OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Bias in transfer and persistence of soil (particulate assemblages)

Keyword(s): transfer, persistence, fidelity, mineral

Submitting subcommittee(s): Trace materials **Date Approved:** 6/12/2025

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)

Bias in particle populations resulting from transfer and persistence processes will affect all standards for bulk methods of soil analysis (bulk elemental analysis; spectroscopy of bulk soil; bulk XRD, particle size analysis) and modal abundance comparison criteria applied to particle-based methods of soil analysis (SEM/EDS particles, PLM, Raman microspectroscopy). This will directly address the interpretation of results of the draft Standard Practice for Polarized Light Microscopy in the Forensic Examination and Comparison of Soils and the OSAC 2024-S-0012 Standard Practice for the Forensic Analysis of Geological Materials by Scanning Electron Microscopy and Energy Dispersive X-Ray Spectrometry.

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)?

We are unaware of ongoing or unpublished studies that address this issue.

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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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?

The 2024 NIJ list Fundamental understanding of how environmental factors can affect trace evidence.

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

A better understanding of the extent and circumstances and the extent of transfer and persistence biases affecting soils should improve:

1. Selection of analytical methods for when particle bias is likely and unlikely. Example: Do intact soil aggregates indicate minimal bias permitting bulk analytical methods (provided the aggregate size is large enough to be representative)?
2. When to conduct an examination of discrete particle size classes to ameliorate biases.

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

Increased understanding of the effects of properties (texture, moisture, grain shape, clay mineralogy, organic matter content, substrate, contact type), both individually and as a group, on transfer and persistence bias will allow examiners to justify use (or elimination) of: analytical methods, size fractionation in analytical schemes, and modal abundance data in comparison or provenance decisions.

Examples:

- What soil textures (or organic matter contents, or clay mineralogy classes) are more or less susceptible to transfer and persistence bias, and how do moisture levels affect this susceptibility?
- If soils are transferred as moist aggregates and begin to dry on a substrate, what properties promote retention or loss of larger particles?
- Do substrate properties (composition, morphology) affect transfer and persistence biases?

A strong foundation based in both empirical studies and theoretical data (Aberle et al 2021, and soil physics) will allow examiners to justify when modal differences could result from transfer and persistence bias. In the absence of a mechanistic explanation, modal differences can serve as a basis for the exclusion of a common source of samples within forensic comparisons.

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

Research on transfer and persistence bias of soils will assist by strengthening the ability of the analysts to justify choices of analytical methods and decision criteria based on case-specific information such as soil properties, substrate properties, and moisture levels. These studies might improve formal reporting on:

1. Limitations of the evidence based on sample size or condition (why certain methods were not used or why quantitative grain count data was not used in interpretation)

2. Identification and significance of unusual characteristics and whether these could be caused by transfer and persistence processes

3. Restrictions on ability to conduct comparisons

4. Enhanced confidence in analytical results

5. Effects of specific case factors (e.g. time, water, location, soil type, vegetation cover, substrate, activity)

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

	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.