

Perspectives on Exposure Assessment Soil Ingestion and Pica

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Soil/Dust Ingestion Mouthing Behavior Colloquium Arlington, VA May 24-25



Overview

- Routes of Exposure
 - Inhalation, Ingestion (food, water), dermal absorption, **Non-food ingestion**
- Potential Dose
 - Contaminant Conc***Intake Rate***Time
- Definition of Exposure

Definition of Exposure: Contaminant Conc*Intake Rate*Time

For a **Person**:

- Exposure over a lifetime =
- Sum exposure each year=
- For a year, Sum over days=
- For a **day**, Sum over hours=
- For an hour, Sum over minutes.....

Need results for a Population!

Exposure

$$\sum_{\text{Birth}}^{\text{Death}} C_d I_d \neq \left(\frac{1}{D} \sum_{\text{Birth}}^{\text{Death}} C_d \right) \left(\sum_{\text{Birth}}^{\text{Death}} I_d \right)$$

C_d = Conc. in Intake on Day "d"

I_d = Intake for Day "d"

Ingestion on a day

For subject “s”

Day “d”

$$\begin{aligned} Y_{sdk} &= \mu_{sd} + E_{sdk} \\ &= \mu + \beta_s + \delta_{sd} + E_{sdk} \end{aligned}$$

Historical Recommendations

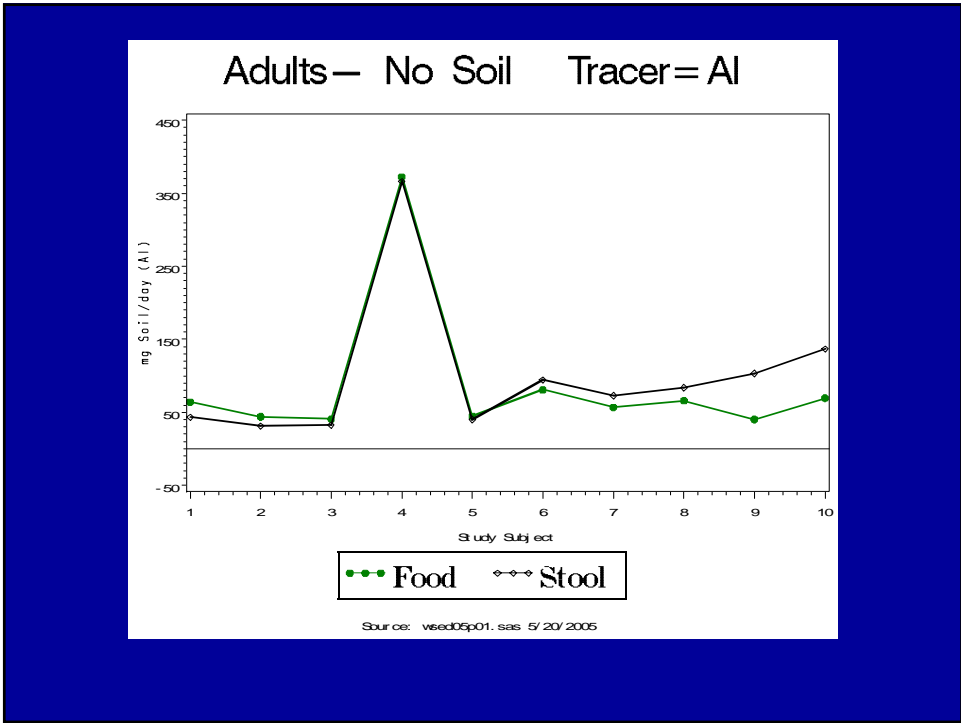
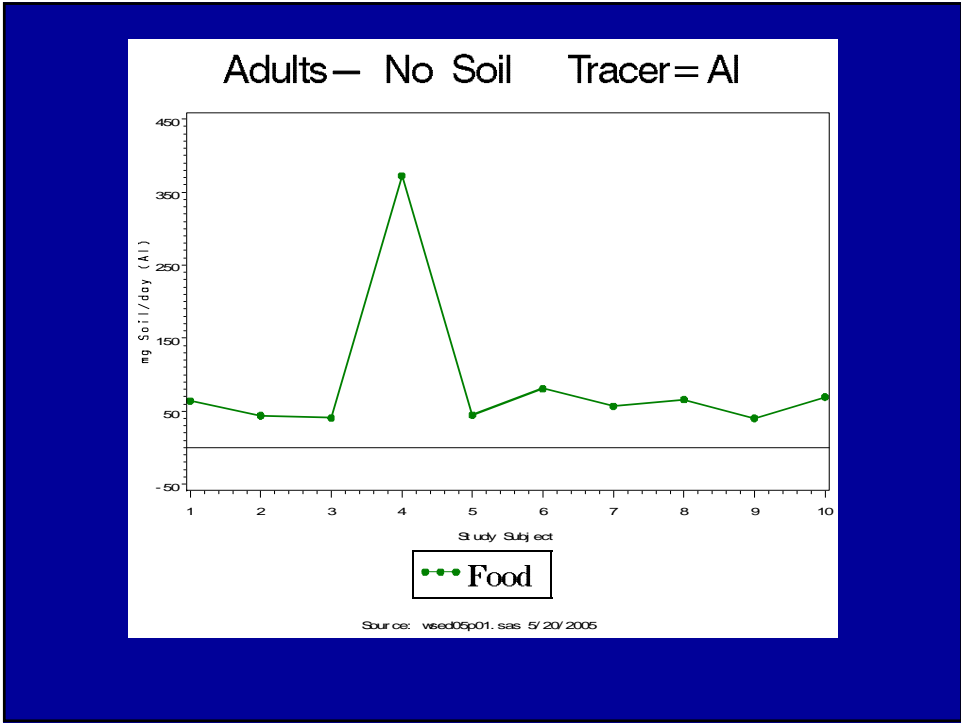
- Guidelines (judgement)
- Measurement Challenges
 - Sample People
 - Sample time (days)
- Error
 - Systematic Bias
 - Measurement error
 - Methodological bias

Soil Ingestion Studies

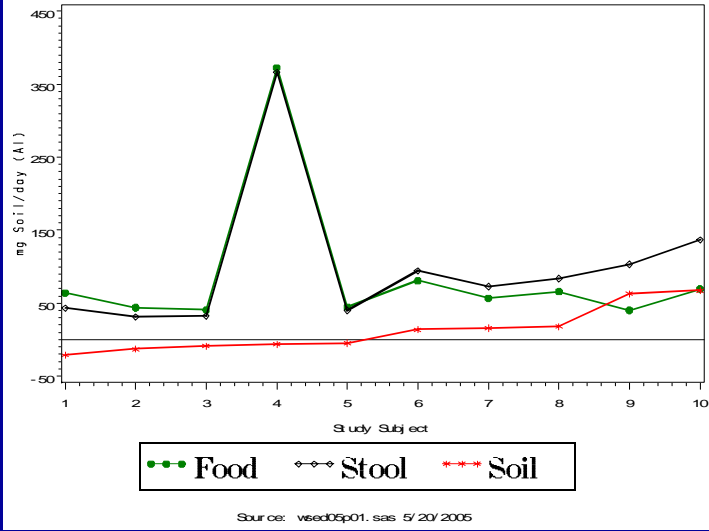
- Directly measure exposure
 - Unbiased?? (Validity)
 - Fewer Assumptions (?)
- Problems...
 - Yes- but much has been learned

Example: Adult Experimental Study

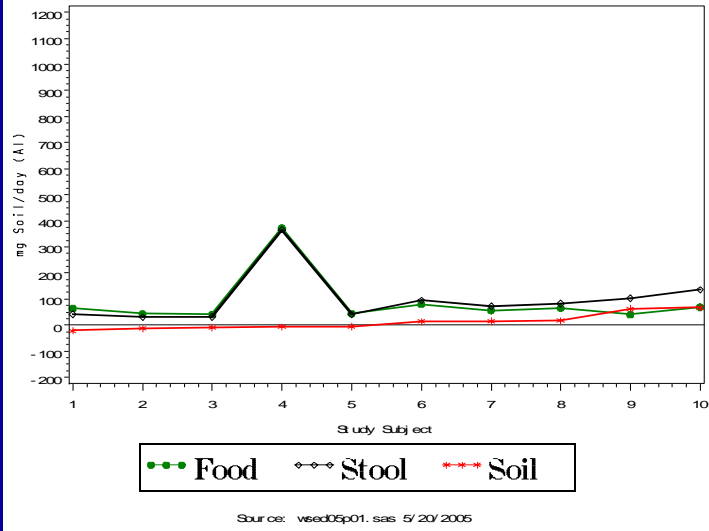
- 10 adults, each followed for 7 days
- Study repeated 4 times
- Experimental Effect:
 - No soil
 - 20 mg/d soil
 - 100 mg/d soil
 - 500 mg/d soil



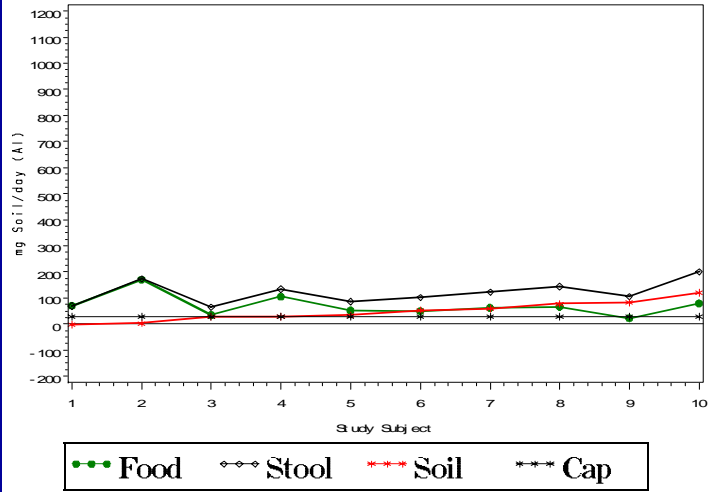
Adults— No Soil Tracer= Al



Adults— No Soil Tracer= Al

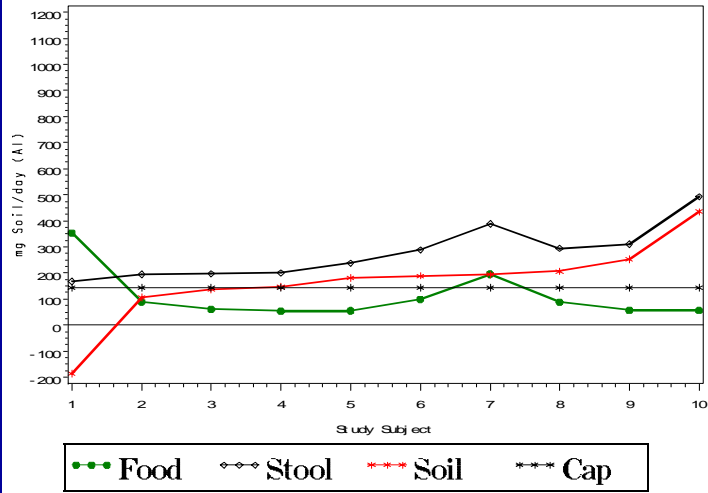


Adults— 20 mg Soil Tracer=Al

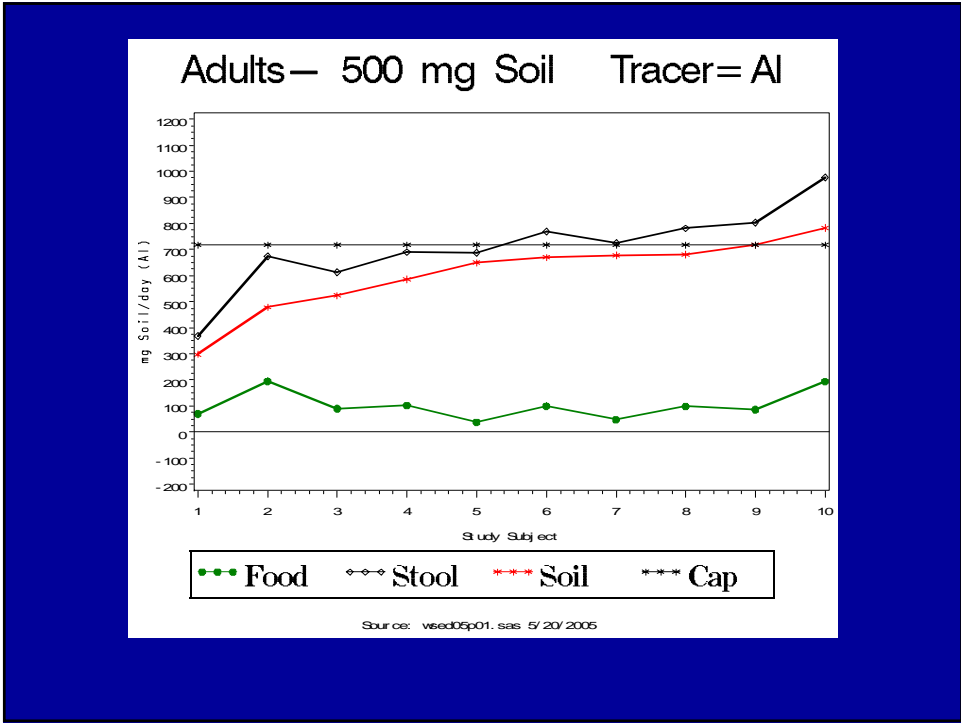


Source: vee005p01.sas 5/20/2005

Adults— 100 mg Soil Tracer=Al



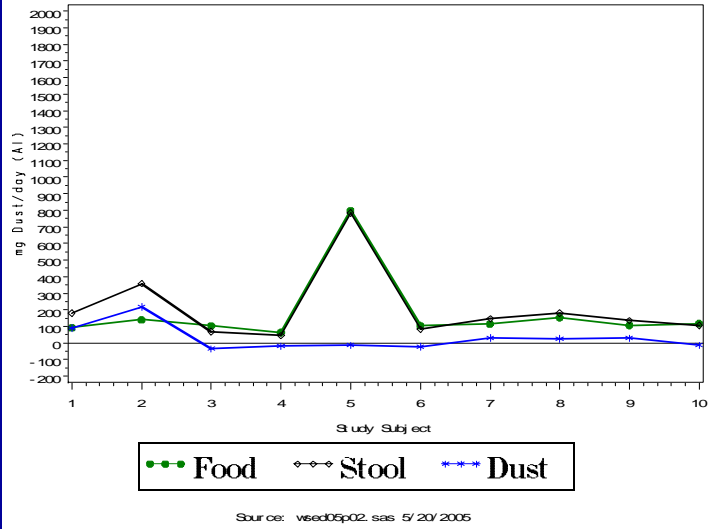
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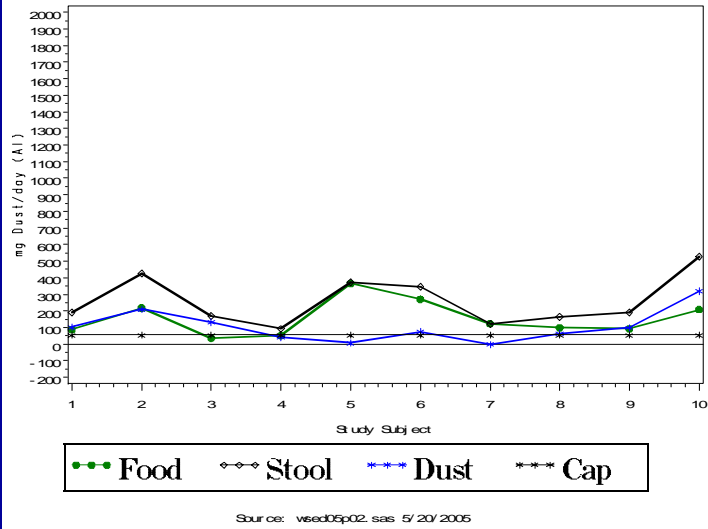
What about Dust?

- Concentration about 1/2 that for soil (for Al)
- Soil capsules = twice the dust

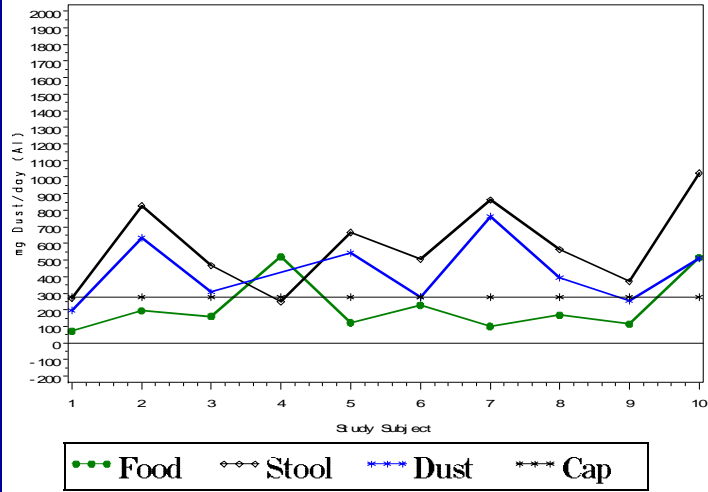
Dust—Adults— No Soil Tracer= Al



Dust—Adults— 20 mg Soil Tracer= Al

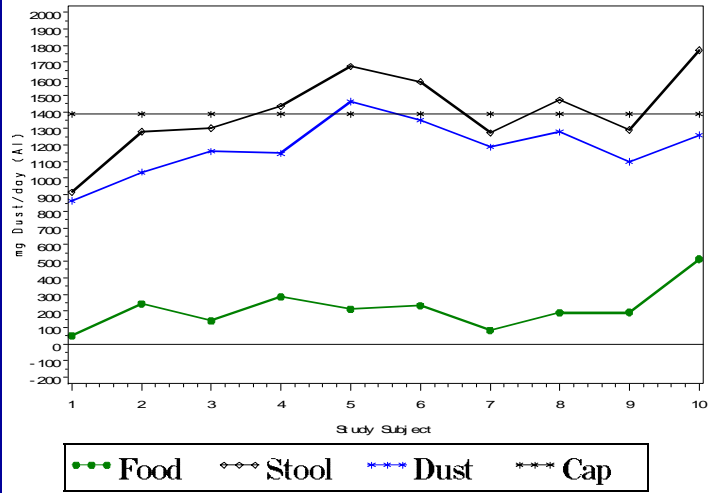


Dust—Adults— 100 mg Soil Tracer=Al



Source: vee005p02.sas 5/20/2005

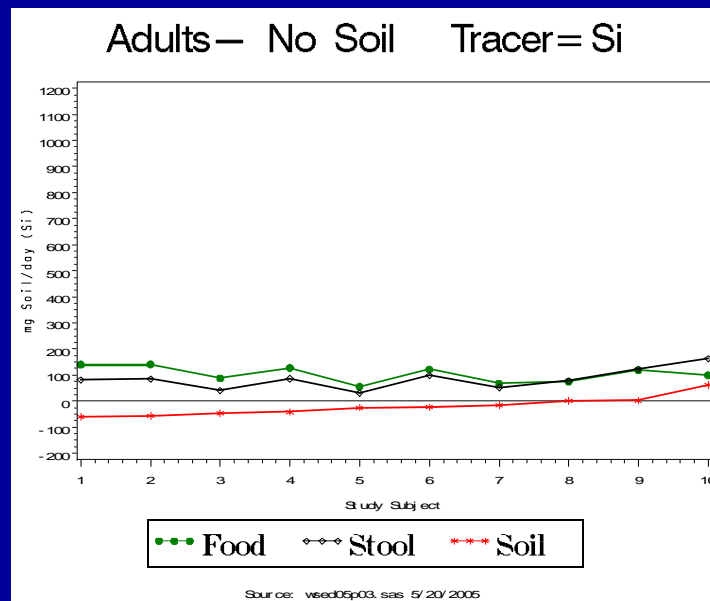
Dust—Adults— 500 mg Soil Tracer=Al



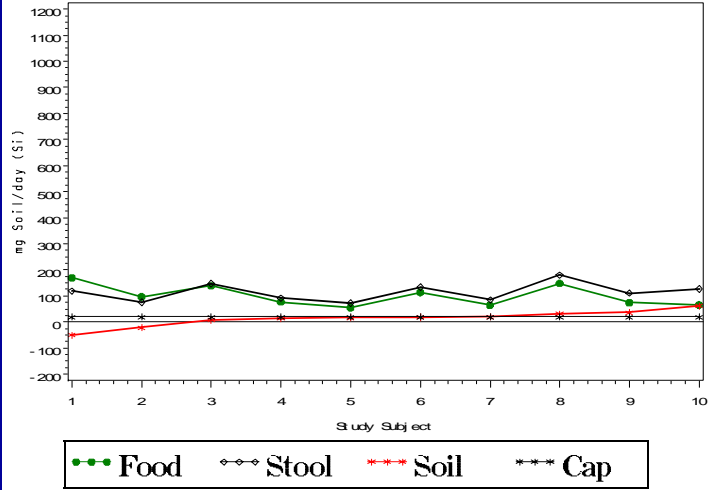
Source: vee005p02.sas 5/20/2005

Different Tracers?

- Example of Si

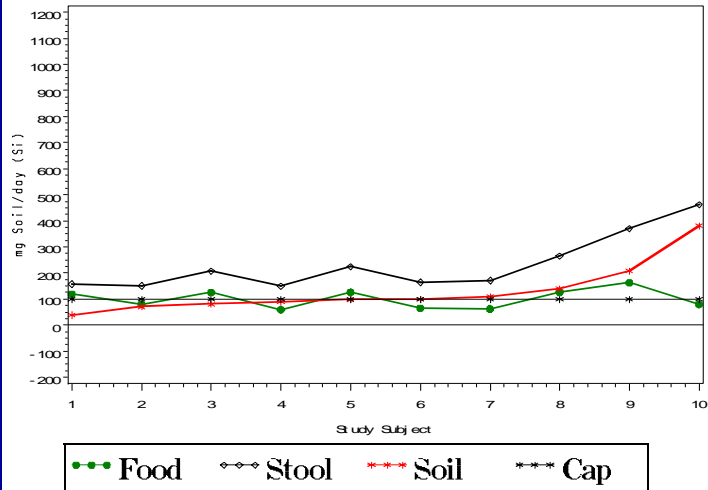


Adults – 20 mg Soil Tracer= Si

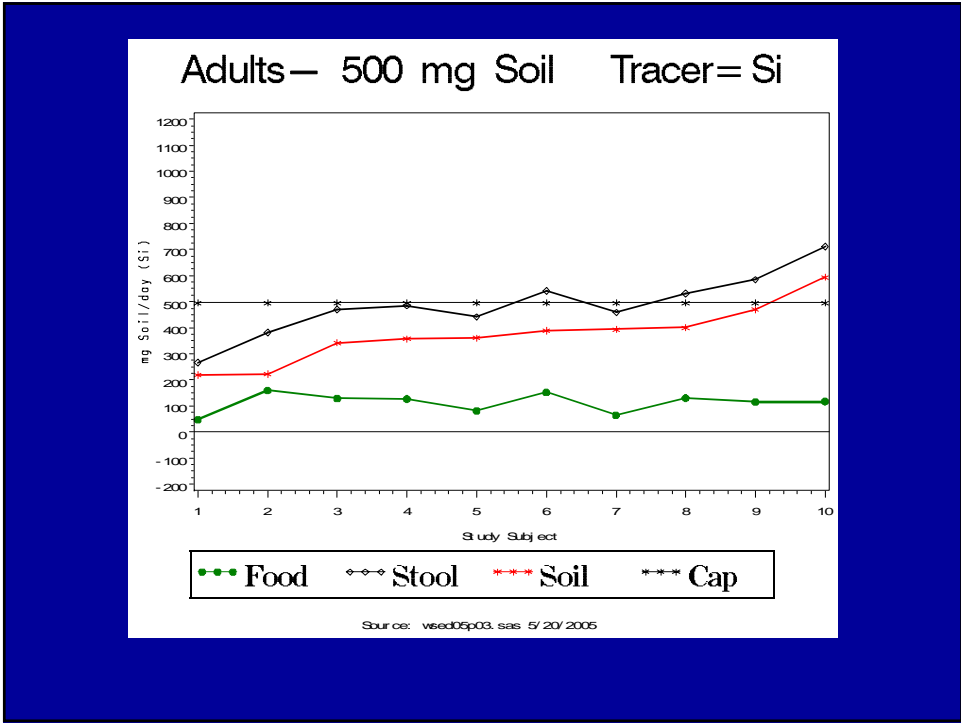


Source: vee05p03.sas 5/20/2005

Adults – 100 mg Soil Tracer= Al



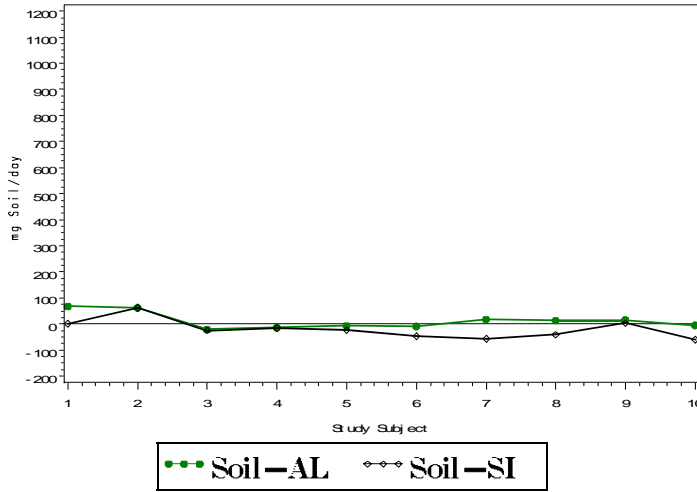
Source: vee05p03.sas 5/20/2005



How do Tracers Compare?

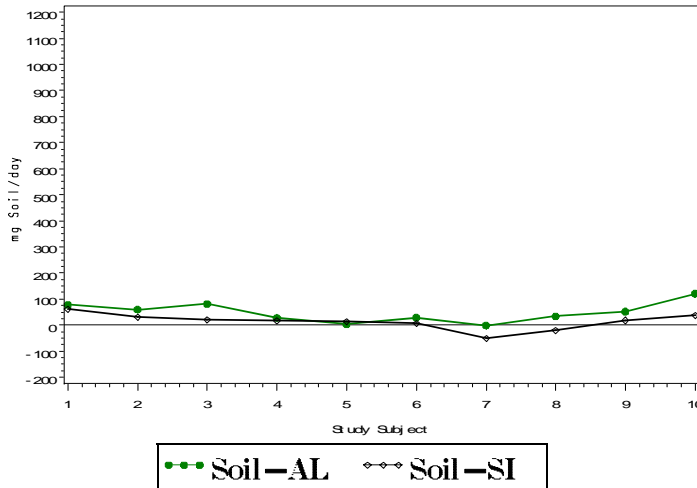
- Al vs Si

Adults— No Soil Tracer=Al,Si



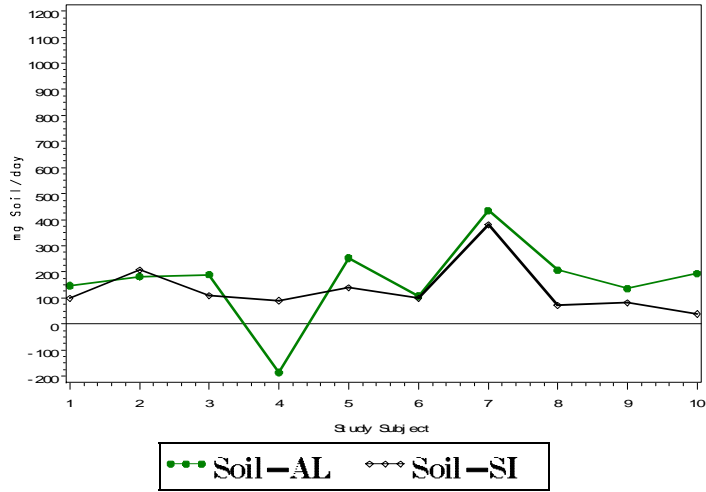
Source: vee005p04.sas 5/20/2005

Adults— 20 mg Soil Tracer=Al,Si



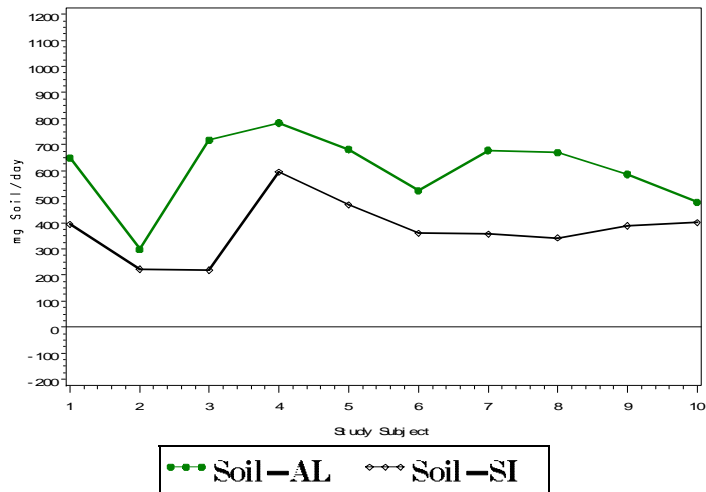
Source: vee005p04.sas 5/20/2005

Adults— 100 mg Soil Tracer= Al,Si



Source: vsee05p04.sas 5/20/2005

Adults— 500 mg Soil Tracer= Al,Si

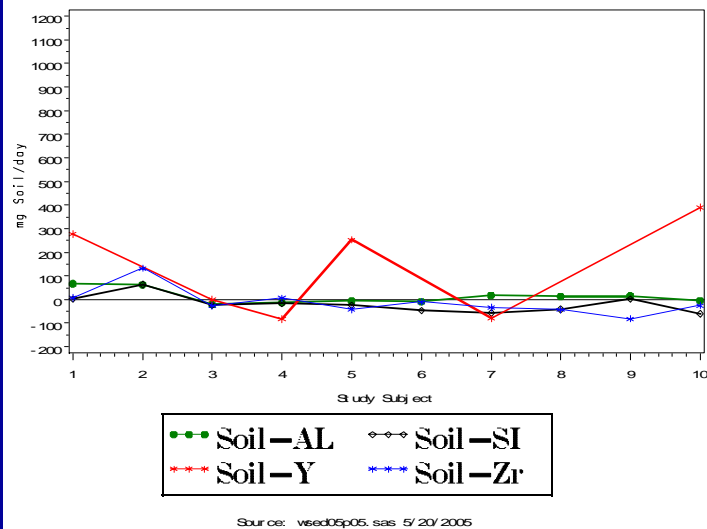


Source: vsee05p04.sas 5/20/2005

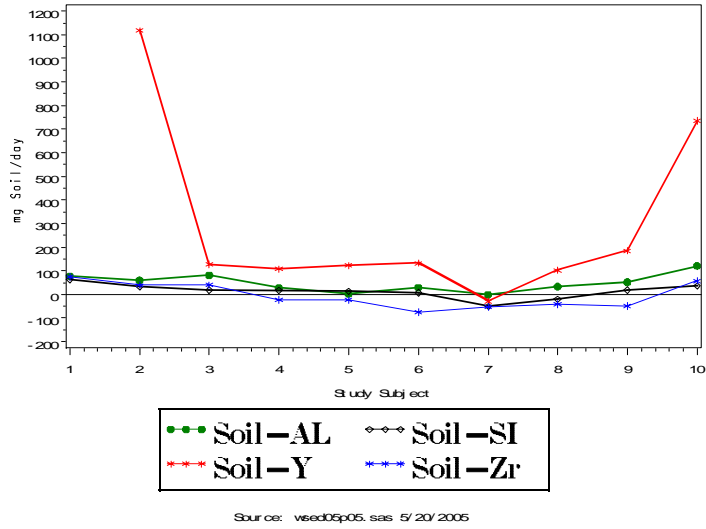
More Tracers?

- Add Y and Zr

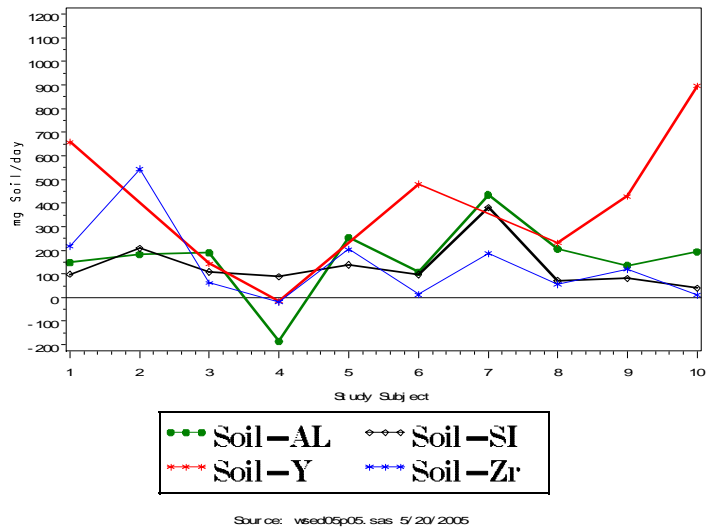
Adults — No Soil Tracer = Al, Si, Y, Zr



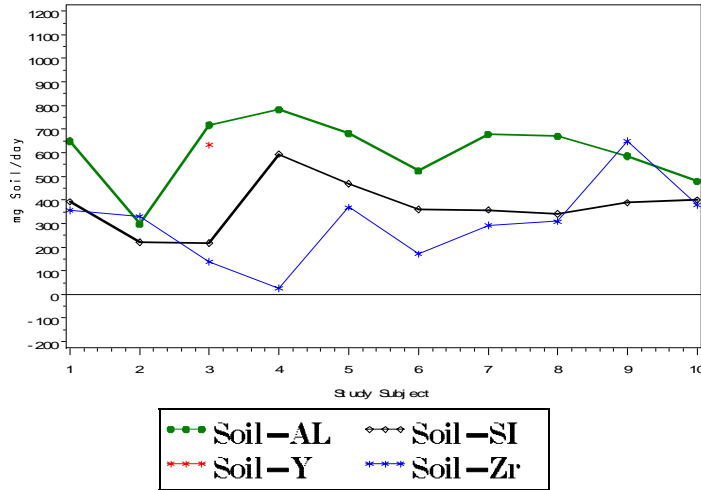
Adults— 20 mg Soil Tracer= Al,Si,Y,Zr



Adults— 100 mg Soil Tracer= Al,Si,Y,Zr

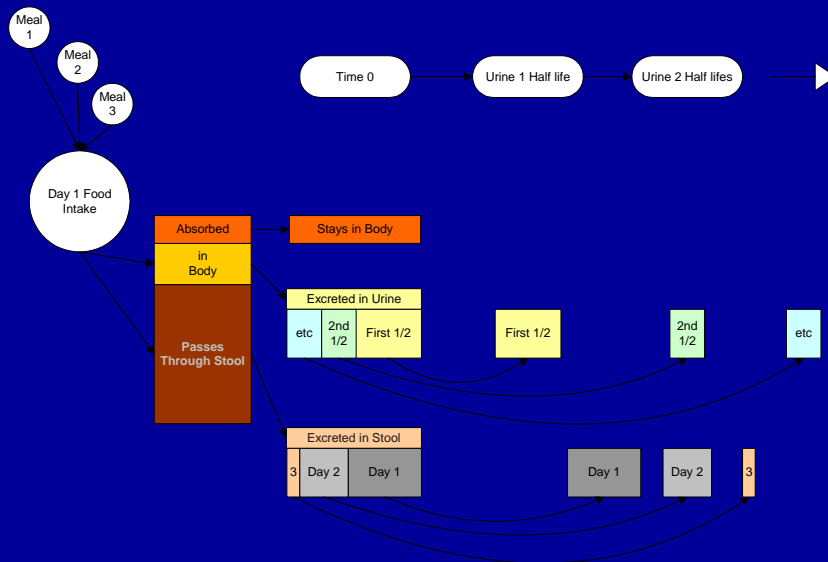


Adults— 500 mg Soil Tracer= Al,Si,Y,Zr



Source: veed06p05.sas 5/20/2005

Basic Description of Transport from Food Ingestion



Ingestion on a day

For subject “s”

Day “d”

$$\begin{aligned} Y_{sdk} &= \mu_{sd} + E_{sdk} \\ &= \mu + \beta_s + \delta_{sd} + E_{sdk} \end{aligned}$$

Ingestion in a Population

For the “ith” subject on the “jth” day, “kth” measure

$$Y_{ijk} = \mu + B_i + D_{ij} + E_{ijk}$$

$$\text{var}(B_i) = \sigma_S^2 = \text{Subject Variance}$$

$$\text{var}(D_{ij}) = \sigma_D^2 = \text{Day Variance}$$

$$\text{var}(E_{ijk}) = \sigma_E^2 = \text{Error Variance}$$

Soil Ingestion Studies

- Directly measure exposure
 - Validity yes
 - Fewer Assumptions ... yes
- Problems...
 - Yes- but much has been learned

Challenges

- Generalizing from
 - Sample of People
 - Sample of time (days)
- Separating Error
 - Systematic Bias
 - Measurement error
 - Methodological bias



Thanks