

## MARUM / GLOMAR Expert Course:

### Microbial CO<sub>2</sub>-fixation in the (dark) ocean: bio(geo)chemistry & ecology

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#### Objectives

Organisms capable of chemoautotrophic metabolism are an integral part of ecosystems and are likely to be one of the earliest organisms that evolved on Earth. They serve an important function by making inorganic carbon available to other organisms, a central component of the global carbon cycle, and by closing element cycles, including the S- and N-cycle. The balance between the fixation of inorganic carbon and its release through heterotrophic processes is primarily responsible for the carbon dioxide and oxygen concentrations in the atmosphere. For many years, the doctrine prevailed that the Calvin-Benson-Bassham (CBB) cycle is the only biochemical autotrophic CO<sub>2</sub> fixation pathway of significance in the ocean. However, ecological, biochemical, and genomic studies carried out over the last decade have not only elucidated new pathways, but also shown that autotrophic carbon fixation via pathways other than the CBB cycle can be significant, especially in the aphotic depth of the ocean. This has obvious ramifications for our understanding of the carbon cycle and energy flow in the ocean. Alternative carbon fixation pathways are widespread in anaerobic and (hyper)thermophilic chemoautotrophic microorganisms, supporting the idea that they are ancient and were of much greater importance (also in comparison to the CBB cycle) in the geological past before the rise of oxygenic phototrophs.

This course will provide an in depth treatment of autotrophic processes in the ocean and the underlying mechanisms, ranging from evolution and biochemistry to ecology. The course will also offer an opportunity for students to discuss the recent literature (see below).

#### Time

09.00 – 13.00

#### Location

MARUM, University of Bremen, 28359 Bremen, Germany  
Building I, room 2060

#### To subscribe

To subscribe to this course, please fill in the [registration form](#).

Any enquiries concerning the course should be addressed to [glomar-courses@marum.de](mailto:glomar-courses@marum.de).

#### Paper to be discussed

see over

to be determined, but options are:

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to be determined, but options are:

1. Swan et al., 2011. Potential for Chemolithoautotrophy Among Ubiquitous Bacteria Lineages in the Dark Ocean. *Science*. 333:1296-1300.
2. Canfield et al., 2010. A Cryptic Sulfur Cycle in Oxygen-Minimum-Zone Waters off the Chilean Coast. *Science*. 330:1375-1378.

### **Background reading**

1. Aristegui J, JM Gasol, CM Duarte, GJ Herndl. 2009. Microbial oceanography of the dark ocean's pelagic realm. *Limnology & Oceanography* 54:1501–29.
2. Dick GJ, K. Anantharaman, BJ Baker, M Li, DC Reed, and CS Sheik. 2013. The microbiology of deep-sea hydrothermal vent plumes: ecological and biogeographic linkages to seafloor and water column habitats. *Frontiers in Microbiology*. 4:124.
3. Hügler M, and SM Sievert. 2011. Beyond the Calvin Cycle: Autotrophic Carbon Fixation in the Ocean. *Annual Review of Marine Science*. 3:261-289.
4. Ulloa O, DE Canfield, EF DeLong, RM Letelier, and FJ Stewart. 2012. Microbial oceanography of anoxic oxygen minimum zones. *Proceedings of the National Academy of Sciences USA*, 109: 15996–16003.