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Forensic Soil Science Support for Environmental Crime Investigations

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Recently there has been an increase in awareness of the importance and relevance of soil materials in forensic science. The Centre for Australian Forensic Soil Science (CAFSS) has been actively involved in specialised soil forensic work, including assisting law enforcement and environmental agencies with: (i) the search, location and recovery of soil and mineral samples and (ii) assessing the range and impacts of natural and man-made soil hazards that present major risk to both national and international soil and water security. The majority of soil forensic cases were overwhelmingly complex, and the challenges of associating relevant information from one source with another, often requires the development of new sophisticated field and laboratory methods (Fitzpatrick 2009; Fitzpatrick and Raven 2010).

The experience gained from conducting over 70 forensic cases has led to the development of guidelines for soil forensic investigations that are designed to provide a "systematic approach" for examining and characterising soils for forensic comparisons (Fitzpatrick and Raven 2010).

This approach involves subdividing methods into the following 4-stages each comprising several steps and involving a combination of techniques: (1) Morphological characterisation of soils for screening of samples. (2) Identification, characterisation and semi-quantification of minerals and organic matter following sample selection and size fractionation (<50µm). (3) Detailed characterisation and quantification of minerals and organic matter using advanced analytical methods. (4) Landform and soil mapping; construction of soil-regolith conceptual models.

Through case studies, this presentation will demonstrate how advanced field and laboratory approaches have been critical in developing coherent, predictive, soil-regolith models, from landscape to microscopic scales, to solve practical soil-based environmental crime investigations for both Australian and overseas stakeholders. To demonstrate the critical importance of soil in environmental crime investigations, the following five case studies, which tackle difficult problems at a range of scales involving highly complex issues, will be presented:

- Formation of polluted salt-affected and Acid Sulfate Soils in what has become known as "one of the world's greatest environmental disasters", where over 90% of the Mesopotamian marshlands in Iraq have changed by dewatering and the burning of reed vegetation through the combined actions of upstream damming and downstream drainage projects undertaken by the regime of Saddam Hussein (Fitzpatrick 2004).
- Six million dollars worth of dinosaur nests and eggs (over 100 million years old) were illegally exported from China and imported into Australia (seized at the request of China).
- Illegal clearance and theft of eleven million dollars worth of tree ferns from national parks in Victoria. The cost to repair the environment was estimated to be more than $300,000.
- Damage to the Australian telecommunication optic fibre cable network from shrink-swell soils and soil corrosion is very costly to repair and if avoided, can save millions of dollars

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