Supplementary Data

Supplementary Data S1

1. Confocal Laser Scanning Microscopy Methods

The photosynthetic apparatus of cyanobacteria is a thylakoid-membrane-bound complex that utilizes various pigments such as chlorophyll, phycobilins, carotenoids, and various binding proteins to achieve its intended energy conversion role (Grossman *et al.*, 1995; Green and Durnford, 1996). When pigments are bound to proteins as complexes, their optical absorbance as well as fluorescence properties change (Falkowski and Kiefer, 1985). Consequently, *in vivo* optical measurements on cyanobacterial cells cannot be taken as the sum of individual pigments, even though these pigments have been studied in detail through purification by solvent-extraction. Environmental factors as well as cell physiology have also been shown to alter the optical properties of the photosynthetic apparatus (Schubert and Hagemann, 1990; Campbell *et al.*, 1998). Therefore, the identification of the auto-florescence source from cyanobacteria can be a complex problem, frequently requiring making measurements at liquid nitrogen temperatures (at this temperature, the pigment–pigment, pigment–protein interactions are minimized) (Kühlbrandt *et al.*, 1994; Beale, 2008; Lamb *et al.*, 2015). Recent technological advances in confocal laser scanning microscopy, however, have offered new insights regarding the *in vivo* fluorescence signal from cyanobacteria (Roldán *et al.*, 2004; Vermaas *et al.*, 2008). It has been shown that a 488-nm laser primarily excites the phycobilins and carotenoids in *Synechocystics* sp. PCC 6803 rather than chlorophyll-a, giving unique insights on how these pigments are spatially distributed in cyanobacterial cells *in vivo* (Vermaas *et al.*, 2008). Consequently, the 488-nm laser line was used extensively in this study to characterize cells from the free-living state (at the exterior of the sinter environment) until the fossilized state (at the interior of the sinter up to about 10-mm depth).

At room temperature, the chlorophyll and phycobilisome pigments in cyanobacteria have a fluorescent emission peak between 640- and 700 nm (Vermaas *et al.*, 2008). Known pigments in this class and their emission maximums are phycocyanin (650 nm), allophycocyanin (665 nm), and allophycocyanin-B (675 nm) (Bittersmann and Vermaas, 1990; Sobiechowska-Sasim *et al.*, 2014). On the other hand, carotenoids are accessory pigments that help channel light energy into primary pigments such as chlorophyll, expanding the overall photoreception range (Green and Parson, 2003). A second role for carotenoids is photooxidation protection against excess visible and ultraviolet light radiation (Wada *et al.*, 2013). Known carotenoids and their emission maximums are β-carotene (560 nm), rhodopin (560–600 nm), and spheroidenone (560–620 nm) (Gillbro and Cogdell, 1989). These emission characteristics are used in this study for the interpretation of organic pigments present in our samples.

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