Iron limitation promotes partial inhibition of the photosynthetic electron transport in the diatom Phaeodactylum tricornutum

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Iron limitation is the major factor controlling phytoplankton growth in vast regions of the oceans. We have used thermoluminescence (TL), chlorophyll fluorescence and P700 absorbance measurements to elucidate the effects of iron deficiency in the photosynthetic electron transport of the marine diatom *Phaeodactylum tricornutum*. First, the effects of iron limitation on photosystem II (PSII) activity were determined by TL and chlorophyll fluorescence measurements. Excitation of iron-replete *P. tricornutum* cells with single turn-over flashes induced the appearance of TL glow curves, with two components with different peaks of temperature and contributions to the total signal intensity: the B band (23^{o}C, 63%), and the AG band (40^{o}C, 37%). Iron limitation did not significantly alter these bands, but induced a decrease of the total TL signal. Far-red excitation did not increase the amount of the AG band in iron-limited cells, as observed for iron-replete cells. Measurements of Chl *a* fluorescence and steady-state light curves showed lower values of F_v/F_m (maximum quantum yield of PSII), Y(II) (effective quantum yield of PSII), and rETR (relative electron transport rates) in Fe-deficient cultures as compared with Fe-replete conditions at all irradiance levels tested. The effect of iron deficiency on the photosystem I (PSI) activity was also examined by measuring the changes in P700 redox state during illumination. The electron donation to PSI was substantially reduced in iron-deficient cells, probably related with the important decline in the content of the soluble cytochrome c_6 carrier observed in these cells. Our results suggest that iron deficiency induces partial blocking of the electron transfer between PSII and PSI, due to a lower concentration of cytochrome c_6. This decreased electron transfer could induce the over-reduction of the plastoquinone pool and, consequently, the appearance of acceptor side photoinhibition in PSII, even at low light intensities.