Molecular responses of phytoplankton to iron limitation

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学　位　論　文　概　要

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（和訳）　植物プランクトンの鉄制限に対する分子応答

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学位論文概要

The present study showed that marine phytoplankton employ several strategies to compensate Fe stress whether it is due to low total Fe or low Fe availability. The present study reveals that marine phytoplankton produce different proteins under low total Fe and ligand-induced Fe-limited conditions. Protein expression under different Fe conditions also varied within phytoplankton species (*Prymnesium parvum*, *Skeletonema marinoi-dohrnii complex* and *Pleurochrysis roscoffensis*). This study also reveals that several proteins are differentially expressed in marine phytoplankton *P. parvum* in response to different exposure levels of nitrate, phosphate and iron. The expression levels of an 83 kDa protein in *P. parvum* can be used as biomarker of N-status, while a 121 kDa protein can be used as a biomarker of P-deplete condition in aquatic systems. In addition, two protein can be used as biomarker of Fe-status (deplete or replete conditions) in aquatic systems. Under Fe-limited condition, marine phytoplankton *P. parvum* alters some of its cellular biochemical processes by up-regulating proteins that are assumed to be involved in Fe uptake, photorespiration, and reduction of oxidative stress in the cells. *Prymnesium parvum* may increase Fe uptake efficiency by increasing Fe acquisition sites (mediated by ABC transporters) when they are grown under Fe-limited condition. Under Fe-limited condition, *P. parvum* may also increase photorespiration which needs high metabolic energy. The phytoplankton may satisfy the demand of high metabolic energy by increasing ATP synthase in chloroplast. Oxidative stress in phytoplankton is thought to be induced by Fe-limitation. *P. parvum* is assumed to up-regulate oxidative stress response proteins MnSOD and STK to minimize the oxidative stresses by inactivating the access electrons in the cells. It was also found that carbohydrate degradation and glycolytic activity was increased under Fe-limited conditions. Marine phytoplankton *P. parvum* also alters its cellular biochemical processes by up-regulating several proteins involved in photosynthesis. The phytoplankton also increased biosynthesis of PSII component proteins under Fe-limited conditions.