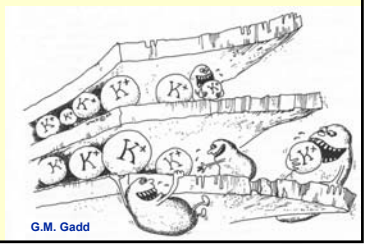
What do you mean by bioavailability ?

- My sediments, exactly!

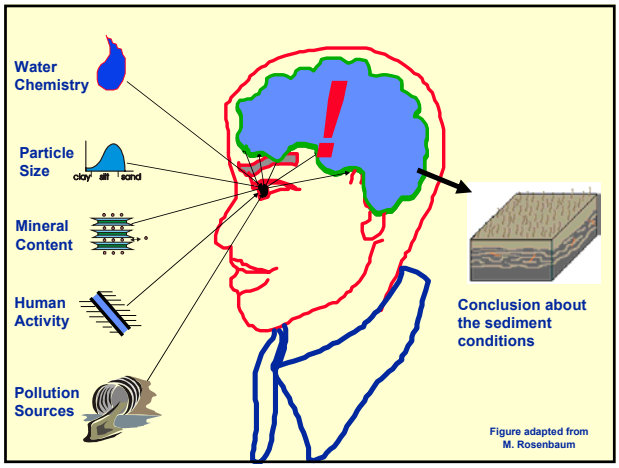
Rodney Stevens & Laila Johannesson

Department of Earth Sciences
Göteborg University

- Needs and risks in standardisation
- Site specificity
- Process relationships
- Database optimisation



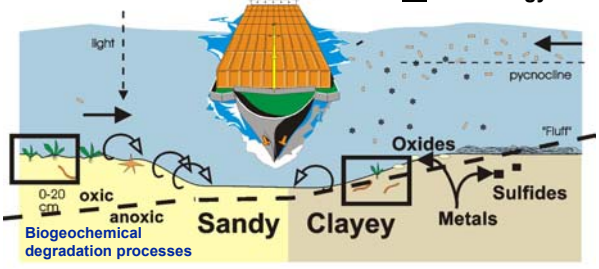
G.M. Gadd



DG VII Transport

H-SENSE

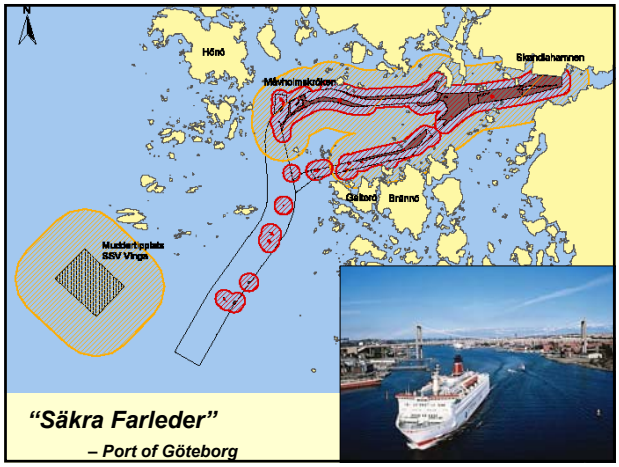
Harbours - **S**ilting and **En**vironmental **Se**dimentology



= Functional Facies

Env. Geol. 43:4 (2003)

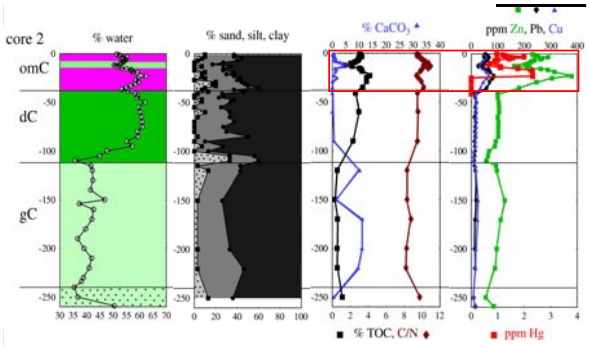
http://hjs.geol.uib.no/hsense/



"Säkra Farleder"

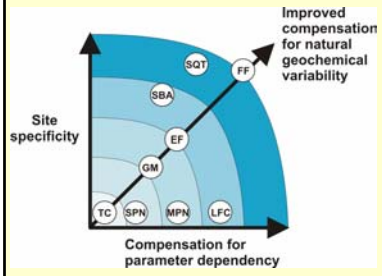
– Port of Göteborg

Torsviken (outside the waste depository)



Brack et al. 2000

Alternative Evaluation Methods



FF = Functional Facies

SQT = Quality Triad

SBA = Bioassay

EF = Enrichment Factors

GM = Gradieint Method

TC = Total Content

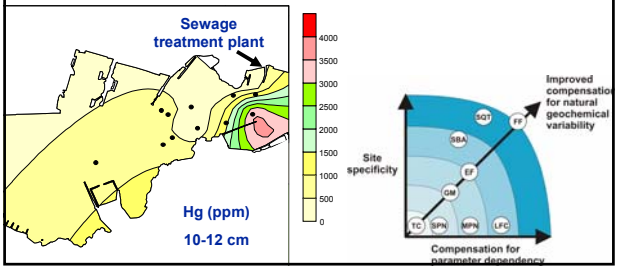
SNP = Single-Parameter Normalisation

MPN = Multi-parameter Normalisation

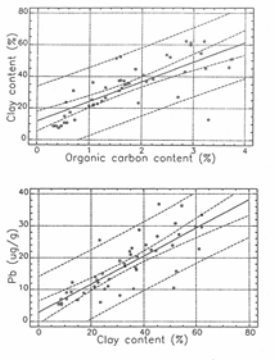
LFC = Leached Fractions Contents

Total metal contents

- Routinely analysed
- Budget or mass flux calculations
- Often used for classification of sediment contamination
- Influenced by grain size, mineralogy and organic-matter content



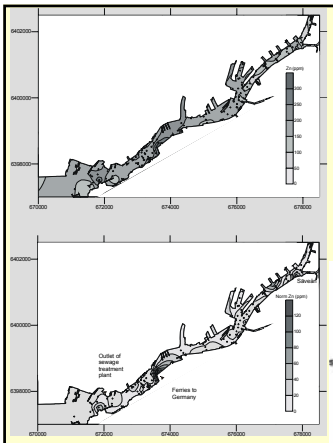
SN = Single-Parameter Normalisation



Clay and organic contents are related to each other due to similar sedimentation and adsorption characteristics.

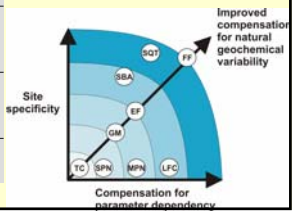
Me_{norm} =

$Me * Clay_{ave}\% / (Clay\%)$

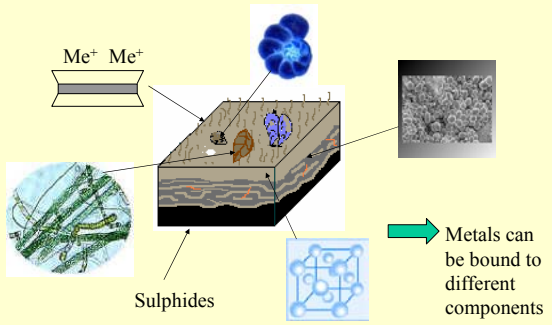


Multiparameter normalisation

Zn* = 156.6 **+** 21.8(**TOC**) **–**1.1(**<16 µm**) **–** 0.4(**Mn**) **+** 76.4(**Fe**)



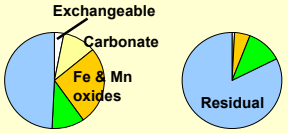
Sediment is heterogeneous



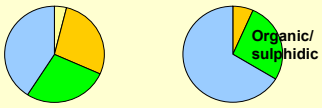
Johannesson 2002

Speciation (Leached Fractions) in Kvillebäcken (stream) and Göteborg Harbour sediment

Mn
Total content
630 and 501 ppm



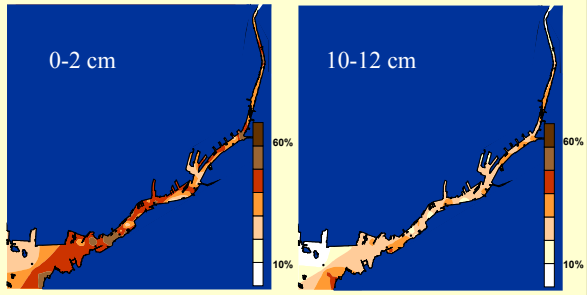
Ni
Total content
= the same

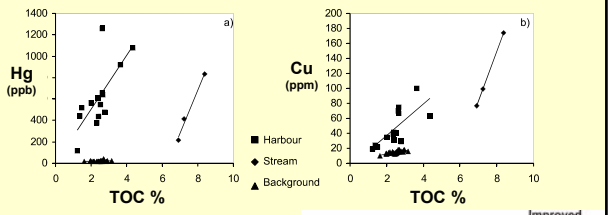


Stream Harbour

Johannesson et al. 2003

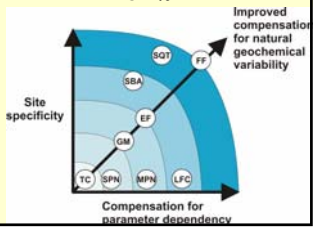
Zn bound to mobile sedimentary components



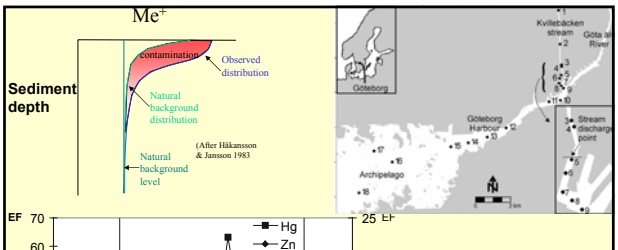


Gradient Method

(Cato 1977)



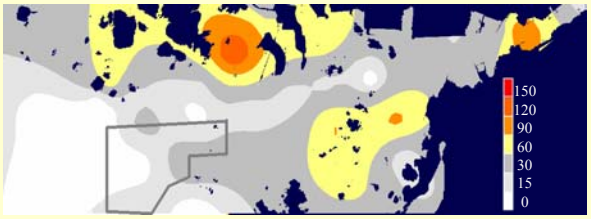
Johannesson et al. 2003



Enrichment Factors

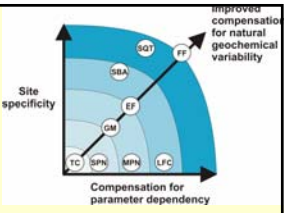
Johannesson et al. 2003

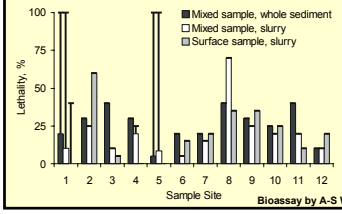
Hg- anrikningsfaktor vid 10-20 cm sedimentdjup



Bakgrund :		Anrikningsfaktor:	
Hg	0.02 ppm	Hg	41
Pb	17 ppm	Pb	2.5
Cu	15 ppm	Cu	2.7
Zn	83 ppm	Zn	1.9

- **Sediment bioassays (SBA)**
  - **Use natural sediments or pore water**
  - **Laboratory exposure with selected organisms**



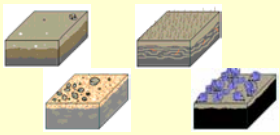


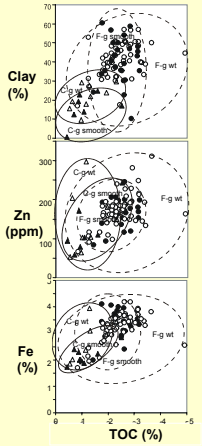
- **Sediment Quality Triad (SQT)**
  - **Combines geochemistry with toxicity and benthos (Chapman)**

Bioassay by A-S Wernersson

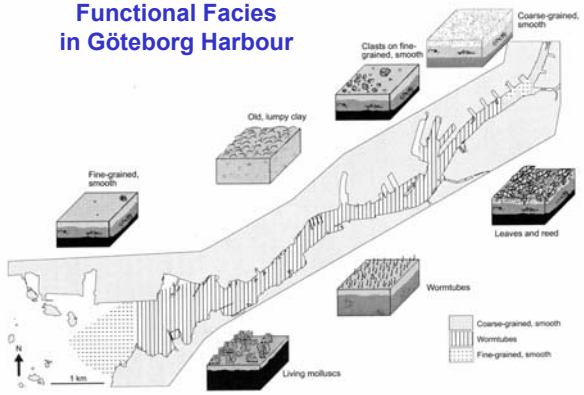
Functional Facies

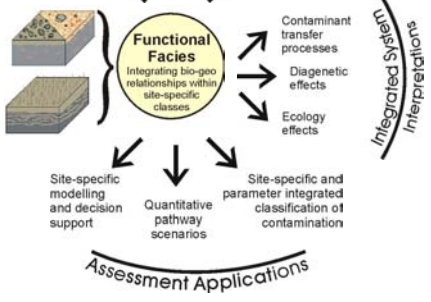
- Integrate physical, geochemical and biological relationships
- Guideline in sampling, analyses & interpretation



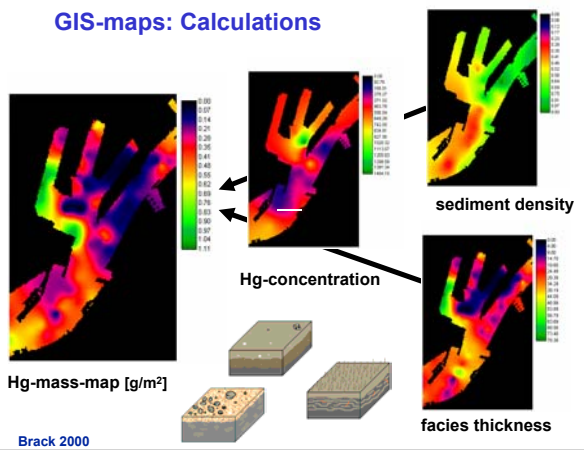


Functional Facies in Göteborg Harbour

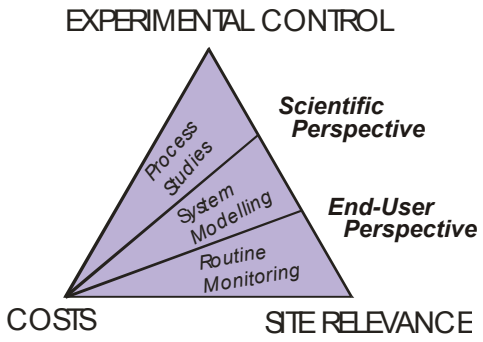




GIS-maps: Calculations



Brack 2000

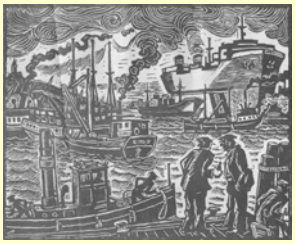


After Newson 1992

Conclusions

- **Standardisation should not be the same as generalisation.**
- **Site-specific evaluation usually requires considerable documentation in addition to total geochemistry due to sediment parameter dependencies.**
- **Bioassay results are also dependent on site-specific processes that can change sediment toxicity.**
- **Databases should be multi-functional, including as much primary data as possible for future flexibility.**
- **Functional facies (or similar classifications) can aid database structure and guide evaluation choices.**

Tack!



A "quiet" pilsner in Göteborg

- Need for comparability
- Risks (site specificity)
  - Resuse
- Process relationships
  - Classification needs
    - No new – numerous application of classificaiton in all disciplines