

OSAC RESEARCH NEEDS ASSESSMENT FORM



Title of research need:

Mineral bias in transfer and persistence of soil

Keyword(s):

transfer, persistence, fidelity, mineral

Submitting subcommittee(s):

Trace Materials

Date Approved:

02/24/2021

(If SAC review identifies additional subcommittees, add them to the box above.)

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)

There is potential for significant bias in the grain population with transfer and persistence of soil evidence.

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 studies that indicate minimal bias in the mineralogy of particles retained on footwear (Stoney et al 2019a,b). Likewise, if moist, clay-containing soils are transferred, intact muddy aggregates are likely to have minimal mineral bias. The application of the approach of Ausemore and Neumann (2020) for the deconvolution of soil mixtures assumes that there is no bias in grain populations due to transfer and persistence. However, there is greater potential for mineral bias in transfer and persistence in dry mineral particles and with fabrics because dry soils will be less cohesive and because mineral shape MIGHT lead to bias in retention with the weave or knit of a fabric. One study of highly unusual mineral particles and a highly unusual fabric indicated strong bias in retention of pyroxene grains within the fabric of Harrison Schmitz' moon suit (Christofferson et al. 2009). Is this bias due to the low moisture of lunar soils? Is this bias due to the minimal chemical weathering of lunar mineral grains? Is this bias due to the unusual fabric, including PTFE fibers comprising the Apollo moon suits? Experiments with a range of particle types (roughness, grain coatings, roundness, angularity, density, surface charge) and a range of materials (a range of fabrics, versus other substrates) could aid in determining if there are potentials for mineralogical bias in transfer and persistence. One counter example of minimal bias on transfer to fabric is Pirrie, 2019.

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)

Christoffersen, R., Lindsay, J.F., Noble, S.K., Meador, M.A., Kosmo, J.J., Lawrence, J.A., Brostoff, L, Young, A., and McCue, T. "Lunar dust effects on spacesuit systems: Insights from Apollo spacesuits," NASA Technical Report, NASA/TP-2009-214786, 2009, <http://hdl.handle.net/2060/20090015239C>.

Stoney, D. A., Bowen, A. M., Ausdemore, M., Stoney, P. L., Neumann, C., & Stoney, F. P. (2019). Rates of loss and replacement of very small particles (VSP) on the contact surfaces of footwear during successive exposures. *Forensic science international*, 296, 39-47. <https://doi.org/10.1016/j.forsciint.2018.12.020>

Stoney, D. A., Bowen, A. M., Ausdemore, M., Stoney, P. L., Neumann, C., & Stoney, F. P. (2019). Differential analysis of very small particles (VSP) from the contact surfaces and recessed areas of footwear. *Forensic science international*, 298, 106-114. <https://doi.org/10.1016/j.forsciint.2019.02.032>

Stoney, David A., Andrew M. Bowen, and Paul L. Stoney. "Loss and replacement of small particles on the contact surfaces of footwear during successive exposures." *Forensic science international* 269 (2016): 78-88. <https://doi.org/10.1016/j.forsciint.2016.11.015>

Ausdemore, M. A., and C. Neumann. "Deconvolution of dust mixtures." *Forensic science international* 308 (2020): 110144. <http://dx.doi.org/10.1016/j.forsciint.2020.110144>

Werner, D., Burnier, C., Yu, Y., Marolf, A. R., Wang, Y., & Massonnet, G. (2019). Identification of some factors influencing soil transfer on shoes. *Science & Justice*, 59(6), 643-653. DOI: [10.1016/j.scijus.2019.07.004](https://doi.org/10.1016/j.scijus.2019.07.004)

Procter, FA, Swindles, GT and Barlow, NLM (2019) Examining the transfer of soils to clothing materials: Implications for forensic investigations. *Forensic Science International*, 305. 110030.8 <https://doi.org/10.1016/j.forsciint.2019.110030>

Scott, Kirstie, Morgan, Ruth, Jones, Vivienne, Cameron, Nigel (2014) The transferability of diatoms to clothing and the methods appropriate for their collection and analysis in forensic geoscience- [10.1016/j.forsciint.2014.05.011](https://doi.org/10.1016/j.forsciint.2014.05.011)

Murray, K., Fitzpatrick, R., Bottrill, R. and Kobus, H., 2016. Soil transference patterns on clothing fabrics and plastic buttons: Image processing and laboratory dragging experiments. *Forensic Science and Criminology*, 2(1), pp.1-12. doi: [10.15761/FSC.1000109](https://doi.org/10.15761/FSC.1000109)

Pirrie, Duncan. "Testing the efficiency of soil recovery from clothing for analysis by SEM-EDS." *Forensic science international* 289 (2018): 83-91. <https://doi.org/10.1016/j.forsciint.2018.05.026>

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 need of "Quantitative methods to augment visual trace evidence screening and examinations" is stated in the NIJ report, but for soils, if bias of mineral in transfer and persistence is "common," then the quantitative methods developed under NIJ funding will be negated.

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

This work is needed to know if grain count data can be used for mixture convolution and for quantitative comparisons in soil examinations.

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

*Increased understanding of the effects of specific variables, both individually and as a group

*Stronger foundation for describing hypotheses (as opposed to limiting to personal experiences)

*Improved comprehension of the effects of soil sorting via activities and other common factors; possible quantification of resulting shifts in mineral populations

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

The results will assist by strengthening the ability of the analysts to speak to the following points – based on soil types and sorting factors:

1. Limitations to sample size/population
2. Identification and significance of unusual characteristics
3. Restrictions on ability to conduct comparisons
4. Enhanced confidence in analytical results
5. Effects of specific case factors (e.g. time, water, location)

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

I

	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.