

by Alastair Ruffell^{1*}, and Bill Schneck²

International case studies in forensic geology: fakes and frauds, homicides and environmental crime

¹ School of Natural and Built Environment, Queen's University Belfast, BT7 1NN, Northern Ireland, UK; Officer for Training and Publications, International Union of Geological Sciences, Initiative on Forensic Geology (IUGS-IFG); *Corresponding author, E-mail: a.ruffell@qub.ac.uk

² Microvision Northwest-Forensic Analysis and Consulting, Inc. (formerly Washington State Patrol Crime Laboratory, 580 West 7th Street, Cheney, WA 99004, USA); Officer for USA, International Union of Geological Sciences, Initiative on Forensic Geology (IUGS-IFG)

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Some case studies are presented ranging from geological fakes and frauds, homicides and one environmental forensic case. Fakes may be true geological materials such as created fossils or gems and precious stones, or where geological methods are used to analyse fakes, such as the stones or ceramics used in making archaeological or art forgeries (e.g., mineral pigments in paintings). Fakes have also been created for reasons of academic rivalry, career advancement and religious belief. Fraud commonly involves over-stated claims of ore content associated with mining and the oil and gas industry. The range of geological fakes, the uses of geological methods in detecting fakes, and the extent of fraud in the mining sector are all extensive and sometimes incredible. The homicide case presented to demonstrate how the types of geological investigation described in the rest of this volume may be applied. We include an environmental forensic case for similar reasons, to show that forensic geology may be applied to more than homicides and fakery.

Fakes

There are hundreds of examples of faked geological materials (crystals and fossils), as well as the use of geological materials in fakes (Ruffell et al., 2011). Whilst there is a large and very interesting volume of literature on individual cases of geological fakes and frauds, this article aims to give a flavour as to the problem of geological fakes and frauds, and how the geologist may assist in the investigation of such. As an example of geological fakery we have selected the volumetrically most significant number globally – that of created, assembled or re-located fossils. Individual countries and regions of the world do have their own, high-volume issues of fraud, for instance South Africa, where mining and precious metal or gem fraud are high, but globally, fossils score highly in published investigations. Faked fossils have involved some very famous scientists, celebrities and collectors through the ages, from Mary Anning of Lyme Regis, accused by Cuvier of faking fossils (Shapin, 1996); through to Sir Arthur Conan

Doyle, wrongly implicated in the Piltdown Man affair; and Sir Fred Hoyle (former Astronomer Royal) who wrongly claimed that *Archaeopteryx* was a fake. Accusations of the faking of the locations of fossils has cost careers (see Osborne (2000) on the Deprat Affair) and reputations, as related below. Many know of the Bre-X mining scandal, the Piltdown Man, perhaps Beringer and the faked fossils, or of Ehrenberg's (Scientific American (1856, p. 240)) detection of substituted silver coins for sand on the Prussian railroads of the 1840s. The greatest fossil faker of all time, Viswa Gupta is well known to many palaeontologists. However, the idea that all of the Pyramids could be constructed of human-made stone (Barsoum et al., 2006), that there are Egyptian pyramids in Bosnia, or of the great Creationist fraudster, Baugh, are perhaps not known to the reader.

The Largest Number of Fakes in the World and in History: Fossils

A Notorious Fraud Fossil Case

The greatest fossil faker of all time was Viswa Gupta, well known to many palaeontologists. In 1989 palaeontologists John Talent and John Pickett visited a site in Nepal that Viswa Gupta of them of Panjab University had described as bearing Devonian conodonts. On searching the location, they found high grade metamorphic rocks and one location with Silurian sediments that yielded a single conodont. At first they were concerned they were in the wrong location, or that Gupta had incorrectly located the site on his published map. On checking the figures in Gupta's papers, and consulting with one Professor Clapper, they realised that Gupta's photographs were of the same specimens held in a North American museum. Unable to explain this, Gupta's university was informed and the story published by Lewin (1989) in the journal 'Science', making it one of the most widely read about fossil fraud.

A Strange Fake Fossil Case

Carl Baugh is a Young Earth Creationist who owns a rock outcrop in Texas where trace fossil human footprints occur alongside those of *Tyrannosaurus rex*. Baugh showed that this proves humans lived alongside

dinosaurs. However, not long after purchasing the land, Baugh was told by the previous owner that he had carved the human imprints alongside real dinosaur tracks. Baugh dismissed this claim by suggesting that the evidence was so damaging to modern science, that the previous owner had been paid off or coerced by the United States government to make the statement of fakery.

Fraud

The Bre-X Scandal

The placing of valuable material amongst or in place of valueless rock or sediment is common, in order to inflate values and convince unsuspecting investors to part with their money. When the Canadian company Bre-X reported high levels of gold in drill core from their site on the Busang River, Borneo, in 1994 the company stock value soared. Some investors who had knowledge of the likely fraud sold their shares and made a profit; others who were less well-informed kept buying Bre-X stock. However, it was the project manager, Michael de Guzman, who was filing gold from his wedding ring and mixing the flakes in with the crushed core samples. De Guzman used realistic ratios of gold to rock to not set off alarm bells, and to keep project going forward. Over the next 2.5 years, de Guzman would buy \$61k of panned gold from locals to use in salting (<http://www.mining.com/web/bre-x-scandal-a-history-timeline/mysteriously>). The geologist who discovered the fraud 'fell' from a helicopter to his death (Goold and Willis, 1997).

A Geological 'Fraud' We Have Likely All Been Part of: the Bottled Water Industry

Bottled water is convenient to buy and carry around, and is often sold as coming from mountain springs or boreholes in attractive locations such as the French Alps (Mather, 2004). In addition, such bottles often carry extensive chemical analyses on their labels, pointing to the health benefits. In reality, much tap water in temperate countries with good infrastructure is of equal, if not better quality than bottled water, hence Mather (2004) calls this fraud, which is a little harsh when it is really the disingenuous labeling of some bottled water that is the issue.

Modern Fraud: Rare Earth Elements

Since 2009, the author and colleagues have been contacted many times concerning the analysis of ingots of precious elements, most especially lithium. Ingots of lithium are being imported into the USA, Canada and Europe, and when assayed with XRF shown to be genuine, when they have been created for fraudulent financial gain. The process is simple: scrap metal is melted into rough ingots. Lithium-rich materials such as batteries are then very vigorously rubbed all over the surface, providing a high Li signature when analysed and sold.

Historical Fraud and Fakery

Geological analyses are routinely used to check for art fraud, usually by the mineral content of paints and pigments, as many materials used in modern fakes were not available at the time the supposed painting

was created. The provenance of stone in sculptures such as marble is also often the subject of a geological-based investigation. A pioneer in the area was Walter C. McCrone, a famous microscopist who worked on the pigments in the Turin Shroud and also suggested the Vinland Map (which, if proven to be genuine, would indicate that most of Greenland and northern North America were known in 1440) was a fake (McCrone and McCrone, 1974), because of the titanium oxide-based pigments used not being known until 1917.

Environmental Case: Fuel Fraud

Staff in the Chemistry department at Queen's University in Belfast were asked in 1998, by Her Majesty's Revenue and Customs, to determine the nature of material used in fuel laundering. Agricultural diesel is cheaper than regular diesel and has dye added to it, such that anyone using it in private or commercial vehicles can be detected and prosecuted. The chemists had been told the material was kieselguhr (diatomaceous earth), a material commonly used in filtering liquids, ready for laundering. If confirmed, a source may be determined, advancing the investigation. The pale-coloured powder was too fine-grained for microscopy, so x-ray diffraction would need to be undertaken. The material was found not to be kieselguhr, but an absorbent clay mineral group called smectite (the main mineral constituent of bentonite, a clay used in cosmetic powders, drilling mud, kitty litter and the only known antidote to paraquat poisoning). This made sense as kieselguhr filters particles not chemicals, whereas smectites preferentially absorb chemicals like dyes. Subsequently, the problem of fuel laundering has grown in many countries where diesel has variable taxation and is dyed as a consequence, with bentonite commonly used to remove the dye.

Homicide Cases

Asphalt and Soil

A case that illustrates the importance of unusual cultural artifacts in soil began on a hot afternoon in East Los Angeles in 1999. The clothed body of a deceased male was observed in the back of a minivan parked on a busy residential street. An experienced detective noticed fresh appearing soil around the wheel wells of the vehicle and collected it. Police apprehended a suspect and searched his residence. Large, barren areas of exposed soil with tire tracks indicated that vehicles often parked in the front yard adjacent to the driveway. The tire impressions were poorly preserved to help in comparison and identification. Investigators collected soil samples from the driveway and soil samples from a ten mile radius to evaluate regional differences in soil color and composition. Laboratory analysis by stereo-binocular microscopy and polarized light microscopy revealed similarities in color and mineralogy between the soil on the vehicle and the driveway. Additionally plaster particles, paint chips, glitter and red, green, white and brown asphalt roofing shingle particles with adhering fiberglass, all similar in size and morphology to those found in the soil on the vehicle, were identified. Asphalt shingles naturally decay, and the asphalt releases the rock granules over time. Rain and wind flush the loose granules off the roof, and they intermix with the soil around the building. This particle association was critical to obtaining a guilty verdict at trial.

Soil Containing Charred Botanicals, Diatoms and Paint chips. Case of a Child Abduction and Murder, USA.

A young girl was abducted from her bedroom in the middle of the night. A video camera at the residence shows a male carrying the girl in her pink blanket leaving the carport. The following day the body of the missing girl was recovered from a canal approximately one mile from her home. The property adjacent to the crime scene was the site of a grass fire one month before the murder. The fire was caused by a spark from a downed power line. Some of the girls' clothing was found within the perimeter of the fire scene. Several weeks transpired before a suspect was apprehended leaving a bank robbery. An observant officer noticed how dirty and black stained his hands and clothing were and quickly notified the detectives working on the homicide. Evidence recovered from the suspect included hand swabs of the black material, fingernail clippings and all of his clothing. Microvision NW collected soil and water from the banks of the canal, charred and uncharred grass from the scene and 50 additional soil and building material samples from the charred field where some of her clothing was found. Charred and un-charred fragments of wheat grass, diatoms unique to that waterway, soil particles and yellow non-automotive maintenance paint chips were found on both the victim's clothing and the suspects clothing and body, that linked the suspect to the crime scene. This case emphasizes the value of multiple evidence types found in soil that can aid in an investigation.

Concrete Catches Killer

Two very different people came into contact with dreadful results on the 11th December, 2003. The first, a serial offender, lived a few miles south of the town of Strabane (County Londonderry, N.Ireland) and had been released from prison four months earlier, following conviction for the rape and false imprisonment of a woman in 2000. The second, a retired librarian aged 65, she walked each day over the bridge into County Donegal (Irish Republic), to attend Mass. On this particular day, she did not return home. Her husband reported her missing, and her family were all alerted in case she showed up at any of their houses nearby, or even in Dublin or London. The river was searched and surveyed by Sonar, with no results. Various pieces of evidence began to accumulate that pointed in the suspects direction. A particularly assiduous detective noted that the fire brigade had been called by the suspects aunt to his house as a car fire was dangerously close to an oil tank – on the day the 65 year old woman went missing; he was a known offender and most critically, once posters were released in mid-January, showing her photograph, a witness (a farmer in his tractor on a country lane near the suspects house) came forward to say he thought he saw her, with blood on her head, in a small red car on the day of the disappearance: indeed the lane was so narrow, he had forced the vehicle to drive partly (on the passenger's side) onto a low bank below a hedge. The house was searched to no avail, as was an adjacent abandoned property. His burnt-out car was searched, and the dog indicated (albeit through the smell of burning) on the passenger and rear seats and samples taken. The police searched the rest of the suspect's house and found the remains of a fire, in which fragments of a red coat and parts of a rosary bead set were found. The missing woman was wearing a red coat on the day she vanished, and the rosary beads

were from the same source as those her husband owned. On this evidence, the suspect and his mother (later released), were arrested. Both explained the coat fragments and rosary as being bought by them at a junk sale – they often bought clothes and sold them on, and burnt what was unsellable.

The suspect was detained and a full search of the area around his house was organised. The search dog indicated around a pile of concrete slabs in a stream 50 m from the suspect's house. The slabs were lifted off and piled them sequentially on the bank, revealing an animal feed sack, inside was the corpse of the missing female.

Concrete control samples from the river banks, the house (where three piles of slabs occurred, one at the river end to the house, the others further away), adjacent farms, road lay-bys, were collected. None of the control slabs could be compared to either the body/river or house slabs, which did compare. Furthermore, the slabs from just above the wrapped body were most similar in size fractions, fragment type and cement makeup to those from the side of the house closest to the river. The suspect was found guilty on 12th April, 2006, some two years after she was buried in the church she was making her way to or from in December 2003: the serial offender, maintained his not guilty plea and thus was detained for life, with no consideration of release unless under the orders of the Home Secretary, as with other serial killers.

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Alastair Ruffell is a Reader at Queen's University, Belfast and works mainly on forensic geology. He has many years operational experience working with the police and other organisations in the use of remote sensing and geophysics in searching the ground for toxic waste, human bodies or buried weapons/contraband in water and peat (wetlands). He also has expertise in the analysis of trace geological evidence for criminal investigations. He is co-author of the book 'Geoforensics' and numerous other publications on forensic geology.



Bill Schneck has a Bachelor of Science degree in Allied Health Science and Geology from Georgia State University, a Master's of Science degree in Geology from Eastern Washington University, and 30 years of experience in forensic science. In 1990, Bill was instrumental in setting up the Microanalysis section of the Washington State Patrol Crime Laboratory in Spokane, Washington. His responsibilities involved the analysis of soil, building materials, fibers, hairs, glass, paint, wood, paper, botanical traces, bloodstain patterns, food, explosives and gastric contents. In 1995, Bill started Microvision Northwest-Forensic Consulting, Inc.