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## Interpreting the transfer method of soil evidence on clothing by identifying trace soil patterns

Murray, K.R.<sup>1</sup>, [Fitzpatrick R.W.](#)<sup>2</sup>, Bottrill, R.<sup>3</sup>, and Kobus H.J.<sup>4</sup>

<sup>1</sup>PhD Student, Centre for Australian Forensic Soil Science, CSIRO and The University of Adelaide

<sup>2</sup>Director, Centre for Australian Forensic Soil Science, CSIRO Land and Water Flagship/ Acid Sulfate Soils Centre, The University of Adelaide, Private Bag No 2, South Australia, 5064. [rob.fitzpatrick@csiro.au](mailto:rob.fitzpatrick@csiro.au)

<sup>3</sup>Senior Geologist, Mineral Resources Tasmania, PO Box 56, Rosny Park, Tasmania, 7018, Australia.

<sup>4</sup>Emeritus Professor, Forensic Science, Flinders University, Adelaide, South Australia

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In a recent homicide in Western Australia, trace fragments of brick particles (often <0.5mm) and soil on the victim's clothing suggested she was initially attacked in her front yard and not in Kings Park where her body was buried [1]. The trial was before a judge only and he concluded that the mineralogical data from the brick particles on the victim's clothing and the bricks from her front driveway suggested she was initially attacked in her front yard and not in Kings Park [2, 3]. However the important issue that emerged during the trial was how the brick and soil particles were transferred to her clothing [2, 3]. During forensic analyses of soil materials on clothing, especially when there are few soil materials present it is often necessary to remove as much soil material as possible from clothing for mineralogical and chemical analysis. The unintentional effect of this forensic testing, (which in this case also included cutting up the victim's clothing) was the near-complete removal of trace soil patterns that may have enabled a better understanding of the circumstances befalling the murder victim. This became the catalyst for designing a range of laboratory [3] and field soil transference experiments on clothing fabrics to study, recognise and classify soil patterns transferred onto fabric when a body is dragged across a soil surface.

Using a series of laboratory experiments [3] and a simulated clothed human body, nearly 1000 experiments tested the soil transfer methods of either placing or dragging weighted fabric on a wet or dry soil surface. Sets of trace soil patterns were recorded; with many patterns unique to a specific method of soil transference. Twenty different anthropogenic and natural soil types and five fabric types [cotton, nylon, nylon-elastane, polyester-cotton and polar fleece (polyester brushed both sides)] were used to ascertain whether some trace soil patterns could universally occur across all soils and fabrics tested. Soil mineralogy and moisture content, irregularities on the fabric surface (such as raised seams) and appendages (such as buttons and metal buckles) had a greater influence on resulting trace soil patterns than the five fabrics tested. This influence was also dependant on the method of soil transfer used. Image processing computer software provided a cheap, accessible, objective and standardised method of providing numerical data on trace soil transferred to fabric. This analysis included Munsell soil colour analysis, the quantity and directionality of individual and aggregate trace soil objects. Digital photographs were taken using a camera in natural and artificial lighting conditions of trace soil patterns on fabric. It was important that this occurred before the simulated clothed body was moved or clothing fabric removed; to keep trace soil patterns in original pristine condition.

*References:*

- [1] Fitzpatrick R.W., Raven M, Self P.G. (2011) Detailed mineralogical characterization of small brick and soil fragments (<0.5mm diameter) by Synchrotron X-ray diffraction analyses for further forensic comparisons relating to Operation Dargan. Centre for Australian Forensic Soil Science Restricted Client Report. p. 1-116.
- [2] Martin B. The State of Western Australia v. Rayney. [No 3]: WASC; 2012. p. 1-369.
- [3] Martin B. Judgement summary: The State of Western Australia v. Rayney. [No 3]: WASC; 2012. p. 1-13.
- [4] Murray, Kathleen R, Fitzpatrick Robert W, Bottrill Ralph S, Berry Ron, Kobus Hilton. (2016) Soil transference patterns on bras: Image processing and laboratory dragging experiments. Forensic Science International. 258, 88-100. <http://dx.doi.org/10.1016/j.forsciint.2015.10.009>

