Oceanographers solve mystery of phytoplankton survival in nutrient-poor Pacific

February 15 2018

UCI oceanographers have discovered that phytoplankton communities in the eastern equatorial Pacific recycle and retain iron in their upper-ocean habitat. A key nutrient, the metal enables them to consume nitrogen, carbon dioxide and other elements to reproduce and grow. Credit: PublicDomainPictures.net

Upwelling in the eastern equatorial Pacific Ocean provides essential nutrients for the region's microscopic plants, but iron – a key ingredient that facilitates nitrogen consumption – is in short supply. To compensate, the phytoplankton band together to recycle the scarce metal and retain it in their upper-ocean habitat, scientists at the University of California, Irvine have discovered.

"For decades, oceanographers have understood the vital, fertilizing role iron plays in the ocean environment," said UCI's Patrick Rafter, lead author on a recent study in *Nature Communications*. "Aquatic plants will not take up nitrogen in the absence of the metal, which is a limiting factor in their reproduction and growth." He will present his findings today at the 2018 American Geophysical Union Ocean Sciences Meeting.

This understanding is important, according to Rafter, an assistant project scientist in Earth system science, because these organisms help regulate the global climate by pulling atmospheric carbon dioxide into the ocean. But certain conditions are necessary for that process to occur.

"There is very little iron entering the ecosystem in this part of the world, which is quite different from what we see in the Atlantic, with huge amounts of metal-carrying dust from the Sahara Desert blowing over it," said co-author Katherine Mackey, UCI Clare Boothe Luce Assistant Professor of Earth System Science. "And at the same time, you have upwelling, driven by ocean circulation and winds, which brings very nitrogen-rich water to the surface."

The observed productivity of Pacific phytoplankton amid this nutrient imbalance has long puzzled oceanographers.

Searching for geochemical clues to explain nitrogen consumption and plant growth in iron-poor waters, Rafter analyzed sediment cores dating back a million years, and he collected water samples aboard a research vessel hundreds of miles west of the Galapagos Islands.

This informed the early-career oceanographer's understanding of the amount of nitrogen being taken up by phytoplankton, which are the basis of the ocean food web. "But I got to the point where I said, 'Wait a minute – iron really is the thing,'" he said. "No matter how I baked the calculations, I could not explain the nitrogen consumption based on the iron being supplied to the system."

Rafter consulted with Mackey, who provided input and numerical tools for solving the problem. Crunching differential equations in what they referred to as a "box model," the scientists concluded that the phytoplankton must be employing some strategy to hold iron within the upper ocean.

"When we say iron is recycled in the system more efficiently than other elements, it doesn't sound like this big, profound statement, but for those of us who have been studying these communities, it's actually a very important insight into how the system works, how marine plant life functions in the ocean," Rafter said. "This microbial community has figured out a way to fertilize itself with iron."

The paper places considerable emphasis on the biological and chemical processes of nitrogen, iron and CO_2 uptake, but the researchers also focused on the basic physics involved in the changing patterns of ocean circulation and upwelling over time, which have a bearing on broader environmental issues.

"What happens in a decade or a century or a million years?" Rafter said. "Our model proves that if you change the rate at which waters are brought up to the surface, you can allow for more or less iron recycling and self-fertilization by phytoplankton. And then you get more nitrogen consumption and, ultimately, more of this plant growth that can affect the ocean/atmosphere partitioning of carbon dioxide – which impacts the global climate."

More information: Patrick A. Rafter et al. Recycled iron fuels new production in the eastern equatorial Pacific Ocean, *Nature Communications* (2017). DOI: 10.1038/s41467-017-01219-7

Provided by University of California, Irvine

Citation: Oceanographers solve mystery of phytoplankton survival in nutrient-poor Pacific (2018, February 15) retrieved 28 April 2024 from https://phys.org/news/2018-02-oceanographers-mystery-phytoplankton-survival-nutrient-poor.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.