IMBeR

Integrated Marine Biosphere Research

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MCS-CNS Annual Report 2020

The Mechanisms of marine carbon storage and

coupled carbon, nitrogen and sulphur cycles in response to global change (MCS-CNS)

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1. Selected highlights

1.a. Selected scientific highlights since last report

Last report was submitted to Brest SSC meeting, June 2019. Each highlight needs to be VERY short, bullet points, with a link to publication if applicable.

- ✓ Dissolved CH4 exhibited complex relations with oxygen in the Bohai Sea and three types of CH4 sources from seafloor were identified. Stratification hampered the upward transport of dissolved CH4 (Zhang et al., 2020).
- ✓ The bioavailability of coastal SDOM would directly influence the carbon budget at sediment-water interface, since we found that resuspension of labile SDOM into overlying seawater may weaken the role of sediment as a net sink of carbon (Cai et al., 2019) .
- ✓ Surface variability of chlorophyll-a at seasonal scale was found to be highly modulated by the photoacclimation process. The mixing-induced entrainment played an important role in the vertical redistribution of particles, especially during the winter bloom period in the northern South China Sea (SCS). Both the physical entrainment and photoacclimation were found to modulate the vertical distributions of chlorophyll-a and particles in an ACE (Xing et al., 2019).
- ✓ Finding three different kinds of physical forcings on mesopelagic sinking particle fluxes within less than a year at a single location in the SCS. Confirming the frequent impact of physical processes of various scales on SCS biogeochemistry and highlighting the important role of physical processes and episodic events (Zhang et al., 2019).
- ✓ Controlling processes of the North Yellow Sea (NYS) seasonal acidification were quantified. Net calcification rate declines to zero when seawater aragonite saturation state reaches 1.5–1.6. Calcification-unfavorable waters may exist in NYS subsurface layers all year round in the 2050 s. (Li and Zhai, 2019)
- ✓ Coastal bacterioplankton are able to quickly utilize and transform lysis products of picocyanobacteria, meanwhile, bacterial community varies with changing chemodiverisity of DOM. DOM released from picocyanobacteria generated a complex labile DOM pool, which was converted to a rather stable DOM pool after microbial processing in the time frame of days to weeks （Zhao et al., 2019）.

1.b. Publications since last report

Please add all publications since last report to the table below (see notes for details on "Class" and "Activity" fields).

***Publication** with DOI*	***Class 1, 2, 3***	***Activity****
Cai, R. H. *et al.* Microbial Processing of Sediment-Derived Dissolved Organic Matter: Implications for Its Subsequent Biogeochemical Cycling in Overlying Seawater. *Journal of Geophysical Research-Biogeosciences* **124**, 3479-3490, doi:10.1029/2019jg005212 (2019).	*3*	
Xing, X. G., Qiu, G. Q., Boss, E. & Wang, H. L. Temporal and Vertical Variations of Particulate and Dissolved Optical Properties in the South China Sea. *Journal of Geophysical Research-Oceans* **124**, 3779-3795, doi:10.1029/2018jc014880 (2019).	*3*	
Zhang, J. J. *et al.* Enhancement of Mesopelagic Sinking Particle Fluxes Due to Upwelling, Aerosol Deposition, and Monsoonal Influences in the Northwestern South China Sea. *Journal of Geophysical Research-Oceans* **124**, 99-112, doi:10.1029/2018jc014704 (2019).	*3*	
Liu, W. W. *et al.* Evidences of aromatic degradation dominantly via the phenylacetic acid pathway in marine benthic Thermoprofundales. *Environmental Microbiology* **22**, 329-342, doi:10.1111/1462-2920.14850 (2020).	*3*	
Wang, Y. Z., Feng, X. Y., Natarajan, V. P., Xiao, X. & Wang, F. P. Diverse anaerobic methane- and multi-carbon alkane-metabolizing archaea coexist and show activity in Guaymas Basin hydrothermal sediment. *Environmental Microbiology* **21**, 1344-1355, doi:10.1111/1462-2920.14568 (2019).	*3*	
Chen, X., Liu, J. H., Xu, Y. L., Wang, Y. N. & Yan, X. J. Erythrobacter nanhaiensis sp. nov., A Novel Member of the Genus Erythrobacter Isolated from the South China Sea. *Current Microbiology* **76**, 57-62, doi:10.1007/s00284-018-1584-z (2019).	*3*	
Hou, N. K. *et al.* OxyR senses sulfane sulfur and activates the genes for its removal in Escherichia coli. *Redox Biology* **26**, doi:10.1016/j.redox.2019.101293 (2019).	*3*	
Li, C. L. & Zhai, W. D. Decomposing monthly declines in subsurface-water pH and aragonite saturation state from spring to autumn in the North Yellow Sea. *Continental Shelf Research* **185**, 37-50, doi:10.1016/j.csr.2018.11.003 (2019).	*3*	
Priyadarshani, W. N. C. *et al.* Seasonal and interannual variability of coccolithophore flux in the northern South China Sea. *Deep-Sea Research Part I-Oceanographic Research Papers* **145**, 13-30, doi:10.1016/j.dsr.2019.01.004 (2019).	*3*	
Chen, S. Z. *et al.* Population dynamics of methanogens and methanotrophs along the salinity gradient in Pearl River Estuary: implications for methane metabolism. *Applied Microbiology and Biotechnology* **104**, 1331-1346, doi:10.1007/s00253-019-10221-6 (2020).	*3*	
Zhao, Z. *et al.* Microbial transformation of virus-induced dissolved organic matter from picocyanobacteria: coupling of bacterial diversity and DOM chemodiversity. *Isme Journal* **13**, 2551-2565, doi:10.1038/s41396-019-0449-1 (2019).	*3*	
Zhang, Y., Chen, B. & Zhai, W. D. Exploring Sources and Biogeochemical Dynamics of Dissolved Methane in the Central Bohai Sea in Summer. *Frontiers in Marine Science* **7**, doi:10.3389/fmars.2020.00079 (2020).	*3*	

Ran, M. X. et al. Sensitive Method for Reliable Quantification of Sulfane Sulfur in Biological Samples. Analytical Chemistry 91, 11981-11986, doi:10.1021/acs.analchem.9b02875 (2019).	*3*	
Liu, D. X. *et al.* Synechococcus sp. Strain PCC7002 Uses Sulfide:Quinone Oxidoreductase To Detoxify Exogenous Sulfide and To Convert Endogenous Sulfide to Cellular Sulfane Sulfur. *Mbio* **11**, doi:10.1128/mBio.03420-19 (2020).	*3*	
Yang, Y. *et al.* A new sea surface temperature proxy based on bacterial 3-hydroxy fatty acids. *Organic Geochemistry* **141**, doi:10.1016/j.orggeochem.2020.103975 (2020).	*3*	

**If appropriate, please list the IMBeR activity through / by / from / during which the publication arose*

****<u>***Notes on publications***</u>****

Publications are logged in the IMBeR Zotero library which is publicly accessible online - https://www.zotero.org/groups/2448334/imber_library_2/library

[Due to space limitations, publications from 1999-2017 are in a separate Zotero library - https://www.zotero.org/groups/38770/imber_library_1/library]

Publications are categorised by "Class" and linked to "Activities":

<u>***Class 1 publications***</u> are specifically generated through/by/from/during <u>***IMBeR activities***</u> - for example, arising from IMBIZOs and IMBeR conferences such as the IMBeR open science meeting and the IMBeR CJK symposia and from the activities of the working groups, regional programmes and the SPIS scoping teams.

<u>***Class 2 publications***</u> are on topics relevant to the IMBeR Science Plan that benefitted from some interaction with IMBeR or <u>***IMBeR activities***</u>, for example by IMBeR symposium attendees, past and present SSC members, working group, regional programme and endorsed project members, or national contacts.

<u>***Class 3 publications***</u> are on topics relevant to the IMBeR Science Plan but for which there is no direct link to or benefit from an IMBeR activity. These might include publications by SSC members, working group, regional programme or endorsed project members or members of the IMBeR international community that were written as part of the normal scientific activity of the authors and would have occurred irrespective of IMBeR's existence. You can report Class 3 publications, but they will no longer be logged in the IMBeR database.

[See https://drive.google.com/open?id=1OQWn41KJvQ-LyWJlkiYnc5qZ2IuNQOrg or https://pan.ecnu.edu.cn/p/DTrpUb4QiFAYoQ4 for further information on "What is an IMBeR publication?".]

<u>***Why list 'Class' and 'Activity'?***</u> This helps us to declare authentically which publications IMBeR has helped to generate, and it makes it easier for us to demonstrate the value of the Regional Programmes, the Working Groups, the Endorsed Projects, and IMBeR in general, and it helps us to justify support for IMBeR activities when we can list tangible outputs.

1.c. Events, Meetings, and Workshops

List all international and national events, meetings and workshops. Describe the level of participation: e.g. chairing session/workshop, organising meeting. Include Endorsed Project meetings and workshops.

- ✓ Annual academic meetings for the project, Jan 4, 2020. Hanzhou, China.

All members of the project attended the meeting and discussed the progress on carbon cycle, coupled carbon-nitrogen cycle and carbon-sulphur cycle.

- ✓ *2. The 2019 academic exchanging meeting of the national key projects on Global Climate Change and Response, Dec 15, 2019, Beijing, China.*

2. International collaboration and links

Dr. Lihua Ran participated IODP 385 cruise in Guaymas Basin, Gulf of California. The cruise is to explore the feedbacks between continental rifting, magmatism, sedimentation, thermal alteration of organic matter, and microbial activity. During the cruise, Dr. Lihua Ran, as a marine micropalentologist, is a menber of the stratigraphic group, and for the post cruise research, Dr. Lihua Ran will work on the impact of microbial activity, hydrothermal activity and igneous activity onmarine silica cycle in the east equatorial Pacific.

3. Education and outreach

Ten students got the Master degree and nine students got Doctoral degree.

5. Planned activities for next year

Activities and Outreach (Convening sessions, meetings, etc)

The 5th International Conference on Geobiology, June 21-24, 2021, Wuhan