The complex response of the chlorarachniophyte *Bigelowiella natans* to iron availability.

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The productivity of the ocean is largely dependent on iron availability, and marine phytoplankton has evolved sophisticated mechanisms to cope with chronically low iron levels in vast regions of the open ocean. The diverse strategies for overcoming iron limitation include efficient acquisition of a range of iron sources, as well as functional replacement of iron-containing enzymes. *Bigelowiella natans* is a model marine chlorarachniophyte with a secondary plastid containing a remnant nucleus called nucleomorph. By analyzing the metabarcoding data generated by the Tara Oceans expedition, we described how its global distribution varies across regions of different iron concentrations. We performed a comprehensive proteomics analysis of the molecular mechanisms underpinning the adaptation of *B. natans* to iron scarcity and report on the temporal response of cells to iron enrichment under culture conditions. Our results highlight the role of phytotransferrin in iron homeostasis and indicate the involvement of CREG1 protein in the response to iron availability. Analysis of the Tara Oceans metagenomes and metatranscriptomes also point to a similar role for CREG1, which is found to be widely distributed among marine plankton but to show a strong bias in gene and transcript abundance towards iron deficient regions. Our analyses allowed us to define a new subfamily of the CobW domain-containing COG0523 putative metal chaperones which are involved in iron metabolism and are restricted to only a few phytoplankton lineages in addition to *B. natans*. At the physiological level, we elucidated the mechanisms allowing for a fast recovery of PSII photochemistry after resupply of iron. Collectively, our study demonstrates that *B. natans* is well adapted to dynamically respond to a changing iron environment and suggests that CREG1 and COG0523 are important components of iron homeostasis in *B. natans* and other phytoplankton.