Assessment of coal spoil piles with respect to soil cover requirements at closure

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# ABSTRACT

The rehabilitation plans for spoil piles often include expensive soil cover systems to prevent. However, we suggest that unlike hard-rock mining, the natural degradation of most sedimentary spoil materials over time will significantly reduce oxygen diffusion and the infiltration of rainfall, preventing the generation and transport of acidic, metalliferous and saline drainage. To investigate the hydrological and geochemical behaviour of spoil piles over time, two large, instrumented columns (1.2 m in height and 0.4 m in diameter) were established in a glasshouse at The University of Queensland. Two types of spoil, a soil-like and a rock-like spoil, were sourced from a coal mine site in Queensland, with various rock fragment sizes. Comprehensive mineralogical and geochemical characterisation, including quantitative X-ray diffraction analysis, acid-base accounting, and major and trace element analysis, have been conducted on nine representative samples. Almost all tested spoil materials were classified as non-acid forming (NAF). The spoils samples were packed into the two columns, with mudstone-to-sandstone ratios of 1:3 and 3:1, respectively. Changes in volumetric moisture content, matric potential, temperature, and oxygen concentration were monitored over depth, along with pore water and pore gas samplers. Additionally, a time-lapse camera was installed to continuously record weathering patterns, and a weather station was set up to calculate evaporation rates which helps estimate the overall water balance within the columns. Results indicate that the spoil with a higher percentage of mudstone exhibits more progressive desiccation and oxygen diffusion patterns at depths above 30 cm but demonstrates higher water-holding capacity at depths below 70 cm, compared to the spoil with a high percentage of sandstone. The experimental data over wetting-drying cycles help understand the long-term weathering behaviour of spoil piles. These insights will inform progressive rehabilitation and closure plans, aiming to reduce, optimise or eliminate the need for an engineered soil cover system at closure.