

Paper Number: 5358

Trace evidence examination using laboratory and synchrotron X-ray diffraction techniques

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On August 7th 2007, Corryn Rayney, a Supreme Court registrar, failed to return home after a boot scooting dancing class at a nearby Community Centre in Bentley, a suburb of Perth, Western Australia. Her body was subsequently recovered on August 16th 2007 after transmission oil from her broken down, abandoned car lead police to a clandestine gravesite along a dirt track in Kings Park, also located in Perth. Soil evidence from the victim's body, clothing, home, vehicle, Community Centre and grave site were analysed extensively in order to identify the likely movement of the victim after she left the Community Centre. The Perth coastal plain consists of predominantly coarse sandy soils, which show minor mineralogical variation throughout the region and consequently bulk soil mineralogy was of little use. However very small (often <0.5mm) red particles were observed on the victim's body, clothing (mainly her bra), home and vehicle. These red particles were not found at the Community Centre or the surrounds of the gravesite.

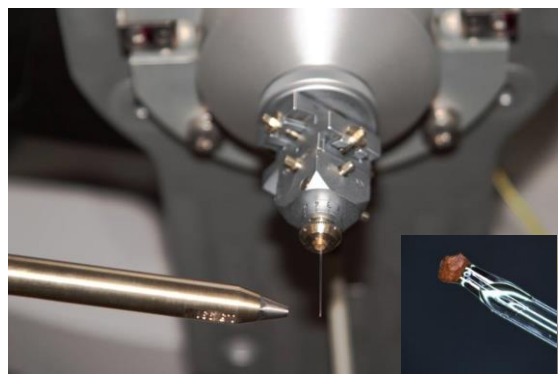


Figure 1: Small brick fragment mounted on a 0.5mm glass capillary with cyanoacrylate glue for XRD analysis at the CSIRO laboratory in Adelaide and the Synchrotron in

Recycled red house bricks were extensively used at the victim's home for paving of the driveway, footpaths and pergola area. The bricks were recycled from houses constructed prior to the 1940's when weaker lime mortar was replaced with stronger Portland cement mortars. Bricks manufacture prior to 1940 were sourced from several localities and the bricks subjected to less than ideal firing conditions. The red bricks used at the victim's home therefore ranged in hardness and durability from soft to very hard, in contrast to the yellow/pale-brown bricks from the Community Centre, which were very hard. Laboratory X-ray Diffraction (XRD) analysis of 42 bricks from the victim's home and the Community Centre confirmed mineralogy could

classify the bricks into 5 or 6 distinct groups [1]. Powdered bulk and small fragments extracted from the 42 bricks were measured on the Powder Diffraction beamline at the Australian Synchrotron (Fig. 1). The Synchrotron results showed that each of the small brick fragments examined could be effectively matched to the whole brick group from which the fragment originated. Fragments of red particles from the forensic evidence were subsequently analysed at the Synchrotron and were shown to be consistent with having originated from the victim's home [1]. The trial was before a judge only and he concluded

that the mineralogy 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 at Kings Park where her body was buried [2, 3].

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.

