

Cuatro Ciénegas: a living ancient world dominated by microbialites. Souza, V., Eguiarte, L. E., Garcia-Oliva, F., Olmedo, G. Trivisano, M., Elser, J. and Siefert J.

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The Cuatro Ciénegas Basin (CCB) in the Chihuahuan Desert of Coahuila has a system of water springs and ponds of diverse geochemical nature. Geological and paleontological evidence suggests that the aquatic environments at this site have a very long history: starting as a shallow coastal sea during the Permian that penetrated the region of CCB with the opening of Pangea in the early Jurassic. Available data lead us to suggest that not only that its marine sediment was rich in microbial mats but also that these marine microbial communities persisted and formed microbial mats in the wet soil and water, evolving and diversifying continuously for millions of years.

These seemingly far-fetched suggestions are based on the fact that all the humid soil and the water at CCB appears to be a living microbial mat. That, in the pozas with calcareous conditions, microbial mats takes the form of stromatolites, reefs and thrombolites while, in non-calcareous conditions, the mats are found as soft structures with layers of microbial communities that reflect their metabolic capabilities (methanogens, sulfur oxidizers, sulfur reducing, cyanobacterial photosynthesis and diatom photosynthesis).

Another discovery from emerging metagenomic data is that the metabolic complementation of each of these mats allows them to perform locally all the necessary tasks of the major biogeochemical cycles in order to sustain the aquatic food webs and support rich microbial growth, despite in the extreme oligotrophic conditions of the valley.

We also have data that at CCB these extensive microbialites are very patchy and differentiated both taxonomically and genetically, implying that, even though they may look as a

continuum in the wetlands, each patch has been isolated for a long time (probably since the post-cretaceous water level decline), allowing each community to diverge in its composition. But selection has been very strong in maintaining its function.

The survival of these unique microbial communities is probably due to the unusual tectonics that uplifted the valley 700 m above sea level and surrounded it with high sierras, but never buried its soil with newer sediments. And hence, the marine sediment biota of the ancient microbial mats, was not substituted by new migrants and the organic matter never enriched its soil and waters with layers of nutrients, resulting in one of the most oligotrophic sites known.

Paradoxically, CCB has also been reported as a hotspot of biodiversity with a larger number of macroscopic endemic species in North America and it is among the richer microbial communities in the world. Suggesting the keystone role of the extensive microbialites of the valley that not only are survivors of the ancient sea and but have richly diversified not despite of, but perhaps because of, the lack of nutrients through their long history.

#### References

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