COVER IMAGE

Phytoplankton bloom off the Atlantic coast of Patagonia. Two strong ocean currents stir up a colourful brew of floating nutrients and microscopic plants. The image was captured on 21 December 2010 by the Moderate Resolution Imaging Spectroradiometer on NASA's Aqua satellite. Seven separate spectral bands are used to highlight differences in plankton communities across the bloom. Image: © Photri Images/Alamy

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Marine cycles in flux

A multitude of minute organisms inhabits the marine realm. Collectively, these microbes largely govern not only the ocean's productivity, but also — through their influence on biogeochemical cycles — its role in mediating Earth's climate. Like life itself, the web of feedbacks between the biology, chemistry and physics of the seas is constantly evolving, as is our grasp of the mechanisms that link these fields in the oceans. In this *Nature Geoscience* Insight we highlight some of the frontiers of change, both in the microbial biogeochemistry of the oceans, and in our understanding of the processes at play.

When it comes to the cycling of elements in the ocean, the physical and chemical setting in which these cycles operate is shifting. Human activities have triggered a plethora of changes in the marine realm, the dramatic loss of seasonal sea ice in the Arctic, the rise in surface water temperatures and carbon dioxide concentrations and the loss of subsurface oxygen being some of the most notable. All of these changes will initiate a biogeochemical response.

In terms of our understanding of the ways in which the oceans operate, it is probably the ocean interior that holds the most surprises. Just a decade or two ago, the biodiversity of the dark ocean, below the sunlit surface layer, was virtually unknown. Thanks to rapid developments in autonomous submarine vehicles and other technological tools that can withstand the enormous pressures and corrosive conditions that characterise the deep sea, our appreciation and knowledge of life at depth is growing rapidly.

Humans rely on the oceans not just for food, but for a whole host of ecosystem services — perhaps the most climatically significant being the uptake of large quantities of anthropogenic carbon dioxide. Only if we understand which processes and players in the marine environment are key to a fully functional ocean do we have any hope of noticing dangerous developments and trying to counter them. We are in a race against time: we need to explore the biogeochemical balance of the ocean before human actions have changed it beyond recognition.

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Anna Armstrong, Senior Editor

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