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Non-oxygenic Photosynthesis in the Sulphurous Lake Cisó, North-Eastern Spain

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1 Introduction

Situated in the Iberian Peninsula, Lake Cisó is a sulphide-rich lake that belongs to the Bañoles karstic system in Girona, north-eastern part of Spain. Lake Cisó is holomictic, and covers a small area of around 650 m² and a maximum depth of around 7 m (Ramirez-Moreno, Martinez-Alonso, Mendez-Alvarez, & Gaju, 2005).

The most important characteristic of the lake is that during the holomictic period, the lake is completely anoxic, which results in high concentrations from the bottom to the surface of hydrogen sulphide H₂S (Ramirez-Moreno et al., 2005). However, when the thermal stratification begins, the lake becomes oxic in the epilimnion, which leads to a more varied microbial assemblage, and the concentrations of hydrogen sulphide increase in the hypolimnion, where only microorganisms that are resistant or metabolically adapted to the hydrogen sulphide can survive. Hence, the microbial assemblage is composed of vertically stratified microbial communities, which are distributed according to a competitive balance of the microorganisms and the physiochemical conditions of the lake (Massana, GarciaCantizano, & PedrosAlió, 1996).

2 Non-oxygenic photosynthesis

Although the surface of the lake becomes oxic for certain time, *Chromatium* (purple sulphur bacteria) and *Chlorobium* (green sulphur bacteria) populations predominate, where they perform a non-oxygenic photosynthesis, releasing sulphur rather than oxygen waste. These photosynthetic sulphur bacteria communities have to permanently compete for available light, which is very limited considering the big amount of communities living in the lake, especially those at depth of just a few millimeters, where light is practically extinguished (Abella, Montesinos, & Guerrero, 1980).



Fig. 1. Lake Cisó, where the healthy *Chromatium* bacteria turn the water a comely pink. (Credits: Carlos Pedrós-Alió).

3 Conclusion

The primitive nature of these green and purple sulphur bacteria that inhabit in Lake Cisó is of great importance, as it allows a better understanding of the non-oxygenic photosynthesis in the early times of the Earth. This lake community contains contemporary relatives of the earth's earliest photosynthesizers: green chlorobium, the first solar-powered sulphide organism (Liebes, Sahtouris, & Swimme, 1998), reside here with other populations of early non-oxygen photosynthesizers, and therefore, the environment of the Archaean landscape about 3.7 million years ago, where sulphur bacteria dominated wet terrains, can be recreated.

Key words: Lake Cisó, non-oxygenic photosynthesis, sulphurous lake evolution, microbial diversity.

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References

- Abella, C., Montesinos, E., & Guerrero, R. (1980). Field Studies on the Competition Between Purple and Green Sulfur Bacteria for Available Light (Lake Siso, Spain). In M. Dokulil, H. Metz & D. Jewson (Eds.), *Shallow Lakes Contributions to their Limnology* (Vol. 3, pp. 173-181): Springer Netherlands.
- Liebes, S., Sahtouris, E., & Swimme, B. (1998). A walk thought time: From stardust to us. Mill Valley, California: John Wiley & Sons, Inc. ISBN 0-471-31700-4.
- Massana, R., GarciaCantizano, J., & PedrosAlio, C. (1996). Components, structure and fluxes of the microbial food web in a small, stratified lake. *Aquatic Microbial Ecology*, 11(3), 279-288. Doi: 10.3354/Ame011279.
- Ramirez-Moreno, S., Martinez-Alonso, M., Mendez-Alvarez, S., & Gaju, N. (2005). Seasonal microbial ribotype shifts in the sulfurous karstic lakes Ciso and Vilar, in northeastern Spain. *International Microbiology*, 8(4), 235-242.