Forensic Geosciences in the United Kingdom and United States

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PREMISE:

• Forensic Geosciences - currently enjoying a renaissance in the U.K., but not in the U.S.

• Notable trends support this concept.

• Possible reasons for these differences.

• Two examples will illustrate different approaches to forensic geoscience cases in the U.K. and the U.S.
Study Approach

• Literature searches of forensic geoscience articles and books (excluding related publications on burial sites, palynology, and diatoms).

Sources:

• California Criminalistics Institute Library Search 2008
• Journal of Forensic Sciences: 1975 - Present
• Journal of the Forensic Science Society/Science and Justice: 1973 - Present
• Forensic Science International 1975 to Present
• Pye, K. Geological and Soil Evidence, Forensic Applications. 2007
Notable Trends

• Past 8 years, U.K. authors have published many more papers and books on Forensic Geoscience than U.S. authors.

• Of the published articles, authors in the U.K. are affiliated more with private companies or academic institutions; authors in the U.S. with academic or government institutions.

• Methods of analysis and the measured soil properties are more traditional in the U.S. than in the U.K.

• More sophisticated methods of analyses and measured soil properties are associated with publications by authors from private or academic institutions.
% Frequency of Published Forensic Geoscience Articles by Authors' Affiliations: U.S. vs. U.K.
Measured Soil Properties: % Frequency of Use in Published Forensic Geoscience Literature: U.S. vs U.K.

- Size/Shape/Texture
- Particle Size Distribution
- Color
- Density Gradient
- Bulk Mineralogy
- Clay Mineralogy
- General Chemistry
- Organic Components
- Major and Trace Elements/Heavy Metals
- Isotope Ratios
- Databases

Measured Soil Properties

% Frequency

U.S. vs U.K.
% Frequency of Analytical Methods Applied to Forensic Soils Testing in Published Forensic Geoscience Literature: U.S. vs. U.K.
% Frequency of Measured Soil Properties in Published Forensic Geoscience Literature by Affiliation - UK

Measured Soil Properties

- Databases
- Isotope Ratios
- Major and Trace Elements/Heavy Metals
- Organic Components
- General Chemistry
- Clay Mineralogy
- Bulk Mineralogy
- Density Gradients
- Color
- Particle Size Distribution
- Size/Shape/Texture

% Frequency

Government + Academic
Private + Academic
Private
Government Laboratory
Academic
% Frequency of Measured Soil Properties in Published Forensic Geoscience Literature by Affiliation: U.S.

Databases

Isotope Ratios

Major and Trace Elements/Heavy Metal

Organic Components

General Chemistry

Clay Mineralogy

Bulk Mineralogy

Density Gradient

Color

Particle Size Distribution

Size/Shape/Texture

% Frequency

Academic

Government Laboratory

Academic + Government

Measured Soil Properties

% Frequency vs. Measured Soil Properties

Y-Axis:
- Databases
- Isotope Ratios
- Major and Trace Elements/Heavy Metal
- Organic Components
- General Chemistry
- Clay Mineralogy
- Bulk Mineralogy
- Density Gradient
- Color
- Particle Size Distribution
- Size/Shape/Texture

X-Axis:
- % Frequency

Legend:
- Academic
- Government Laboratory
- Academic + Government
Privatization of Forensic Science:

• 1991 Forensic Science Service began selling services as an agency

• 2005 FSS became a GovCo

Many scientists left to open private laboratories
Academics became major providers of forensic data
University instrumentation becomes available
Competition among providers lowered costs
Research at former government labs decreased
Quality control became a major issue
Academic and private labs began to actively publish a lot of forensic related articles/books.

• 2010 FSS closes
Case Examples
USA Case

- Suspect Bennette Douglas was charged with the murder of two female acquaintances.

- Douglas killed his victims and buried them in different places in northern San Diego County, California.

- Both sites were within the Peninsular Range Batholith and were within 5 miles of each other.
The Evidence

• Two shovels and a hoe all with adhering soil were found in the suspect’s garage.

• These along with soil samples from the burial sites were submitted to the laboratory for analyses.
Examinations

• Samples were examined for:
  - Color
  - Particle size distribution
  - Mineralogy
Examination Methods

• Whole Samples (color and grain morphology)
• Sieved Samples (color and grain morphology)
• 90 to 180 micron fraction:
  - Whole fraction (Mineralogy)
  - Light Minerals - Separation (Mineralogy)
  - Heavy Minerals - Separation (Mineralogy)
Examination Techniques

• Stereomicroscopy

• Polarizing Light Microscopy (PLM)

• X-ray Diffraction – Used instrument at local university.
Results

• Soil from Hoe - different color/aggregate morphology than soils from either burial site.

• Soil from both shovels - different color/grain sizes/aggregate morphology and plant material than soils from Reidy Creek burial site.
• Soil on one shovel similar in color, particle size distribution, and mineralogy to Mountain View Park burial site.

• Soil on other shovel is similar in most features to Mountain View Park site; however, differs in having fewer zircon.

• X-Ray Diffraction results confirmed microscopy data.
Robert Young - A Northern Ireland Loyalist paramilitary gang member and drug dealer was convicted of murder in 2005.

Use of QEMSCAN, an automated SEM fitted with Energy Dispersive X-ray spectrometers was important in providing crucial analytical data leading to the conviction of Mr. Young.
• Young suspected of being one of two gunmen who shot and killed a rival gang leader.

• During their escape, the gunmen were believed to have fled through a yard containing waste materials including plaster board.

• Young was apprehended and his car was searched.

• Small amount of plaster board was observed on the floorboard of Young’s vehicle.
• Gypsum was identified using x-ray diffraction in plaster board samples from Young’s car and from the yard along the escape route.

• QEMSCAN showed the samples had similar chemical compositions including minor/trace elements; and similar textural features.

• These samples differed in minor/trace elements and textural features from four commercially available plaster board samples that were also tested using QEMSCAN.
Study Conclusions

Privatization of forensic laboratories in the U.K. has:

• Increased the cooperation between academic institutions and the forensic community.

• Increased the number of institutions (both private and academic) interested in pursuing forensic geoscience research.

• Allowed for more funding and time to pursue research in forensic geosciences in academic settings that have more research oriented resources available.

• Created issues with quality control of work products
Study Conclusions (Cont’d)

Forensic laboratories in the United States face different challenges that have precluded the development of forensic geosciences including:

• Dependency on limited public funds which can vary from year to year

• The concentration of limited monetary and workload resources on DNA analyses and databases

• The closing of Trace Evidence Units/or their consolidation

• Inundation with casework and not enough analysts
Private/Government Funded Institutions

Government Run Forensic Laboratories

Private Forensic Laboratories

Academics

UK

USA
....and now for something completely different....
2010 and 2011 Recent Developments

- 2010 3rd International Soil Forensics Conference
- The IUGS Initiative
2010 International Soil Conference – Long Beach, California

- 12 Nations were represented including delegates from:
  - Australia
  - Canada
  - Colombia
  - Netherlands
  - Germany
  - UK
  - United Arab Emirates
  - United States
Presentation Highlights

• Forensic Geosciences and the NAS Report
• QEMSCAN applications to Forensic Geoscience
• XRF applications for soil provenance studies
• Biomarkers to distinguish soils in urban areas
• Soil sampling strategies using spatial data analysis
• New applications of old mineral exploration techniques and use of various map and image tools to locate buried bodies.
• Locating buried bodies via examination of chemical processes in soils occurring during decomposition.
• Case studies and historical perspectives
SWGGEIO

• A proposed Scientific Working Group for Forensic Geoscience

• Facilitators: Chris Taylor - US Army Lab and Bill Schneck - Washington State Patrol

• First informal gathering was a luncheon at 2010 Soil Forensics Conference in Long Beach, California
IUGS Initiative on Forensic Geology

- International Union of Geological Sciences (IUGS):
  - Non-governmental scientific organization.
  - Supports and facilitates international and interdisciplinary cooperation in geology.
Initiative on Forensic Geology (IFG)

- Initiative status:
  - Highest level for an international working group affiliate of the IUGS
  - Provides the Forensic Geology discipline with global status and funding
- The IFG was established in 2011 due to the efforts of Laurance Donnelly of the UK
# IFG Officers

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<tr>
<th>NAME</th>
<th>OFFICE</th>
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<tr>
<td>Laurance Donnelly</td>
<td>Chair</td>
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<td>Rob Fitzpatrick</td>
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<td>Lorna Dawson</td>
<td>Communication</td>
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<td>Alastair Ruffell</td>
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<td>Skip Palenik</td>
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<td>Chris Palenik</td>
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<tr>
<td>Raymond Murray</td>
<td>Honorary Committee Member</td>
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## IFG Regional Officers

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<tr>
<td>Ahmed Saeed Al Kaabi</td>
<td>Middle East</td>
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<td>Rosa Maria Di Maggio</td>
<td>Europe</td>
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<td>Roger Dixon</td>
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<td>Russia</td>
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<td>James Robertson</td>
<td>Australia and Pacific</td>
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<td>Bill Schneck</td>
<td>USA</td>
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<td>Ritsuko Sugita</td>
<td>Japan and Asia</td>
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Prospective Goals and Objectives

• To promote Forensic Geology around the world

• Provide Forensic Geology training, out-reach and dissemination of Forensic Geology related information world wide

• Establish best practices guidelines.

Website:  http://forensicgeologyinternational.org/
Upcoming Events in Forensic Geology

- **2011:**
  - IUGS-FGI Inaugural Committee Meeting – Rome.

- **2012:**
  - International Geological Congress – Brisbane
  - 4th International Conference on Criminal and Environmental Soil Forensics – the Netherlands
  - Forensic Soils Workshop – AAFS, Atlanta
Not "DIRT" again?!!!