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Below-ground attributes on reclaimed surface minelands over a 40-year chronosequence

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Reclamation following mining activities often aims to restore stable soils that support productive and diverse native plant communities. The soil re-spread process increases soil compaction, which may alter soil water, plant composition, rooting depths and soil organic matter. This may have a direct impact on vegetation establishment and species recruitment. Seasonal wet/dry and freeze/thaw patterns are thought to alleviate soil compaction over time. However, this has not been formally evaluated on reclaimed landscapes at large scales. Our objectives were to (1) determine soil compaction alleviation, (2) rooting depth and (3) spatial patterns of soil water content over a time-since-reclamation gradient. Soil resistance to penetration varied by depth, with shallow compaction remaining unchanged, but deeper compaction increased over time rather than being alleviated. Root biomass and depth did not increase with time and was consistently less than reference locations. Plant communities initially had a strong native component, but quickly became dominated by invasive species following reclamation and soil water content became increasingly homogeneous over the 40-year chronosequence. Seasonal weather patterns and soil organic matter additions can reduce soil compaction if water infiltration is not limited. Shallow and strongly fibrous-rooted grasses present in reclaimed sites added organic matter to shallow soil layers, but did not penetrate the compacted layers and allow water infiltration. Strong linkages between land management strategies, soil properties and vegetation composition can advance reclamation efforts and promote heterogeneous landscapes. However, current post-reclamation management strategies are not facilitating natural seasonal weather patterns to reducing soil compaction.