Effects of Acid Mine Drainage on Benthic Diatom Communities, Stream Sediments and Surface Waters of Lousal and Aljustrel Areas

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ABSTRACT

Acid waters are special environments that support specific biological communities. They support changes of pH, frequently associated with high sulphate concentrations; they have high conductivity and low alkalinity. Acidification process promotes ionization and dissolution of metals that are toxic to the aquatic organisms. So, impacted communities experiment lethal levels of pH and metals which lead to a decrease on algal richness and diversity (i.e. Mulholland et al. 1986; Planas 1996; Verb and Vis 2000 a, b); communities are restricted to tolerant organisms that are able to survive in these conditions. The same metals that affect primary production are essential, in low concentrations, to organism's physiological mechanisms.

There is an optimal range of concentrations for each metal, above or below that, metal becomes toxic or lethal to the algae. Benthic algae are important components of aquatic environments and provide food and habitat to most of organisms (e.g. invertebrates). As they are attached to substrate, they work as indicators of environmental disturbances: physical (i.e. temperature, current velocity, light), chemical (i.e. pH, conductivity, metals, nutrients) and biological (i.e. predation) that occur in the communitie's development. Diatoms have been used on water quality as indicators of environmental changes.

Diatom's metal response models are difficult to establish because metal contamination is frequently associated with acidic environments (Dixit et al. 1991). Several studies on metal polluted rivers have shown that diatoms respond to perturbations not only at the community level through shifts in dominant taxa (Gustavson and Wängberg 1995; Hirst et al. 2002), changes in diversity (Leland and Carter 1984; Medley and Clements 1998), but also at the individual level with alteration in cell wall morphology. In particular, size reduction (Gensemer 1990; Cattaneo et al. 1998, 2004) and frustule deformations (McFarland et al. 1997; Dickman 1998; Gold et al. 2003; Nunes et al. 2003; Cattaneo et al. 2004) have been sometimes associated with high metal concentrations. Other causes, such as silicon limitation and extreme pH are also indicated for such abnormalities (Barber and Carter 1981).

The aim of this study was to know the real impact of AMD in Lousal and Aljustrel surrounding streams, with the help of physical and chemical analysis of waters, sediments and diatoms. As, Fe, Mn, Pb, Zn were found in high concentrations in acid waters and in sediments and their solubility increased with acidity.

Shannon-Weaver Diversity Index was low in AMD impacted sites and the diversity of the diatom assemblages was also low, with the most abundant taxa being acidophilic (Pinnularia acoricola and Eunotia exigua). Spatial variation, due to mine influence, was more important than the seasonal variation, which didn't show any pattern.

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palabras clave: drenaje ácido de mina, diatomeas béntónicas   ***key words:*** acid mine drainage, benthic diatoms

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