Nov 10, 2009

SEVENTH FRAMEWORK PROGRAMME

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Consolidation
Integrating Sustainable Approaches in Site Remediation
International Conference November 9 – 11, 2009 in Copenhagen, Denmark

UPSOIL*: New frontiers in cost-effective sustainable in-situ remediation approaches

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Panicked response to crisis → Sustainable Remediation?

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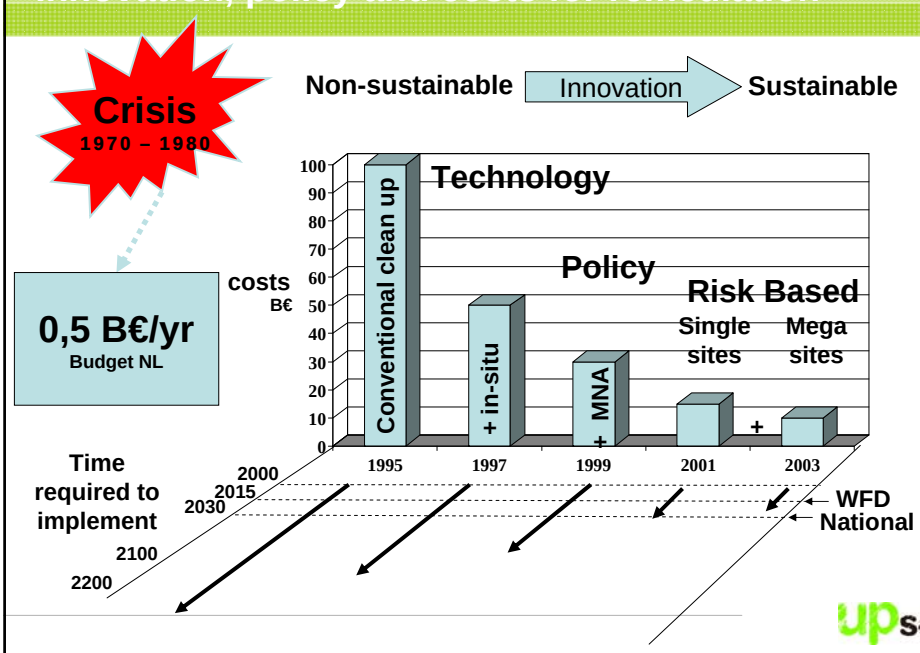
Innovation, policy and costs for remediation



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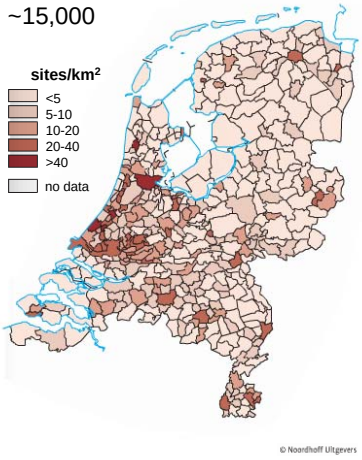
Soil Remediation in The Netherlands

Remediated sites (2007)

Priority sites (2007)
~15,000



Data: RIVM

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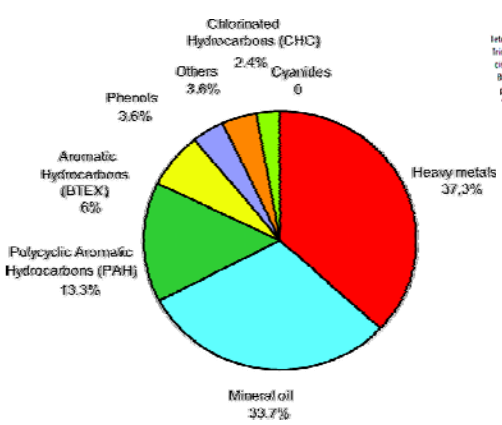
Soil Contaminants in Europe



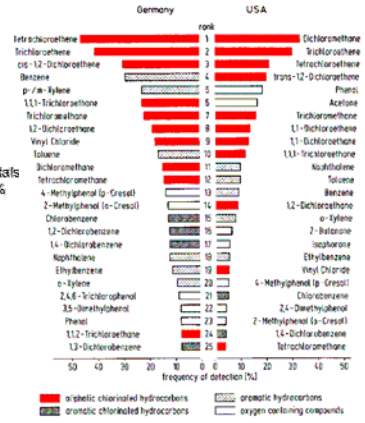


Figure 4.7. Organic groundwater contaminants from hazardous waste sites in Germany (250 sites) and the USA (500 sites) (considered concentrations ≥ 1µg/L) (Kerndorff *et al.*, 1992).

Data: EIONET-European Environment Information and Observation Network

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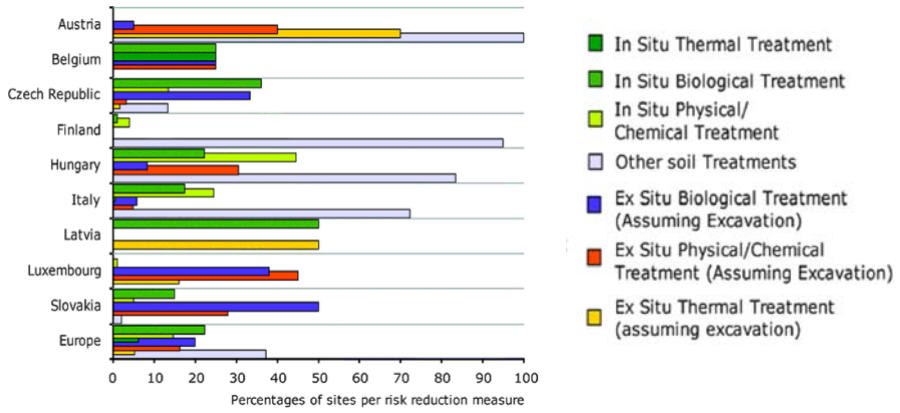
Soil Remediation Technology Use in Europe



Data: EIONET-European Environment Information and Observation Network

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Uncertainties in In-situ Remediation

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FP7/Theme 6 – Environment (Including Climate Change) 2007-2008

- Soil
  - 2008
    - > UPSOIL (Sustainable remediation, Cost-effectiveness)
      - – In-situ degradation, TPH and Chlorinated Aliphatics
    - > UMBRELLA (Heavy metals, Bio-approach)
  - 2007
    - > SOILCAM (Characterization and Biodegradation monitoring)
    - > MODELPROBE (Characterization, Modeling)
    - > ISOSOIL (Forensics, Characterisation and monitoring)
- Water
  - AQUAREHAB - (Rehabilitation technologies → basin scale)

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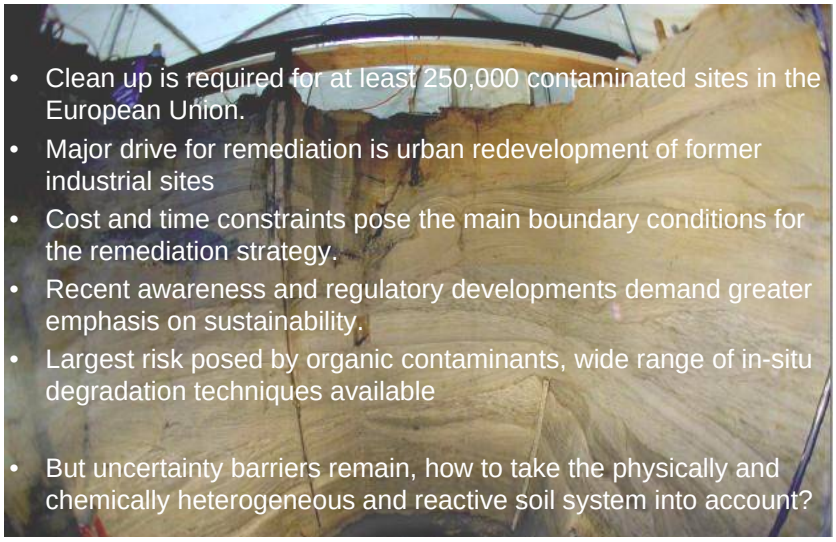
UPSOIL: Soil Remediation Context



- Clean up is required for at least 250,000 contaminated sites in the European Union.
- Major drive for remediation is urban redevelopment of former industrial sites
- Cost and time constraints pose the main boundary conditions for the remediation strategy.
- Recent awareness and regulatory developments demand greater emphasis on sustainability.
- Largest risk posed by organic contaminants, wide range of in-situ degradation techniques available
- But uncertainty barriers remain, how to take the physically and chemically heterogeneous and reactive soil system into account?

University of Waterloo, Thomson (MSc Thesis, 2004)

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UPSOIL Ambition:

To develop robust technologies and approaches that optimize in-situ soil and groundwater remediation for cost, time and sustainability

Technologies	Dimensions		
	cost	time	sustainability aspects
conventional:			
Excavation (source zone)	-	+	-
Pump-and-treat (plume)	-	-	-
***in-situ*:**			
Bioremediation (plume)	+	-	+
Natural Attenuation (plume and source)	+	-	+
Chemical treatments (plume and source)	-	+	-

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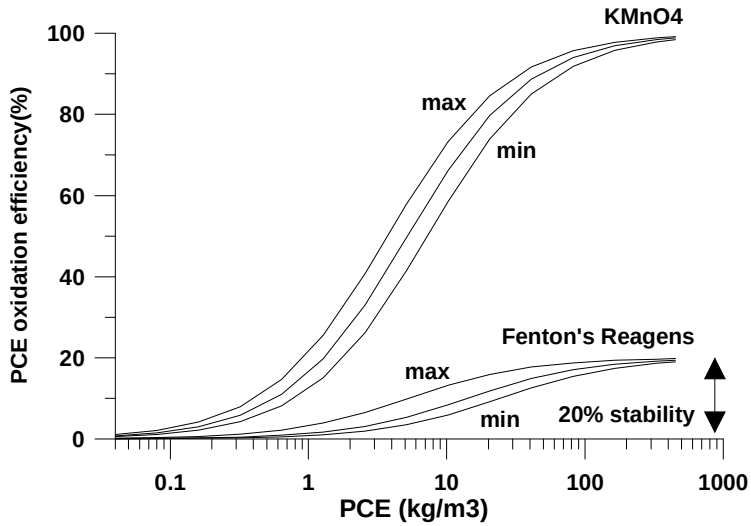
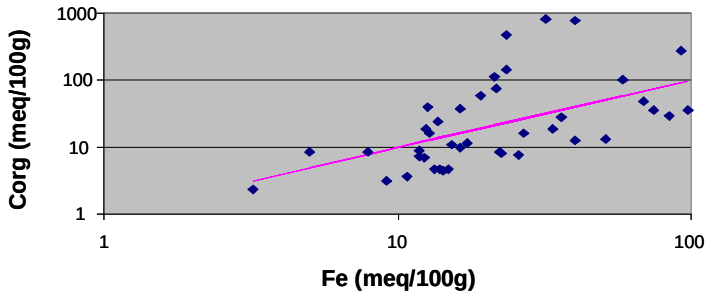
ISCO selection criteria (pre-UPSOIL study)

Remediation Efficiency (Site-specific)



Smart coupling: oxidation or reduction?



- Oxidant demand (e.g. organic matter)
- Reductant demand (e.g. iron oxides)
- (Natural)Metals liberation and mobilisation

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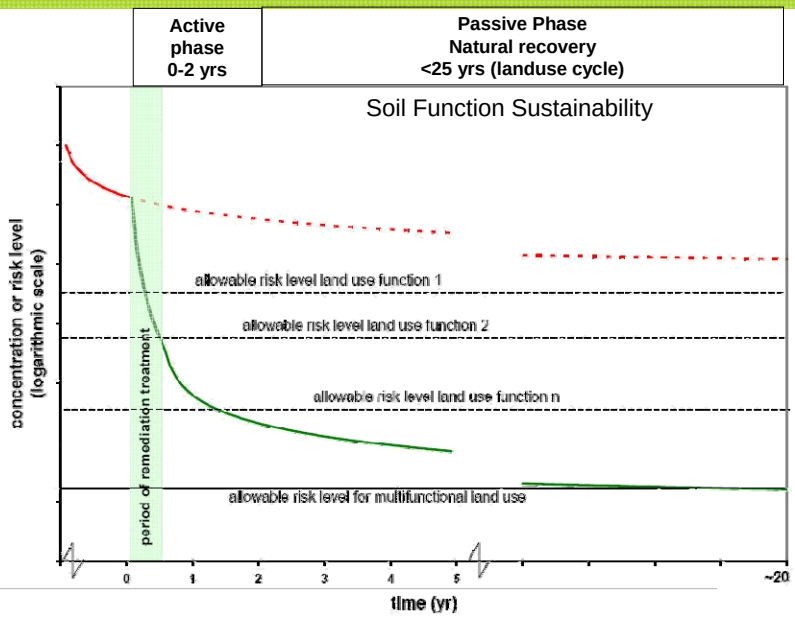
Smart coupling: Active vs. Passive



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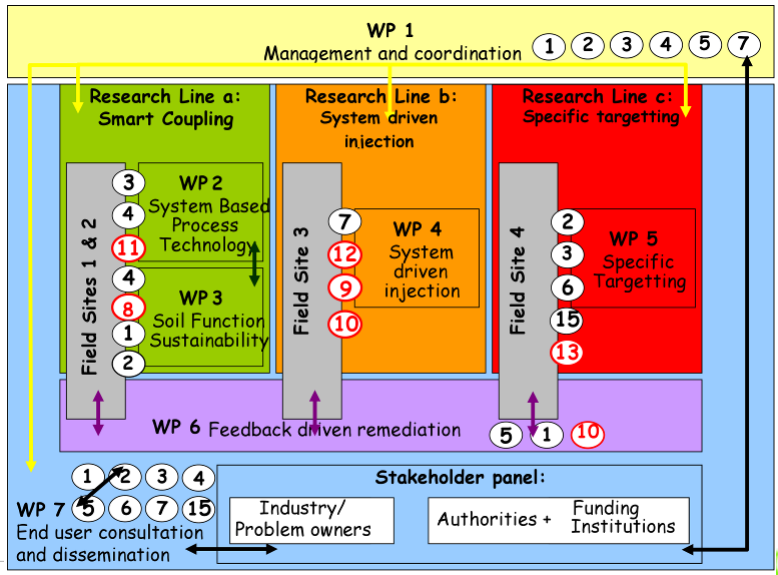
UPSOIL Project Structure



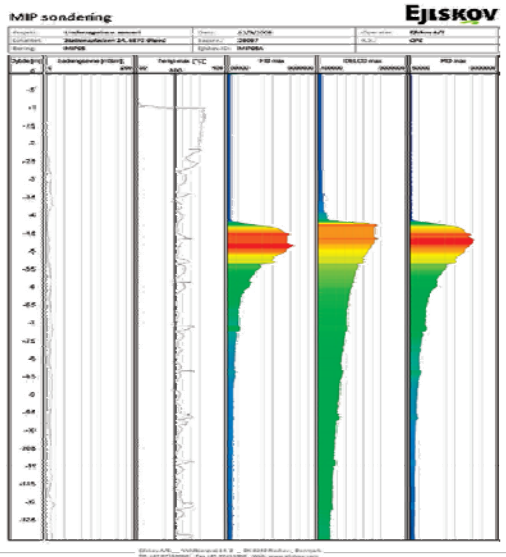
Partners and Field Sites

Field Sites

- Klaipeda (LT):
  - LNAPL
  - Mineral Oil
  - BTEX
- Kligewiece (PL):
  - LNAPL
  - Mineral Oil/BTEX
  - Metals
  - …
- Andalucia (ES):
  - LNAPL: Mineral oil
  - DNAPL: CAH
- Austria (AU):
  - DNAPL: CAH

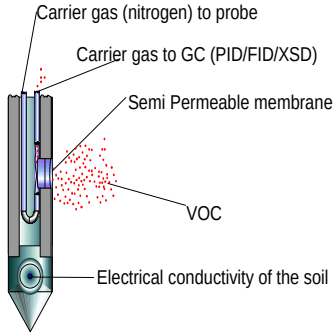
Harbour of Klaipeda, LT

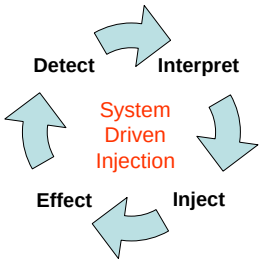
WP 4: System Driven Injection



- Klaipeda field site
- Method testing

Optimized MIP-Injection System





- Develop and test the coupling of Geoprobe MIP and liquid injection system in full scale by Ejlskov A/S and other UPSOIL partners
- Automated contamination detection and injection response
- Based on contaminant and site-specific soil characteristics

- Highly targeted remediation effort
- Minimize soil disturbance
- Minimize use of remedial agent

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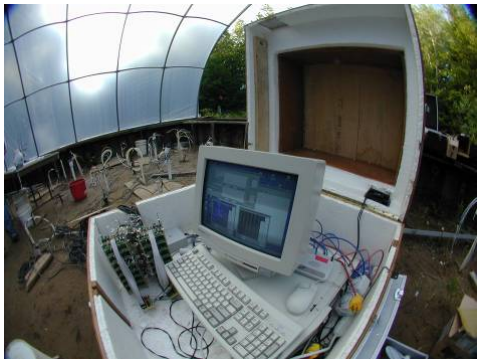
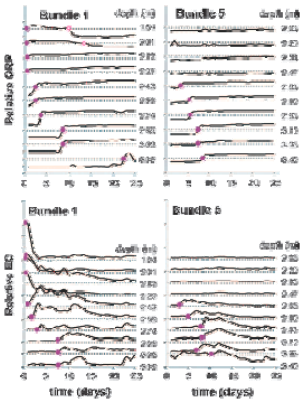
WP6: Feed-back driven remediation





L. Cavé et al./ Ground Water Monitoring & Remediation 27, no. 2: 77–84

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Multi-level Wells Sampling + EC/Redox Monitoring

L. Cavé et al./ Ground Water Monitoring & Remediation 27, no. 2: 77–84

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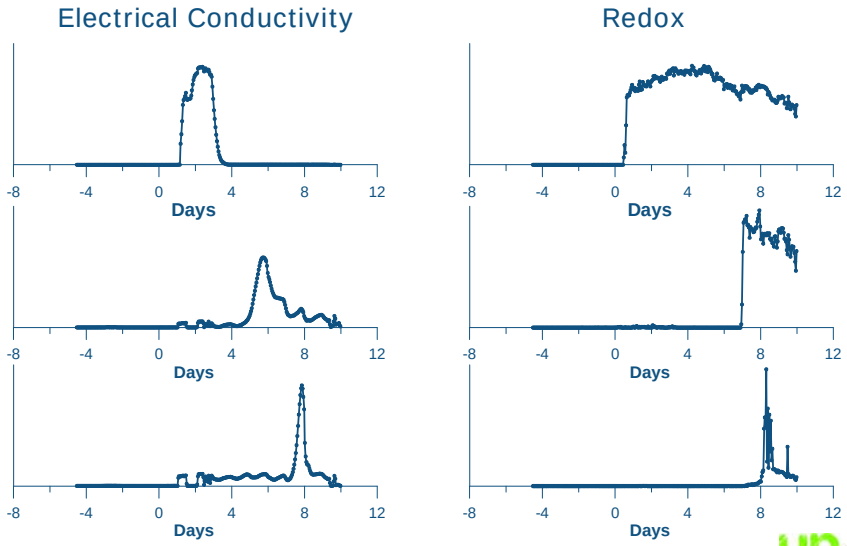
Feedback-driven Remediation
Monitoring as a Guide to Sampling



L. Cavé et al./ Ground Water Monitoring & Remediation 27, no. 2: 77–84

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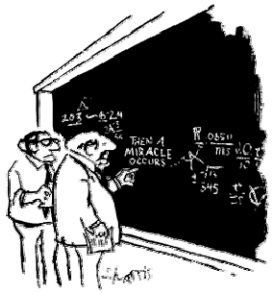
From “Black Box” to “Dark Room”



"I think you should be more explicit here in step two."

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UPSOIL in Short: soil-integrated approach (1)

- soil structure, properties and functions are integral factors in selecting the type of remedial treatment,
- side-effects of treatment, for example at multi-contaminant sites, on overall risk are taken into account,
- active remediation (chemical or biological) allows natural attenuation potential to be fully utilized and stimulated,
- the injected remedial agent is better targeted at the location/distribution of the contaminant within the soil

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UPSOIL in Short: soil-integrated approach (2)

- modelling and dynamic monitoring of the remediation progress are used in real-time to allow feed-back driven remediation,
- reactant species are more selective towards the contaminant and less degrading towards the soil matrix,
- indicators can diagnose whether viable microbial soil populations are present and that microbial dynamics are such that the natural attenuation capacity of the soil has been restored.

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Thank you for your attention

•UPSOIL is a collaborative EU project within the 7th Framework Programme.

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