Soil formation from mining residues: example of weathering of spoil tips, Hauts-de-France region

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Spoil tips from coalfield symbolize the past mining and industrial activities of the North of France, becoming a scar in the landscape, classified to World Heritage (UNESCO). They are mining residue storage coming from coal extraction, and are constituted by schists (carbonaceous material, quartz, illite, chlorite, pyrite) and scoria with coal residues. Although these materials are considered as sterile, some of them present natural revegetation, the formation of a new soil and a novel ecosystem with pioneer species. Moreover, spoil tips could be a source of pollution (e.g. metals, sulphur). All these aspects are either the cause or the consequence of a main process: the weathering of spoil tip bedrock materials. Therefore, it is important to study this weathering to better understand relationships between mining residues and ecosystems.

We selected two spoil tips with different characteristics: the Haillicourt spoil tip (H-ST) composed of black schists and presenting a short revegetation by pioneer plants, and the Ostricourt spoil tip (O-ST) with a similar bedrock material but presenting a strong colonization by a forest. A neoformed soil is clearly observable on O-ST (with several horizons), but not really identifiable on H-ST.

Neoformed soils were characterised via fine biogeochemical (pH, C/N ratio) and mineralogical (XRD, STXM-XANES, TEM) analysis. Products of spoil tip weathering mostly consist in interstratified clays and typical sulphur-bearing minerals (jarosite). These phases are more abundant where the vegetation is very developed. Some Fe-rich detrital phyllosilicates (as chlorite) are also identified and have a nanoscale intracrystalline zonation (STXM-XANES) of iron redox, resulting of a lower kinetic of weathering.

These mineralogical investigations, coupling to C/N ratios and pH measurements (showing that O-ST soils are more acidic than H-ST soils), allow to constrain the interaction between revegetation of mining residues and the soil formation, giving important keys for the rational management of spoil tips.