Atmosphere

Gaseous versus particulate

Dispersion from an area

Outdoor versus indoor air

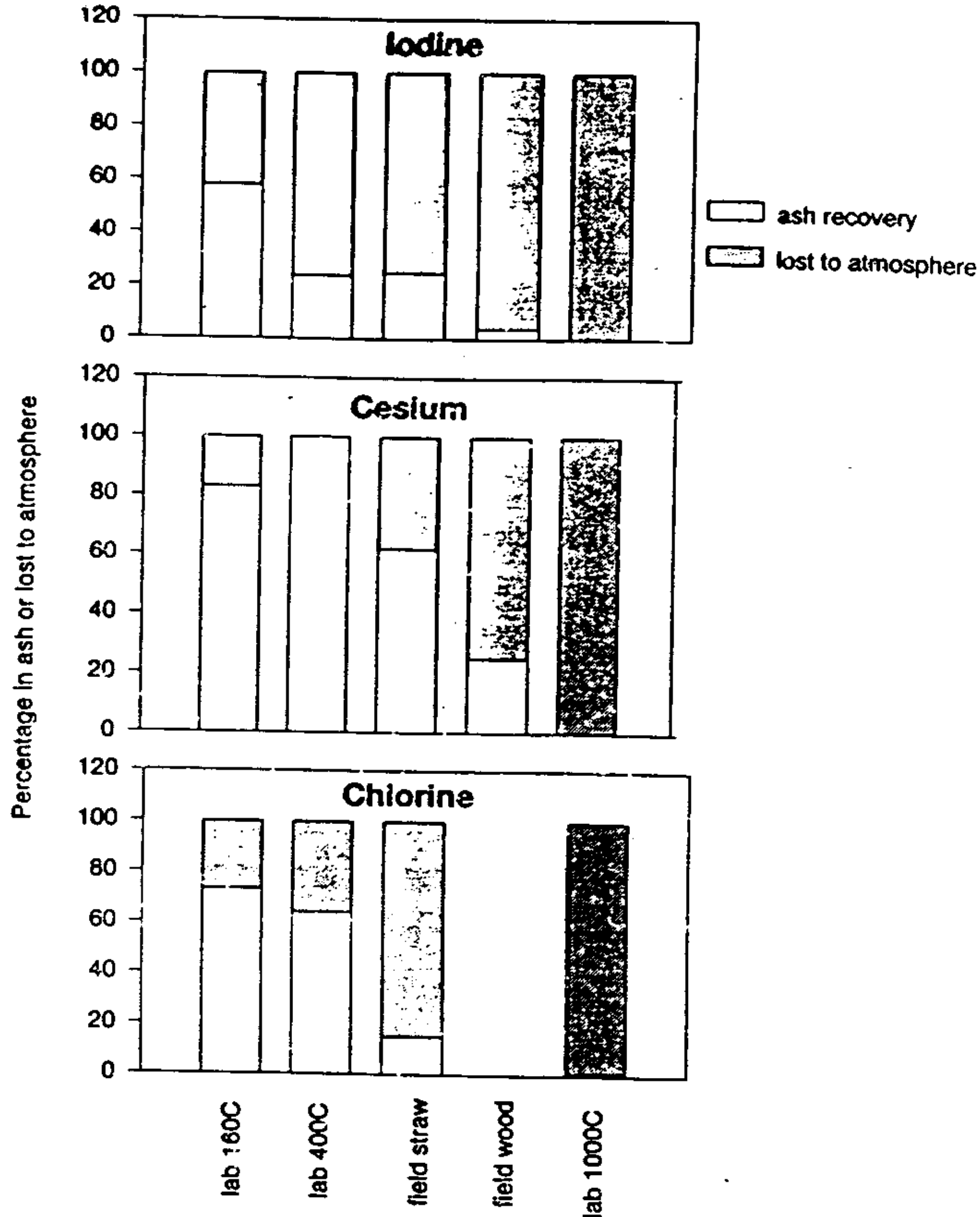
Sources of contaminant

- degassing, dust load
- fires
- bubble and splash-formed aerosols

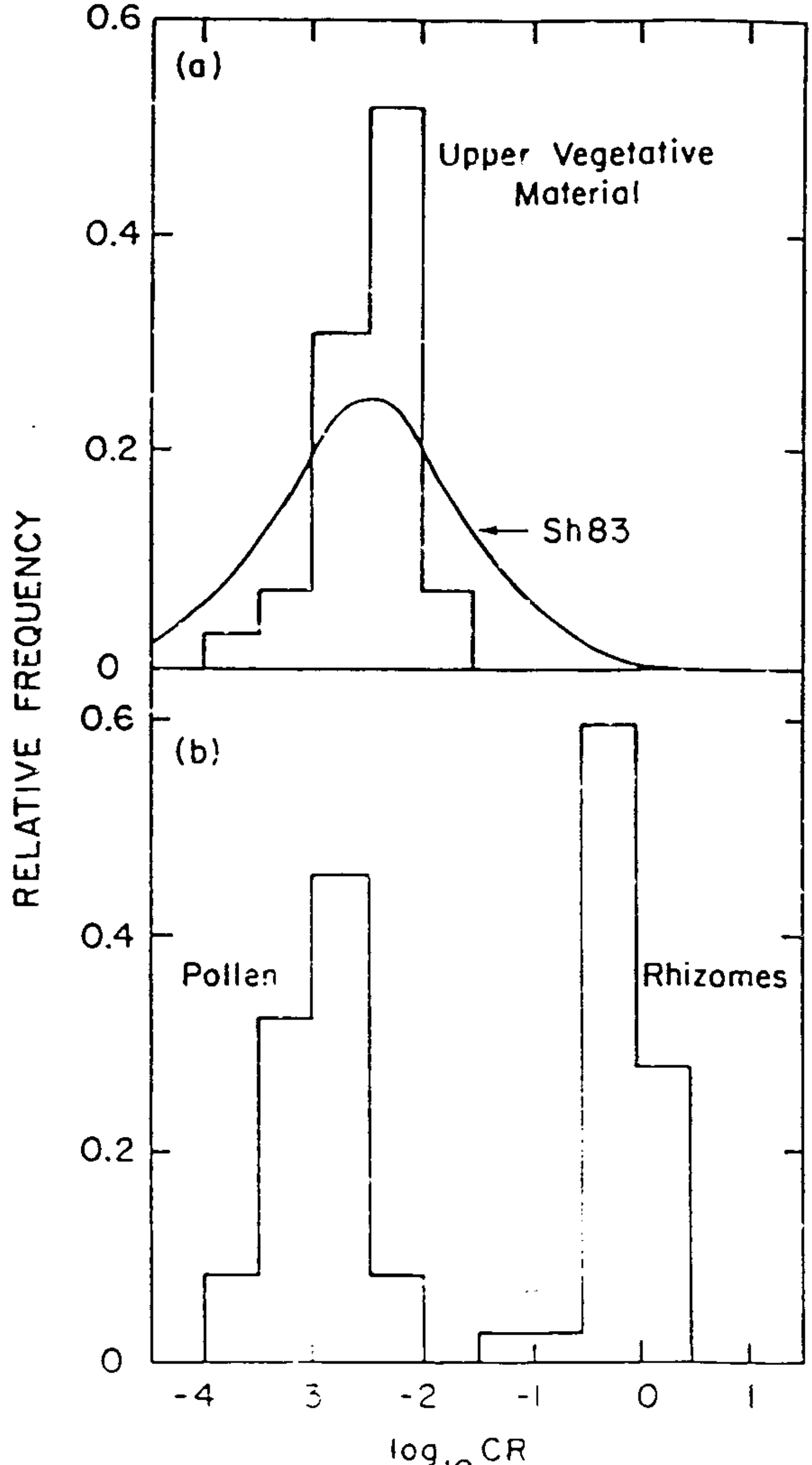
Hilroy

Fires as a source of contamination

- if critical group is self-sufficient:
  - fuel is local (contaminated) plant material
- how much contamination goes to the atmosphere
- what happens to the ash


Iodine
Cesium
Chlorine
ash recovery
lost to atmosphere
Percentage in ash or lost to atmosphere
0
20
40
60
80
100
120
lab 160C
lab 400C
field straw
field wood
lab 1000C

HLBoon



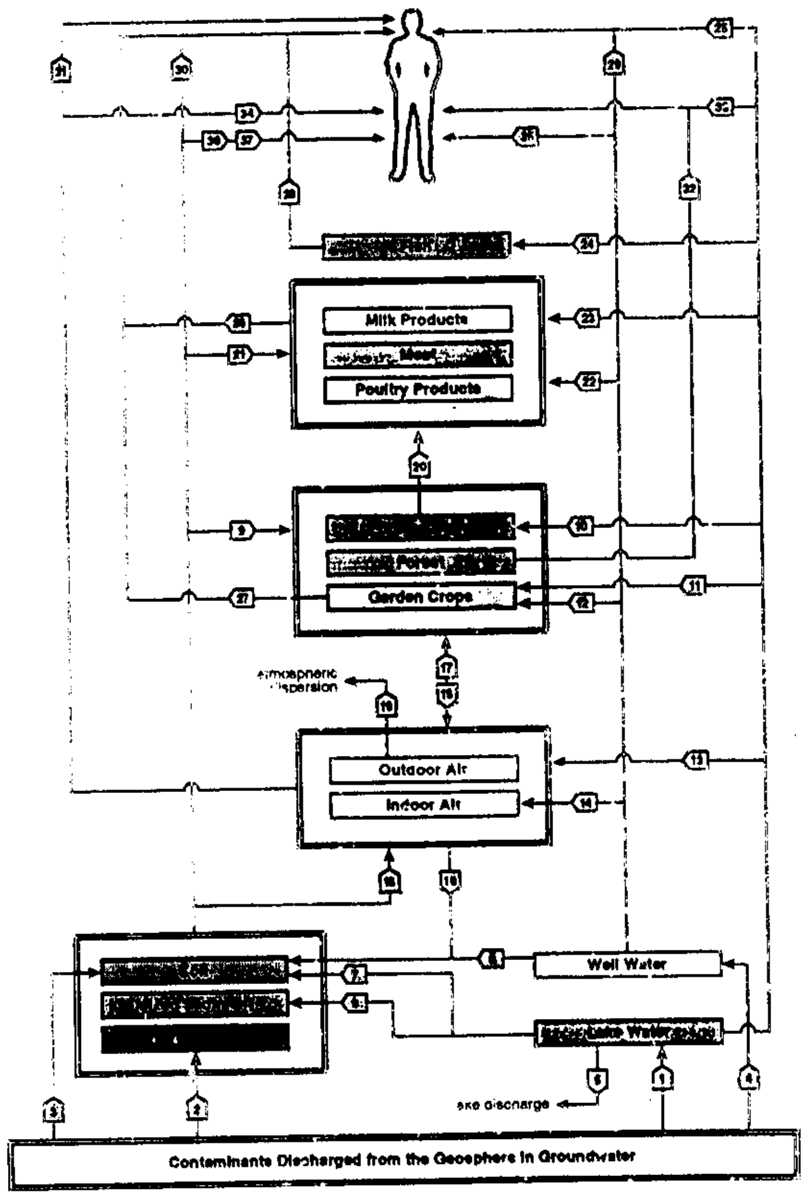
0.6
(a)
Upper Vegetative Material
0.4
0.2
Sh83
0
RELATIVE FREQUENCY
0.6
(b)
0.4
Pollen
Rhizomes
0.2
0
-4
3
-2
-1
0
1
log10 CR

Hilroy

Human Realm

- Intrusion
- Food processing
- Dust and inadvertent exposure
- Sewage

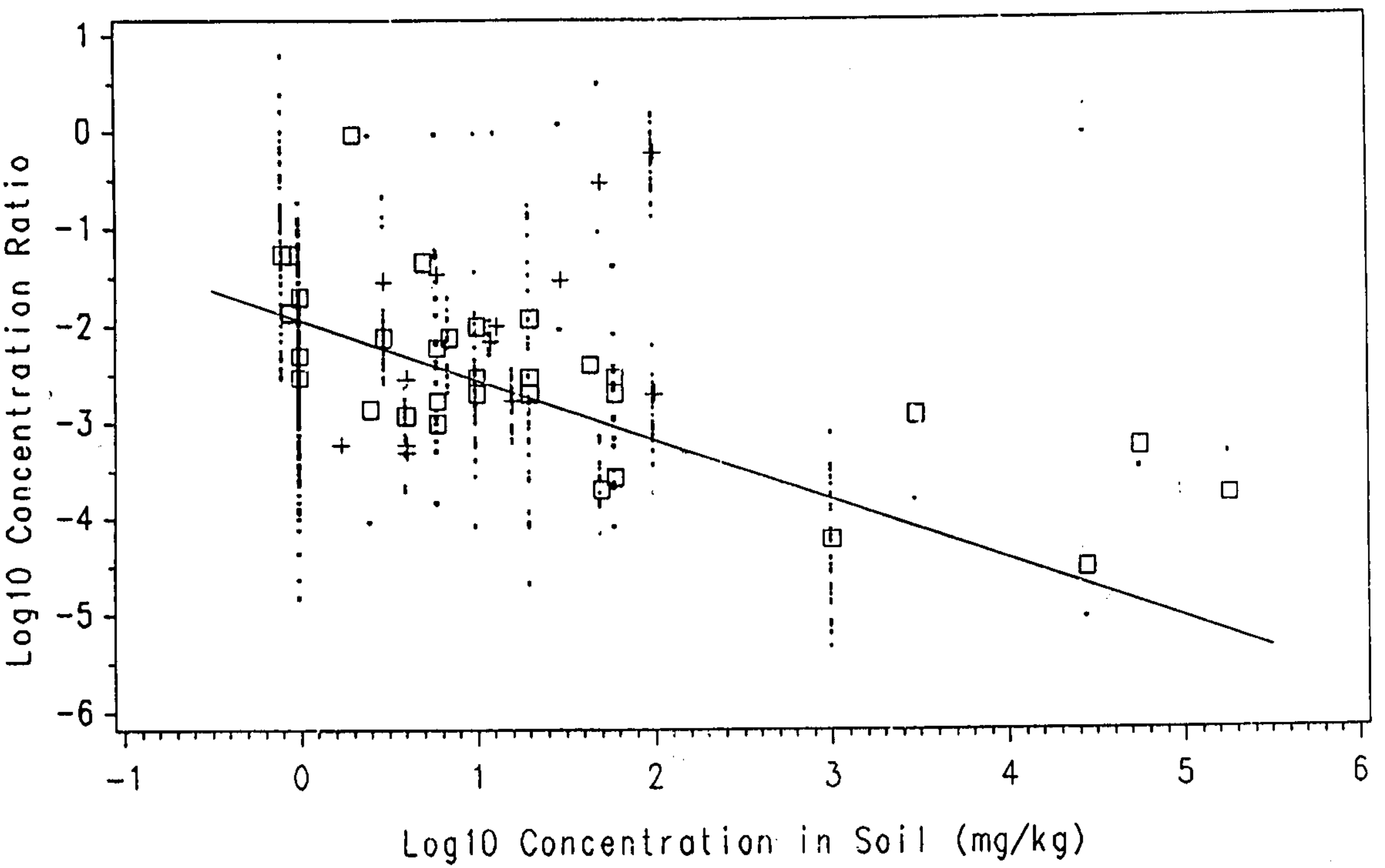
Transport and Exposure Pathways for Man Included in the Biosphere Model, BIOTRAC



1 Geosphere discharge to lake water
2 Geosphere discharge to compacted sediment
3 Geosphere discharge to bottom of soil profile
4 Geosphere discharge to well water
5 Loss through lake discharge
6 Transfer from lake water to mixed sediment
7 Transfer from lake water to soil (irrigation)
8 Transfer from well water to soil (irrigation)
9 Transfer from soil/sediments to plants (root uptake)
10 Transfer from lake water to leaves of forage crops (irrigation)
11 Transfer from lake water to leaves of garden crops (irrigation)
12 Transfer from well water to leaves of garden crops (irrigation)
13 Transfer from lake water to air
14 Transfer from well water to indoor air
15 Transfer from soil/sediments to air
16 Transfer from air to soil (deposition)
17 Transfer from air to plant leaves (deposition)
18 Transfer from plants to air
19 Loss through atmospheric dispersion
20 Transfer from forage crops to milk products, meat, and poultry products
21 Transfer from soil/sediments to milk products, meat, and poultry products
22 Transfer from well water to milk products, meat, and poultry products
23 Transfer from lake water to milk products, meat, and poultry products
24 Transfer from lake water to fish
25 Transfer from lake water to man (ingestion)
26 Transfer from fish to man (ingestion)
27 Transfer from garden crops to man (ingestion)
28 Transfer from milk products, meat, and poultry products to man (ingestion)
29 Transfer from well water to man (ingestion)
30 Transfer from soil/sediments to man (ingestion)
31 Transfer from air to man (inhalation)
32 External exposure of man to wooden building materials
33 External exposure of man to lake water
34 External exposure of man to air
35 External exposure of man to well water
36 External exposure of man to soil/sediments
37 External exposure of man to inorganic building materials

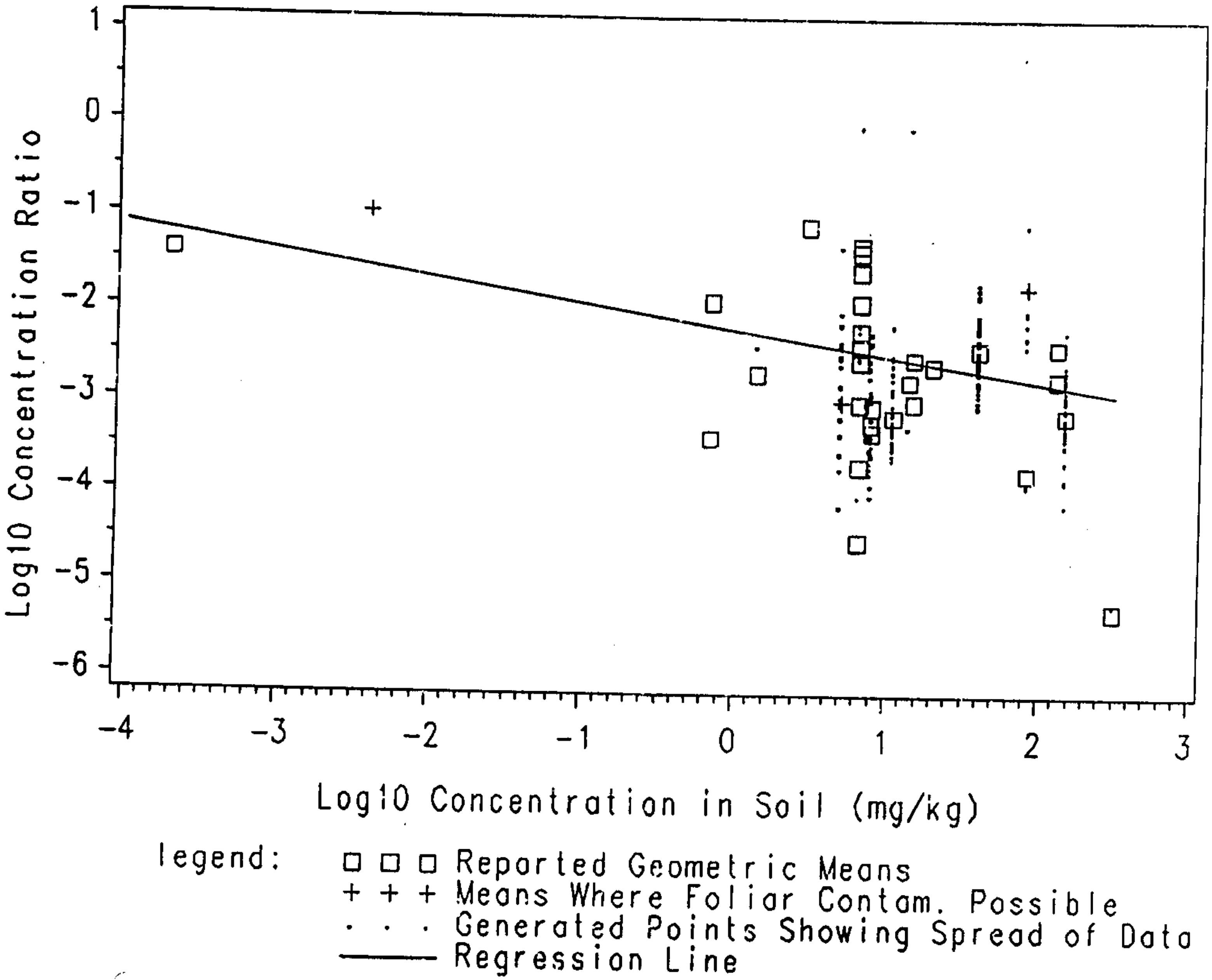
EIS 9-9.A

CR for U versus Soil Concentration

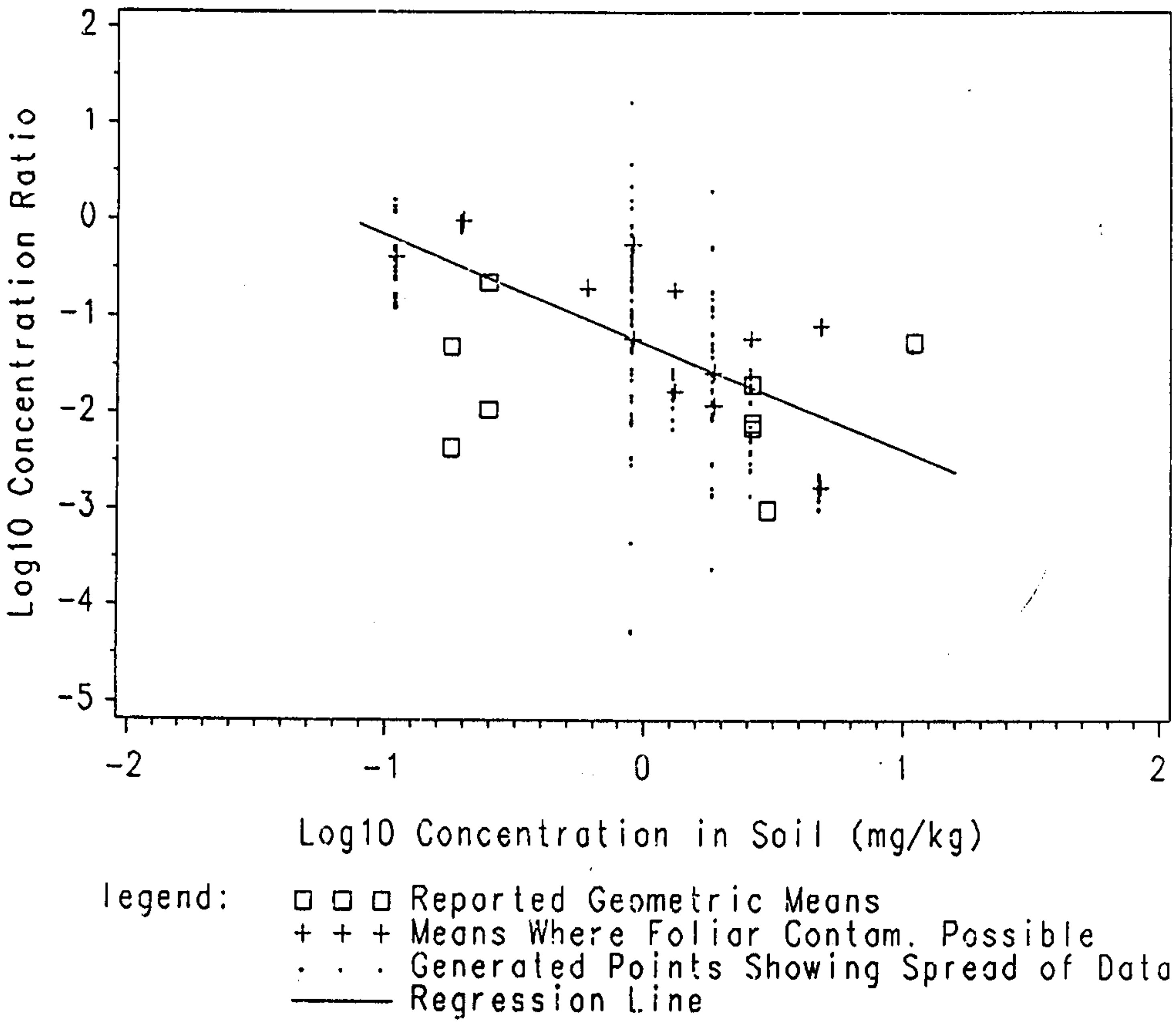


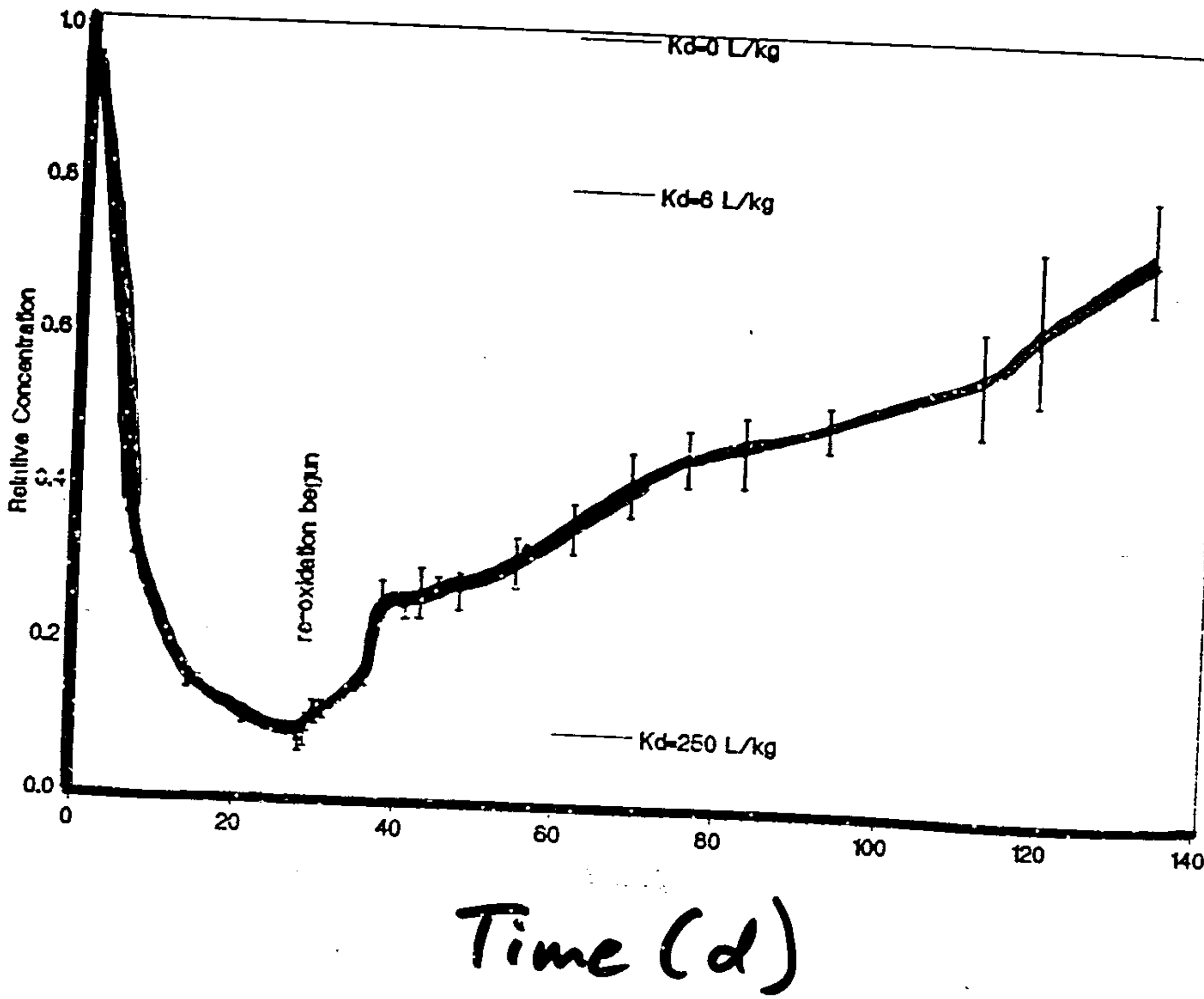
legend: □ □ □ Reported Geometric Means
\+ + + Means Where Foliar Contam. Possible
. . . Generated Points Showing Spread of Data
——— Regression Line

CR for Th versus Soil Concentration

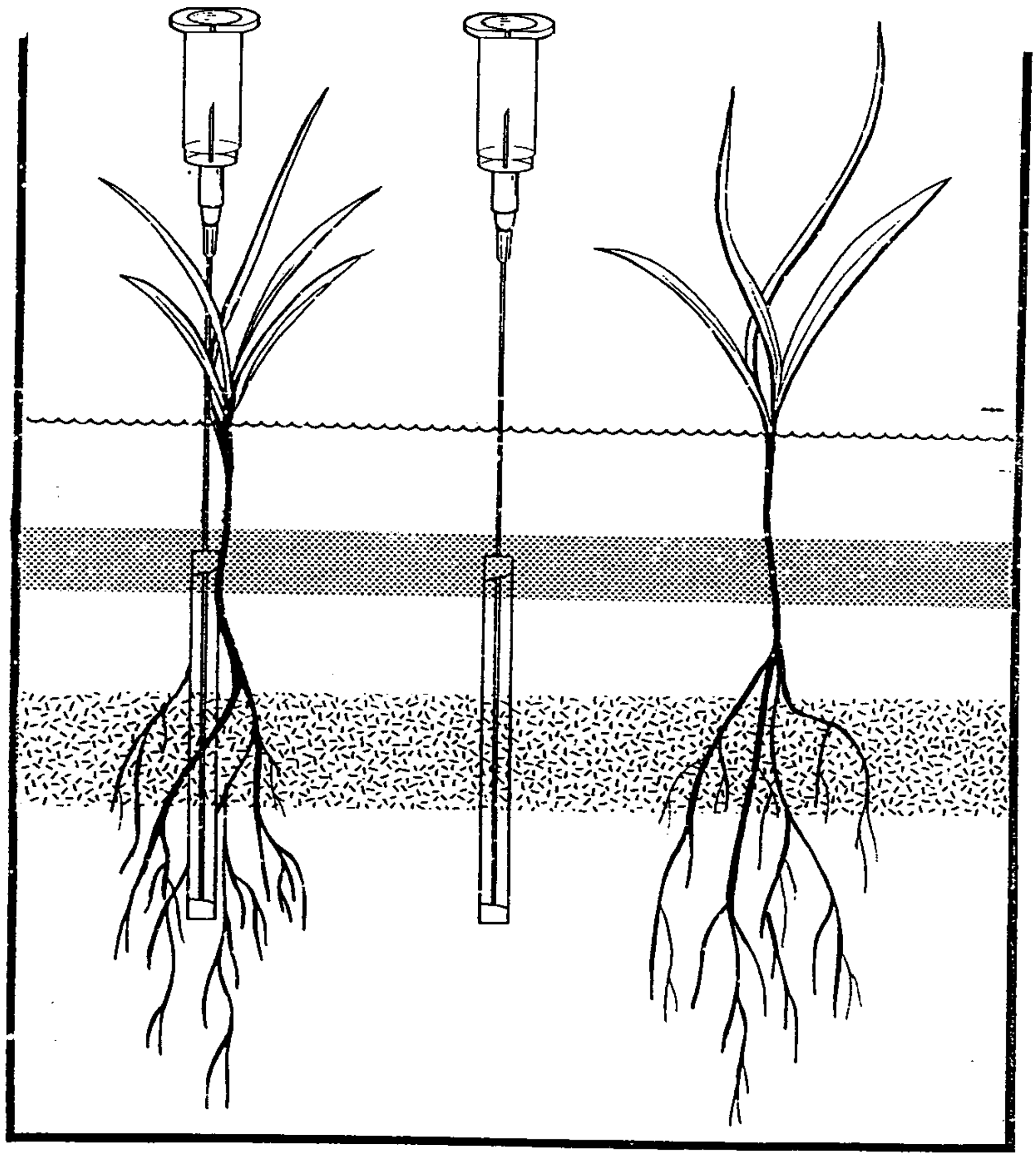


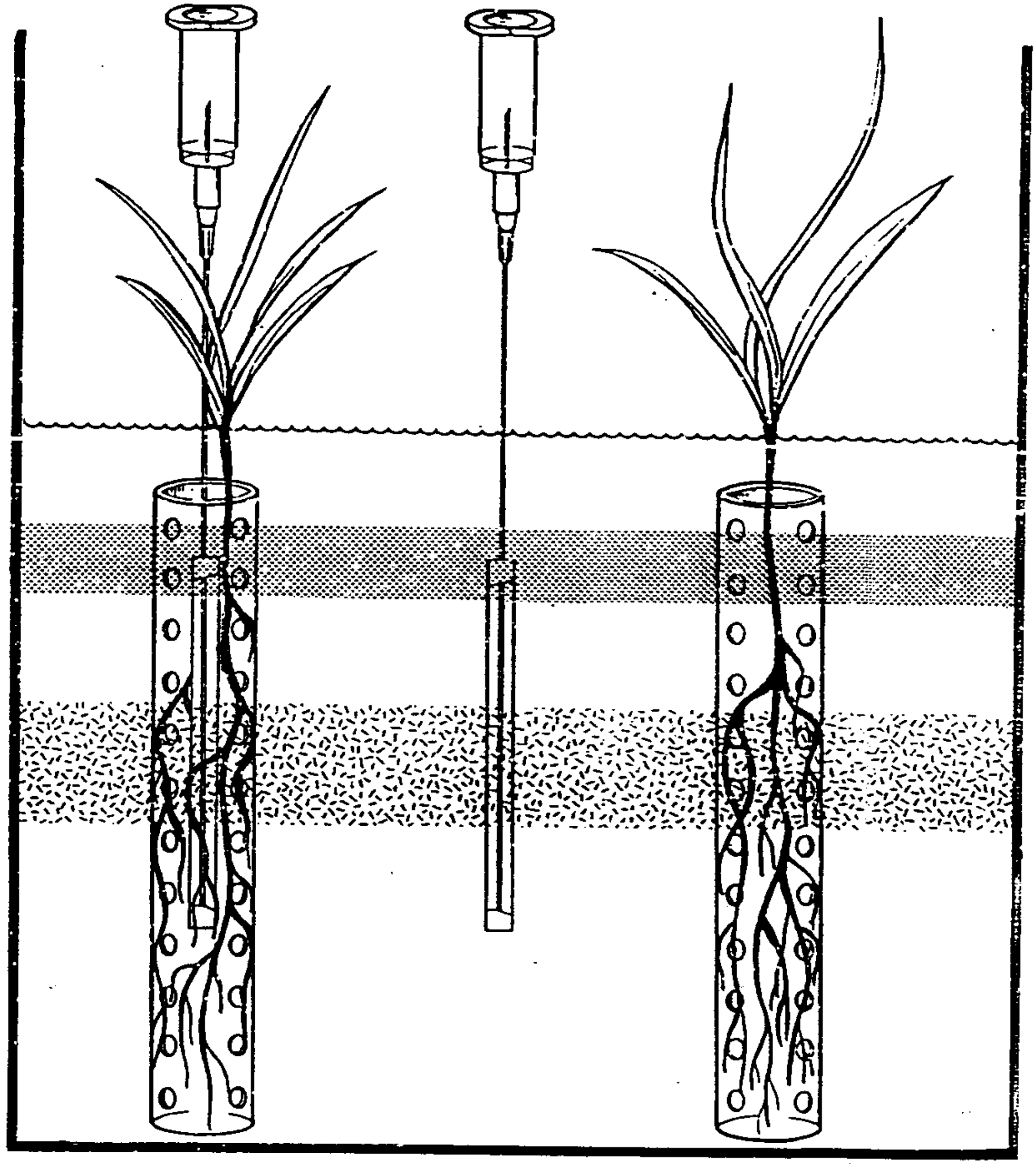
CR for Pb versus Soil Concentration





Kd=0 L/kg
Kd=6 L/kg
Kd=250 L/kg
re-oxidation begun
Relative Concentration
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
120
140
Time (d)





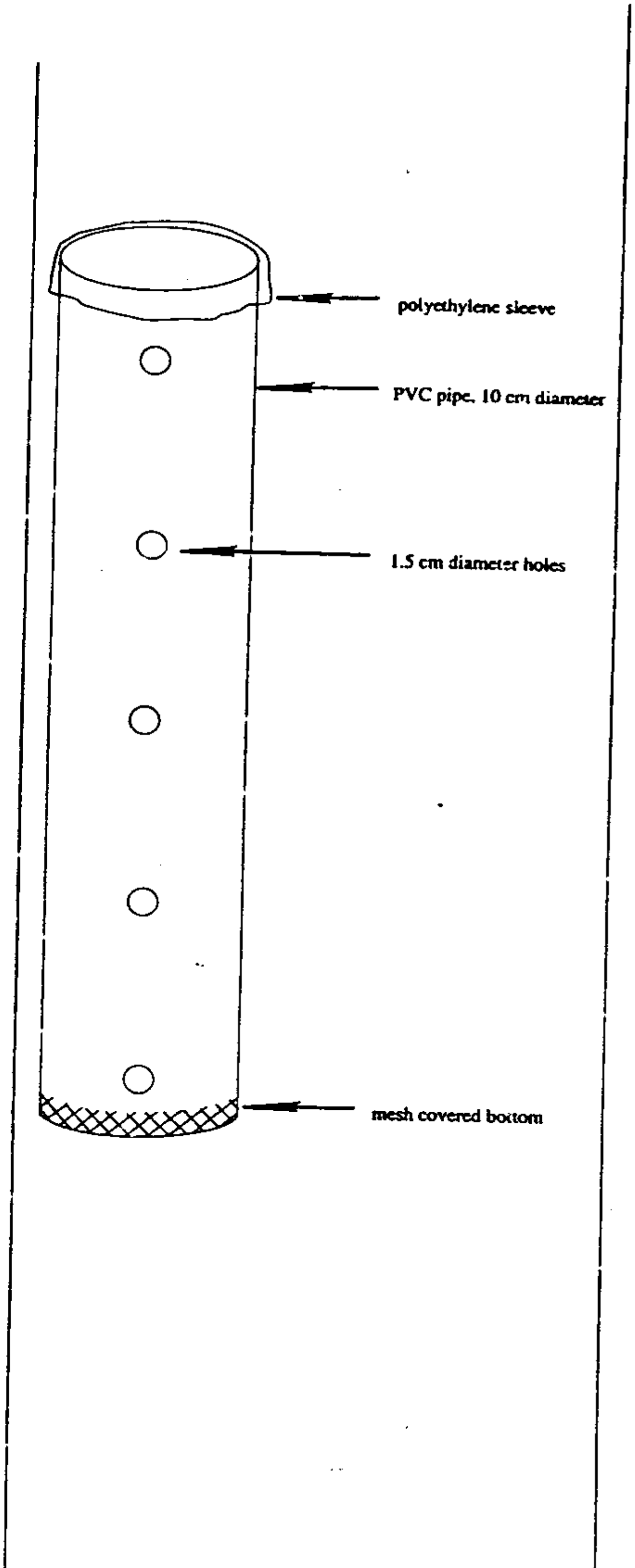


Figure 1A.

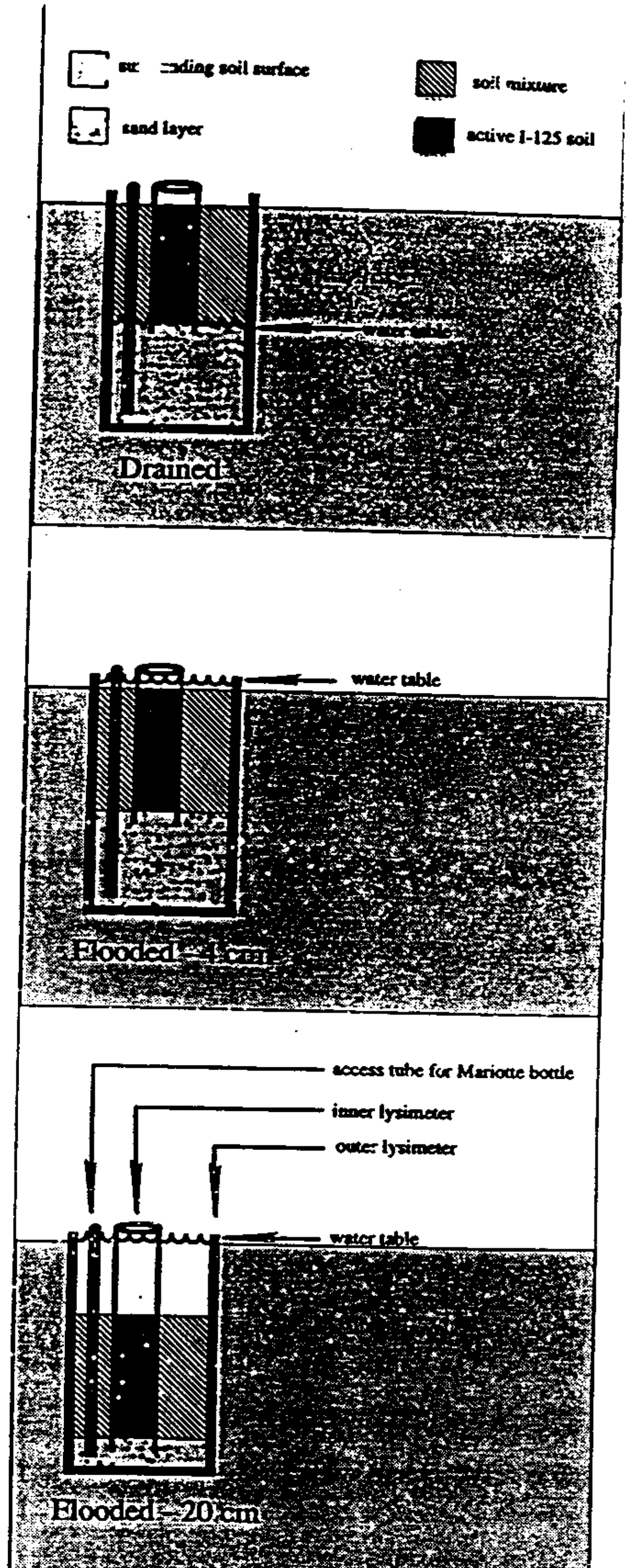


Figure 1B.

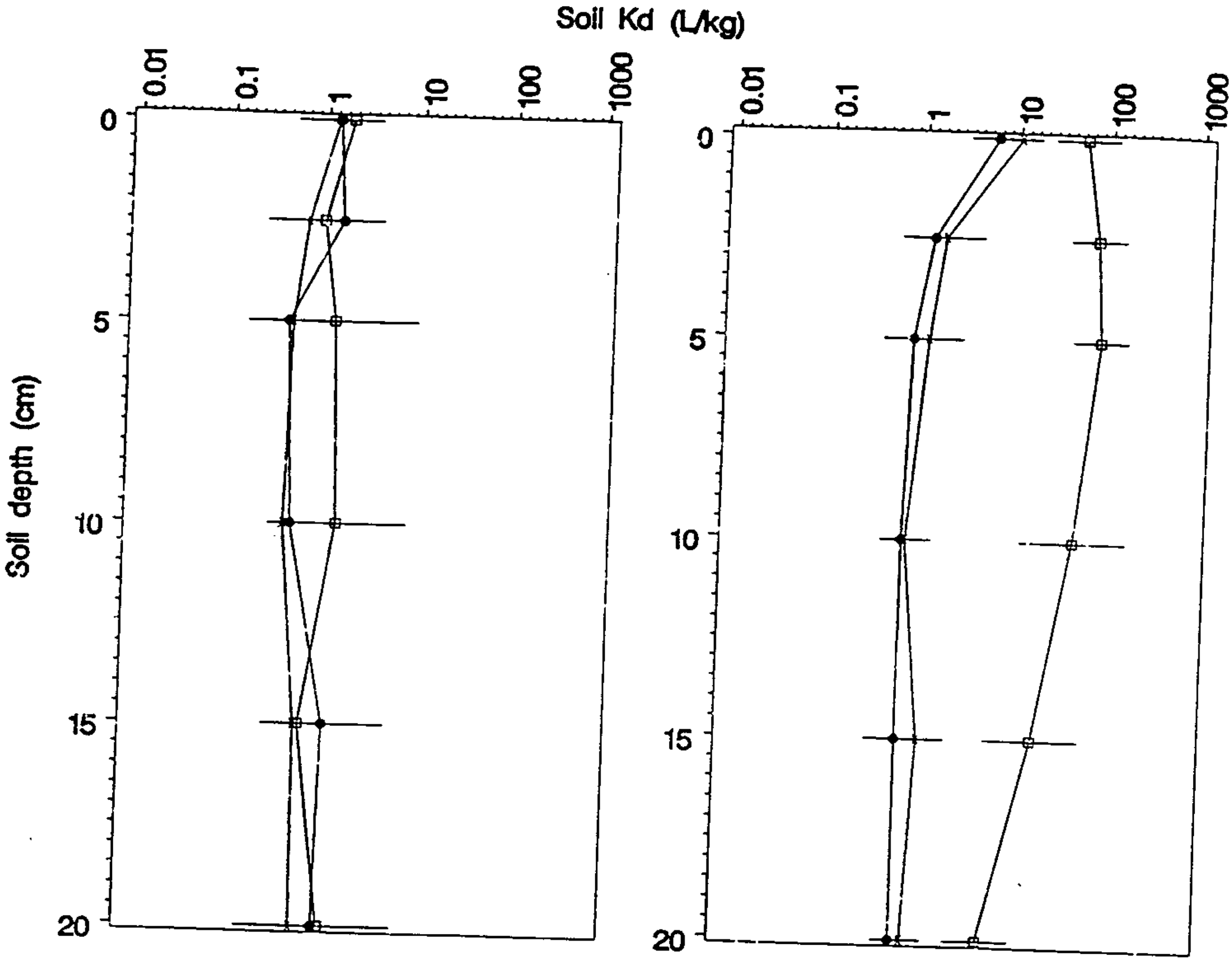
Figure 1:

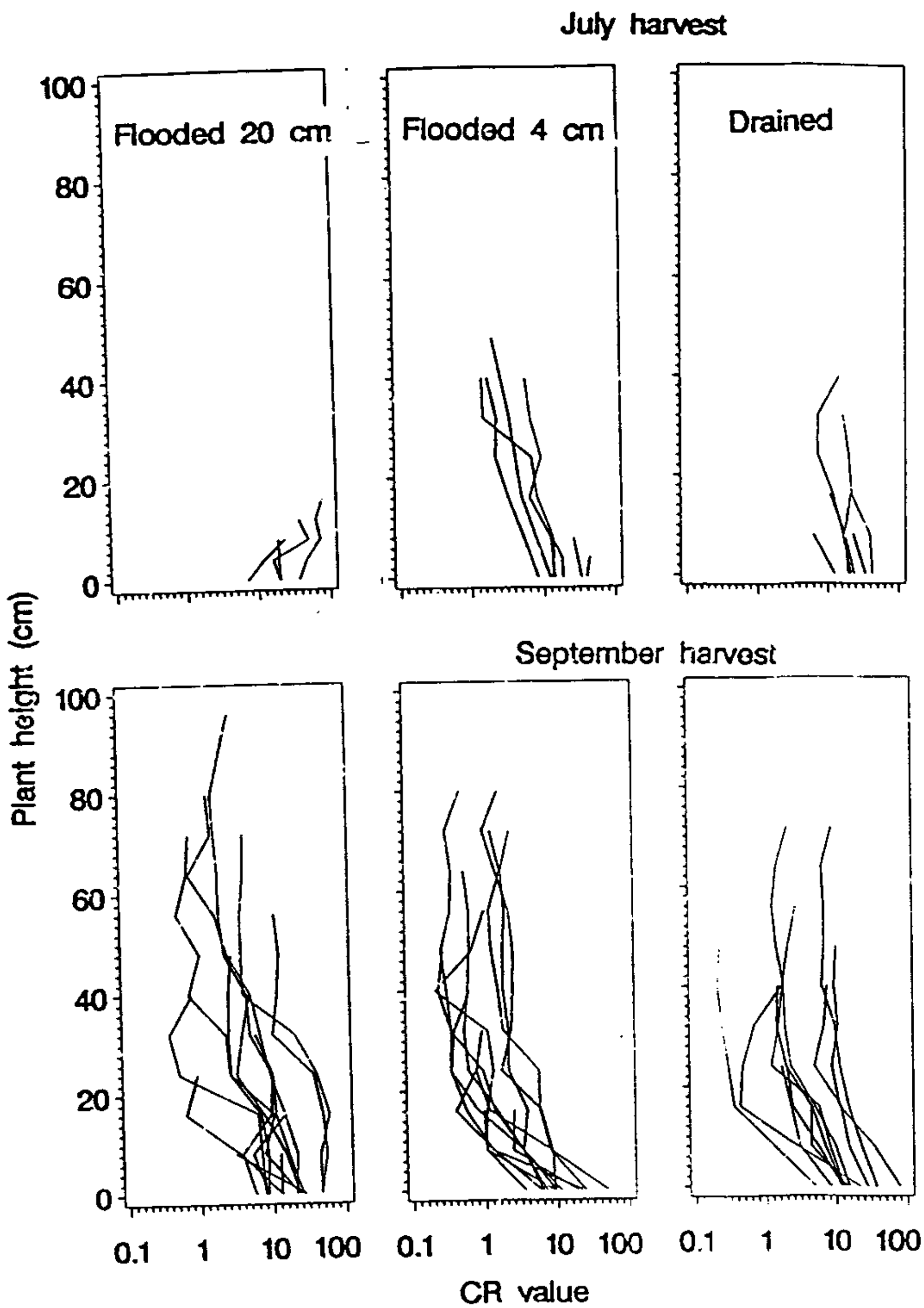
Sheppard and Motycka

Plant/soil concentration ratios (DW) for ^{125}I in wild rice (Z.aquatica)

PLANT PART	FLOODED SOIL	DRAINED SOIL	SIG.
seed	0.25	0.17	
panicle	1.8	1.4	
upper stem	3.5	2.1	•
leaf #5	28	6.8	
leaf #4	34	12	
[illegible]	[illegible]	[illegible]	•
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	

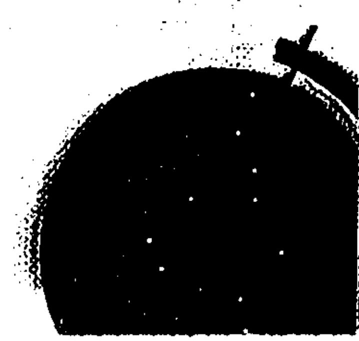
"Figure 2"




July harvest
Flooded 20 cm
Flooded 4 cm
Drained
September harvest
Plant height (cm)
0
20
40
60
80
100
0.1
1
10
100
CR value

Food processing

- gains
  - dust from the harvesting
- losses during preparation
  - removal of outer leaves, hulls, chaff
  - leaching during cooking



Hilroy

Concentration Ranges in Raw Tissues and Mean Cooked/Raw Concentration Ratic

Sample	*I* (*mg kg^{-1}*)	*Br* (*g kg^{-1}*)	*Cl* (*g kg^{-1}*)	*F* (*mg kg^{-1}*)
Beet root flesh				
Concn range	0·60–2·6	0·024–17	1·3–16	20–30
n	7	8	15	2
Mean ratio	0·97	1·11	1·19*	0·41
Cabbage head				
Concn range	0·1–2·4	0·016–20	1·1–11	10–60
n	8	9	14	2
Mean ratio	0·98	0·96	0·81*	2·2
Corn kernel				
Concn range	0·30–1·1	0·001–1·0	0·17–1·4	10–30
n	2	10	9	1
Mean ratio	0·99	0·58*	0·67*	0·33
Overall ratio	0·98	0·89	0·86*	0·77

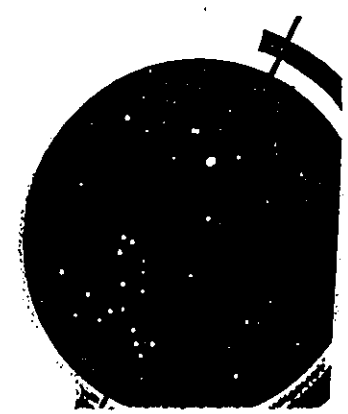
*$p < 0.05$ for comparison of ratios to unity.

Examples of unusual pathways

organic soils as fuel or chemical resource

‘soil’ as a building material

ingestion of soil



DEVELOPMENT OF EXPERTISE IN NUCLEAR WASTE MANAGEMENT IN THAILAND

WORKSHOP 2
1997 May 26-30

on
Environmental Issues
Performance Assessment

Presented for
Human Resources Development Linkage Program

by
Atomic Energy of Canada Ltd.

AECL, Whiteshell Laboratories
Pinawa, MB, Canada R0E 1L0

1. INTRODUCTION

This workshop is the second of two workshops organized for the Human Resources Development Linkage Program, and presented, by Atomic Energy of Canada Limited (AECL). The AECL staff presenting these workshops are experts working in the Canadian Nuclear Fuel Waste Management Program. Brief resumes for the presenters are included at the back of this program.

The topics to be covered in Workshop 2 include Environmental Issues and Performance Assessment. The topics covered by Workshop 1, held on 1997 March 17-26, included Natural Analogs, Engineered Barriers and Hydrogeology. A study visit by Thai experts to AECL's Whiteshell Laboratories and the Underground Research Laboratory near Pinawa, Manitoba, Canada, is scheduled for 1997 June 16-25.

2. ENVIRONMENT ISSUES

The ultimate goal of a waste management program is to protect the environment, for people living now and for future generations. This includes protection of the water, soil and natural biota, because humans are very dependent on their environment. Protection is assured be using expert judgement, computer simulations and careful scientific investigations. This course will introduce the topic of radioecology and describe the types of models and parameter values needed to assess waste management decisions. It will also provide insights into research opportunities and the international network for collaboration on all issues related to nuclear waste in the environment.

COURSE OUTLINE & PROGRAM
Presented by: Steve Sheppard
Duration: 2 days

Monday, May 26, all-day

- *Introduction*
  - Objectives of environmental work
  - History of radioecology
  - Concerns with waste management
  - Nuclear Fuel Waste and Low & Intermediate Level Waste: Overview of International programs

- *Processes of Radionuclide Migration from Waste Facilities*
  - Discharge to the biosphere
  - Lakes and rivers
  - Soil
  - Atmosphere
  - Human realm
  - Natural realm

Tuesday, May 27, all-day

- *Models of the Environment*
  - General issues
  - Discharge models
  - Lake and river models
  - Soil models
  - Atmospheric models
  - Food chain and dose models for humans
  - Models for impacts on non-human biota
  - Alternate models

- *Parameters for Environmental Models and Use of Models*
  - Probability density functions, sources, truncations, correlations
  - Model use, sensitivity analysis

- *New Issues, Research Opportunities and International Programs*
  - Dose to non-human biota, population doses, chemical toxicity, landscape models
  - Research opportunities
  - International Biosphere Programs

3. PERFORMANCE ASSESSMENT

The assessment of the performance of a disposal concept, and predicting its safety over long time periods into the future, require the use of computer-based modelling. A comprehensive assessment model for a total disposal system is very complex, including a large number of scenarios, parameters and processes. The Systems Variability Assessment Code (SYVAC) is the modelling code developed in Canada as part of the Canadian Nuclear Fuel Waste Management R&D program. This course unit will cover the approach, structure and use of the SYVAC code for performance assessment.

COURSE OUTLINE & PROGRAM
Presented by: Ted Melnyk
Duration: 2.5 days

Wednesday, May 28, all-day

- *Introduction to SYVAC3*
  - Canadian Program and Radiological Criteria
  - Assessment Methodology
  - Risk/Variability/SYVAC approach
  - Conceptual Example

- *SYVAC3 code and Executive Functions*
  - Execution control/deterministic vs probabilistic
  - File reading and writing
  - Parameter sampling and assignment
  - Time series management

- *SYVAC3 Input/Output and Model Links*
  - Input files
  - Radionuclide decay chains
  - Output files/output displays
  - DE Models/Response Functions/Convolution
  - Time Series/Math Library
  - Interfaces to system models

Thursday, May 29, all-day

- *Handling System Models*
  - Scenario Analysis
  - Links to R&D programs
  - Robustness and Efficiency
  - Hooks to SYVAC3
  - Include files and Model Variables
  - Large and complex models
    - Configuration Control
    - QA steps
    - Software Tools
    - R&D requirements

- *Sensitivity Analysis and SYVAC3 Applications*
  - Sensitivity Analysis of Large System Models
  - Displaying Sensitivity Analysis Results
  - SYVAC3 System Models applications
    - New York State LLW
    - Scottish Nuclear
    - Uranium Mine Tailings
    - LILW - MB, CRL
    - external programs - MOTIF, CATHENA
    - CNFWMP - 2 interim, EIS, 2nd assessment

Friday, May 30, morning

- *Canadian Assessment and Display Package*
  - CC3 Models used for Canadian Assessment
  - CC3 Model Display package demonstration

Stephen C. Sheppard

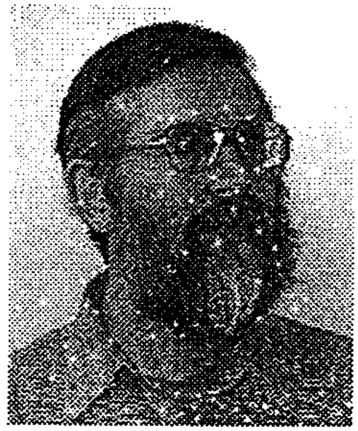
Education

1974	B.Sc., Honours, physical sciences, University of Guelph
1975	M.Sc., Soil-plant relations, With Distinction, University of Guelph
1982	Ph.D., Soil science/plant physiology, University of Manitoba

Work Experience

1975-1976	Research Associate at the University of Guelph, conducting research on the contribution of phosphorus from agricultural land to surface waters.
1976-1979	Faculty at the University of Guelph, conducting research in soil fertility and teaching.
1982-present	Research scientist with AECL at Whiteshell Laboratories in Pinawa, Manitoba, working in the Environmental Science Branch of the Canadaian Nuclear Fuel Waste Management Program.

Dr. Sheppard is a Senior Scientist responsible for the biosphere models in several nuclear environmental safety assessments. He is also actively involved in research on reactions of contaminants with soil, uptake by plants and animals, and ecological toxicity assessment with plants and invertebrates. He has just finished serving as Editor, Canadian Journal of Soil Science and is currently serving as Associate Editor for the Journal of Environmental Quality and as a SETAC book Editor. He has been the senior author of over 57 scientific journal publications, has been author or co-author of over 90 other publications.



Ted W. Melnyk

Education

Born in UK. Primary and secondary school in Ontario, Canada.

1966	B.Sc. (Honours Chemistry), University of Western Ontario, London, Ontario, Canada, Board of Governors' Gold Medal, Society of Chemical Industry Merit Award.
1968	M.Sc. (Physical Chemistry), University of Western Ontario, London, Ontario, Canada
1973	Ph.D. (Physical Chemistry), 1973, Imperial College of Science and Technology, London, England

Work Experience

1973-1974	Postdoctoral Fellowship in Mathematics Department at Dalhousie University in Halifax, Nova Scotia, Canada.
1974-1976	Assistant Professor in Chemistry Department, Dalhousie University, Halifax, Nova Scotia, Canada.
1976-1979	Variety of short term research and teaching positions.
1979-1980	Research Assistant in Mathematics Department at Dalhousie University in Halifax, Nova Scotia, Canada.
1980-1985	Research scientist with AECL at Whiteshell Laboratories in Pinawa, Manitoba - Mathematical modelling in support of sorption experimental programs in geochemistry; - conducting laboratory experiments and modelling of contaminant diffusion through geological media.
1985-present	Research scientist with AECL at Whiteshell Laboratories in Pinawa, Manitoba - Mathematical modelling and systems code development for the transport of contaminants in hydrogeological systems.