

Hydrographic systems developing on spoil tips from the former coal mining industry in the Northern France

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In the Northern France, the coal mining industry of the 18th to 20th centuries has left a legacy of more than 300 spoil tips made of black shale and shaly sandstone debris from the Carboniferous coal deposits. They reach heights of up to 180 m and cover land surfaces of several hectares, disrupting the interactions between surface water and soils in the region. This impact, whether in terms of water pathways, water composition or interaction with preexisting surface waters, has been little considered from the viewpoint of regional flow system evolution and water quality.

The spoil tips, with steep slopes and highly porous texture, intercept rain. Over time a new local hydrographic system may develop, where water runoff and water infiltration lead to springs and ponds at the base of the tips. The waters of this system can have specific chemical compositions, governed by the composition of rocks they are in contact with (including weathering processes), by interaction with soil, and by polluting elements, frequently of anthropogenic origin. In this sense, each coal mining spoil tip may represent a mini-hydrosystem.

Following this hypothesis, we have selected three conical spoil tips in the “departement du Nord”: Ostricourt, Sabatier-Nord (Raismes) and Ledoux-Lavoir (Condé sur l’Escaut). We measured physicochemical parameters in the surface waters around the tips on a seasonal basis over 2 years: pH, conductivity, oxygen concentrations and redox potential. We also determined the chemical composition of several water samples with ICP-OES, ICP-MS and ion chromatography analysis. This approach allowed to define mini-drainage basins spanning the different slopes and surroundings of the tips. Pure tip drainage waters could be distinguished from mixed zones where drainage and rain water accumulate together, as well as from ponds that essentially collect surface runoff waters. Based on the geochemical signatures of the waters around the spoil tips, it was possible to identify waters of a different nature, with increased trace element concentrations, indicating the presence of buried pollution sources. Thus a hydrographic and water quality map is proposed for the three investigated spoil tips and their surroundings.