Spectral Evolution under Iron Stress in Two Model Cyanobacterial Cells

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Iron is the second most abundant element and an essential micronutrient for plant growth. The solubility of iron in water is low, which limits its availability, especially in aquatic environments. Global iron levels for most marine bodies are <1 nM, while for freshwater, they generally do not exceed 18 µM. This suggests that aquatic photoautotrophs experience a constant iron deficiency. Iron is essential for maintaining photosynthetic activity, and many cyanobacteria have evolved a specialized protein called IsiA (Iron-stress-induced). The role of this protein continues to be investigated. Interestingly, unlike *Synechocystis* 6803, the diazotrophic cyanobacterium *Anabaena* 7120 has multiple copies of IsiA that form a unique complex with monomeric PSI that lacks the usual PsaL subunit. In this study, we followed the changes in spectral properties from iron surplus to iron deficiency in whole cells. Based on our analysis, we determined that under iron stress, the levels of PSI declined at a significantly faster rate than those of PSII. In fact, the levels of PSII did not decrease considerably under iron starvation. We also observed that in *Synechocystis* 6803, the response to iron stress was immediate. In comparison, in *Anabaena* 7120, the response to iron stress was gradual and slow. Upon comparing the IsiA-fluorescence decay profiles between the two strains, we observed almost no change in *Synechocystis* 6803; however, the decay lifetime slowed down under prolonged iron stress in *Anabaena* 7120. We propose that the additional copies of IsiA proteins in *Anabaena* 7120 are responsible for exhibiting characteristics that differ from those of *Synechocystis* 6803. Further work is being conducted to elucidate the expression and roles of these additional IsiA proteins under iron stress in *Anabaena* 7120.

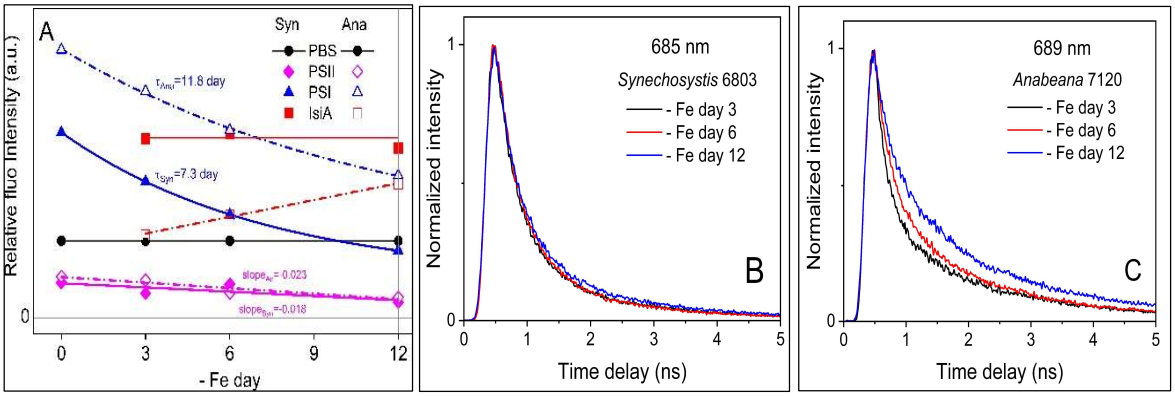

Figure 1. (**A)** Comparison of relative fluorescence emissions from each pigment-protein complex (excitation at 410 nm) for *Synechocystis* 6803 and *Anabaena* 7120 at various stages of Fe deficiency. **(B, C)** Dynamics of IsiA fluorescence emission decay in whole cells at various stages of Fe deficiency. IRF, instrument response function; FWHM, full width at half maximum.

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