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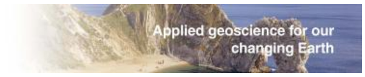

Assessing the link between the Geochemistry of Soils and the Bioaccessibility of Arsenic, Chromium and Lead in the Urban Environment

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29th June 2010

Northampton

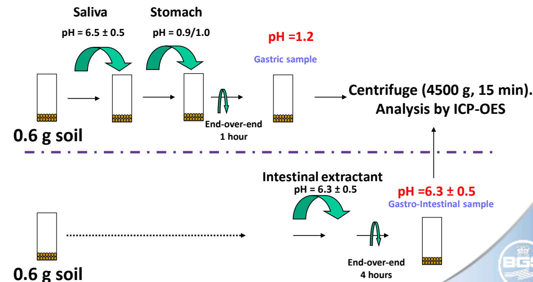
- Large Market town in central England
  - Population of c. 200,000
  - Busy Road and Rail links
- Primary industrial activities were shoe making and other leather industries
  - Now a hub for finance and distribution industries
- BGS surveyed the area as part of the G-BASE programme
- Ironstone soils, naturally elevated in arsenic
- 45% of the soils have As concentrations above the residential SGV of 32 mg mg^{-1}

What have we done?

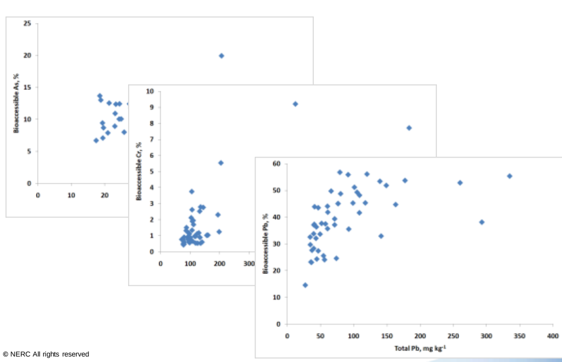
- 275 Surface soils (G-BASE Urban sampling program)
  - Composite samples
  - 5 auger flights at a depth of 10-20cm from the centre and corners of a 20 x 20m square
  - Collected from unbuilt ground every kilometre square
- XRF analysis of major and trace elements
  - All samples
- Bioaccessibility
  - Subset of 50 samples
  - Using the newly validated BARGE UBM method

Bioaccessibility

- Primary exposure route
  - Adults – 20 to 100 mg day^{-1}
  - Children – 80 to 400 mg day^{-1}



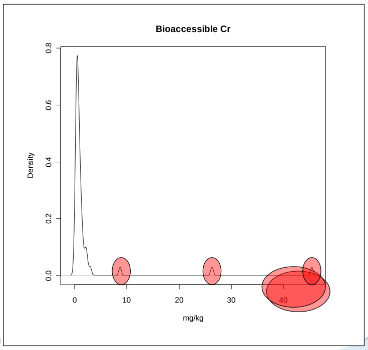
Total vs Bioaccessible PHEs



Data modelling

- Predict the bioaccessibility of PHEs using the major element geochemical data
- R
  - Density plots to identify populations in data
  - Identify and remove hotspots from the model
    - Background bioaccessibility prediction

Density plots



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- Predict the bioaccessibility of PHEs using the major element geochemical data
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  - Linear regression model based on the major element concentrations and PHE in the soils

Optimum models

	As	Cr	Pb
Intercept	-3.036	-3.506	-11.1
Soil pH	5.26E-01	3.55E-01	n/a
Na	n/a	1.22E-03	n/a
Mg	2.66E-04	n/a	n/a
Al	n/a	-1.23E-05	n/a
P	8.13E-04	n/a	n/a
Mn	-1.15E-03	n/a	n/a
Fe	-2.66E-05	-2.04E-05	n/a
As	6.97E-02	n/a	n/a
Cr	n/a	2.35E-02	n/a
Pb	n/a	n/a	0.581

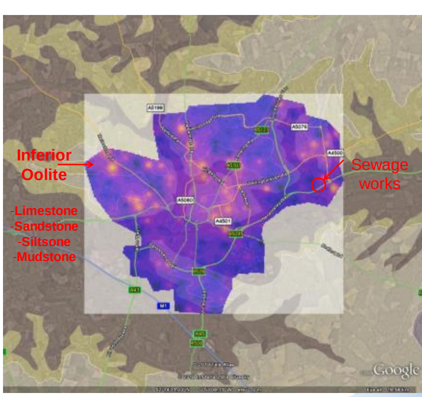
* All coefficients significant at the 99% CI min

Data modelling

- Predict the bioaccessibility of PHEs using the major element geochemical data
- R
  - Density plots to identify populations in data
  - Identify and remove hotspots from the model
    - Background bioaccessibility prediction
  - Linear Regression model based on the major element concentrations and PHE in the soils
  - Predict the background bioaccessibility of the whole area
  - Mapping of background bioaccessibility, even for removed hotspots (limitation)
    - As a layer in Google Earth

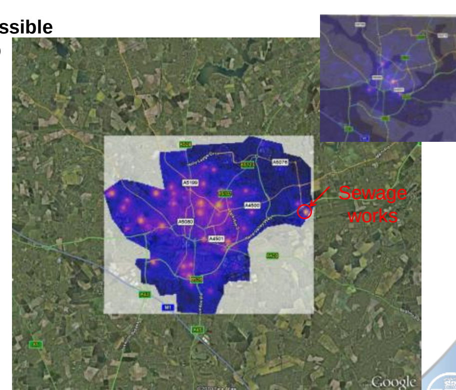
Bioaccessible As

interpolated
0-0.5
0.5-1
1-1.5
1.5-2.0
2.0-2.5
2.5-3.0
3.0-3.5
3.5-4.0
4.0-4.5
4.5-5.0
5.0-5.5
5.5-6.0
6.0-6.5
6.5-7.0
7.0-7.5
7.5-8.0
8.0-8.5
8.5-9.0
9.0-9.5
9.5-10

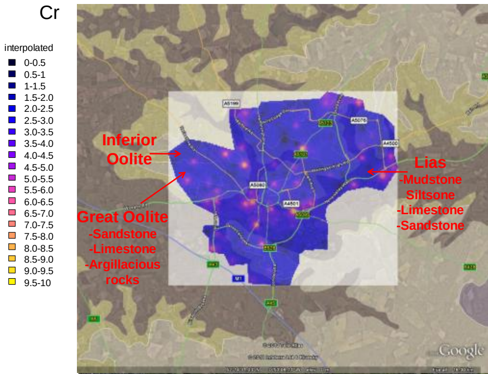


Bioaccessible Pb

interpolated
0-5
5-10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-100



Bioaccessible Cr



Conclusions

- Possible both geogenic and anthropogenic influences on bioaccessibility of PHEs
  - As – mainly influenced by soil geochemistry – inferior oolite
  - Cr – mixed influences, background geology and possibly the previous industrial heritage of Northampton (shoemaking and tannaries)
  - Pb – see the input from the urban environment, roads, sewage works
- Looking forward
  - We have a large NIR dataset to investigate
  - Need to investigate methods to separate the geochemical controls from the anthropogenic inputs

Thankyou!