

Table III. Properties of carboxysomes from *Cyanobium* spp. and *Synechococcus* spp. cells grown at high and low CO₂

Derived properties of *Cyanobium* spp. and *Synechococcus* spp. carboxysomes based on experimentally determined carboxysome dimensions and cellular Rubisco quantities.

Property	<i>Synechococcus</i> spp. (β)		<i>Cyanobium</i> spp. (α)	
	High CO ₂	Low CO ₂	High CO ₂	Low CO ₂
Carboxysome diameter (nm) ^a	240 ± 54 (162)	234 ± 37 (50)	103 ± 8.9 (85)	104 ± 9.9 (170)
Total carboxysome volume (nm ³) ^b	4.38 × 10 ⁶	4.06 × 10 ⁶	3.46 × 10 ⁵	3.57 × 10 ⁵
Internal carboxysome volume (nm ³) ^c	3.81 × 10 ⁶	3.51 × 10 ⁶	2.72 × 10 ⁵	2.80 × 10 ⁵
Carboxysome surface area (nm ²) ^b	1.38 × 10 ⁵	1.31 × 10 ⁵	2.54 × 10 ⁴	2.59 × 10 ⁴
Surface area-volume ratio	0.031	0.032	0.073	0.073
Rubisco active sites per carboxysome ^d	2.49 × 10 ⁴	2.30 × 10 ⁴	1.78 × 10 ³	1.83 × 10 ³
Rubisco holoenzymes per carboxysome ^d	4,042	3,732	288	297
Carboxysomes per cell ^e	2.4	4.2	17.6	18.1

^aCarboxysome diameters were determined experimentally from electron microscopic analysis and represent the maximum cross-sectional width. Numbers are mean values ± SD, with the number of measured carboxysomes in parentheses. ^bVolume and surface area of carboxysomes calculated for idealized icosahedrons of the diameters listed. ^cInternal volumes are calculated for ideal icosahedrons assuming shell thicknesses of 4 nm for α -carboxysomes (Iancu et al., 2007) and 5.5 nm for β -carboxysomes (Kaneko et al., 2006). ^dRubisco quantities per carboxysome are estimated assuming that Rubisco holoenzymes occupy spheres of diameter of 12 nm and have packing densities of 74% (Kepler packing). This arrangement is a realistic packing arrangement for both α -carboxysomes and β -carboxysomes based on estimated stoichiometries for both carboxysome types (Long et al., 2011; Roberts et al., 2012). The resulting packing arrangement results in a Rubisco active site concentration of 10.9 mM within carboxysomes of both types. Reducing the volume occupied by Rubisco to 11-nm-diameter spheres increases the active site concentration within carboxysomes to 14.1 mM and reduces the estimated number of carboxysomes per cell by approximately 1.3-fold. This range of Rubisco volumes is estimated from the crystal structure of *Synechococcus* spp. PCC 6301 Rubisco (Newman and Gutteridge, 1990), which is identical to that of *Synechococcus* spp. PCC 7942. ^eCarboxysomes per cell were calculated from modeled carboxysome volumes, assumed Rubisco packing densities (above), and Rubisco active site concentration data in Table II.

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