

Using FALCON an array of artificial catchments to study the role of surface heterogeneity on erosion and other ecosystem processes in early stages of ecosystem development

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This study combines results from a series of artificial catchments FALCON and two chronosequences of rehabilitated and unrehabilitated post-mining landscapes near Sokolov (Czech Republic). All study sites were formed by the deposition of post-mining overburden consisting of Miocene clays impregnated with carbonates and fossil organic matter (kerogen). Each chronosequence consists of four sites and covers the first 65 years of ecosystem development. FALCON was established in 2019 and allows the first stages of ecosystem development to be studied in detail. It consists of four parallel catchments (0.25 ha each) that are completely isolated hydrologically. Two catchments are rehabilitated and two are not, as is common in the region, copying the approaches used at the sites of the rehabilitated and unrehabilitated chronosequences. The remediated areas were leveled and planted with alders, while no action was taken in the non-remediated areas where the longitudinal undulations created by the fill remain. In the remediated areas, alders formed a closed canopy in the 10-15 year old areas. In unrehabilitated areas, sheath willow, birch, and aspen are the predominant trees colonizing the areas and forming a closed canopy in the 15-25 year old areas.

Detailed surface change studies using erosion pins and 3D terrain models created using drones show that the surface area in the undulating areas is decreasing more than in the apartment areas, while sediment loss measurements show no difference between the apartment and undulating areas. In wavy areas, there is a great heterogeneity in the erosion process. The upper part of the undulations is heavily eroded, while the eroded material accumulates in the depression. The depressions contain more silt and clay material, have higher water retention and lower infiltration rates, while the opposite is true for the elevated wave tops. Studies along the chronosequence also show that the elevated portion of the waves retain portions of the original mudstone that are more resistant to weathering, such as pelocarbonates. These stone-like parts of the mudstone provide the safe spaces for woody vegetation to colonize. In contrast, the vegetation in the depressions between the waves is dominated by grasses. The study shows that vegetation establishment depends on the formation of microsites with specific soil conditions created by surface processes in the initial phase of ecosystem development. Surface heterogeneity affects also proportion of surface and subsurface runoff and quality of run off water.