Environment and nutrient control of nitrogen fixation

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Key Considerations

Biological nitrogen (N_2) fixation has great biogeochemical implications in nitrogen cycling, which is the major source of new nitrogrn input to the oceans and controls the marine primary productivity. Numerous factors can affect the extent of N_2 fixation. A better understanding of the major environmental factors and nutrient status controlling this process is required. Iron (Fe) and phosphorus (P) are thought to be co-limiting factors in most regions. Special attention has been given to studying the effects of mineral dust deposition which is believed to promote N_2 fixation through increasing availability of both Fe and P. Recently, the effects of ongoing climate change (ocean warming and acidification) on N_2 fixation drew much attention, but various studies led to controversial conclusions.

Methods & Results

The impact of Fe on natural N_2 fixation was investigated via field incubation experiments using natural phytoplankton assemblages in the Bay of Biscay and along the Iberian Margin during the BELGICA cruise in May 2014. N_2 fixation rates in oligotrophic waters were greatly stimulated through the addition of dissolved Fe, demonstrating the limitation of N_2 fixation by Fe.

Three bioassays (+Fe, +P, +Dust) incubation experiments were performed in the laboratory to examine the effects of nutrient and dust additions on *Trichodesmium* IMS-101. The results indicate that dissolved Fe, P and dust additions could stimulate both the *Trichodesmium* growth and N_2 fixation.

Semi-continuous dilution culture experiments were conducted on *Trichodesmium* IMS-101 under future high pCO_2 (400 & 800 ppm) and warming seawater (24 & 28°C) conditions. The preliminary findings suggest that future ocean warming and acidification may be beneficial for *Trichodesmium* growth and possibly for N_2 fixation as well.