

# OSAC RESEARCH NEEDS ASSESSMENT FORM



**Title of research need:** Reliability (Reproducibility) and Accuracy of Grain Population Data by Polarized Light Microscopy

**Keyword(s):** Grain Counts, Polarized Light Microscopy, Heavy Minerals, Light Minerals, Population Comparison

**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)

Yes, "Standard Guide for the Use of Polarized Light Microscopy in the Forensic Examination and Comparison of Sands and Soils". This research would provide critical data for guiding the interpretation of mineral grain populations in evidence soil samples.

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 not aware of any studies addressing this issue in a forensic context.

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)

Chayes, F. Petrographic Modal Analysis: An Elementary Statistical Appraisal. 1956, John Wiley & Sons.  
Dryden, A.L. Accuracy in percentage representation of heavy mineral frequencies. Proc. Nat. Acad. Sci., 1931, 63: 505-516.  
Pante, E. and Dustan, P. Getting to the point: Accuracy of point counts in monitoring ecosystem change. Marine Biology, 2012, 3. Article ID 802875 .<https://doi.org/10.1155/2012/802875>  
Pirrie, D. et al. Automated SEM-EDS (QEMSCAN®) Mineral Analysis in Forensic Soil Investigations: Testing and Reproducibility. In: Ritz, K. et al. (Eds.) Criminal and Environmental Soil Forensics, 2009, Springer, pp 441-430.  
Weber, J.S. et al. Quantitative asbestos content in friable samples: Development of a stratified Point Counting Method. J. Amer. Industrial Hygiene Assoc., 1990, 51: 447-452.  
Webster, J.R. et al., Heavy mineral analysis of sandstones by Rietveld Analysis. Advances in X-Ray Analysis, 2003, 46: 198.  
Dunkl, István, et al. "Comparability of heavy mineral data—The first interlaboratory round robin test." Earth-Science Reviews (2020): 103210. <https://doi.org/10.1016/j.earscirev.2020.103210>

Soil Survey Staff. 2014. Kellogg Soil Survey Laboratory Methods Manual. Soil Survey Investigations Report No. 42, Version 5.0. Section 7B on "Optical Analysis", pp 557-581. R. Burt and Soil Survey Staff (ed.). U.S. Department of Agriculture, Natural Resources Conservation Service  
Cady, John G., L. P. Wilding, and L. R. Drees. "Petrographic microscope techniques." Methods of soil analysis: Part 1 Physical and mineralogical methods 5 (1986): 185-218. <https://doi.org/10.2136/sssabookser5.1.2ed.c8>

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 supports the need: "Determination of accuracy and reliability of forensic analyses and conclusions, including potential sources of error". This research would determine the accuracy and reliability of a quantitative method employed in forensic soil examination.

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

Mineral grain analysis of sand-sized mineral grains by PLM is one of the most commonly employed tests in forensic soil examinations conducted in the USA. It employs an inexpensive instrument that is available in the vast majority of forensic testing laboratories and produces data that experts believe to be highly discriminating. Interpretation of mineral grain analysis results currently relies heavily on experience-based expert assessments or interpolation of geology/soil science research to forensic scenarios. While the geological literature has a significant amount of published data that can help inform forensic soil examiners, there is currently a dearth of published research in this area that specifically assesses forensic applications of this technique. Results from the proposed research would provide insights into the reproducibility and accuracy of this technique as applied to typical forensic evidence samples. The research could reveal variables that impact the results obtained by different examiners, potentially producing recommendations that would lead to more uniform mineral classification and counting procedures employed and results obtained. An understanding of the reproducibility and accuracy of grain count data is critical in the development of objective criteria for comparing grain count data from different samples.

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

The Trace Materials Subcommittee would gain a better understanding of the reliability and accuracy of PLM grain population data generated by forensic scientists. This knowledge data would enable the subcommittee to develop robust criteria for comparing data sets from different samples. These interpretation criteria could then be evaluated during a black box study, which would be a critical step in validating this method for use in forensic soil examination.

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

An understanding of the reliability and validity of the testing methods employed by forensic scientists is critical to improving the services offered to the criminal justice system. This research would provide baseline data on the reproducibility and accuracy of this method, opening opportunities for future research to develop robust comparison criteria that could be assessed during a validation study. Validating this method would improve the confidence that the criminal justice system can have in the results that are reported and the testimony provided in court related to this type of examination.

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.*