The geoforensic analysis of soils from footwear

Morgan, R. M. [a], Bull, P. A. [b], Freudiger-Bonzon, J. [b, c, d], Jellis, T. [b], Nichols, K. [b], Dunkerley, S. [b], Parmee, J. [b]

[a]University College London, Jill Dando Institute of Crime Science, Brook House, 2-16 Torrington Place, London, WC1E 7HN, UK
[b]Oxford University Centre for the Environment, University of Oxford, South Parks Road, Oxford, OX1 3QY, UK
[c]Faculty of Geosciences, University of Fribourg, Switzerland
[d]Faculty of Geosciences and the Environment, University of Lausanne, Switzerland

Abstract

Utilising experimental and case work examples, this study demonstrates the spatial mixing of different soil layers which have been introduced onto the soles of footwear pre-, syn- and post-forensic event. The persistence of sediments introduced onto footwear (both uppers and soles) is identified, highlighting appropriate methods of collection of these materials from both outer and inner parts of the footwear. Experimental studies support the practical observations of sample collection in real criminal case scenarios but highlights pitfalls which can result in false-positive and negative conclusions during the analysis and interpretation of recovered samples.

Experimental studies using three layers of plasticine of different colours identifies that time is more important in the explanation of the spatial distribution of materials on the soles of footwear although selective pressure caused by gait has a contributory effect. The introduction of three soil layers, each containing specific physical and chemical markers, supports the experimental proxy work undertaken with plasticine. Complementary chemical analysis of the soils using XRF confirmed the complex mixing patterns over time. We conclude that care must be taken when sampling footwear for forensic comparison, often more so than is presently exercised.

The persistence of sediments on and in footwear is identified in four criminal case work studies utilising surface texture analysis of quartz grains and palynomorph identification using both binocular and scanning electron microscopy. These studies also provide provenance indicators of the materials from both real case and experimental studies. These persistence and provenance identifications are tested and confirmed under experimental conditions.