OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Surficial distribution of anthropogenic particles from point sources to aid in the interpretation of soil and dust evidence.

Keyword(s): Individualization of particles, point source locations, relative age of particles, urban crime scenes

Submitting subcommittee(s): Trace Materials **Date Approved:** June 27, 2024

(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)

This research need will directly address the draft Standard Guide for the Analysis of Soils and Other Geological Evidence for Criminal Forensic Applications. This research need will also 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 many *forensic* studies that address this issue. However, some types of particles have societal impact so there may be environmental studies that can be applied to forensic problems (many of the references listed in 3 fall into this category).

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)

Aitkenhead, M., Coull, M.C. & Dawson, L.A. 2014. Predicting sample source location from soil analysis using neural networks. Environmental Forensics, 15, 281-292.
Bowen, A.M. & Caven, E.A. 2013. Forensic provenance investigations of soil and sediment samples. In: Pirrie, D., Ruffell, A. & Dawson, L.A. (eds) Environmental and Criminal Geoforensics. Geological Society, London, Special Publications, 384, 9-25.

Eby, N., Soucy, A. & Fontaine, S. 2017. Using factor analysis to identify soil contaminants from the Palmerton, PA, zinc smelters. Conference Paper, Annual Meeting Geological Society of America, At Seattle. Washington, USA. DOI: 10.1130/abs/2017AM-299320.
Gomez MS Thesis Analysis of Retroreflective Glass Beads in Soil Samples for Forensic Investigations (2023, ASU)
MacDonald et al (2011). Dendroanalysis of metal pollution from the Sydney Steel Plant in Sydney, Nova Scotia. Dendrochronologia, 29, 9-15.
Millette et al. (2009). Distinguishing coal, coke and other black particles. The Microscope, 57, 51-57.
Millette et al. (2012). Characterization of coal ash including fly ash particles. The Microscope, 60, 73-84.
Nirei et al. (2011). Classification of man-made strata for assessment of geopollution. Episodes, 35, 333-336.
Odabasi et al. (2016). Investigation of spatial and historical variations of air pollution around an industrial region using trace and macro elements in tree components. Science of the Total Environment, 550, 1010-1021.
Palenik, S. J. (1979). The determination of geographical origin of dust samples. In W. C. McCrone, J. G. Delly & S. J. Palenik (Eds.), *The Particle Atlas, Edition Two* (Vol. 5, pp. 1347-1361). Ann Arbor, MI: Ann Arbor Science Publishers.
Perone et al. (2018). Oak tree-rings record spatial-temporal pollution trends from different sources in Terni (Central Italy). Environmental Pollution, 233, 278-289.
Pirrie, D., Dawson, L. & Graham, G. 2017. Predictive geolocation: forensic soil analysis for provenance determination. Episodes, 40, 141-147.
Pirrie, D., Pidduck, A. J., Crean, D. E., Nicholls, T. M., & Awbery, R. P. (2019). Identification and analysis of man-made geological product particles to aid forensic investigation of provenance in the built environment. Forensic science international, 305, 109974.
Stoney, D.A., Bowen, A.M. & Stoney, P.L. 2015. Utilization of environmentally acquired very small particles as a means of association. Forensic Science International, 254, 26-50.
Suzuki et al. (2009). Existence state of bromine as an indicator of the source of brominated flame retardants in indoor dust. Environmental Science and Technology. 43, 1437-1442.
van Gijtenbeek, Mathijs. Testing the Forensic Predictive Geolocation Significance of Human-Made Particulates in Urban Surface Soils. Diss. University of South Wales (United Kingdom), 2022.

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?

This research addresses: "Fundamental understanding of how environmental factors can affect trace evidence"

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

Particles commonly encountered in dust and soil analyses that are not further investigated (ash, glass spheres, rubber), if better understood in terms of their origin, characteristics and distribution, could assume greater forensic significance.

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

1. A component of geological trace evidence analysis will be added to the array of materials that can be analyzed in soils and dusts, improving the quality of the interpretation.

2. Geological methods can be better applied to the high-volume and challenging urban environments.

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

In cases in which point source particulates occur as evidence, the new research will provide insights into the most relevant analyses to conduct and improve the interpretation of their significance in criminal investigations, particularly for provenance and intelligence investigations.

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

	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.

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