral Fellow, Xiamen University (2013-2017)
Visiting Scientist, Oldenburg University, Germany (2015-2016)
Assistant Professor, Xiamen University (2017-Present)

研究方向：
分子水平溶解有机质组成表征，利用超高分辨质谱和分子标志物示踪水体不同溶解有机质来源、迁移和转化过程
Research Interests: Molecular level characterization of dissolved organic matter, utilizing ultrahigh resolution mass spectrometry and molecular markers to trace the sources, transport and transform of different organic matter in aquatic environment

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美国斯克里普斯海洋研究所、台湾海洋大学访问学者（2014-2015）
厦门大学博士后（2013-2017）
厦门大学副教授（2017—至今）
Joint Doctoral Program, University of Tokyo, Japan (2009-2011)
PhD, Xiamen University (2012)
Visiting Scientist, Scripps Institute of Oceanography and National Taiwan Ocean University (2014-2015)
Postdoctoral Fellow, Xiamen University (2013-2017)
Associate Professor, Xiamen University (2017- Present)

研究方向：
海洋生态学、群落生态学
Research Interests: Marine ecology, community ecology

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德国基尔大学博士（2001）
台湾海洋大学应用地球科学研究所，洪堡访问研究员（2002-2003）
德国不来梅大学海洋环境研究中心，博士后、助理研究员（2002-2016）
厦门大学教授（2016—至今）
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Postdoctoral Researcher and Research Associate, Center for Marine Environmental Sciences, University of Bremen, Germany (2002-2016)
Professor, Department of Geological Oceanography, Xiamen University (2016-Present)

研究方向：
亚洲-澳大利亚古季风、太平洋和印度洋的古海洋学、浮游有孔虫的生态学、微量元素及稳定同位素组成、大洋边缘沉积物的供应控制过程
Research Interests:
Asian-Australian palaeo monsoon, palaeoceanography of the Pacific and Indian Ocean, ecology, trace element and stable isotopic composition of plankic foraminifera, understanding processes controlling sediment supply across/along ocean margins

流动人员 NEW ADJUNCTS

陈明茹 博士
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研究方向：
海洋鱼类生物学，尤其是中上层鱼类和板鳃鱼类的生殖生物学研究

Research Interests:
Marine fish biology, especially in reproductive biology of pelagic fish and elasmobranch

陈友淦 博士
Dr. Yougan Chen
chenyougan@xmu.edu.cn

研究方向：
水声通信、信道编码、协作通信与网络、编码协作

Research Interests:
Underwater Acoustic Communications, channel coding, cooperative communications and networking, coded cooperation

邓强 博士
Dr. Qiang Deng
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研究方向：
大气与海洋数值模型

Research Interests:
Numerial modeling of the atmosphere and ocean

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研究方向：
鱼虾遗传育种及病害防控

Research Interests:
Genetic breeding disease prevention and control of fish and shrimp

徐鹏 博士
Dr. Peng Xu
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研究方向：
鱼类基因组资源开发、经济鱼类的基因组辅助选育、种群遗传学和进化基因组学、鱼类适应性进化
Research Interests:
Fish Genomics and Genetics, Genome-assistant Breeding and Selection, Population Genetics and Evolution Genomics, Genetic Mechanism of Adaptive Evolution

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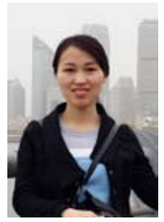
研究方向：
浮游生物学、微型浮游动物、原生动物学、分子和环境浮游生物学

Research Interests:
Planktology, Microzooplankton, Protozoology, Molecular and Environmental Planktology

新进博士后、研究员
New Postdoctoral Fellows and Research Scientists



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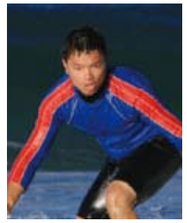

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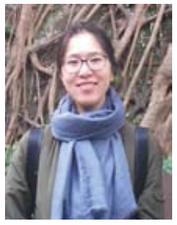

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Illustration 1: Sounding instruments used to measure the depth of the ocean. From The Physical Geography of the Sea (1855) by Matthew Maury. http://www.divediscover.whoi.edu/history-ocean/maury.html

Illustration 2: The Challenger Expedition, from the H.M.S. Challenger Library. http://www.hmsc.19thcenturyscience.org/

1700

1800

1855

1900

1872-1876

Sounding instruments to measure the depth of the ocean

The Challenger Expedition

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