ATTENUATION OF ACID MINE PIT WATERS BY MICROBIAL SULFATE REDUCTION

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Acidic pit lakes are formed when metal mines are abandoned and water filled them up. A biochemical oxidation of the metal sulfides takes place generating extreme chemical conditions such as low pH, high redox potential and extremely high metal concentrations together with a low availability of carbon and nutrients. Due to their high depth-to-surface-area ratio and the low mixing rates, pit lakes often show a sharp decline in dissolved oxygen, transitioning to anoxic conditions relatively quickly. We hypothethised that these factors can create conditions for a higher diversity of anaerobic microbial metabolisms which will differ from the known aerobic microbes usually found in acid drainages. To test this hypothesis, three different pit lakes (Filón Centro, La Zarza Perrunal and Brunita) formed in distinct metal mines in Spain were sampled. Chemical analysis (pH, redox potential, conductivity, oxygen gradient and ion concentrations) was combined with microbial diversity profiling based on 16S rRNA gene amplicon sequencing and lipidomics, along with scanning electron microscopy on suspended particulate matter. Results showed a steep gradient of physychochemical conditions, from the oxidant conditions in the top layers to highly reducing conditions at the bottom acompanied with a decrease in soluble metals such as copper and zinc. This finding mirrors the presence of a higher diversity in the deeper layers and the abundant presence of taxa affiliated with sulfate-reducers (*Desulfomonile*, *Desulfosporosinus*, etc). The presence of high concentrations of sulphate, combined with anoxic conditions and low levels of carbon sources seemd to have promoted the conditions for extremely acidophilic sulphate reducers tolerant to high concentrations of metals. The sulphide produced by their metabolism further influences lake chemistry by precipitation of the dissolved metals as sulphide minerals (e.g., CuS, As_2S_3, PbS, ZnS, FeS_2), obervation confirmed by the detection of ZnS precipitates in the watercolum.