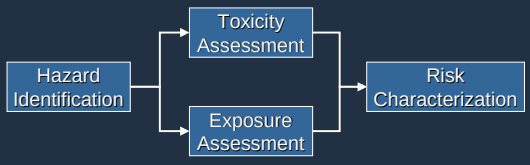
The Socrates Award Lecture 2006

Top Ten Most Polluted Areas in the World

Margrit von Braun
University of Idaho
Blacksmith Institute Project

Basic Risk Assessment Process



The Selection Process

The scoring system considered these criteria:

- The size of the affected population.
- Severity of the toxin or toxins involved.
- Impact of children's health and development.
- Evidence of a clear pathway of contamination.
- Existing and reliable evidence of health impact.

Voting for Top Ten Most Polluted

- Focus mainly on developing countries with little money.
  - Over 300 nominations for polluted places, 35 were selected from which to develop the Top 10.
  - Most do not have multinational involvement.

Diagnosis of Polluted Places: Complications

- Many of these places are not well known to outsiders, and many times forgotten by their own governments.
- Data difficulties
- Not “ranked” 1 though 10

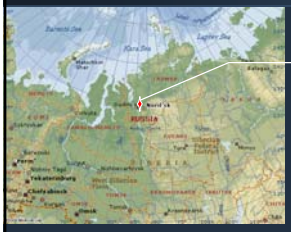
Diagnosis of Polluted Places: Complications

- The selected sites are ***representative*** of the scope and scale of sites that document the global span of such problems.
- Unfortunately they are by no means isolated or unique.

Top Ten

- Dzerzhinsk, Russia
- Norilsk, Russia
- Rudnaya Pristan, Russia
- Chernobyl, Ukraine
- Mailuu-Suu, Kyrgyzstan
- Ranipet, India
- Linfen, China
- La Oroya, Peru
- Kabwe, Zambia
- Haina, Dominican Rep.

Norlisk, Russia



Potentially affected people: 134,000

Pollutants: SO_2, Sr-90, Cs-137
Type: Air, Water, Soil
Source: Platinum Plant, mills
Cleanup effort: Unknown
Active

Norlisk, Russia

- World's largest heavy metals smelting complex; over 4 million tons annually of Cd, Cu, Pb, Ni, As, Se, and Zn are dispersed into the air.
- Since November 2001, Norilsk has been shut to foreigners
- One of 90 "closed towns" in Russia where Soviet-levels of secrecy persist.

Norlisk, Russia

"Where the snow is black, the air tastes of sulfur and the life expectancy for factory workers is 10 years below the Russian average."

Health
- High respiratory diseases in children around this area

Cleanup Activity
- Unknown

Haina, Dominican Republic

Potentially affected people: 85,000

Pollutants: Pb
Type: Soil
Source: Battery Recycling Legacy
Cleanup effort: None

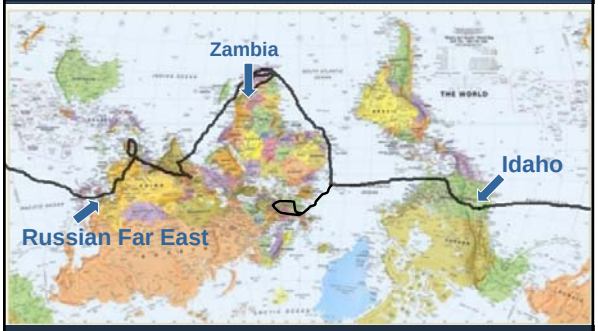
Haina, Dominican Republic

- The contamination is caused by the past industrial operations of the nearby Metaloxa battery plant.

Health

- 1997 study: 5% with lead levels >79 µg/dL, and only 9% were under the WHO regulated 9 µg/dL.
- Birth deformities, eye damage, learning and personality disorders, and in some cases, death from Pb poisoning have been documented.

Bunker Hill; Rudnaya Pristan, RFE; Kabwe, Zambia

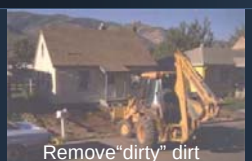


Bunker Hill; Rudnaya Pristan, RFE; Kabwe, Zambia

- Provide overview of the challenges of international environmental health problems.
- Discuss the role of the developed world in attacking these problems.

	Idaho Bunker Hill 1974 Lead Levels	Current Standards
Children's Blood (µg/dl)	70	10
Ambient Air (µg/m^3)	17	1.5
Yard Soil (mg/kg)	7400	500-1000
House Dust (mg/kg)	12,000	500-1000

Remediation of Yards


Remove"dirty" dirt


"Clean" yard


Replace with clean dirt

Industrial Complex Demolished

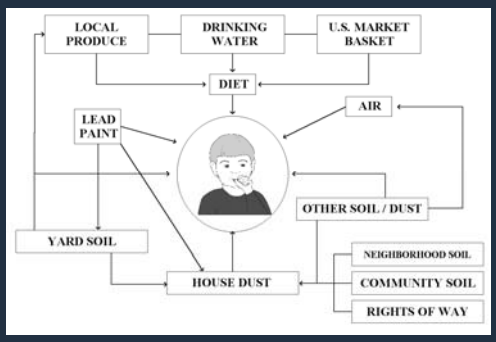

Lead Smelter

Smelter Demolition

Conversion from Mining Town to Ski Resort

Success at Bunker Hill

- Involvement of families, NGOs, and community leaders
- Scientists
- Risk-Based Cleanup: Solve health problems by understanding pathways of exposure and engineering remedies
- Economic development
- Ecological restoration
- $500M (from legal actions against mining companies & gov't); expect $350M more



Rudnaya Pristan, Russia

Potentially affected people: 90,000

Pollutants: Pb
Type: Soil
Source: Lead mining
Cleanup effort: None
Legacy and Active

Rudnaya Pristan, Russia

Soviet era lead smelter

Far East St. Univ.
Pac. Geog. Inst.
Dalpolymetal Inc.
Electrozariad Inc.
International Lead Mngmt. Center
Univ. of Idaho
TerraGraphics Env. Engr., Inc.

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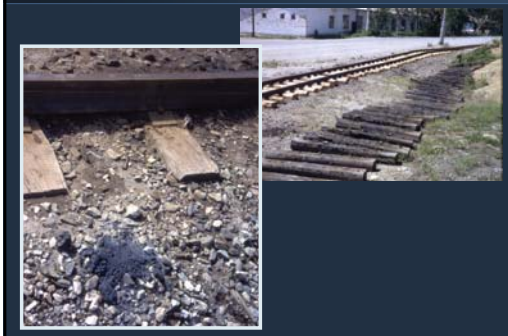

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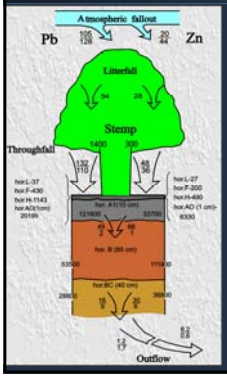
Historical (Soviet Era) Studies

- Outside of smelter complex
- Metals levels: leaves, mollusks, sediments, precipitation, agric. products, soil, ambient air
- Dietary supplements (algal chelation)
- Not: air stack emissions, lead levels in workers or residents (“Soviet company is in compliance”)

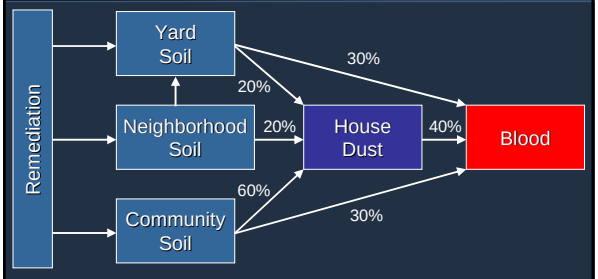
Natural Cleansing: Long Term Cycles

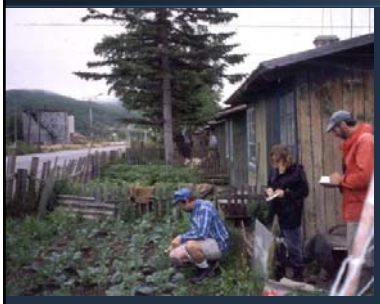


CONCLUDED:
- 1000’s years to “clean”

DECIDED:
- Relocate residents
- Dietary supplements
- Demolish and rebuild smelter
- Then…1989

US: Soil/Dust = 85% of Pb Children’s Blood





Rudnaya Pristan, Russia Soil Pb

	Min mg/kg	Avg mg/kg	Max mg/kg
Gardens	476	2095	4310
Yards	896	2241	4610
Roadsides	2020	6119	22,900
Railroad	24,400	59,375	95,000
Beaches	610	3405	6200
River Banks	464	591	656

Rudnaya Pristan, Russia

- BLL: 1.6 – 56.7 ug/dl (avg. = 12.4 ug/dl)
- Potatoes grown in contaminated soil = 50% caloric intake.
- Educational programs in schools and health centers.

Future Needs/Plans

- Consider options to sever pathways
- Industrial modernization or demolition
- Revegetation
- Stable community
- Community education

Kabwe, Zambia

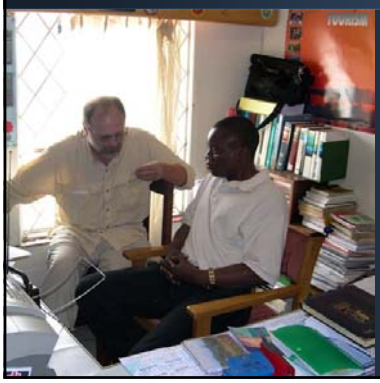
Potentially affected people: 250,000

Pollutants: lead
Type: Soil
Source: lead mine, smelter
Legacy
Cleanup effort: Early progress

Kabwe, Zambia

Health

- On average, children's blood levels in Kabwe are 5 to 10X allowable levels.



Kabwe, Zambia

Cleanup Activity

- NGO, Kabwe Environmental and Rehabilitation Foundation (KERF) for educational services.
- World Bank $20 million grant, completed the scoping study, and initial clean-up begins 2007.

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Commitment to Success at Bunker Hill

- Risk-Based Cleanup
  - Solve health problems
  - Understand pathways
- 25 years
- $500M to date; $350M more expected
- Lessons Learned?

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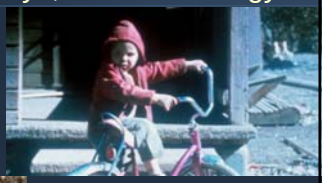
Receptors, Pathways, and Technology



Lessons Learned

- Different sources – and quantities - of capital
- Legal systems
- Public “Interest”
  - Perception of “Rights” for health damages
  - Concern for health is universal
  - Involvement varies – activism, hopelessness, not apathy
- Need for local expertise
  – work on the next generation
- Level of technology, maintenance issues

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Science Needs for Understanding Pathways

- Sampling techniques
- Fate and transport of contaminants
- Barriers
- Environmental Media Modeling
- Ecotoxicology
- *In situ* groundwater passive treatment

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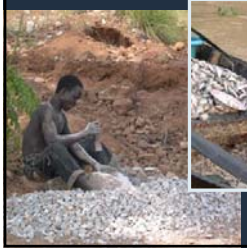
International Environmental Challenges

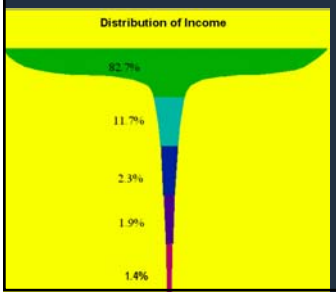
- Different sources – and quantities - of capital
- Legal systems
- Public "Interest"
  - Perception of "Rights" for health damages
  - Concern for health is universal
  - Involvement varies – activism, hopelessness, not apathy
- Need for local expertise
  – work on the next generation
- Level of technology,
  maintenance issues

The role of the developed world in attacking these problems

The majority of the world's population has little influence on regulation of the environment and quality of life.



The developed world controls the majority of resources required for development (i.e., raw material, energy and food surpluses) as well as the science, information sources and weapons.



Trends

- Collapse of colonialism
- Industrialization
- Multinational businesses
- Climate change, pollution, scarce resources --- pressures from socio-economic divisions, political conflicts

Key Players

- Local Communities
- Educational institutions
- NGOs
- Attorneys & legal system
- Health officials
- Scientists, engineers
- Importance of Networks

Primary Lessons Learned

- Do not underestimate what is possible
- Requires continual pressure
- Success drove industry overseas