ALTERATION OF EXCHANGEABLE CATION DISTRIBUTION AND ASSOCIATED CHEMICAL CHANGES IN ACIDIFYING SURFACE MINED SOILS

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Two mining areas of different ages, one area mined in 1972 and the other in 1977, were sampled in June and July of 1978. Twenty-five 100 cm cores were taken from each area and subdivided into 10 cm segments. Material from each segment was analyzed for pH, SO_4-S, and total-S, while half the total of samples from each core were analyzed for CEC, base saturation percentage, and water extractable cations.

General trends show lower pH, base saturation, and total-S in the 1972 minesoil, as well as higher SO_4-S and water extractable cations. The variability of the data is extremely high as indicated by the coefficients of variability (CV), greater than 200% for some of the sulfur data. The effectiveness of the regression equations calculated to describe changes with depth and age is reduced by this variability, but the equations still suggest the presence of a weathered zone to the 20 cm depth in the 1977 minesoil.

Calculations of the minimum sampling density required to estimate the property means range from a low of 35 samples per mining area to estimate pH within ±0.5 units to over 400 samples to estimate SO_4-S within ±100 ug/g soil.

A subsequent laboratory study involved two artificial minesoils composed of geologic materials from an area undergoing mining. This study had the principal objective of measuring changes in exchangeable cation distribution on the two artificial minesoil mixes as a function of applied acidity level, time of application, and temperature. The mixes were saturated with Na and Ca prior to acidification resulting in an approximately 1:1 distribution (equivalent basis) on the exchange sites.

Essentially all of the chemical changes measured are complete after an elapsed time of 6 days, some within 1 day. Statistical analyses generally showed significant differences due to all main effects except temperature. Values for pH, exchangeable Na and Ca, and water extractable Na and Ca are most influenced by the strongest acid treatment, whereas the effects of the two less concentrated treatments are low and nearly indistinguishable from each other. Nevertheless, the relatively small loss of exchangeable Ca, even in the most concentrated acid treatment, indicates that the base saturation of highly Ca saturated minesoils such as those at the mine site would not change greatly except under extreme acidification.

More A1 was released from the oxidized mix, possibly from solubilization of A1 coatings. Release of Mg and A1 from both mixes indicates mineral decomposition due to acid attack. The general decrease in the ratio of the 18 A (smectite) to 7.2 A (kaolinite) peak heights suggests a loss of smectite minerals compared with kaolinite.