Effect of Forestry Reclamation Approach Practices on Soil Water Chemistry[1]

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Abstract: Proper reclamation of surface mined lands is essential for restoration of ecosystem services. Reclamation practices, especially those in mountainous / steep-terrain areas, tend to incorporate spoils of different weathering stages (e.g., saprolite, blast-rock fragments), mixed at different proportions with and without soil as topsoil-replacement material. This is likely to greatly alter soil properties as compared to the pre-existing native soils (e.g., organic matter, pH, free iron/manganese oxides, etc.), and which affect soil biogeochemical processes. In this presentation we emphasize the role of redox as a process that promotes dissolution and release of constituents in reclaimed mine sites. Sites[3] reclaimed using sandstone spoils of different weathering stages, placed at different compaction efforts, were instrumented with water sampling devices 12 years after reclamation. Water samples were collected weekly during the 3-year study and analyzed for total metals concentrations, ionic composition, total alkalinity, and dissolved organic carbon, in addition to *in-situ* measurement of dissolved oxygen, pH, temperature, total dissolved solids (TDS), and redox potential. On average, solution attributes were similar to that of stream water from non-disturbed watersheds and did not exceed regulatory thresholds values (e.g., TDS < 300 $\mu S\ cm^{-1}$). Yet, wide within-season fluctuation was observed, resulting in many (statistical) 'outliers.' For example, TDS fluctuated during the 2017 growing season in non-compacted brown mine soils as much as an order of magnitude, from 178 to 1,762 $\mu S\ cm^{-1}$, which was associated with corresponding increases in pH (5.47 to 6.73). Both pH and TDS were inversely correlated with changes in Eh (from 363 down to 67 mV, respectively). The TDS values exceeding the regulatory thresholds were mostly associated with low Eh and circumneutral pH values, pointing to the role of redox in promoting dissolution (rather than acid dissolution). The high variability in the data likely pointed to a limited ability of the soil to buffer changes in moisture, pH, and redox potential. The results are discussed in the context of current FRA practices and of expected future trends as soil development continues.[3]

Additional Key Words: redox-potential, spoil, TDS, buffer capacity.

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3. Work reported here was conducted near 38° 02' 42" N; 81° 30' 30" W.