Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.8683

Redox Reactions and Their Impact on Metals and Nutrients Dynamic in Reclaimed Mine Soil

AMIR HASS[1], JEFFREY SKOUSEN[2] AND ROBERT CANTRELL[1]

[1]West Virginia State University
[2]West Virginia University
Presenting Author: amirhass@wvstateu.edu

Mine reclamation practices often utilize crushed rock spoils from weathered geologic formations (overburden) as substrate for soil development. In the Appalachia region of the US, these are mostly composed of sandstone. As acid dissolution processes are the dominant during early mine soil development, redox processes receive less attention. Here, we present results from a 3-year study of monitoring pore water composition of a 12-year-old reclaimed mine soil, exemplifying the role of redox processes in dynamics and solubility of soil inorganic-N and transition metals. The research site was constructed in 2005 and is located in southern West Virginia, USA. Reclamation included placement of crushed overburden, composed of saprolite and near-surface weathered sandstone strata, at different compaction levels as 4-ft topsoil layer prior to reforestation. In 2017 the site was instrumented with shallow (100-cm) observation wells. The wells were sampled weekly for dissolved metal content, ionic composition, alkalinity, and DOC. Additionally, *in-situ* measurements of pH, EC, DO, temperature, and ORP were recorded at the time of sampling. Redox potential was inversely related to pH, with elevated EC levels associated with low Eh and circumneutral pH (rather than with high acidity). Dynamics of dissolved inorganic-N suggested dissimilatory reduction of NO_3 to NH_4. The prevailing soil conditions, i.e., circumneutral pH, low organic matter content, high C/N ratio, and moderate Eh levels, further support this as the preferred pathway (as opposed to denitrification). Manganese solubility was significantly affected by fluctuation in moisture and Eh. Drought conditions drastically altered prevailing high moisture regimes in the compacted site, leading to aerated conditions and sharply decreasing solution pH (from average of 5.85 to below 4.30). A brief decrease in Mn solubility (likely due to oxidation and precipitation) was followed by sharp increase upon further decline in pH (below ca. 5.10). Similar increases in solubility of Zn, Ni, Co (and Al) upon aeration were followed by sharp declines, likely due to coprecipitation/sorption onto iron-oxides (Fe concentration declined from average of 10.3 to 0.08 mg L^{-1} during that period). Findings are discussed with respect to soil pools fluxes and capacities amid increasing intensity and frequency of extreme weather events.