

JRC EUROPEAN COMMISSION
Chicago, 12-18 February 2009 - AAAS Annual Meeting

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SOIL BIODIVERSITY: THE BIOLOGICAL ENGINE OF THE EARTH

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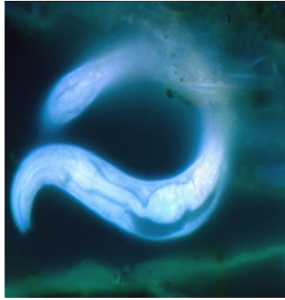
Cranfield UNIVERSITY

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SOIL BIOTA

Life in earth...



Life on Earth...



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ROLES OF SOIL BIOTA


"BIOLOGICAL ENGINE OF THE EARTH"

GOODS - provision of:

- food and fibre
- biotechnological compounds

SERVICES - regulation of:


- nutrient cycling
- water flow and storage
- soil structural dynamics
- biotic regulation
- detoxification
- atmospheric composition




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THE SOIL BIOMASS



- Handful of arable soil (c. 200g).....
-approximately 0.5 g of fresh biomass (mainly microbial)



5 tonnes per hectare – equivalent to 100 sheep


grassland – 20 times greater = 2000 sheep per hectare

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WHAT CONTROLS SOIL BIOTA ?

- **RESOURCES**
 - food (substrate), water, air
- **ENVIRONMENT**
 - abiotic (temperature, pH etc.)
 - biotic (who's there - community context)
 - importance of interactions with the big green autotrophs
- **LIVING SPACE = habitat**



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PROPERTIES OF SOIL BIOTA

- GENOTYPIC**
 - fundamental information – the blueprint
- PHENOTYPIC**
 - expressed information – the parts
- STRUCTURAL**
 - the physical organisation – the engine
- FUNCTIONAL**
 - processes – the working engine

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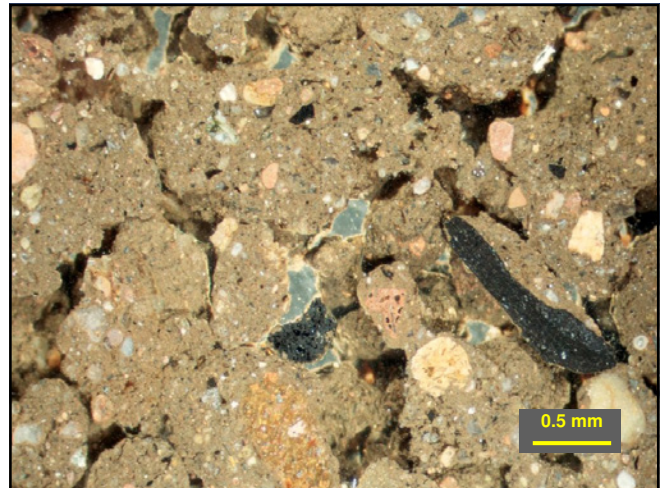
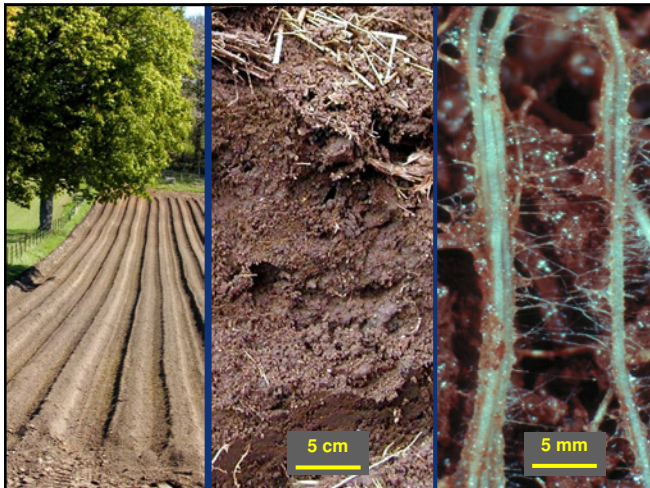
THE SOIL GENOME

```

ATGCCGTACCGTCGATCG
TAGCCGTATATCGCTAGC
TAGGCCTTGATCGATGCG
CTAGCTGATCGATCGAT
AAGTCTGATCGATCGAT
TCGCCTGATCGATCGAT
GGTCTGATCGATCGAT
TCGTCTGATCGATCGAT
TTCTGATCGATCGATCG
ATCGTATAGTTCGTGACG
ATGCCGTACCGTCGATCG
TAGCCGTATATCGCTAGC
TAGGCCTTGATCGATGCG
CTAGCTGATCGATCGAT
AAGTCTGATCGATCGAT
AAGTCTGATCGATCGAT
TCGCTCTAGAGATCTGC
    
```

- Extraordinarily complex !
- Unrealised until advent of DNA analyses
 - 10,000 'species' of bacteria in 100 g forest soil

*Torsvik et al. 1990
 Appl. Env. Microbiol. 56, 782-787*



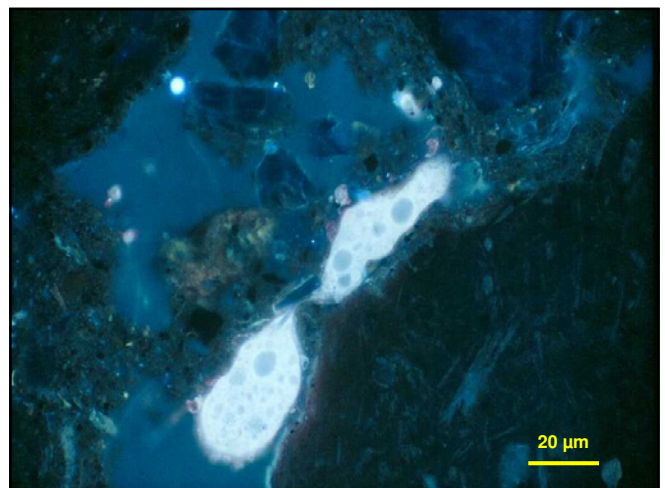
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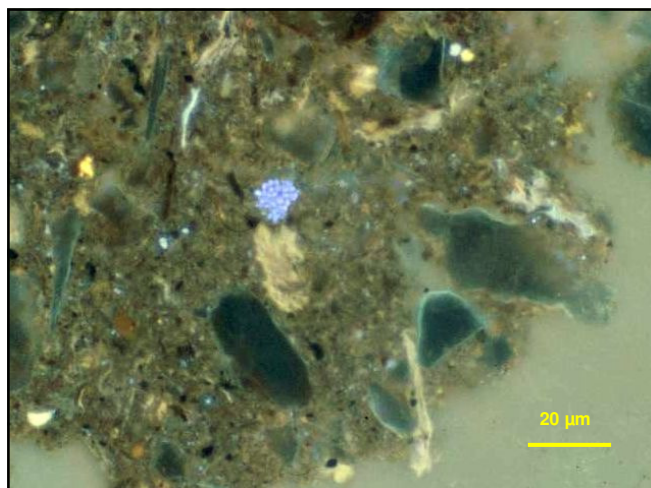
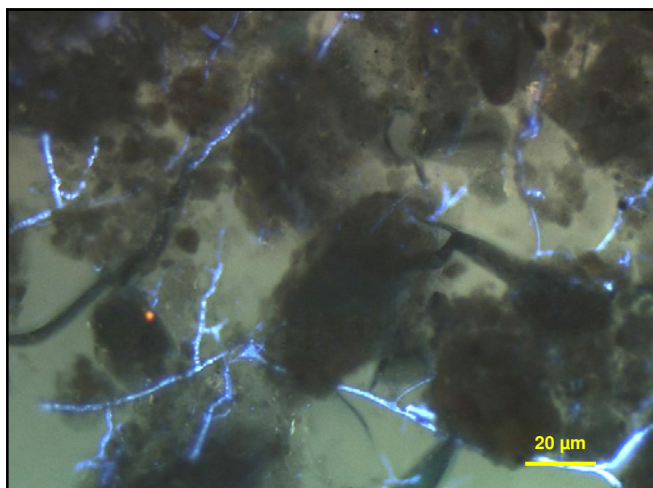
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THIN SECTION OF MINERAL SOIL

Bright field illumination

LIFE ?





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MOVING INTO 3-D...

Advanced Photon Source
Argonne National Laboratory

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X-ray MICRO-TOMOGRAPHY

A photograph of an X-ray micro-tomography setup, showing a sample holder and a detector.

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TOMOGRAPHIC SLICES

107
369
500
2.3 mm
2.9 mm



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PORES FOR THOUGHT...



Two images showing pore structures, likely generated from X-ray micro-tomography data.

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SOIL STRUCTURE

- WHY IS THE SPATIAL ORGANISATION OF SOILS SO IMPORTANT ?
- The pore network provides the physical framework in which all soil processes occur
- The shape of pore networks governs the distribution and regulates the movement of gases, liquids, particles and organisms through the soil matrix....

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SOIL ARCHITECTURE

- Soil is a complex living system, founded on biodiversity and an appropriate spatial configuration
- Appropriate biodiversity (community structures) living within such an inner space lead to an effective functioning of the system

