

Biogenic sulphides as markers of bacterial sulphate reduction in sulphidic layers of acidic pit lakes

I. YUSTA¹, A. ILIN¹, L. VAN DER GRAAF², I. SÁNCHEZ-ANDREA², C. FALAGÁN³, J. SÁNCHEZ-ESPAÑA⁴

¹University of the Basque Country, Apdo. 644, Bilbao, Spain
(i.yusta@ehu.es)

²University of Wageningen, Wageningen, The Netherlands

³University of Exeter, Penryn Campus, Exeter, UK

⁴Spanish Geological Survey, Calera 1, 28760, Tres Cantos, Madrid, Spain (j.sanchez@igme.es)

The formation of biogenic sulphides has been successfully observed in three acidic pit lakes (APLs) formed in the abandoned metal mines of Filon Centro-FC and Cueva de la Mora-CM (Huelva, Spain) and Corta Brunita-CB (La Unión, Murcia). High contents of dissolved metals and sulphate, permanent anoxia in the bottom waters, and the presence of certain species of sulphate reducing bacteria (SRB) are key factors leading to sulphide precipitation. However, this process is not always present or easily detected in meromictic APLs. On-site water sampling at precise depths followed by filtration (0.45 μm) allows to compare suspended particulate matter (SPM) with water chemistry and biomass composition, and to study the tiny sulphide particles which otherwise would be lost in the dominant detrital matrix of the bottom lake sediments.

The anoxic sulphidic layers in CM and CB are ~2 m below the oxycline, whereas in FC this layer is situated much deeper at only 3-5 m above the lake bottom. Filters obtained from these layers always present a deep greenish brown color, contrasting with the reddish to white colors at other depths. This SPM also shows higher values in P, S and metals as compared to other particles sampled at other depths. Local singularities are found related to sulphide morphology –generally spherical but also lenticular in CuS and wire-like in As-sulphides–, particle size (in the order of 0.5-4 μm , but also ~30 nm in CuS precipitates), and sulphide composition –chiefly are CuS but locally appear ZnS and AsS. Microbiota's role is well constrained in CM, where >50% of the biomass is composed by SRBs, and promising preliminar studies at FC and CB show different SRB species in the sulphidic layers. Zn sulphides are only prevalent in CB, where the dissolved Zn content is also abnormally high (~400 mg/L) compared with the contents in CM and FC (5-30 mg/L). On-going TEM and geomicrobiological studies will help explaining the differences between bacterial communities and sulphide mineral particles in these APLs.