Mimmicing field conditions of pyritic mines in the laboratory: chronic toxicity of Fe and SO42- and acute toxicity of Cu and Zn to fluvial periphyton in acidic and alkaline conditions

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Several studies have highlighted the biofilm sensitivity to a large group of toxicants. Heavy metals are one of the most common inorganic pollutants in aquatic ecosystems (Genter, 1996). Many of the heavy metals in aquatic ecosystems, such as Cu, Mn, Fe and Zn, are essential micronutrients for algal growth. However, at high concentrations these elements can be toxic to algae as well as to other aquatic organisms (Hall et al., 1989; Nies, 1999). The present study used a system of indoor channels colonized with fluvial biofilms to study the chronic effects of Fe, $SO4^{2-}$ and acidity/alkalinity and the acute effects of Cu and Zn in the biofilms.

Biofilms were subjected to four different treatments during 8 weeks: treatment 1: 1 mg Fe/L+700 mg $SO4^{2-}$/L at pH of 8.1-8.3; treatment 2: 0.01 mg Fe/L + 300 mg $SO4^{2-}$/L at pH of 8.1-8.3; treatment 3: 0.01 mg Fe/L+300 mg $SO4^{2-}$/L at pH of 3.6-3.9; treatment 4: 1mg Fe/L+700 mg $SO4^{2-}$/L, at pH of 3.6-3.9. These conditions aimed to mimic the water conditions of the surrounding streams of Aljustrel mining area (Alentejo, Southwest of Portugal).

The acute effects of Cu and Zn in the biofilms (24h exposure) took place after the indoor channel system experiment, in vials containing the water of the respective treatment and concentrations of 100-8000 µg Zn/L and 15-1200 µg Cu/L.

Disturbances in the ecosystem would first lead to physiological and biochemical changes within the biofilm that can evolve in community changes if the perturbations are maintained. So the endpoints AFDW (Ash-Free-Dry-Weight), Chla (Chlorophyll a), diatom taxonomy, PhytoPAM (Pulse Amplitud Modulated) fluorometry parameters (F0, OptQY and effQY), enzymatic activities [catalase (CAT), superoxide dismutase (SOD), ascorbate peroxidase (APX) and glutathione reductase (GR)] and non-enzimatic [GSH (total glutation) and PC (total phytochelatins] were analysed.

The main question was if pH and/or Fe+SO4 might ameliorate metal effects. Based on the results it seems that communities from acidic environments are more tolerant to metal exposure: it may explain why acidic areas with several metals and often in high concentrations have algal growth. In addition, comparing the alkaline treatment, the presence of Fe may partially ameliorate metal effects.

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