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Pedogenesis under endemic vegetation on steep slope of a spoil tip: soil horizon differentiation in less than a decade

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Soil is a finite resource, requiring a rational management. Thus, the balance between soil loss and formation is a key parameter, which can only be assessed if we have a good knowledge of pedogenesis processes and kinetics. This means considering all the factors involved in soil formation like climate, vegetation/organisms, relief, parent geological material and subject to time.

In the Northern France, industrial and economic development over the last two centuries, particularly coal mining, has considerably reduced the amount of naturally-formed soil. On the other hand, new anthropogenic systems have been set up, and interact with the environment, leading to the formation of neo-soils.

This is the case of the many spoil tips in the Nord Pas-de-Calais region, which consist of mine tailings subject to supergene conditions. The aim of this study is to evaluate soil formation and horizon differentiation on the selected spoil tip of Ostricourt. Here, the parental material is black shale, with coal residues, subject to a degraded oceanic climate characterized by abundant rainfall (> 740 mm/year). The topography is a strong constraint, as the steep slopes of the spoil tip promote gully erosion, and control the drainage (soil loss). However, despite these steep slopes and the young age of the spoil tip (< 50 years old), a neo-soil is observed under vegetation. To characterize this pedogenesis, we focus our study on the south slope, which was cleared of all vegetation until 2016. At this point (t=0), no signs of weathering or soil formation were observed. Only the fragmentation of the shale and a few traces of oxidation of primary minerals such as pyrite were visible. 8 years later, an endemic short vegetation is established. And in the same (short) amount of time, all the signs of a soil formation are identified in terms of mineralogy transformation, organic matter incorporation, evolution of biogeochemical characteristics, etc. All the conditions are right to describe the horizonation process, and quantify kinetics. In less than one decade, a Technosol appears, initiated and maintained by vegetation, and favored by a parent material enriched in clays and sulfur and a rainy climate.