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Functional Groups and Activities of Bacteria in a Highly Acidic Volcanic Mountain Stream and Lake in Patagonia, Argentina

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Abstract:

Acidic volcanic waters are naturally occurring extreme habitats that are subject of worldwide geochemical research but have been little investigated with respect to their biology. To fill this gap, the microbial ecology of a volcanic acidic river (pH ≈ 0-1.6), Rio Agrio, and the recipient lake Caviahue in Patagonia, Argentina, was studied. Water and sediment samples were investigated for Fe (II), Fe (III), methane, bacterial abundances, biomass, and activities (oxygen consumption, iron oxidation and reduction). The extremely acidic river showed a strong gradient of microbial life with increasing values downstream and few signs of life near the source. Only sulfide-oxidizing and fermentative bacteria could be cultured from the upper part of Rio Agrio. However, in the lower part of the system, microbial biomass and oxygen penetration and consumption in the sediment were comparable to non-extreme aquatic habitats. To characterize similarities and differences of chemically similar natural and man-made acidic waters, our findings were compared to those from acidic mining lakes in Germany. In the lower part of the river and lake, numbers of iron and sulfur bacteria and total biomass in sediments were comparable to those known from acidic mining lakes. Bacterial abundance in water samples was also very similar for both types of acidic water (around 10^5 mL^{-1}). In contrast, Fe (II) oxidation and Fe (III) reduction potentials appeared to be lower despite higher biogenic oxygen consumption and higher photosynthetic activity at the sediment-water interface. Surprisingly, methanogenesis was detected in the presence of high sulphate concentrations in the profundal sediment of Lake Caviahue. In addition to supplementing microbiological knowledge on acidic volcanic waters, our study provides a new view of these extreme sites in the general context of aquatic habitats.