B149 The Selection and Spatial Analysis of USDA-NRCS Soil Survey Map Units Based on Typical Soil Color for Forensic Investigations

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Learning Overview: The goal of this presentation is to review the goals and approaches of forensic soil examinations and present a new reference data set that may be used in geographic interpretation of soil color. This presentation will describe the nature and structure of the United States Department of Agriculture-Nature Resource Conservation Service (USDA-NRCS) National Cooperative Soil Survey (NCSS) data and how it can be judiciously applied in a soil provenance investigation, possibly to provide context to forensic soil comparison

Impact on the Forensic Science Community: This presentation will impact the forensic science community by examining the fact that soil color is very commonly considered in forensic soil examinations as it is easily observed, non-destructive, and commonly discriminating. However, prior to recent advancements, linking color of evidentiary soils to soil maps to aid in a forensic soil provenance interpretation was exceeding tedious because color is a text field in the official series descriptions. The recently digitized soil color data now enables color to be more easily used as part of a soil provenance interpretation and to possibly provide context for the rarity of a soil color within an area of interest.

Soil color is commonly observed early in the examination scheme of forensic soil traces and has value in soil comparison and in soil provenance examinations in which the goal is provide leads for the likely geographic source of the material. The NCSS provides detailed soil surveys for most of the country, representing the spatial arrangement of soils at scales from 1:12,000 to 1:63,000. Typically, each soil map unit (the basic unit of spatial delineation) contains information associated with one or more soil series concepts.[1] This database lacks soil color information, but reasonable selections of representative color data are documented in the Official Soil Series Descriptions (OSDs). Typical moist and dry soil colors were extracted from the OSDs (roughly 26,000 documents) and arranged into a new database containing Munsell colors as Hue, Value, and Chroma, as well as the calculated RGB and L*a*b* color parameters.[2] This creation of this database has enabled the linking of soil color data to the detailed Soil Survey Geographic (SSURGO) database via soil series name, thus the creation of query-able soil color maps. The resultant soil color maps permit selection of map units by the color of either the dominant component or of any constituent soil series within each map unit. These query-able soil color maps have limitations and uncertainties due to the natural variability found in the source data and the interpolations made in creation of soils maps, but provided that the users of these maps understand their inherent limitations, these soil color maps may have utility in forensic soil reports or other applications.

The new availability of query-able soil color maps enables spatial analysis and integration with geological, botanical, and infrastructure maps in the interpretation phase of a forensic soil provenance examination. An example of a derived soil color map that was used to aid in the successful search for a body based on soil evidence will be presented, with identifying case details withheld.

Soil color maps of an area of interest provide context for soil comparisons by objectively representing color prevalence and have been applied to both emphasize rarity or commonness of a particular soil color. In one case, soil evidence was purported to be derived from the infield of a baseball diamond. The color of this synthetic soil was absent from any of the soil series mapped within the county. Likewise, soil survey data has been cited for how spatially extensive soil with similar properties, including color, are within an area to de-emphasize the significance of failing to exclude a common source.

Reference(s):

1. Soil Survey Staff, Nature Resource Conservation Service, United States Department of Agriculture, *Soil Survey Geographic (SSURGO)* Database. Available online.
2. *Soil Colors of the Continental United States*. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcseprd1423827 and https://nrcs.app.box.com/v/soils/folder/53525984812.

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