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Energy dissipation mechanisms in the FCPb light-harvesting complex of the diatom *Cyclotella meneghiniana*

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Abstract

Transient absorption spectroscopy has been applied to investigate the energy dissipation mechanisms in the nonameric fucoxanthin-chlorophyll-a,c-binding protein FCPb of the centric diatom *Cyclotella meneghiniana*. FCPb complexes in their unquenched state were compared with those in two types of quenching environments, namely aggregation-induced quenching by detergent removal, and clustering via incorporation into liposomes. Applying global and target analysis, in combination with a fluorescence lifetime study and annihilation calculations, we were able to resolve two quenching channels in FCPb that involve chlorophyll-a pigments for FCPb exposed to both quenching environments. The fast quenching channel operates on a timescale of tens of picoseconds and exhibits similar spectral signatures as the unquenched state. The slower quenching channel operates on a timescale of tens to hundreds of picoseconds, depending on the degree of quenching, and is characterized by enhanced population of low-energy states between 680 and 710 nm. The results indicate that FCPb is, in principle, able to function as a dissipater of excess energy and can do this *in vitro* even more efficiently than the homologous FCPa complex, the sole complex involved in fast photoprotection in these organisms. This indicates that when a complex displays photoprotection-related spectral signatures *in vitro* it does not imply that the complex participates in photoprotection *in vivo*. We suggest that FCPa is favored over FCPb as the sole energy-regulating complex in diatoms because its composition can more easily establish the balance between light-harvesting and quenching required for efficient photoprotection.