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Diversification of antenna chlorophylls in the Cyanobacteria

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Cyanobacteria are oxygenic photosynthetic prokaryotes. While they had been called blue-green algae based on their physiological characteristics, in recent decades, they are called cyanobacteria based on the knowledge that they are accommodated in the domain Bacteria. Cyanobacteria have extensive morphological diversity in their cell organization, ranging from single-celled to differentiated multicellular or filamentous forms with or without branching patterns. Part of filamentous cyanobacteria develops unique differentiated cells called heterocyst which carries out atmospheric nitrogen fixation and akinate which is resting-state cells. They also have very diverse cell division patters including binary fission (including budding), multiple fission forming baeocytes and hormogonia formation. Heterocyst formation and the baeocyte formation with more than thousand of baeocytes are unique in part of cyanobacteria. Cyanobacteria are rare bacteria whose ancestors can be observed in the fossil records which are estimated more than 2.0 billion years old. Diverse morphology was observed even in those records. More than 2,000 species has been described under Botanical Code in the Cyanobacteria.

Cyanobacteria had long been characterized to contain Chl *a* and phycobiliprotein until the mid of nineteen-seventies. However, chlorophylls, such as Chl *b* (1), DVChl *a* (2), MgDVP (3), Chl *d* (4) and Chl *f* (5) were found to act as antenna in certain cyanobacteria at 1975, 1988, 1994, 1996 and 2010, respectively. A total seven chlorophylls, Chl *a*, DVChl *a*, Chl *b*, DVChl *b*, Chl *d*, Chl *f* and MgDVP, are used as antenna chlorophyll in cyanobacteria. Comparing those diversities with those in eukaryotic photosynthetic organisms which has only three types of chlorophylls, Chl *a*, Chl *b* and Chl *c*, diversification of antenna chlorophyll has been occurred more frequently in the cyanobacterial lineage.

Cyanobacteria are generalists that have huge range of ecological habitat not only in aquatic environments from marine to freshwater but also in terrestrial environments, ranging from polar to tropical zone. They also found in hot or cold, highly eutrophic or oligotrophic, acidic and alkaline and symbiotic environments. They seem to be able to grow in almost all environments where liquid water and sunlight are available. This broad range habitat is due to the acquisition of the effective inorganic carbon transport system, the adaptation mechanism to light quality, the tolerance mechanism to high/low temperatures and so on though the accumulation of mutation on their genome followed by natural selection. The chlorophyll diversification is also seemed to be the result of natural selection to survive in various niche with various light quality.

In this presentation, I would like to discuss the chlorophyll diversification in cyanobacteria on the viewpoint of niche adaptation based on the current reports on the molecular phylogeny of cyanobacteria, the properties of antenna chlorophylls and niche of cyanobacteria which have unusual antenna chlorophylls.

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