

Microbial life in the acid lake and hot springs of Poás Volcano, Costa Rica

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Research in recent years has shown that certain life forms can thrive under extreme thermal and chemical conditions. Although acid crater lakes and hot springs represent some of the most extreme environments on Earth, they appear to be suitable biotopes for several groups of microorganisms. Among these, the thermoacidophiles have major uses in the biotechnology industry. Here we present the preliminary results of a search for potential of life in the acid crater lake and thermal springs of Poás Volcano, one of the most active volcanoes of Central America. It hosts an active hydrothermal system supplied with heat and volatiles by a shallow magma body, which is responsible for a long standing vigorous fumarolic activity. The active summit crater contains an acid warm lake (pH= ~1 and T=30°C) with a diameter of ~280 m and a depth of ~40 m), consisting of a concentrated chloride-sulphate brine (12 000 ppm Cl⁻ and 9000 ppm SO₄²⁻). The lake is also enriched in rock-forming elements (e.g., 1200 ppm Al, 1300 ppm Ca, 100 ppm Si, data from September 2000), and carries native sulfur particles.

Several acid hot springs, situated in the nearly vertical crater walls, discharge into the lake. Among the most accessible on the northeast-east side, the White Algae Thermal Spring is named after a white mat which covers the moist acidic basin. Its water has a temperature of 42.4 °C and a pH of 2.5, and is rich in SO₄²⁻ (~2000 ppm), whereas the Cl⁻ content is below detection limit. A second spring, the Green Algae Thermal Spring, derives its name after the green mats that cover the stream bed at 20-30 meters downstream from the discharge point. Here, the water has a temperature of 46.3 °C and a pH of 2.2, and has similar chemical characteristics.

Lake water was cultured using a TF-medium with polythionate at 30°C and a pH range between 2.5-3.0. Wet sediments collected from the lake bottom as well as the waters from the Green and White Thermal springs and their mats were cultured using a BY-culturing medium at a pH of 3.0 and 70 °C, which is usually used to isolate *Sulfolobus*. As a result of the culture process both samples became turbid. Bacteria grown in the TF-medium were non-spore forming and Gram negative short rod and were identified as *Thiobacillus sp.*, and the BY-medium culture includes rod shaped bacteria and a spherical acidophilic bacteria, which is likely to be a new species.

The microbial mats that live attached to bedrock or pebbles were collected from both thermal springs and kept at 5°C. Algae and bacteria were identified by optical and electron microscopy. In both springs, bacteria which have forming spore and Gram negative rod were isolated from the mats. They were identified as *Bacillus sp.*, which are indicative of thermophilic systems. The major algae that form the green mat were identified as *Cyanidium caldarium*, which is dark green. Plant cells without cell walls but with fungi mycelia were observed in the white mat. The plant cells are covered by a deposit of a white material, probably sulphur. Diatoms, observed in the mats from both thermal springs, include *Navicula sp.* and *Cymbella sp.*

Reference: Kenji Sugimori, Hiroaki Igarashi, María Martínez, Eliécer Duarte, Erick Fernández, Eduardo Malavassi, Manfred van Bergen, Juan Segura, Juan Valdés 2002. *Microbial life in the acid lake and hot springs of Poás Volcano, Costa Rica*. Proceedings Colima Volcano International Meeting 2002, Colima, México.