Investigating Magnetic Susceptibility in Soil Associations within the Puyallup Watershed

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Abstract:

Magnetic susceptibility measures concentrations of ferrimagnetic minerals. In soils, it is sensitive to soil-forming factors such as climate, weathering, and pollution, and can be used to trace sediment sources. In this study, we investigate differences in magnetic susceptibility among soils to distinguish them from glacial sediment. Soils in the Puyallup watershed are grouped into associations based on parent material: the Puyallup association on alluvial material, Kapowsin on volcanic ash, Buckley on lahar deposits, and Alderton on glacial till. As soil-forming processes act through time, soils develop distinctive depth profiles. To investigate soil magnetic properties across depth horizons, soil cores were collected from five sites within three soil associations (Puyallup, Kapowsin, and Buckley) near native vegetation when possible. These were supplemented by 62 Alderton topsoil samples collected by Pierce College students. Magnetic susceptibility was measured at high and low frequencies. On average, Puyallup soils had the highest magnetic susceptibility (up to 2.3×10^{-6} m^3/kg), except one site, Siebenthaler Park, which requires further investigation. Alderton, Kapowsin, and Buckley soils had significantly lower magnetic susceptibility, with Alderton soils the lowest (up to 0.508×10^{-6} m^3/kg). These results are consistent with the soils' parent materials: The lowland soils are of lower susceptibility than Emmons glacier sediment, but higher than the other parent materials. Magnetic susceptibility, therefore, is a useful tool to differentiate between lowland and glacial sediment sources. This will help determine the origin of sediment within the watershed, and thus the watershed's geologic history, soil composition, and hydrology.

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