PHYTOREMEDIATION

A view from the other side of the fence

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Background

- Why is this guy here?

- What is the

  Department of Energy

  Office of Science

  Office of Biological and Environmental Research

  Environmental Remediation Sciences Division?

DOE's Challenge

- **180 million cubic meters of contaminated groundwater**
- **75 million cubic meters of contaminated soil**
- **3 million cubic meters of buried waste**

- **Many inorganic contaminants that are unique to DOE**

Source: Scott R. McMullin, DOE-SR, Workshop on Phytoremediation of Inorganic contaminants, ANL, 1999

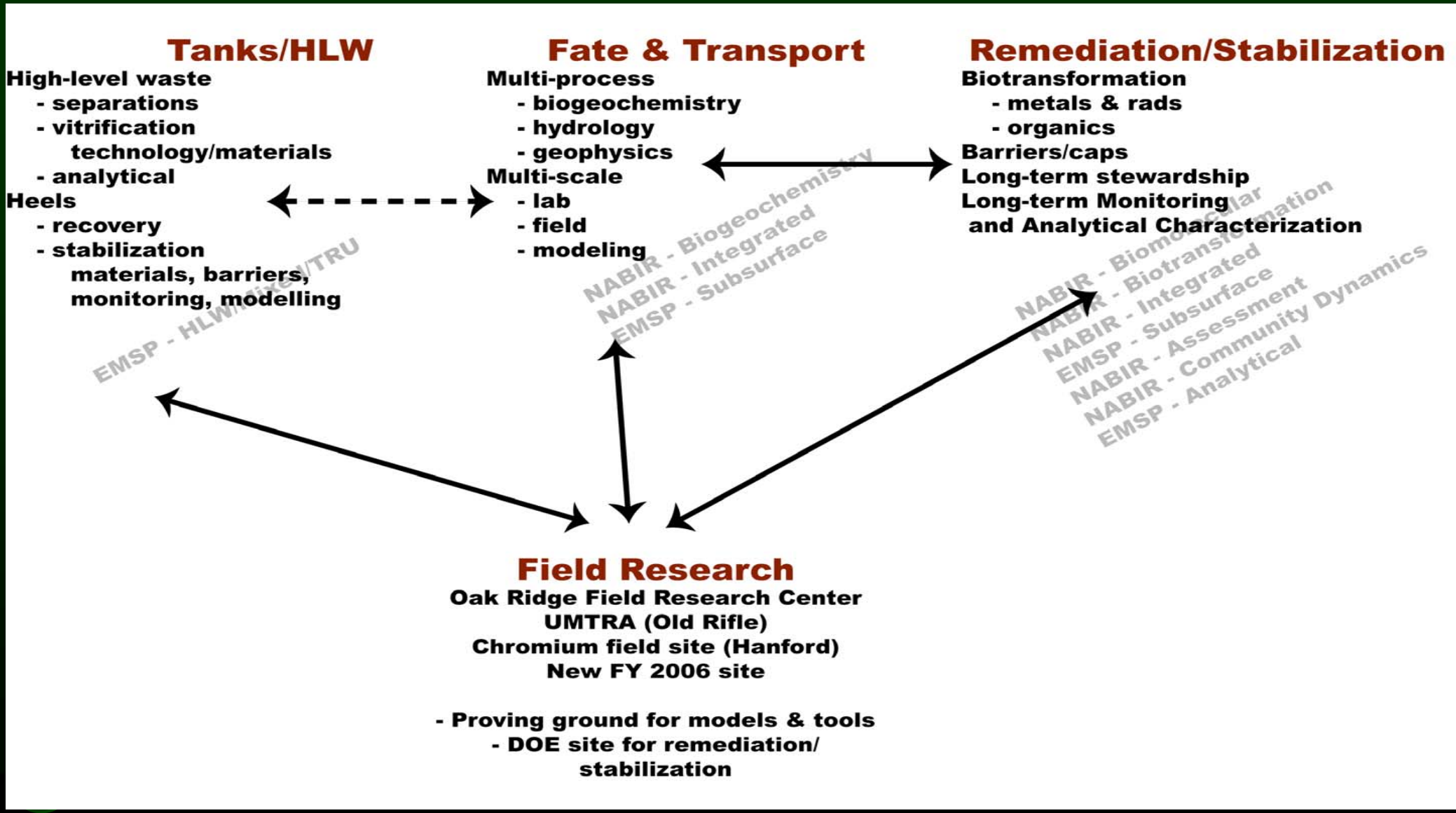
Environmental Remediation Sciences Division

Long-term goal

- **By 2015, provide sufficient scientific understanding to allow a significant fraction of DOE sites to incorporate coupled biological, chemical and physical processes into decision making for environmental remediation.**

[NOTE: new version of goal -- OMB review pending]

Science Themes



ERSD seeks to advance the science needed to support cleanup of the DOE complex by:

- Supporting critical areas of science
- Funding research that supports ERSD long-term goal and DOE clean-up mission
- Emphasizing scaling and application to field scale
- Providing continuing funding opportunities

Phytoremediation needs:

- Soil, Environmental and Analytical Chemistry
- Agronomy
- Molecular Biology, Biochemistry, Plant Physiology
- Civil, Mechanical, Chemical and Biochemical Engineering
- Ecology, Hydrogeology
- Environmental, Corporate and Patent Law
- Project Management and Finance
- Appropriate cost-benefit analysis

POLLUTION

CAN FLOWERS CLEANSE THE EARTH?

Plants hold great promise in waste cleanup

AS EASY AS 1, 2

Cleaning up polluted sites that cover a wide area is expensive and time-consuming. Newly identified plants make the process much easier and cheaper.

1 Crops such as sunflowers and Indian mustard, which have been selected for their ability to absorb lead or other pollutants, are planted in contaminated soil.

2 The plants are harvested and discarded in a specially designated site or sent to a smelter where the metals can be extracted and sold off.

RAY VELLA/BW

Already, a handful of companies—such as Phytotech in Monmouth Junction, N.J., Phytokinetics in Logan, Utah, and Applied Natural Sciences in Hamilton, before finding a few, such as Indian mustard, that are both large and able to vacuum up metals. Once grown, the plants can be harvested and put into a smelter to recover the metals (diagram) or disposed of appropriately in approved landfills. Even if the metals aren't recovered, the amount of waste—in the form of contaminated plants rather than dirt—is reduced by 98%.

Raskin's work is now being sponsored by $1.2 million from Phytotech. The company's tests in Ukraine suggest Indian mustard could clean up strontium-laden soils near Chernobyl within five years.

The plants are only part of the story. The high-tech cleanups of tomorrow may simply be a matter of letting a thousand flowers bloom.

By John Carey in Washington

Argonne National Laboratory

Photo courtesy of ANL

Copper treatment at SRS

E.T. cap - Monticello, Utah

TCE Phyto at S.R.S.

SRS D-Area TCE treatment

Integrated approach to the Remediation of Heavy Metal-Contaminated Lands Katowice, Poland

The project combined basic research with large scale phytoremediation technology development and ecological risk assessment

International phytoremediation research

- ✓ Site selection & characterization
- ✓ Screening for best heavy metal accumulators
- ✓ Selection of amendments
- ✓ Amendment application technique
- ✓ Harvest and biomass disposal
- ✓ Ecological risk assessment
- ✓ Economic evaluation

U.S. DOE Office of Environmental Management
Institute for Ecology of Industrial Areas (Katowice, Poland)
Florida State University, Central European Advanced Technologies
Edenspace (Phytotech)

Systematic approach to phytoremediation

Site Identification

potential sites

Evaluate Candidate Sites

Lab Studies

Plant species screening
Soil amendment toxicity
Transpiration effects

plants & soil

Treatability Studies

Plant Stress Monitoring

Kautsky Kinetics
Laser-Induced
Fluorescence Imaging

soil sampling & analysis

Select & Characterize Site

design, layout, plant, monitor

Field Studies

preparation/planting/plant care
amendment application
harvesting/crop disposal

Commercial Scale

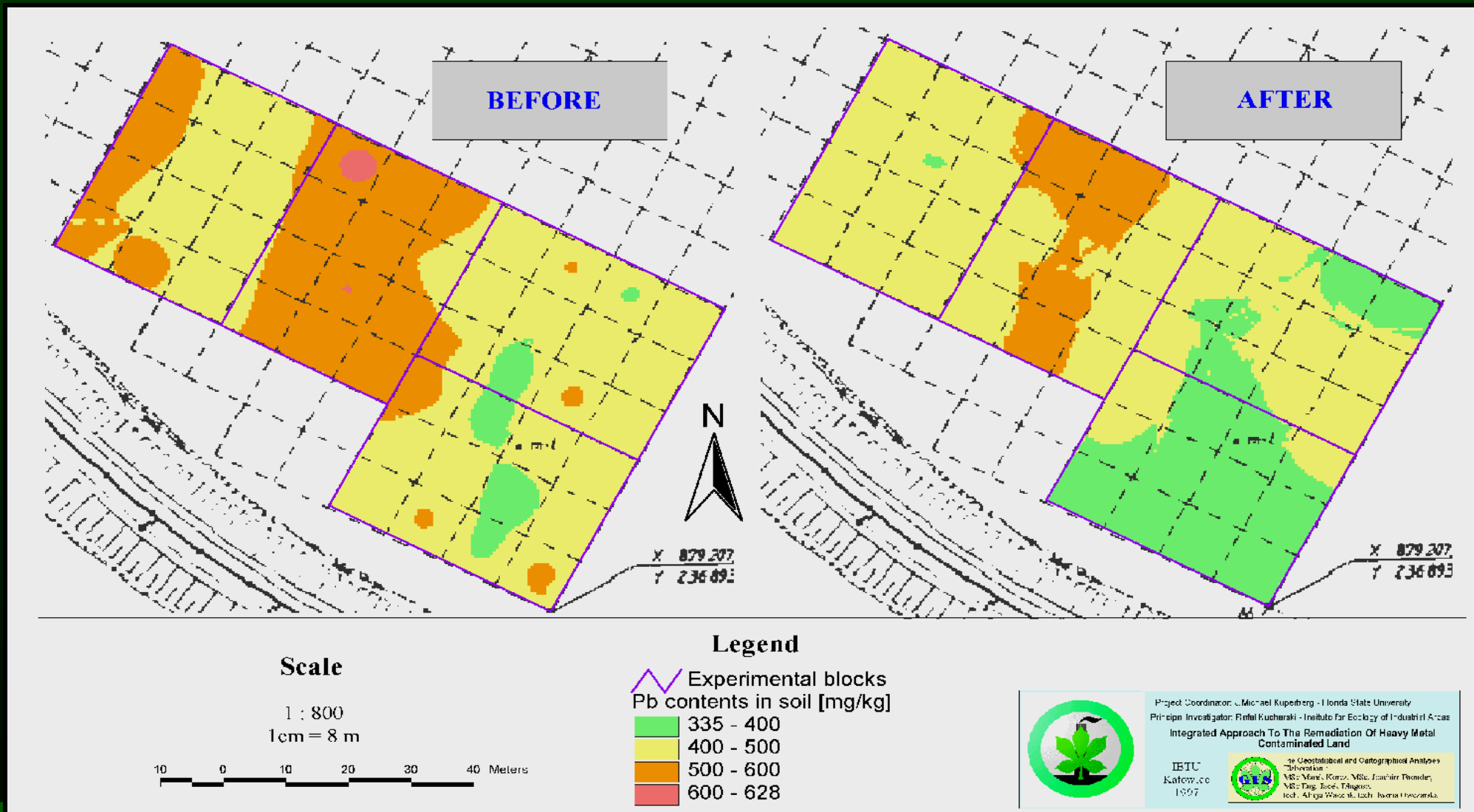
Plant Growth

- 84 tons of sunflower from 2 acres
- Also evaluated Brahinia, *Brassica sp.* & maize
- Used innovative plant stress measures

Disposal

- Chopped into small pieces (2-3 in) at harvest
- Harvested material was composted
- Residue was disposed in permitted landfill

Results after one year



Conclusions

- ERSD funds basic science to support the DOE mission of environmental remediation
- Declining budgets force on-going evaluation of priorities
- Currently anticipate elimination of all science addressing “surficial science”
- Focus on high-level waste and processes controlling the fate and transport of subsurface contamination (metals and radionuclides)