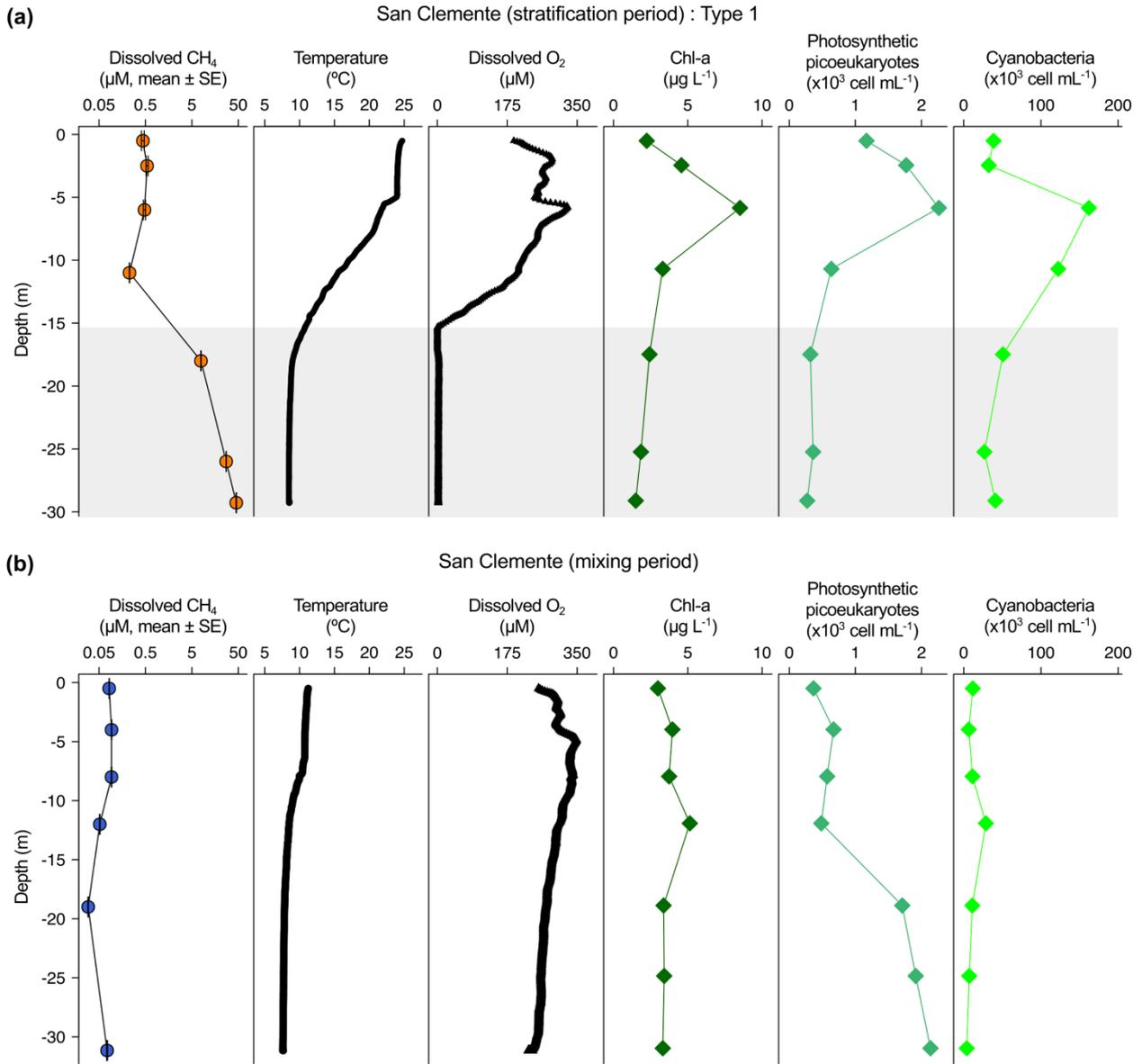


## *Supplementary Material*

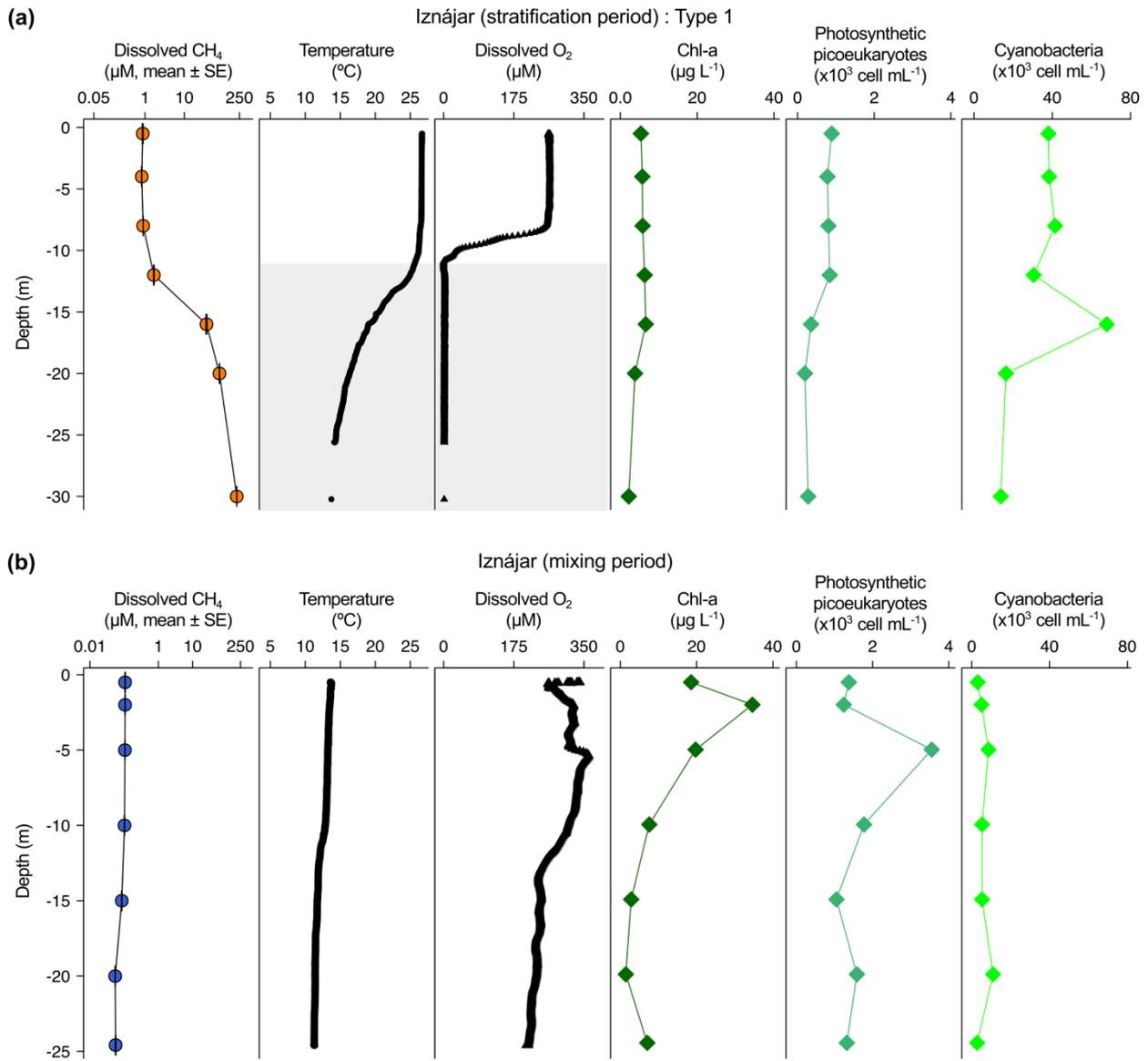
**Figures S1 – S13**

**Table S1**

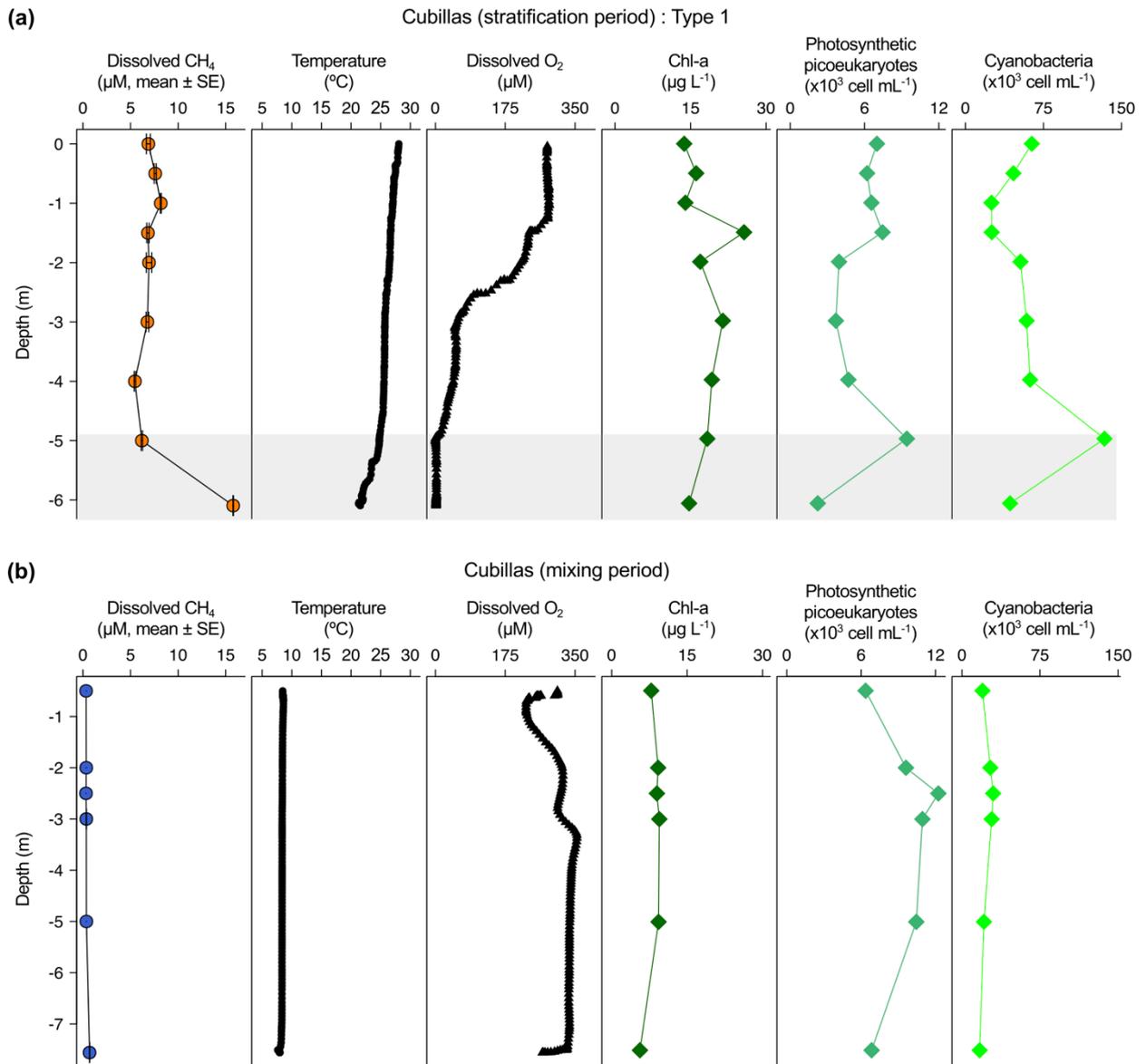


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**Figure S1. Water column profiles of physicochemical and biological parameters in San Clemente reservoir.** Dissolved methane concentration (CH<sub>4</sub>, μM), temperature (°C), dissolved oxygen concentration (DO, μM), chlorophyll-a concentration (Chl-a, μg L<sup>-1</sup>), abundance of photosynthetic picoeukaryotes (cell mL<sup>-1</sup>) and abundance of cyanobacteria (cell mL<sup>-1</sup>) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone (DO < 7.5 μM).

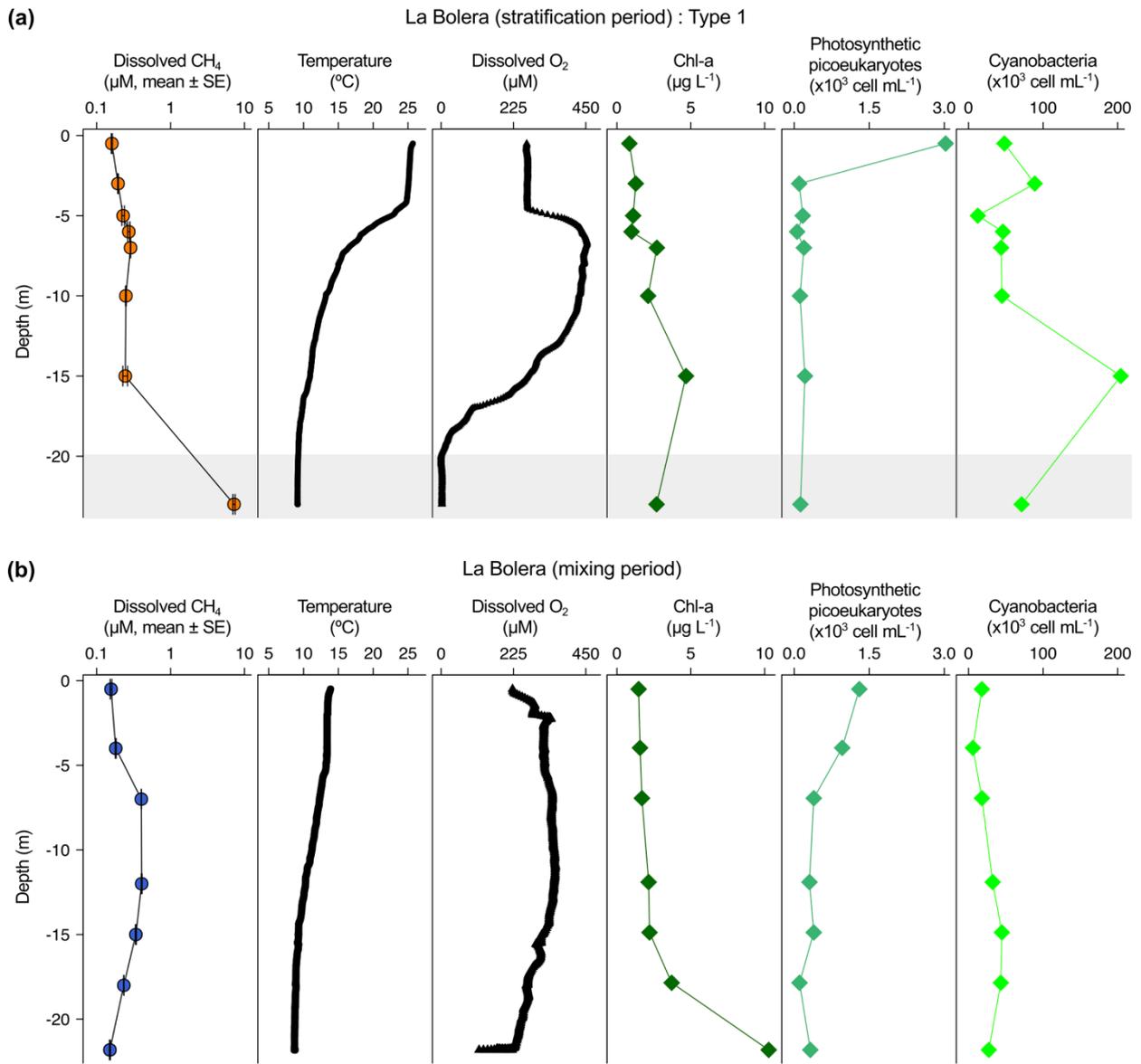


**Figure S2. Water column profiles of physicochemical and biological parameters in Iznájar reservoir.** Dissolved methane concentration (CH<sub>4</sub>, μM), temperature (°C), dissolved oxygen concentration (DO, μM), chlorophyll-a concentration (Chl-a, μg L<sup>-1</sup>), abundance of photosynthetic picoeukaryotes (cell mL<sup>-1</sup>) and abundance of cyanobacteria (cell mL<sup>-1</sup>) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone (DO < 7.5 μM). The sampling for temperature and the dissolved oxygen was developed a day before than the sampling for CH<sub>4</sub> and the biological parameters because of logistical problems.



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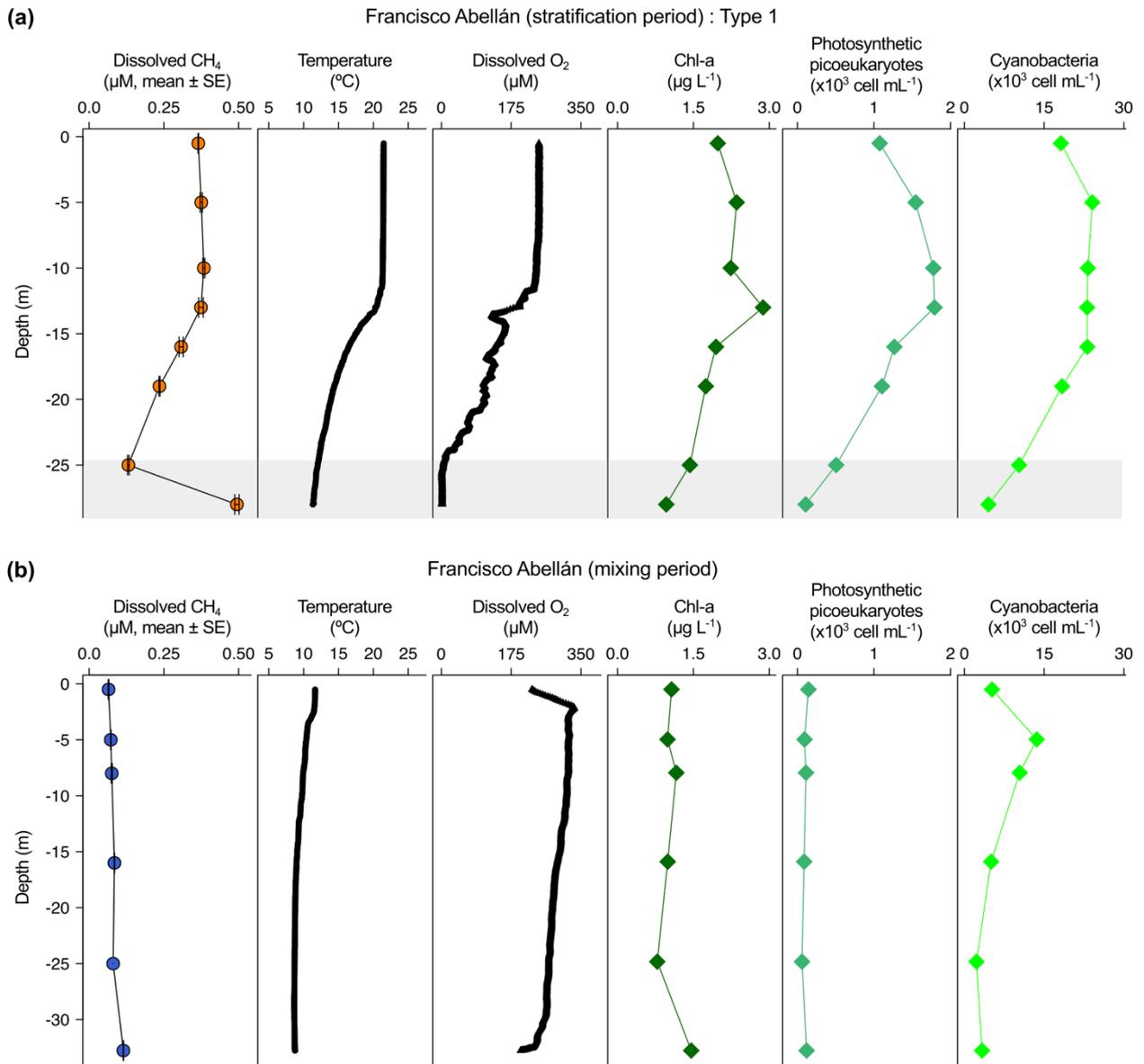
**Figure S3. Water column profiles of physicochemical and biological parameters in Cubillas reservoir.** Dissolved methane concentration ( $\text{CH}_4$ ,  $\mu\text{M}$ ), temperature ( $^{\circ}\text{C}$ ), dissolved oxygen concentration ( $\text{DO}$ ,  $\mu\text{M}$ ), chlorophyll-a concentration ( $\text{Chl-a}$ ,  $\mu\text{g L}^{-1}$ ), abundance of photosynthetic picoeukaryotes ( $\text{cell mL}^{-1}$ ) and abundance of cyanobacteria ( $\text{cell mL}^{-1}$ ) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone ( $\text{DO} < 7.5 \mu\text{M}$ ).



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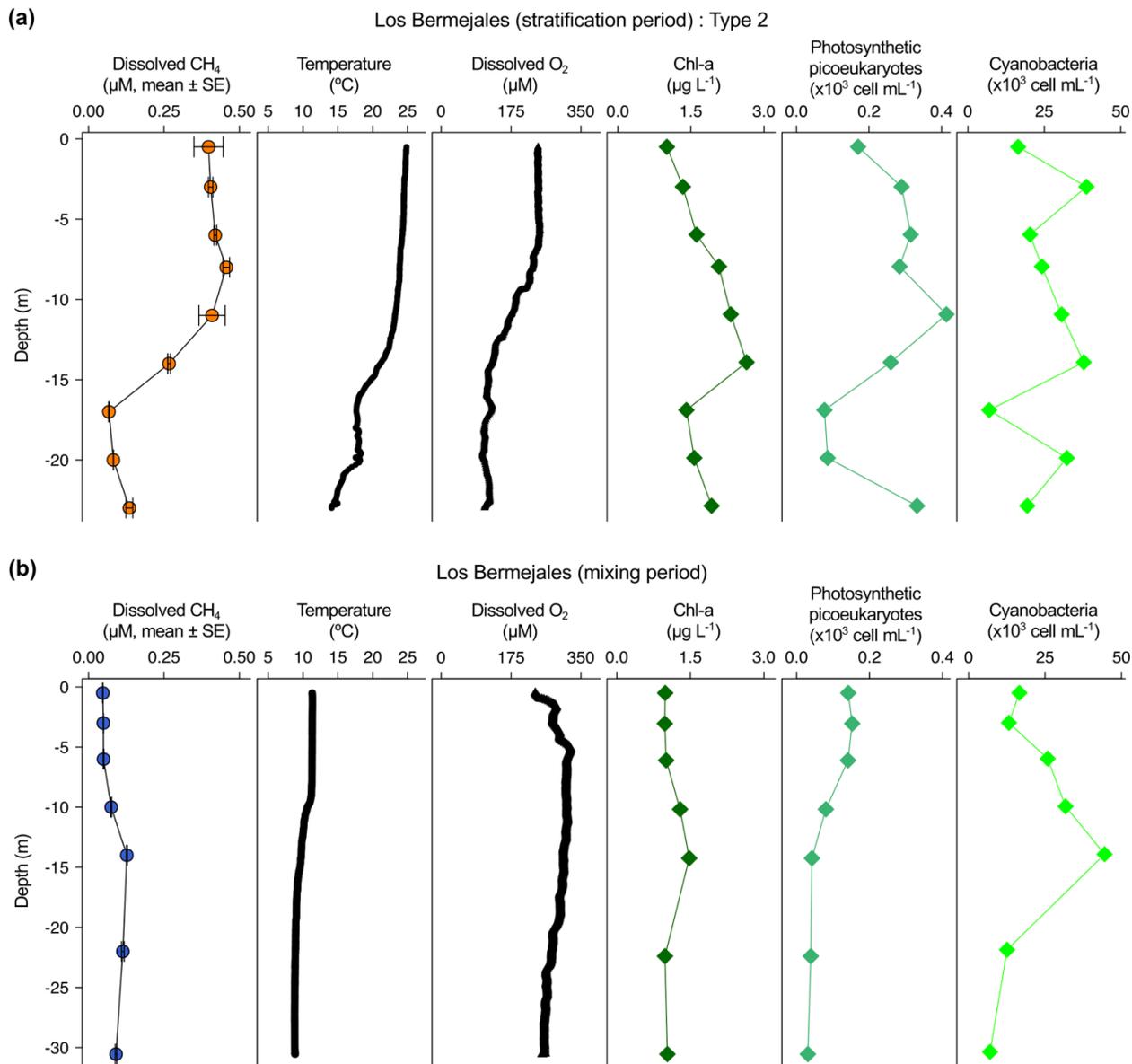
**Figure S4. Water column profiles of physicochemical and biological parameters in La Bolera reservoir.** Dissolved methane concentration ( $\text{CH}_4$ ,  $\mu\text{M}$ ), temperature ( $^{\circ}\text{C}$ ), dissolved oxygen concentration ( $\text{DO}$ ,  $\mu\text{M}$ ), chlorophyll-a concentration ( $\text{Chl-a}$ ,  $\mu\text{g L}^{-1}$ ), abundance of photosynthetic picoeukaryotes ( $\text{cell mL}^{-1}$ ) and abundance of cyanobacteria ( $\text{cell mL}^{-1}$ ) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone ( $\text{DO} < 7.5 \mu\text{M}$ ).

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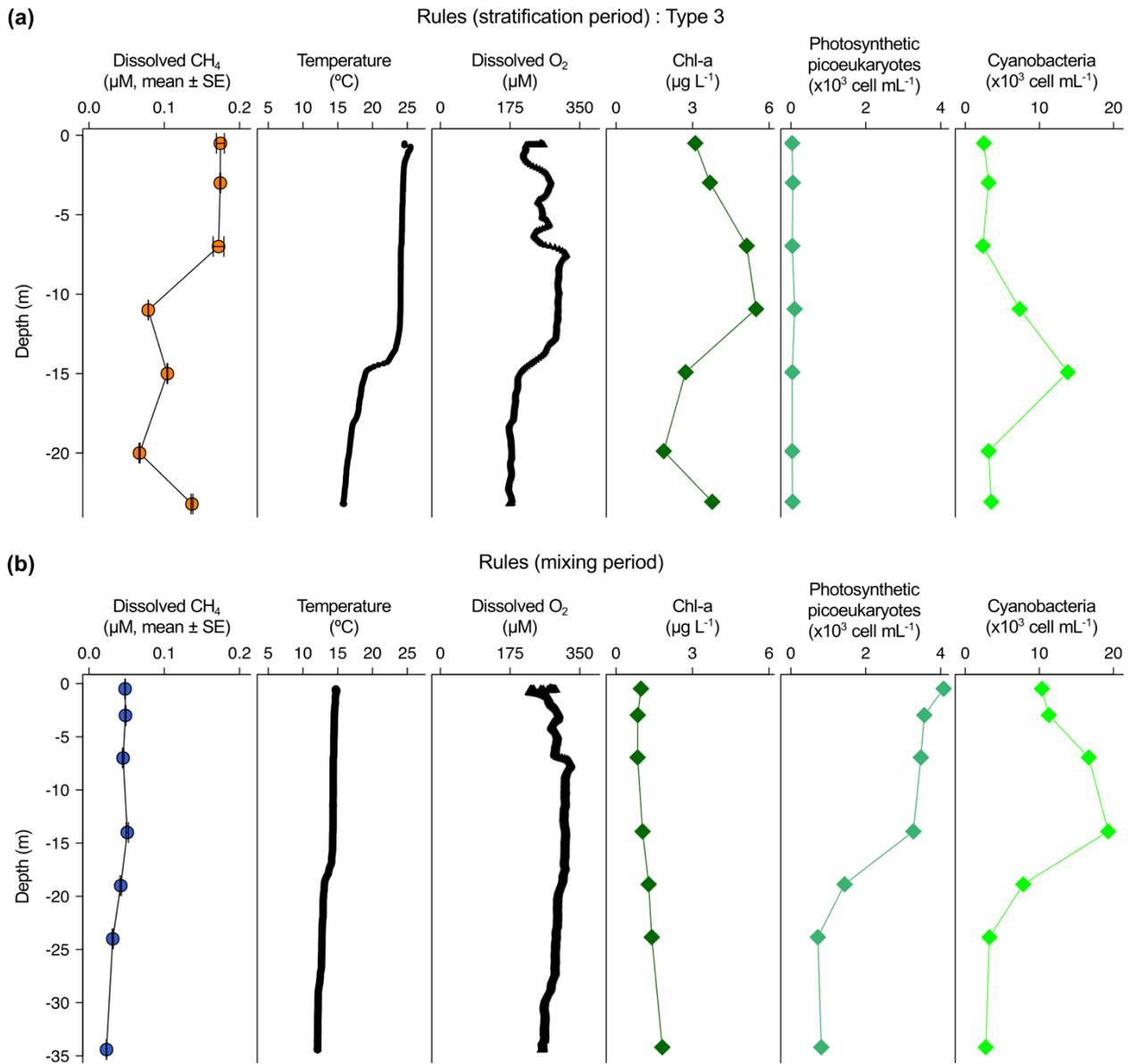


**Figure S5. Water column profiles of physicochemical and biological parameters in Francisco Abellán reservoir.** Dissolved methane concentration (CH<sub>4</sub>, µM), temperature (°C), dissolved oxygen concentration (DO, µM), chlorophyll-a concentration (Chl-a, µg L<sup>-1</sup>), abundance of photosynthetic picoeukaryotes (cell mL<sup>-1</sup>) and abundance of cyanobacteria (cell mL<sup>-1</sup>) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone (DO < 7.5 µM).

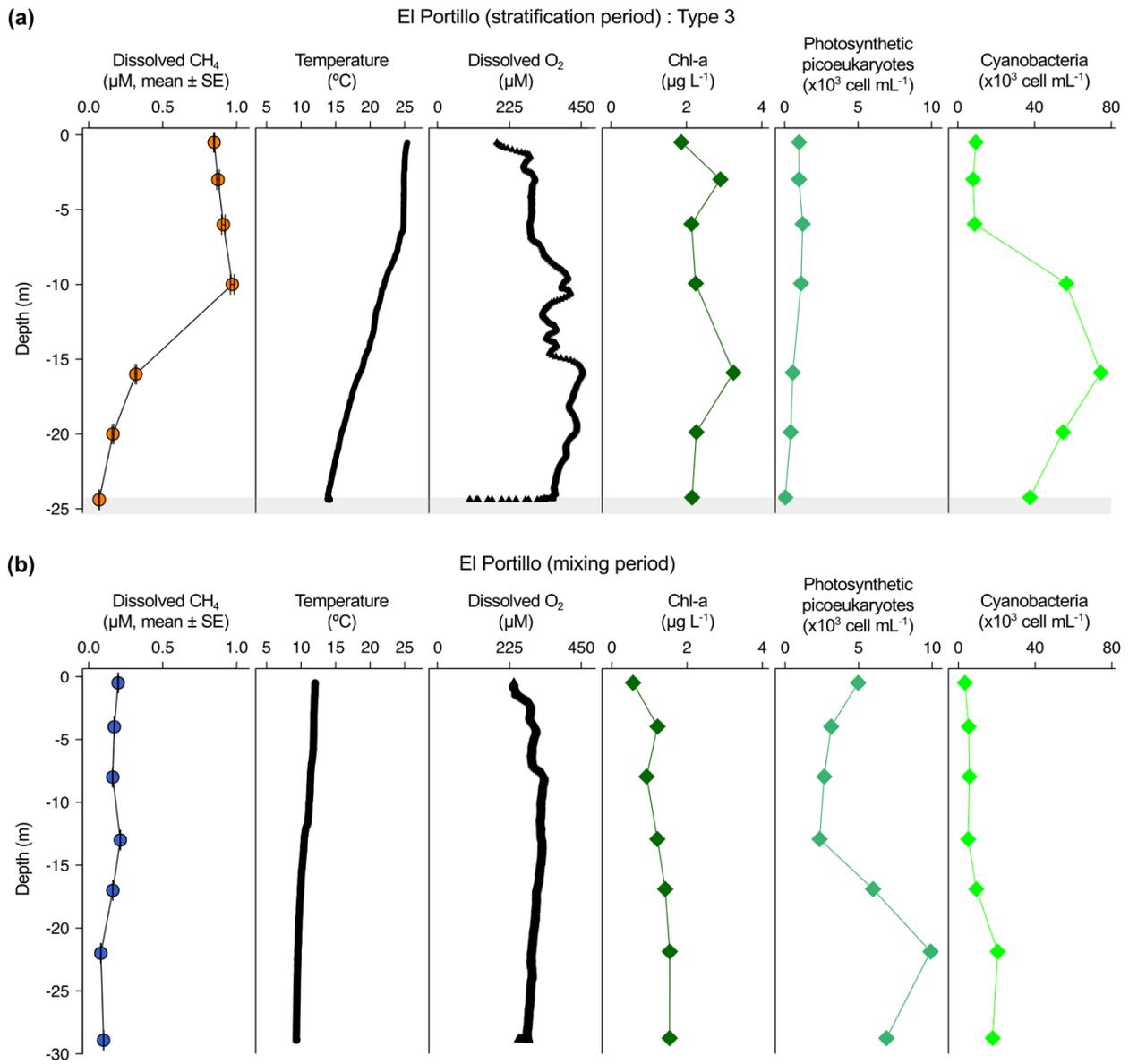
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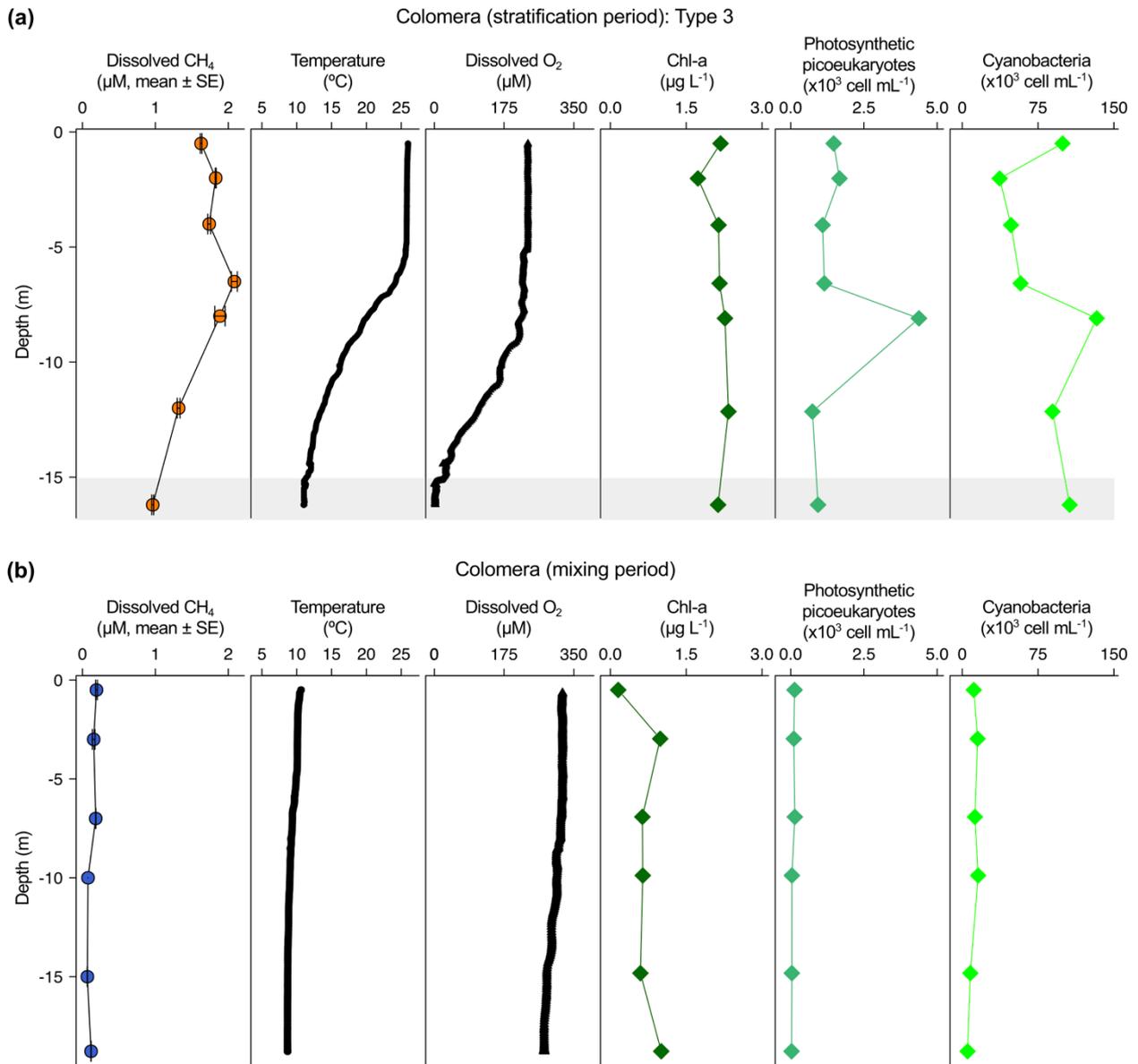
40 **Figure S6. Water column profiles of physicochemical and biological parameters in Los Bermejaes reservoir.** Dissolved methane concentration (CH<sub>4</sub>, μM), temperature (°C), dissolved oxygen concentration (DO, μM), chlorophyll-a concentration (Chl-a, μg L<sup>-1</sup>), abundance of photosynthetic picoeukaryotes (cell mL<sup>-1</sup>) and abundance of cyanobacteria (cell mL<sup>-1</sup>) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone (DO < 7.5 μM).



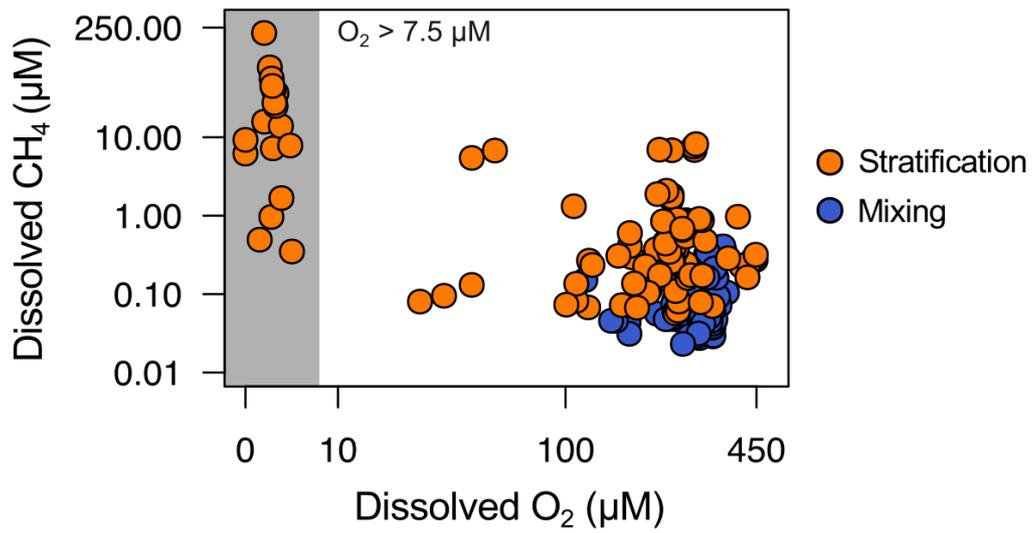
**Figure S7. Water column profiles of physicochemical and biological parameters in Rules reservoir.** Dissolved methane concentration (CH<sub>4</sub>, μM), temperature (°C), dissolved oxygen concentration (DO, μM), chlorophyll-a concentration (Chl-a, μg L<sup>-1</sup>), abundance of photosynthetic picoeukaryotes (cell mL<sup>-1</sup>) and abundance of cyanobacteria (cell mL<sup>-1</sup>) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone (DO < 7.5 μM).



**Figure S8. Water column profiles of physicochemical and biological parameters in El Portillo reservoir.** Dissolved methane concentration ( $\text{CH}_4$ ,  $\mu\text{M}$ ), temperature ( $^{\circ}\text{C}$ ), dissolved oxygen concentration ( $\text{DO}$ ,  $\mu\text{M}$ ), chlorophyll-a concentration ( $\text{Chl-a}$ ,  $\mu\text{g L}^{-1}$ ), abundance of photosynthetic picoeukaryotes (PPEs,  $\text{cell mL}^{-1}$ ) and abundance of *Cyanobacteria* (CYA,  $\text{cell mL}^{-1}$ ) in El Portillo reservoir water column during the stratification period (A) and the mixing period (B).

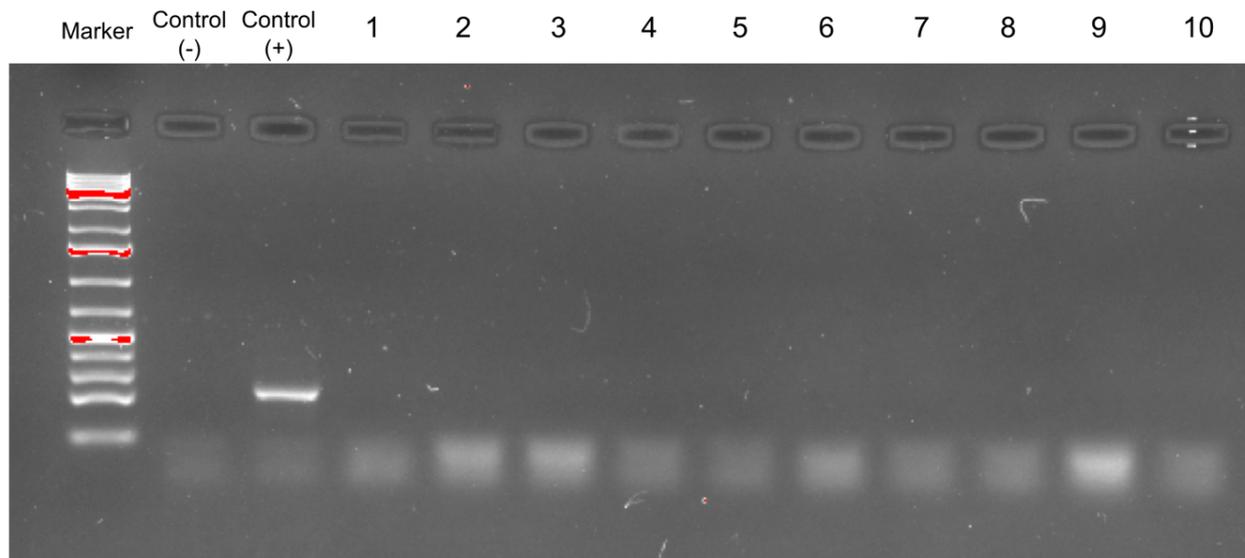


55 **Figure S9. Water column profiles of physicochemical and biological parameters in Colomera reservoir.** Dissolved methane concentration ( $\text{CH}_4$ ,  $\mu\text{M}$ ), temperature ( $^{\circ}\text{C}$ ), dissolved oxygen concentration ( $\text{DO}$ ,  $\mu\text{M}$ ), chlorophyll-a concentration ( $\text{Chl-a}$ ,  $\mu\text{g L}^{-1}$ ), abundance of photosynthetic picoeukaryotes ( $\text{cell mL}^{-1}$ ) and abundance of cyanobacteria ( $\text{cell mL}^{-1}$ ) during the stratification period (a) and the mixing period (b). The grey area represents the anoxic zone ( $\text{DO} < 7.5 \mu\text{M}$ ).

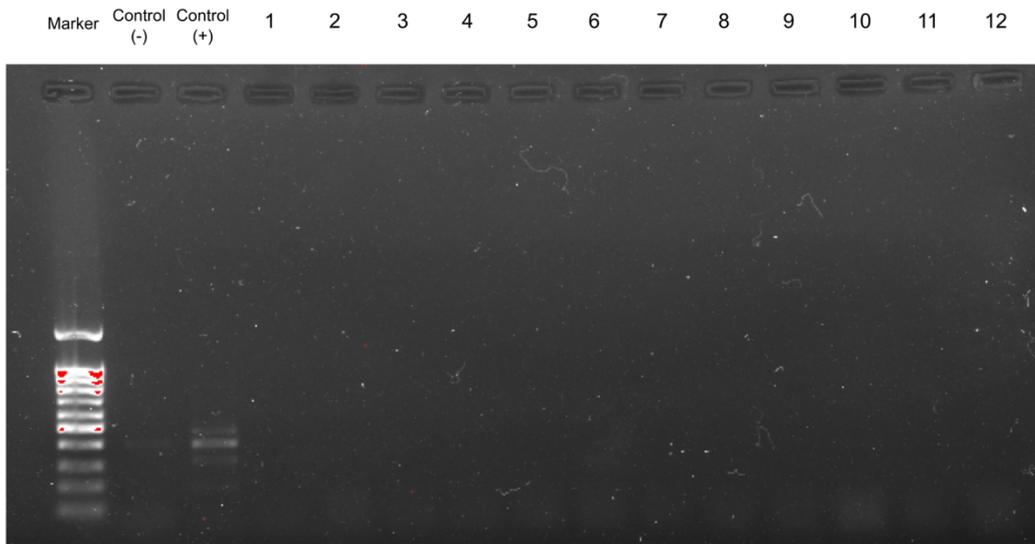


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**Figure S10. Relationship between the dissolved oxygen ( $\text{O}_2$ ,  $\mu\text{M}$ ) and the dissolved methane ( $\text{CH}_4$ ,  $\mu\text{M}$ ).** The plot shows the two well differentiated groups. Note that the log scale in both axes.

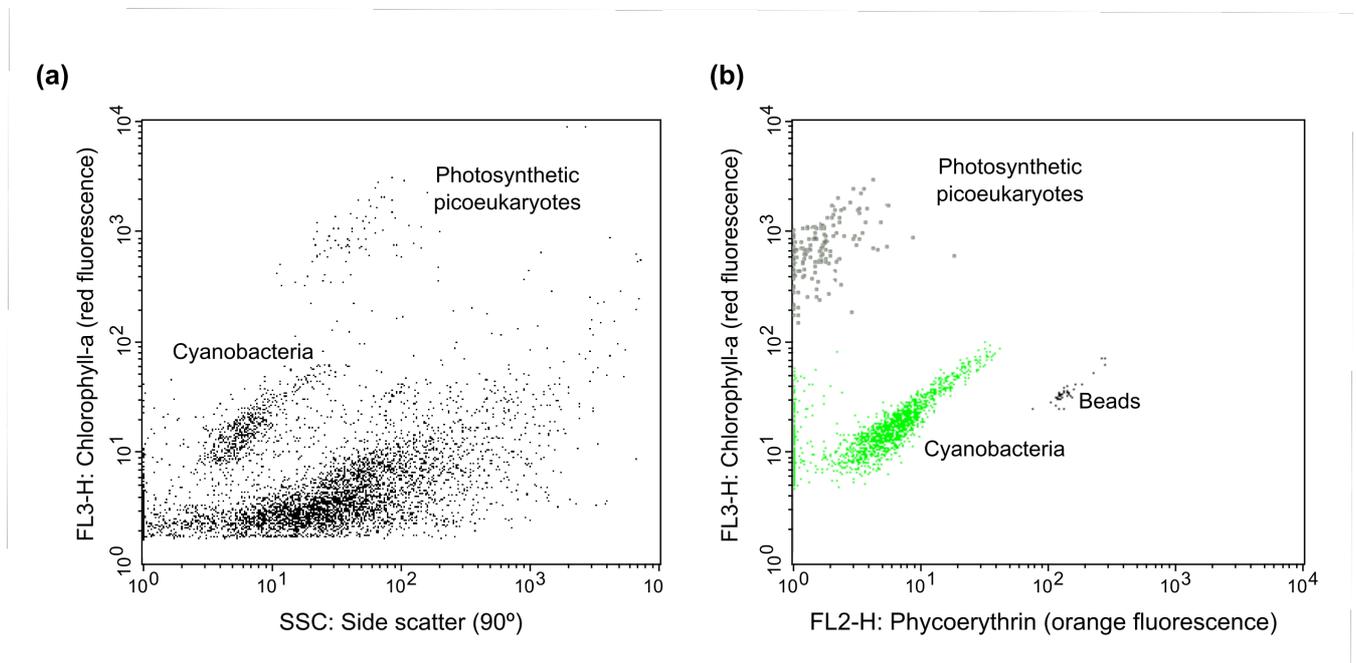


**Figure S11. Results of the PCR for the gene *mcrA* in oxygenated waters.** A 1.5 % agarose gel electrophoresis showing part of the results of the PCR for the gene *mcrA*. In this order: the marker, the controls, and samples (1-10) from oxygenated waters. More details in the Methods section.



**Figure S12. Results of the PCR for the gene *phnJ* in oxygenated waters.** A 1.5 % agarose gel electrophoresis showing part of the results of the PCR for the gene *phnJ*. In this order: the marker, the controls, and samples (1-12) from oxygenated waters. More details in the Methods section.

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**Figure S13. Flow cytometric signatures of cyanobacteria and photosynthetic picoeukaryotes populations in the epilimnion of Béznař reservoir.** (a) Side scatter (SSC) on the x-axis and chlorophyll-a (red fluorescence, FL3) on the y-axis. (b) Phycoerythrin (the orange fluorescence, FL2) on the x-axis and chlorophyll-a (red fluorescence, FL3) on the y-axis. Populations selected in the plot A were colored on the plot B. We used yellow-green 0.92  $\mu\text{m}$  latex beads (Polysciences) as an internal standard.

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**Table S1.** Results of the Generalized Additive Models (GAMs) fitted the concentrations of dissolved CH<sub>4</sub> (μM) in the oxygenated samples (dissolved oxygen > 7.5 μM) during the stratification period, the mixing period and the simple version of the model with the two periods. S.E. = Standard Error; EDF = Estimated Degrees of Freedom.

	Drivers	Estimate (±SE)	EDF	t-value	F-value	P-value
Log <sub>10</sub> (CH <sub>4</sub> ) during the stratification period  n = 78 R <sup>2</sup> <sub>adj</sub> = 0.81 Deviance explained = 82.7 % GCV = 0.06 AIC = 8.45	Intercept	0.43 (0.03)		-15.61		<0.001
	Log <sub>10</sub> (Photosynthetic picoeukaryotes abundance, PPEs, cell mL <sup>-1</sup> )		1.00		52.32	<0.001
	Mean depth (m)		1.95		29.12	<0.001
	Water temperature (°C)		1.41		6.92	<0.01
	Log <sub>10</sub> (Cyanobacteria abundance, CYA, cell mL <sup>-1</sup> )		1.00		5.53	<0.05
Log <sub>10</sub> (CH <sub>4</sub> ) during the mixing period  n = 82 R <sup>2</sup> <sub>adj</sub> = 0.52 Deviance explained = 53.9 % GCV = 0.05 AIC = -3.68	Intercept	-1.06 (0.03)		-42.2		<0.001
	Mean depth (m)		1.77		31.12	<0.001
	Log <sub>10</sub> (Photosynthetic picoeukaryotes abundance, PPEs, cell mL <sup>-1</sup> )		1.00		19.00	<0.001
Log <sub>10</sub> (CH <sub>4</sub> ) during both periods  n = 160 R <sup>2</sup> <sub>adj</sub> = 0.49 Deviance explained = 49.7 % GCV = 0.16 AIC = 165.25	Intercept	- 0.75 (0.03)		-24.0		<0.001
	Temperature (°C)		1.92		58.70	<0.001
	Log <sub>10</sub> (Chlorophyll-a concentration, Chl-a, μg L <sup>-1</sup> )		1.00		9.30	<0.01