OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Evaluation of current methodologies in forensic soil examinations

Describe the need: Many analytical techniques can be used to distinguish soils from each other. The current techniques in common use in casework include polarized light microscopy (PLM), color, XRD, SEM/EDS, and particle size distribution. However, little research has been done to compare the relative effectiveness and efficiency of different analytical techniques available to typical forensic service providers in 1) differentiating soils that are from different sources and 2) finding commonalities between soils from the same source.

Keyword(s): Soils, mineralogy

Submitting subcommittee(s): Trace Materials **Date Approved:** September 19, 2023

Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

(Draft) Standard Guide for the Analysis of Soils and Other Geological Evidence for Criminal Forensic Applications (This guide will recommend which methods of examination and suited to different types of soil evidence, and the order of use)

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

There are some studies, some listed below, that compare select examination methodologies. However a comprehensive evaluation of commonly used methods has not been conducted.

3. Key bibliographic references relating to this research need: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)

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3) Menchaca, Patricia R., Robert C. Graham, and Theodore Younglove. "Developing and testing a soil property database for forensic applications in southern California." Journal of forensic sciences 63.4 (2018): 1043-1052.
4) Suarez, M. D., Southard, R. J., & Parikh, S. J. (2015). Understanding variations of soil mapping units and associated data for forensic science. Journal of forensic sciences, 60(4), 894-905.

5) Guedes, A., Murray, R. C., Ribeiro, H., Rodrigues, A., Valentim, B., Sant'Ovaia, H., & Noronha, F. (2013). Integration of different sediment characteristics to discriminate between sources of coastal sediments. Geological Society, London, Special Publications, 384(1), 97-108.
6) Newland, T. G., Pitts, K., & Lewis, S. W. (2022). Multimodal spectroscopy with chemometrics for the forensic analysis of Western Australian sandy soils. Forensic Chemistry, 28, 100412.
7) Newland, Talia G., Kari Pitts, and Simon W. Lewis. "Multimodal spectroscopy with chemometrics: Application to simulated forensic soil casework." Forensic Chemistry 33 (2023): 100481.
8) Testoni, S., Dawson, L., Melo, V., Lopes-Mazzetto, J., Ramalho, B., & Salvador, F. (2022). Soil Colour and Plant-Wax Markers: Application in Forensic Investigations under Urban Subtropical Environments. Forensic Sciences, 2(1), 57-71.
9) Woods, B., Lennard, C., Kirkbride, K. P., & Robertson, J. (2016). Soil examination for a forensic trace evidence laboratory–Part 3: a proposed protocol for the effective triage and management of soil examinations. Forensic Science International, 262, 46-55.

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest? Is your research need identified by NIJ?

No

5. In what ways would the research results improve current laboratory capabilities?

Evaluating the relative efficiency and effectiveness of analytical techniques in common casework practice could improve workflow and test the scientific underpinning of current practice.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

Many advanced analytical techniques (e.g. non-human DNA, leaf wax analysis, selective dissolution, etc.) have demonstrated utility in differentiating soils. However, these methods are not typically available to typical forensic service providers and lead to confusion about best practices in forensic geology examinations. Some methods (bulk elemental, FTIR) are more susceptible to transfer and persistence biases. Whereas others (leaf wax) may be susceptible to contamination. Typical experimental designs to answer questions about the efficiency and effectiveness of different techniques will likely provide constraints on error rates. These comparisons can also provide support for the most commonly and long used methods such as color analysis and microscopic techniques.

7. In what ways would the research results improve services to the criminal justice system?

This research would provide scientific rigor of existing practice and independent assessment of the weight of forensic geology evidence.

8. Status assessment (I, II, III, or IV): III

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.