Forensic Application of X-ray Diffraction (XRD) in Soil Analysis: A Comparative Study within the Faculty of Science, Mahidol University

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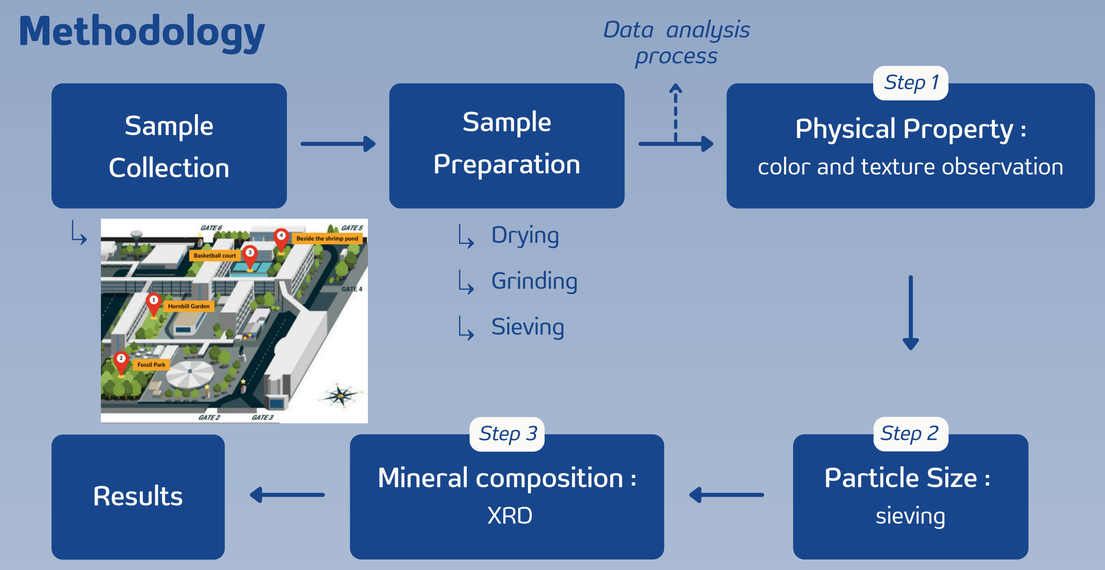
Abstract

Soil analysis is an essential tool in forensic science, as it offers the potential to associate individuals, objects, or locations with specific crime scenes through its unique mineralogical and site-specific properties. This study aims to characterize and compare the mineralogical composition of soil samples collected from various locations within the Faculty of Science, Mahidol University. X-ray diffraction (XRD), a widely recognized analytical technique for identifying crystalline structures and mineral phases, was employed to investigate the spatial variability in soil composition. The results provide a detailed mineralogical profile of each sampling site, contributing to a better understanding of local soil heterogeneity and demonstrating the potential application of XRD-based soil analysis in forensic and environmental studies.

Objectives

1. To study the differences in mineral composition of soil from various locations within the Faculty of Science at Mahidol University.
2. To apply the use of X-ray Diffraction (XRD) techniques in analyzing and identifying the mineral composition of soil.

Methodology




Sample collection


Sample preparation


Prepared sample


Sieving

Conclusions

- Most soil samples consisted mainly of fine to medium sand-sized particles. While some variation in distribution was observed, it was not distinct enough to clearly differentiate between sampling locations.
- XRD analysis effectively identified the minerals present in each sample. Quartz was found in all locations, while other minerals appeared only in some. These mineral differences revealed unique characteristics that were not apparent through physical analysis.
- Overall, XRD provides more detailed and reliable information than physical methods for distinguishing soil samples from different areas. Therefore, soil can be considered a valuable and credible form of evidence in forensic science.

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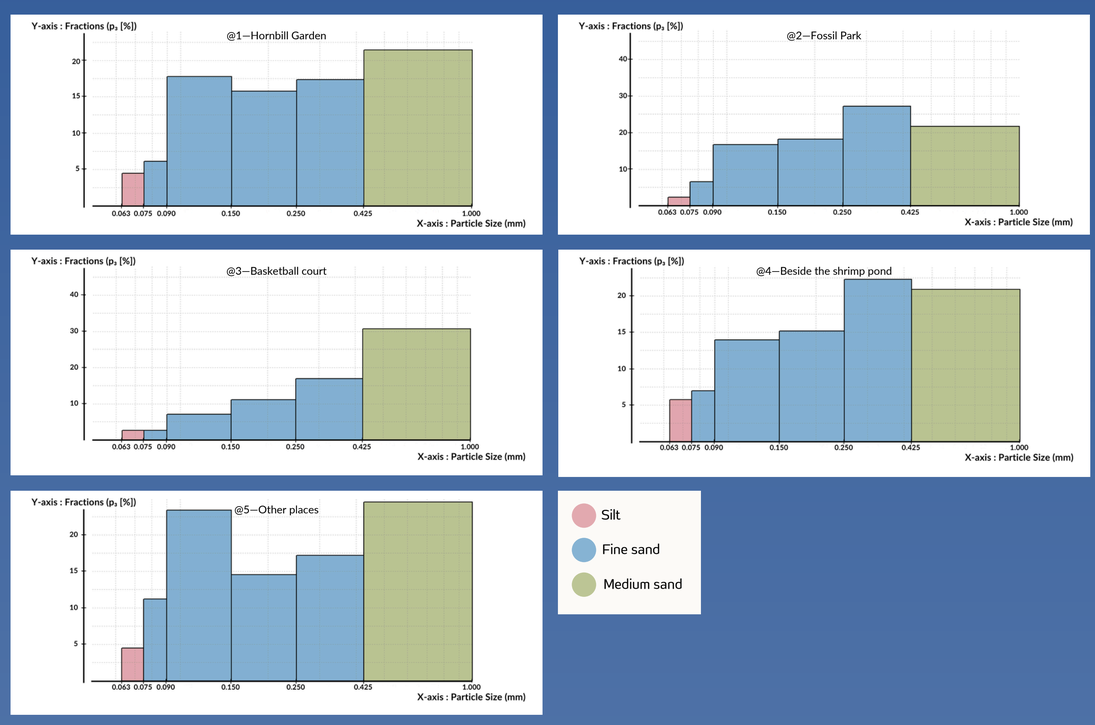
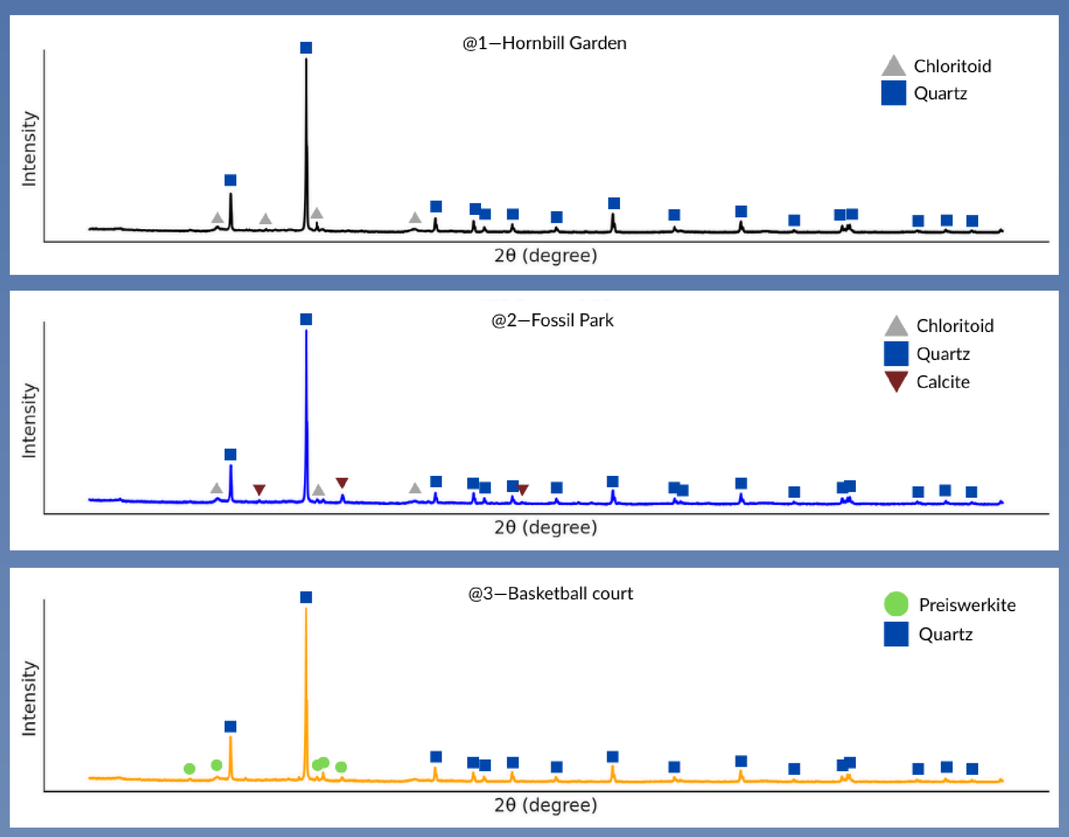
References

Rob Fitzpatrick, Mark Raven, and Sean Forrester. A Systematic Approach to Soil Forensics: Criminal Case Studies Involving Transference from Crime Scene to Forensic Evidence, pages 105–127. Springer, 01 2009.

Results



Graphs. 1-5 show the particle size distribution of soil samples collected from five different locations. Each bar indicates the percentage by weight of soil particles retained on a specific sieve size.



Graphs. 6-10 show the X-ray diffraction (XRD) patterns of soil samples collected from five different locations. Each peak represents a mineral found in the sample, with symbols used to indicate the identified minerals. Quartz was found in all samples, suggesting it is a common and major component in the soils. Other minerals were found only in some samples. These differences in mineral content show the unique characteristics of soil from each location.