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Marine Particles and Phycospheres 2019 – SSM Report

This was a highly successful conference on all levels. It brought together a new cross-section of the scientific community, and this resulted in very vibrant discussions, poster sessions, and the start of multiple new collaborations. The excitement of participants was palpable, and attendees nearly unanimously expressed the wish for this meeting to be held again in the future. The topic is highly contemporary, with multiple groups across the US, Europe and Australia devoting new efforts to the understanding of these microscale processes in the ocean, and with major philanthropic organizations (Simons Foundation, Moore Foundation) allocating sizeable funds to these and closely related topics. The well-organized logistics at Monte Verita', the friendly and helpful personnel on site, and the relaxed and pleasant atmosphere not only contributed greatly to the positive outcome of this meeting, but also made for an excellent showing of ETH Zurich, the CSF, and the Swiss scientific environment overall. For the organizers, this was clearly 'mission accomplished'.

Metabolic and ecological interactions that occur between marine microbes have emerged as key drivers of ocean biogeochemistry. Recognition of such an important role for microbial interactions was unanticipated only a few years ago, with marine microbes conceptualized as passive recyclers of carbon and nutrients scavenged from seawater. Recently, new research positioned cell-cell interactions as major regulators of ocean element cycles. This conference focused on the developing biogeochemical implications of microbial interactions in two critical microscale hotspots of the ocean: the phycosphere and marine particles.

The scientific communities studying the phycosphere and marine particles often moved in separate circles, despite the clear links and parallels between the two processes. A main concept underpinning this conference was that bridging the two communities would offer much added value to both, and could lead to new ways of conceptualizing and integrating the two processes. Recent field efforts in the oceanographic community, including the *Tara Oceans* expeditions, have highlighted the global importance of microbial interactions based on patterns of species co-occurrence and evidence for abundant symbiotic and parasitic microbial species. Similarly, large international research efforts and collaborations, with substantial philanthropic backing from organizations such as the Simons and Moore Foundations, have begun to focus on interrogating the fundamental mechanisms of microbial interactions. The mechanistic understanding of interactions for both particle and phycosphere microenvironments is undergoing rapid expansion across research disciplines, as demonstrated by an increasing presence of this theme in high-impact journal publications, and by growing synergies between biologists, engineers, chemists, mathematicians, and physicists. This conference provided the opportunity to bring together leading scientists with complementary expertise and perspectives, with the aim of forging new cross-disciplinary discourse and collaborations.

Throughout the conference, we heard invited presentations from preeminent researchers spanning the physics, chemistry, and biology of these two critical oceanic microenvironments. The consensus was that invited talks, but also contributed talks, were of the highest quality, showing great effort and preparation by speakers, and reflecting the cutting-edge nature of the scientific topic. A recurring theme was the desire to better integrate the two groups of scientists, who currently often work independently from each other, into a more coherent and coordinated scientific community. The interdisciplinary nature of both, presenters and attendees led to the identification of some fundamental lines of inquiry that have the potential to drive the community forward as a whole. This theme was

further driven by the use of a brainstorming activity focuses on big-picture directions for the field. During this activity, groups were formed with a broad range of academic experiences and were tasked with identifying the most pressing open questions in the connected world of particles and phycospheres. After discussing amongst group members, attendees returned for a conference-wide discussion of driving questions in our newly emerging field. A major outcome of this activity was the identification of key focus areas, that were often consistent between individual groups. This activity and the themes identified within it, have the potential to drive this scientific community forward in a manner that incorporates concepts from diverse scientific disciplines. It will be particularly powerful in inspiring young scientists, who obtained not only a holistic view of the field based on its history, but also a projection of what the most pressing questions and challenges are going forward, thus likely shaping their views and directions as they move on to their independent careers.

Conceptual and technical challenges involved in studying microbial interactions at miniscule scales have led to date to a focus on macroscale lines of inquiry using bulk analysis tools, which overlook mechanisms central to microscale phenomena such as particle and phycosphere processes. By bringing together researchers from diverse backgrounds, we aimed to provide a fresh, interdisciplinary, and inter-community view of the processes in these two important microenvironments and to contribute to understanding how they scale-up to affect global biogeochemical cycles. Such a fundamental understanding is critical to grasping how the microbial ecology of the oceans will shift in a rapidly changing world. Beyond the effort of sharing, comparing and disseminating new paradigms in our understanding of marine particles and phycospheres, this conference aimed to dig into recent technological breakthroughs, such as advanced imaging, single-cell genomic and metabolic analyses, and molecular biology techniques, which are beginning to offer novel glimpses into phycosphere and particle processes. Many of these technical advancements are still in their infancy and beyond common reach. During the conference, we carried out a second brainstorming activity focused on emerging technologies to answer critical questions surrounding these two microenvironments. The interdisciplinary nature of our attendees led to a vigorous and stimulating discussion about existing techniques that were common in one scientific discipline, but not in others. Out of this activity many attendees were exposed to techniques that are not well known, but have large applicability within our community. Another outcome of this activity was a large discussion about scientific reproducibility and the drive for standardization of the techniques we use across these two related, but often separate fields. With the launch of standardization efforts, both fields and our understanding of microscale oceanic processes stand to benefit tremendously.

A great many attendees expressed their deep appreciation for the timeliness of this conference and the quality of all activities, including in particular presentations, but also posters and brainstorming events. The logistics allowed us to ‘keep’ all attendees on site for each of the evenings of the conference, where intense follow-up scientific discussions happened on the terrace well into midnight for each evening. This was truly a pleasure to witness. Through careful consideration of the separate fields involved in the study of these oceanic phenomena and critical discourse on the current and emerging paradigms, this conference has shaped the future of this important and rapidly evolving field. It appears very likely that a second edition will be planned, possibly at the same site if that is a possibility, or possibly elsewhere, in approximately two years time.

The organizers would like to sincerely thank those who sponsored this conference. The Congresso Stefano Franscini, The Swiss National Science Foundation, The Swiss Society for Microbiology, The Simons Foundation, and ETH Zürich. Without the generous support of these sponsors, we would have been unable to craft a conference of this quality and impact.

Sincerely,
Roman Stocker
ETH Zürich
(On behalf of the organizers)