Science in Synch

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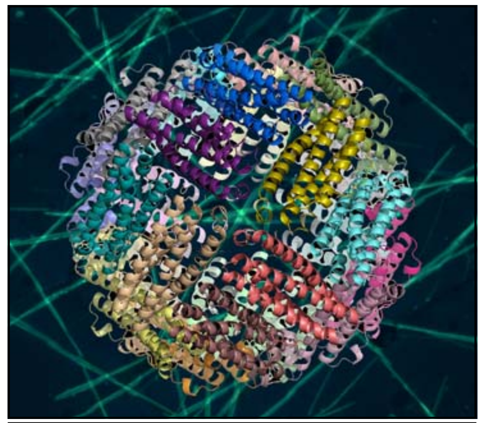
Putting the Bloom on the Diatom

University of British Columbia researchers Michael Murphy and Angele Arrieta used the Canadian Light Source and the Stanford Synchrotron Radiation Laboratory synchrotrons to determine the molecular structure of ferritin, an iron storage protein recently discovered in a group of phytoplankton called pennate diatoms. The discovery, made by a team of scientists from the University of Washington and UBC that included Murphy and Arrieta, sheds light on how the ferritin contributes to the diatoms' success and possible future implications for combating atmospheric carbon dioxide. The work was published in the journal *Nature.*



Molecular model of the ferritin protein from the diatom *Pseudo-nitzschia multiseries*, the green objects in the image background.
Image courtesy of Adrian Marchetti, University of Washington.

Diatoms are unicellular plants that account for much of the primary productivity in the world's oceans, and are responsible for most of the 'snow' that is seen falling through the water column in videos of deep-sea exploration. As with most organisms, the availability of nutrients such as iron limits the growth and population size of diatoms. Finding enough iron for metabolism is a struggle for most forms of life (think of anemia, caused by iron deficiency in the blood). Many creatures, ranging from bacteria to mammals, make use of ferritin proteins to store iron.

"It was surprising to find that this family of diatoms contains ferritin, when most diatoms do not," said Murphy. "It's been even more surprising to find that this ferritin is genetically distinct from all other forms of ferritin found in bacteria or animals."

Most diatoms are dependent on the iron they can scrounge from the ocean, mostly from dust blown offshore or from upwellings from the ocean bottom, with a rapid flourishing of the tiny algae when iron is available, followed by die offs once the supply runs out.

The particular diatom species investigated by the UW/UBC research group have come up with the genes necessary to make ferritin and store iron, allowing them to dominate plankton blooms after an iron input.

"I came in to show that these genes actually were making ferritin, and the synchrotrons helped us do that," explained Murphy.

The ability to cache iron has given this group of diatoms a competitive advantage, enabling them to dominate areas of the world's oceans that are typically iron-poor, such as in the expanses around the Antarctic. At the same time, their perseverance also allows them to take quick advantage of times of iron influx, for example, with the ferritin-producers contributing to inshore blooms that cause shellfish bans along the BC coast.

The study's findings have implications for understanding the nature of plankton blooms, including so-called geoengineering schemes that call for fertilizing the world's oceans with iron, with the resulting plankton growth drawing more carbon dioxide out of the atmosphere, consigning it to the ocean bottom when the blooms die.

"This is only the first step in learning about how this system works. We really don't understand the causes of these blooms or their effects on the rest of the environment when they occur," said Murphy. "It would be a bad idea until we do know, and we still have much to learn."

Fast facts:

- Using the CLS, scientists identified the molecular structure of ferritin, and iron storage protein recently found in diatoms.
- Diatoms are unicellular plants that make up much of the primary productivity in the world's oceans, absorbing CO_2 as they grow. Those that can produce ferritin can accumulate the most iron and dominate phytoplankton blooms.
- The discovery is key to understanding how iron is used by phytoplankton, and how the resulting blooms influence atmospheric CO_2.

Reference: Marchetti et al. 2009. Ferritin is used for iron storage in bloom-forming marine pennate diatoms. *Nature* 457, pp. 467-470.

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Canadian Light Source Inc. University of Saskatchewan, 101 Perimeter Road, Saskatoon, SK Canada S7N 0X4
Phone: (306) 657-3500 Fax: (306) 657-3535