SILICAMICS 3

Biogeochemistry and genomics of silicification and silicifiers

12-15 October 2021

Second Institute of Oceanography, Hangzhou (China)
& on line

SILICAMICS 3

Biogeochemistry and genomics of silicification and silicifiers

12-15 October 2021

Second Institute of Oceanography, Hangzhou (China)

& on line

The SILAMICS conferences aim to develop an integrative approach that includes chemistry, biogeochemistry, biochemistry, physiology and genomics to better understand biosilicification and silicifiers in past, contemporary and future oceans.

BACKGROUND

Silicifiers are among the most important organisms on planet Earth. They are able to take advantage of the abundance of silicon (the second-most-abundant element in the Earth's crust) to build silica structures, which can help for protection against predators, for motility, or for facilitating the penetration of light and nutrients. At the same time, silicifiers have a paramount impact on the cycling of silicon, carbon and other nutrients in marine waters.

The SILICAMICS transdisciplinary conference focuses on the marine realm, for which numerous unknowns still remain regarding the global marine silica cycle. Marine diatoms have dominated over siliceous sponges and radiolarians over the last 150 M years. Today diatoms play a key role in the trophic networks of the most productive coastal and open-ocean ecosystems, as well as in the biology-mediated transfer of CO2 from the surface to the ocean interior (i.e. the biological carbon pump). The physiology and biochemistry of biosilicification have been studied in diatoms and other silicifiers but many gaps remain regarding mechanisms, evolutionary significance, variations in response to environmental change and the impact of these processes on marine biogeochemistry. Moreover, benthic diatoms and their role in coastal ecosystems have been largely overlooked despite significant contributions to coastal primary production. Along the same vein, the roles of other siliceous organisms, such as benthic sponges, rhizaria and silicoflagellates in the silica cycle, are starting to be better constrained at a global scale.

In the last two decades, the genomes of several diatom species have been sequenced. Scientific programs (such as Tara Oceans and the Gordon and Betty Moore Foundation's projects) have provided additional DNA sequence information from diatoms as well as from other silicifying organisms. Genomics data can now be exploited to address fundamental research questions about the role of different silicifiers in coastal and open-open ecosystems, and their controls on C, N, P, and Si biogeochemical cycles. The interactions between silicifiers and other organisms are starting to be elucidated at different spatial and temporal scales, and their impact on nutrient cycling and ecosystem functioning are now being addressed. It is an exciting time to study the biology of ocean silicification processes.

The first SILICAMICS conference, organized by the IUEM (University of Brest, France) held in l'Aber Wrac'h (near Brest, France) in September 2015. It provided an extraordinary opportunity to develop interdisciplinary connections between researchers with expertise and interest in silicification and silicifiers and to learn about the latest advances in the silicon world. This conference concluded with the organization of a special issue in Frontiers in Marine Science (Moriceau et al 2019), that includes 13 manuscripts, and with the publication of a review paper in Nature Geoscience (Tréguer et al., 2018).

The second SIMICAMICS conference, held at the University of Victoria (British Columbia, Canada) in June 2018, continued developing interdisciplinary connections between experts in Si cycles, and the biology and genomic of silicifiers. Among the major outputs from this conference is the implementation of an international SILICA SCHOOL which brings together students and teachers of 31 institutes from 12 different countries. Launched in November 2020, it provides a transdisciplinary e-learning experience for a Master of Marine Science degree, as a Short Private On-line Course (SPOC). A second output is the publication of a review article in Biogeosciences on the Si biogeochemical cycle in the modern ocean (Tréguer et al. 2021) that incorporates a decade of new knowledge about net input/output fluxes, and new estimates of biogenic silica production of plankton and sponges at world ocean scale.

SILICAMICS 3

To further develop an integrative approach that includes chemistry, biogeochemistry, biochemistry, physiology and genomics to better understand biosilicification and silicifiers in past, contemporary and future oceans, the SILICAMICS 3 conference will facilitate once more the exchange of information between scientists from different 'silicon' disciplines and expertise, with the aim of moving forward in our understanding of the impact of silicifiers on Earth.

The third SILICAMICS conference is organized by the Second Institute of Oceanography, Ministry of Natural Resources (P.R. China). It will take place in October 2021 in Hangzhou (capital city of Zhejiang Province, China) and on-line.

OBJECTIVES

(1) to enhance interactions among researchers from different disciplines, such as chemistry, biochemistry, physiology, biogeochemistry and genomics, for a better understanding of silicification processes and the role of silicifiers in marine ecosystems,

(2) to facilitate a constructive dialogue between top-level senior scientists and early-career researchers through a Gordon-like conference format that will provide valuable and challenging opportunities for mutual learning

(3) to build a niche for preparing future research proposals to obtain national and international research funding.

THEMES

After an introduction on the potential role of silicon for building block for life, this conference comprises invited conferences, oral and poster communications, about 7 themes, which include: Past variations in the global silica cycle; Updating the Si cycle in the modern ocean; Genomic and proteomic tools for silicifiers; Pelagic and benthic silicifiers; Silica cycle in coastal ecosystems; Isotope chemistry providing tools for processes and fluxes; Modelling the Si cycle and silicifiers in the modern and future ocean.

SCIENTIFIC COMMITTEE

- Kate Hendry (University of Bristol)
- Su Mei Liu (Ocean University of China)
- Manuel Maldonado (CSCIC, Blanes)
- Aude Leynaert (CNRS, IUEM-UBO, Brest)
- Brivaela Moriceau (CNRS, IUEM-UBO, Brest)
- Jill Sutton (IUEM, Brest)
- Paul Tréguer (IUEM-UBO, Brest)
- Jianfang Chen (SIO, Hangzhou)
- Fei Chei (SIO, Hangzhou)
- Fabrice Not (CNRS, Sorbonne University)

ORGANISING COMMITTEE

- Jianfang Chen (SIO, Hangzhou)
- Fei Chei(SIO, Hangzhou)
- Lihua Ran (SIO, Hangzhou)

ABSTRACTS

On the Potential of Silicon as a Building Block for Life

Janusz Jurand Petkowski

Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology

© Janusz Jurand Petkowski

Janusz Jurand Petkowski

Janusz J. Petkowski is an astrobiologist who works as a Research Scientist in the Department of Earth, Atmospheric and Planetary Sciences at the Massachusetts Institute of Technology (MIT). He is interested in biosignature gases, theoretical biochemistry, and in research leading to finding life outside Earth.

ABSTRACT

Despite more than one hundred years of work on organosilicon chemistry, the basis for the plausibility of silicon-based life has never been systematically addressed nor objectively reviewed. We present a comprehensive assessment of the possibility of silicon-based biochemistry. We assess whether or not silicon chemistry meets the requirements for chemical diversity and reactivity as compared to carbon. To expand the possibility of plausible silicon biochemistry, we explore silicon's chemical complexity in diverse solvents found in planetary environments, including water, cryosolvents, and sulfuric acid. In no environment is a life based primarily around silicon chemistry a plausible option. We find that in a water-rich environment silicon's chemical capacity is highly limited due to ubiquitous silica formation. Any sort of biochemistry is implausible in cryogenic solvents, because of solubility limits. Sulfuric acid, surprisingly, appears to be able to support a much larger diversity of organosilicon chemistry than water. We should therefore think about silicon as a contributor to biochemistry (as a common heteroatom in hypothetical sulfuric acid biochemistry and a specialized heteroatom in water solvent) rather than a main building block of life.

Causes and consequences of past variations in global Si cycling

Patrick J. Frings

GFZ German Research Centre for Geosciences in Potsdam, Germany

© Patrick Frings

Patrick Frings

Patrick Frings studied Environmental Geography and Quaternary Science in London, UK, where he first became interested in Si biogeochemistry. Following a PhD in Lund University, Sweden, that investigated silicon cycling in modern rivers and wetlands, he his now a postdoctoral fellow at the GFZ German Research Centre for Geosciences in Potsdam, Germany. His research focuses on the development and application of 'novel' stable isotope tools to trace present and past weathering and biogeochemical cycling.

ABSTRACT

Silicon cycling is intimately coupled with many other elements, due to the central role Si plays in both the inorganic rock cycle and in biological nutrient cycling. Perhaps the most important coupling is with the carbon cycle, where Si and C are intertwined on long-timescales by weathering reactions, and on shorter timescales via biological activity. These issues, and more, provide considerable incentive to understand the global Si cycle and its interactions with other elemental cycles. The modern Si cycle on land and in the oceans is reasonably well understood. On land, ecosystems dominated by vascular plants stimulate the release of dissolved Si through weathering of silicate minerals. This ultimately makes it way to the ocean, where it feeds an diatom-dominated ocean Si cycle. Yet modern terrestrial ecosystems and diatoms are both relative newcomers on the evolutionary scene. The global Si cycle, and the element cycles coupled with Si, may have fundamentally changed as these ecosystems, and those they replaced, appeared and evolved. Here, I will discuss the evidence for, and implications of, long timescale changes in continental and oceanic Si cycling. In particular, I will address how and why weathering fluxes of dissolved Si may have varied, and the constraints that can be placed on past land-to-ocean Si fluxes from marine sedimentary records. I will also address the impact of radiolarian and sponge appearance around the Ediacaran-Cambrian transition. They have long been thought to have induced a reduction in oceanic Si concentrations, though the timing and magnitude of any decrease are poorly known. Simple box-models suggest they likely brought about a transition to a nearly-modern ocean Si cycle. A compilation of new and existing chert Si isotope data suggests this drawdown should be placed before the main phase of the Cambrian explosion. Together, these arguments lead to the speculation that lower oceanic Si made conditions more favourable for the main stage of the Cambrian Explosion, by reducing the energy expenditure required to maintain safe intracellular Si levels. These examples underscore the dual role of Si biogeochemistry as both an archive and a driver of Earth system evolution.

Impacts of global change on the silicon cycle in the world ocean

Paul J. Tréguer[1,2]

1 Univ Brest, CNRS, IRD, Ifremer, Institut Universitaire Européen de la Mer, LEMAR, Rue Dumont d'Urville, 29280, Plouzané, France, 2 State Key Laboratory of Satellite Ocean Dynamics (SOED), Ministry of Natural Resource, Hangzhou 310012, China

© Paul Tréguer

Paul Tréguer

Paul J. Tréguer is a marine biogeochemist of the Marine Institute for Marine Studies (IUEM), University of Brest (UBO). He recently co-authored the book « Ocean – evolving concepts », published by Wiley eds. He is interested in the biogeochemistry of the polar seas and of the coastal ocean. Since 1995, he led the publications of three review articles on the world ocean silica cycle.

ABSTRACT

Tréguer et al. (2021) recently published an updated version of the Si cycle of the world ocean, showing a possible steady state scenario at 15.6 Tmol Si yr-1 (see Figure 1). Here, I revisit the different input and outputs fluxes, especially those which need improvements, like the inputs of silicic acid due to the dissolution of minerals (including turbulent dissolution of sand grain dissolution on beaches under the pressure of the intensive and continuous shaking by the waves), and the biogenic silica long-term burial fluxes. A potential source of silicic acid in the North Pacific deep ocean is also discussed. The potential impacts of global change on the Si cycle are presented, which include the impacts on riverine inputs of silicic acid / amorphous silica, and of other anthropogenic impacts at regional scale, and the impacts of climate change on the production of pelagic and benthic silicifiers at world ocean scale.

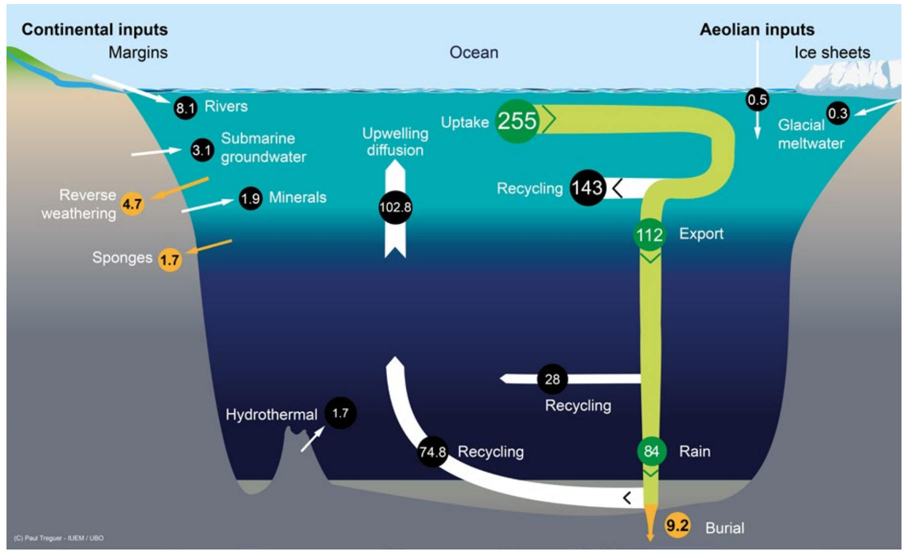


Figure 1 : schematic view of the Si cycle in the modern world ocean (input, output, and biological Si fluxes), and possible balance (total Si inputs = total Si outputs = 15.6 Tmol Si yr-1) in reasonable agreement with the individual range of each flux (F). All fluxes are in teramoles of silicon per year (Tmol Si yr-1), in Tréguer et al. (2021)

The Silica School

Jill N. Sutton

Univ Brest, CNRS, IRD, Ifremer, Institut Universitaire Européen de la Mer, LEMAR, Rue Dumont d'Urville, 29280, Plouzané, France

Jill Sutton

Jill Sutton is an Assistant Professor in the department of biology at the University of Brest (UBO, France) and is affiliated with the European Institute for Marine Science (IUEM, France). She is a marine biogeochemist and is interested in the evolution of marine biogeochemical cycles and the development of biogeochemical proxies, for example natural abundance silicon and boron stable isotopes in marine organisms. She also created the Silica School SPOC (an online course) with Professor Paul Tréguer (UBO-IUEM, France).

ABSTRACT

The "Silica School" project to develop on online course titled "Silica: from stardust to the living world" launched June 2018 during the "Silicamics 2" conference hosted at the University of Victoria (Canada). The principle objective of the Silica School was to highlight the current level of knowledge on silica research by offering an interdisciplinary graduate level e-learning opportunity (SPOC; small private online course) to member universities and institutes of the "Silica School Consortium". The Silica School Consortium currently includes individuals associated with universities and scientific agencies and/or institutes that offer upper level undergraduate and graduate level education and research opportunities (i.e. international student exchanges and internships). The Silica School SPOC is an e-learning opportunity created by Dr. Jill Sutton and Professor Paul Tréguer (European Institute for Marine Studies, University of Brest). It is an e-learning experience (a small private online course, or SPOC) hosted by the University of Brest on the subject of "Silica: from stardust to the living word" that examines the role of silica under four major themes: (1) Silica in the Universe, (2) Silica in the Ocean, (3) Silicifiers in the living world, and (4) Silica in the future. The objective of the SPOC is to offer students the tools and knowledge to help them better understand the importance of silica in the natural world alongside the opportunity to interact with international experts studying silica in the fields of chemistry, biology, geology, and physics. The Silica School SPOC also offers a platform for international opportunities in postgraduate interdisciplinary education by providing teaching resources between international partner universities. An update on the project and new developments will be presented at Silicamics 3.

Pelagic and benthic silicifiers

Si utilization by sponges: a review of recent advances

Manuel Maldonado

CEAB, CSIC, Blanes, Spain

Manuel Maldonado

Dr. Manuel Maldonado is a senior scientist of the Spanish National Research Council (CSIC) at the Centre for Advances Studies of Blanes (CEAB), where it founded the group of Sponge Ecobiology and Biotechnology (SEB). His research has addressed diverse aspects of the biology and ecology of marine sponges, with especial emphasis on the utilization of silicon by these organisms. In this latter field, he attempts to combine molecular and cell biology approaches to decipher the intricacies of sponge silicification with investigations on the ecological and biogeochemical effects that the utilization of silicon by sponges has on the marine ecosystems. By such a relatively multidisciplinary, broad-spectrum endeavor, it is pursued to obtain an integrative, global perspective on this challenging subject.

ABSTRACT

Sponges are relevant silicon (Si) users that accumulate impressive stocks of biogenic silica in their populations and also in the marine sediments. These processes are not inconsequential to the ecological and biogeochemical functioning of the ecosystems. Here, the main steps of Si cycling through a sponge aggregation will be summarized, exemplifying how the partial dissolution of the sponge silica deposited to the sediments triggers a feed-back mechanism that provisions bottom water with silicic acid to sustain sponge growth and, in the long run, the persistence of the population. We will also show that the portion of sponge silica remaining in the sediments becomes an important Si sink at both the local and global levels. Furthermore, the silicon isotopic signal (delta30Si) of the sponge silica in the sediments has an increasing applicability in palaeoceanography studies. Here we will revisit the global database of sponge silica utilized to infer past changes in the concentration of silicic acid (DSi) and will present novel data on the Si isotope composition of the silica produced by demosponges cultured under experimental DSi concentrations. We will also present new ultrastructural findings on the silicification process of sponges revealed by electron microscopy and will discuss all these findings in the light of the Si transport system recently discovered in sponges. From this set of recent advances, strategies and guidelines will be formulate for future research on Si utilization by sponges, its ecological significance, and the biochemical implications.

Rhizaria in the silicon cycle: new kids on the block

A. Leynaert [1], N. Llopis Monferrer, P. Tréguer, J. Sutton, F. Not

1 Univ Brest, CNRS, IRD, Ifremer, Institut Universitaire Européen de la Mer, LEMAR, Rue Dumont d'Urville, 29280, Plouzané, France

Aude Leynaert

Aude leynaert is a CNRS senior scientist and she works at "Marine Environmental sciences Laboratory" (LEMAR) in the European Institute for Marine Studies (IUEM). She is a marine biogeochemist, particularly focusing on the silica cycle. She has worked for a long time on pelagic diatoms by measuring their biogenic silica production with 32Si. More recently, she looked at the contribution of benthic, and sympagic diatoms and also at other silicifing organisms, such as rhizarians and sponges.

ABSTRACT

In 2015, at the first SILICAMICS conference, it became apparent that many unknowns remain regarding the global cycle of marine silica. One of these gaps concerned siliceous rhizarias. Since then, it has been shown that on a global scale, these protists would represent 1/3 of the biomass of the large zooplankton in the upper water column, highlighting an unexpected role of this taxon in the biological carbon pump. A review of existing data, combined with recent work, shows that these protists also play an underestimated role in the silica cycle. They are by far the most silicified planktonic organism in the ocean, and their contribution to silica production could reach 19%. This contribution would be almost equally distributed between small (< 600µm) and large individuals, and there would be as many in the surface layer as in the mesopelagic zone. However, the factors that control their distribution and their growth rate are not yet well understood, nor how they share the silicic acid resource with the other silicified organisms. In addition, we discuss the Antarctic Rhizaria paradox, i.e., the potentially high accumulation rates of biogenic Si due to Rhizaria in siliceous sediments despite their low production rates in surface waters.

Disentangling polar biogeochemistry through (silicon) isotope geochemistry

Katharine Hendry1, Jade Hatton, Jon Hawkings, Hong Chin Ng, Helena Pryer, James Ward, and Amber Annett

1 School of Earth Sciences, Faculty of Science, University of Bristol, Wills Memorial Building, Queen's Road, Bristol BS8 1RJ


Katharine Hendry

Kate Hendry is a biogeochemist and chemical oceanographer at the University of Bristol, interested in understanding nutrient cycling in the modern ocean, and the link between past climatic change, ocean circulation, nutrient supply and biological productivity. She has a particular fascination with the polar regions, and has worked extensively in both the Antarctic and Arctic.

ABSTRACT

The polar regions are home to important and dynamic components of the silicon cycle, from subglacial weathering to biological production and carbon sequestration in marine sediments by silicifiers. The Arctic, parts of the Antarctic, and glaciated mountain ranges (the 'third pole') are also some of the most climatically sensitive locations on Earth, where the most dramatic warming and associated physical and chemical changes have been observed in recent decades. If we are to comprehend the implications of anthropogenic climate change for future oceans, we need to examine how such rapid change in the polar regions could be either amplified or mitigated by silicon cycle feedback mechanisms. Here, we will explore polar silicon cycling through the lens of isotope studies.

Subglacial weathering in polythermal ("wet-based") glacial systems—mobilises silicon, both in dissolved form (DSi) and as reactive, amorphous particulates. However, the degree to which (and rate at which) this bioavailable silicon reaches the ocean or remains trapped within coastal fjord systems by physical, chemical and biological processes remains a matter of debate. Another major unknown is the role of fjord and marine sediments in silicon cycling: are particulate reactive silica phases (glacial weathering products, biogenic opal) preserved within sediments, or does sedimentary cycling release DSi back into the overlying water? We can use stable silicon isotopes to begin the careful disentangling of these different processes, each of which results in different—but overlapping—fractionation. We use Arctic and Chilean Patagonian case studies to illustrate how these silicon isotope measurements can be coupled together with trace metals and their stable isotopes, and radioisotopes, to build a more complete picture of the nature and rates of important silicon cycling components that are active in glaciated environments.

The Si cycle in the coastal ocean

Su Mei LIU[1,2], Xiaoyan Ning[1], Paul Tréguer[3]

1 Frontiers Science Center for Deep Ocean Multispheres and Earth System, and Key Laboratory of Marine Chemistry Theory and Technology MOU, Ocean University of China (sumeiliu@ouc.edu.cn; nxy@ouc.edu.cn); 2 Laboratory for Marine Ecology and Environmental Science, Qingdao National Laboratory for Marine Science and Technology, China; 3 Institut Universitaire Européen de la Mer, Université de Bretagne Occidentale, France (Paul.Treguer@univ-brest.fr)


Su Mei Liu

Su-Mei LIU is a professor of Chemical Oceanography at Ocean University of China. Her research focuses on nutrient cycles, nitrogen isotopes, silicon dissolution, environmental evolution, atmospheric nutrient deposition, social-ecosystem interactions.

ABSTRACT

The availability and composition of nutrients affect phytoplankton primary productivity and composition of phytoplankton species. The silica cycle is intimately related to marine primary production and carbon export, food webs and trophic structure of aquatic systems. The Chinese marginal seas, which are facing rapid environmental changes with land-use change, increase in population and pollution drainage in the watersheds, aquaculture, over-fishing, and climate change, are characterized as a river-dominated margin, with the major Chinese estuaries (such as the Changjiang and Huanghe) exporting up to 4-15% of nutrients required for phytoplankton production and diatom growth. In this presentation, the Chinese marginal seas, composed of the Bohai (BH), Yellow Sea (YS), East China Sea (ECS), and South China Sea, are given as an example as a unique and interesting system to address the Si cycle in the coastal ocean. The riverine input of dissolved silicate (DSi) display different trends. The Three Gorges Reservoir had a rather limited impact on dissolved nutrient concentrations at the river mouth over the period 2003–2016, that is, after full operation of the Three Gorges Dam, dissolved silicate remained most likely stable with a possible weak increase over the last 10–20 years. During 2001 to 2018, DSi concentrations in the lower reach of Huanghe showed decreasing trends throughout the study period, and extremely low nutrient concentrations were observed since 2014 in response to the retention effect of large reservoirs. In the Chinese marginal seas, Si fluxes delivered by submarine groundwater discharge (SGD) exceed the riverine inputs for the BH, YS, and ECS. Si production is mainly supported by regenerated dissolved silicate, and most of the BSi that reaches the sediment-water interface is accumulated in sediments. For the BH and YS, mainly import Si flux is SGD. For the ECS shelf, Si flux imported through Taiwan Warm Current Water flow and the invasion of Kuroshio water is more than 3 times SGD delivery. Further studies should include reverse weathering, silica dissolution of aerosols, and production of biogenic silica.

References:

Liu J., J. Du, L. Yi, 2017a. Ra Tracer-Based Study of Submarine Groundwater Discharge and Associated Nutrient Fluxes into the Bohai Sea, China: A Highly Human-Affected Marginal Sea. Journal of Geophysical Research: Oceans, 122 (11), 8646-8660.

Liu J, Su N, Wang X, et al. Submarine groundwater discharge and associated nutrient fluxes into the Southern Yellow Sea: A case study for semi-enclosed and oligotrophic seas-implication for green tide bloom. Journal of Geophysical Research: Oceans, 2017b, 122(1), 139-152.

Wang X, Baskaran M, Su K, et al., 2018. The important role of submarine groundwater discharge (SGD) to derive nutrient fluxes into River dominated Ocean Margins–The East China Sea. Marine Chemistry, 204: 121-132.

Wu, Bin, Su Mei Liu, Jing Ling Ren, 2017. Dissolution kinetics of biogenic silica and tentative silicon balance in the Yellow Sea. Limnology and Oceanography, 62, 1512-1525.

Wu, B., Liu, S.M., 2020. Dissolution kinetics of biogenic silica and the recalculated silicon balance of the East China Sea. Science of The Total Environment, 743, 140552

Wu, Nian, Su-Mei Liu, Gui-Ling Zhang, Hong-Mei Zhang, 2021. Anthropogenic impacts on nutrient variability in the lower Yellow River (Huanghe), Science of The Total Environment, 755, 142488

Zhang, Jing, Ya Nan Du, Guo Sen Zhang, Yan Chang, Ying Chun Zhou, Zai Feng Zhang, Ying Wu, Jia Wei Chen, An Yu Zhang, Zhuo Yi Zhu, Su Mei Liu, 2021. Increases in the seaward river flux of nutrients driven by human migration and land-use changes in the tide-influenced delta. Science of the Total Environment 761, 14450

An integrated view of diatom interactions

Flora Vincent, Charlotte Nef & Chris Bowler

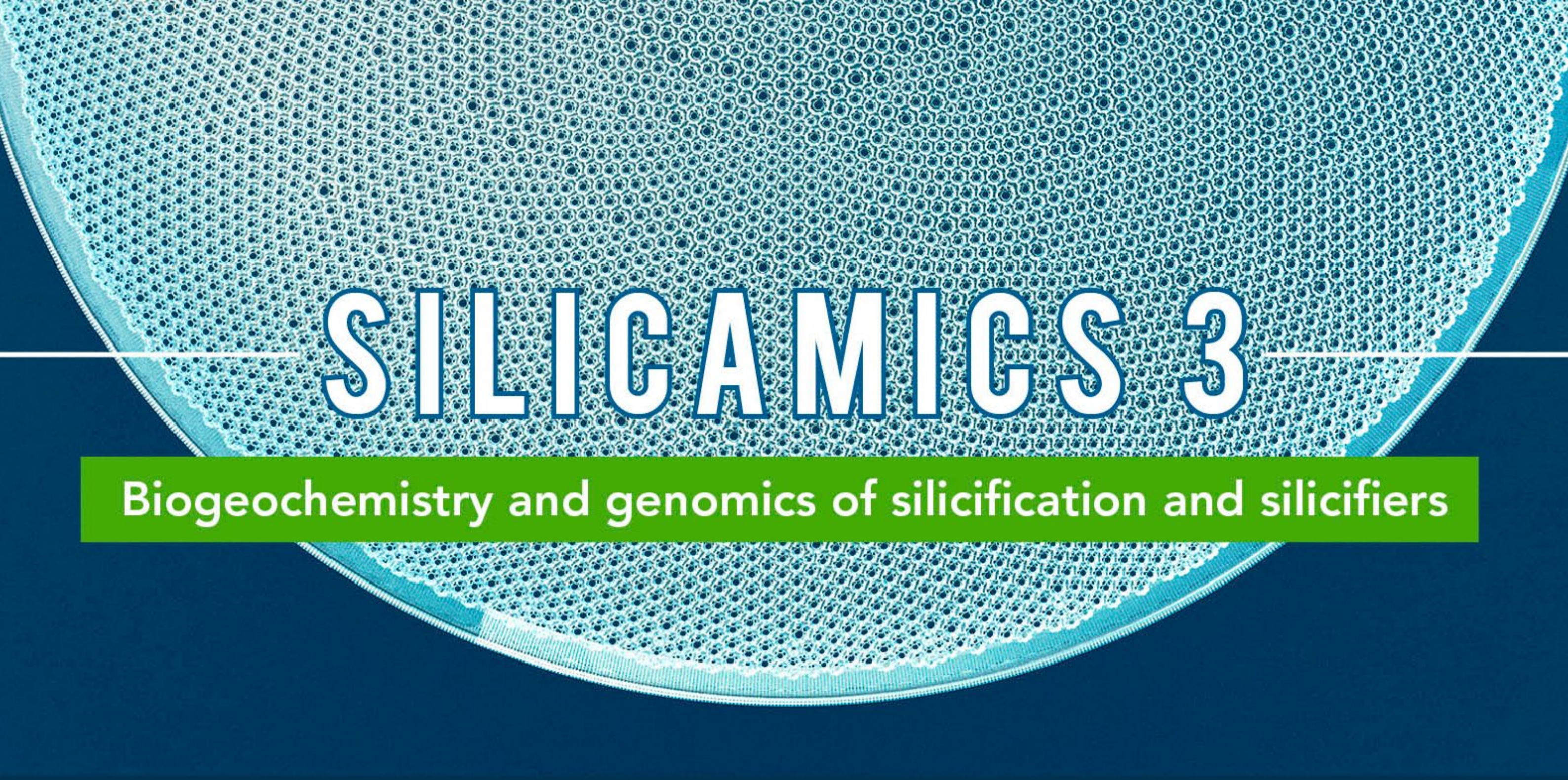
Institut de Biologie de l'ENS (IBENS), Département de biologie, École normale supérieure, CNRS, INSERM, Université PSL, 75005 Paris, France

Chris Bowler is Director of Research at CNRS and head of the Laboratory of Plant and Algal Genomics at the Institut de Biologie de l'Ecole Normale Supérieure in Paris. His major research interest is in understanding the response of plants and marine diatoms to environmental signals. In marine diatoms he established molecular tools to assess gene function and he has played a major role in coordinating the whole genome sequencing of several species, as well as coordinating the Tara Oceans project.

Chris Bowler

ABSTRACT

Marine microbial communities, composed of bacteria, archaea, and protists, as well as viruses, play essential roles in the functioning and regulation of Earth's biogeochemical cycles and in providing resources at the base of marine food webs. Their roles within planktonic ecosystems have typically been studied under the prism of bottom-up research, namely, understanding how resources and abiotic factors affect their abundance, diversity, and functions. However, how species interact with each other is critical to form the ecosystems that sustain life on Earth. Top down direct interactions (such as symbiosis, viral infection, epibiosis) drive co-evolution, influence species distribution, contribute to ecosystem stability, and affect global biogeochemical cycles. Diatoms are an extremely good case study for exploring biotic interactions. They are pivotal in marine microbial communities and are known to interact with numerous other organisms in the ocean. These interactions can provide insights about why diatoms can thrive in oligotrophic waters, how they can outcompete other organisms in eutrophic conditions, and ultimately how these interactions impact plankton communities and evolution.



12-15 October 2021

Second Institute of Oceanography, Hangzhou (China) & on line

https://www-iuem.univ-brest.fr/silicamics-3/?lang=en