Adlassnig, w., Sassmann, S., Lendl, T., Wernitznig, S., Hallberg, K.B., Hofhansl, F., Lang, I., Lichtscheidl, I.:

Heavy Metal Household of the Former Mining Site Schwarzwand (Salzburg, Austria): spontaneous self cleaning by plants and biofilms

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Abstract:
The Schwarzwand is a unique hygric, copper contaminated habitat formed by mining activities from the 16th to 18th century. Today, a large spoil heap and several creeks fed by copper rich mine drainage are present. The vegetation of the Schwarzwand differs clearly from the surrounding subalpine forests. It is by no means impoverished but rather a hotspot of biodiversity. Interestingly, most of the copper is precipitated within the Schwarzwand and the creeks leave the Schwarzwand virtually clean. This study maps the distribution of copper within the Schwarzwand and within selected vascular plant, mosses and microorganisms and correlates them with water and soil chemistry in order to identify the sinks of the copper and to elucidate the remarkable capability of the Schwarzwand to clean itself.
Two types of water could be distinguished, one acidic precipitating limonite with a constant copper content of about 0.6 mg · l-1, and one circumneutral, which decreases far more rapidly in copper content than would be expected due to chemical considerations. A dense microbial mat covering most of the bed of the circumneutral creeks could be identified as the main sink. It consists of the cyanobacterium Phormidium sp. and retains copper both by adsorption to mucilaginous sheaths and by precipitation as secondary minerals such as sampleite. Layers of dead biofilm can be found covered by a few centimetres of soil at the banks of the circumneutral creeks; the extremely high concentration and the low solubility of copper in this soil indicates permanent immobilisation of the heavy metals. High concentrations of copper were also found in mosses of the family Bryaceae which, however, play a negligible role for the heavy metal household of the habitat due to their low biomass.
The retention of copper within the Schwarzwand is a remarkable example for the sustainable self-cleaning of a contaminated habitat which takes place without any human intervention. The artificial establishment of microbial communities similar to the Schwarzwand could result in cheap and sustainable strategies for the remediation of suitable metal contaminated waters.