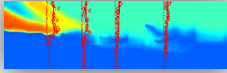


Monday 10th June 2019

| | |
|----------------------|---|
| 8.30 – 9.00 | Registration |
| 9.00 – 9.30 | Introduction <ul style="list-style-type: none">■ Course overview■ Introduction of presenters |
| 9.30 – 10.30 | Introduction to Solute Transport Modelling I <ul style="list-style-type: none">■ Advection■ Dispersion and diffusion |
| 10.30 – 11.00 | Tea/Coffee Break |
| 11.00 – 11.30 | Introduction to Solute Transport Modelling II <ul style="list-style-type: none">■ Advection dispersion model■ Dual domain mass transfer (DDMT) approach |
| 11.30 – 12.30 | Introduction to MT3DMS: Theoretical Background and Solution Techniques |
| 12.30 – 13.30 | Lunch Break |
| 13.30 – 14.15 | Introduction to MT3DMS: Theoretical Background and Solution Techniques |
| 14.15 – 15.00 | Introduction to the Graphical User Interface (GUI) ORTI3D + QGIS version |
| 15.00 – 15.30 | Tea/Coffee Break |
| 15.30 – 17.30 | MT3DMS Exercise 1: Conservative Transport Behaviour <ul style="list-style-type: none">■ Transient solute plume evolution■ Effect of dispersion |
| 17.30 – 18.30 | Icebreaker |



Tuesday 11th June 2019

8.30 – 10.00 Introduction to Geochemical Modelling

- General theory and principles
- Types of reactions and processes

10.00 – 10.30 Introduction to PHREEQC

- Background
- Structure
- Keywords

10.30 – 10.45 Tea/Coffee Break

10.45 – 12.30 PHREEQC Exercises

- Water compositions
- Mixing of aqueous solutions
- Mineral equilibria / saturation indices

12.30 – 13.30 Lunch Break

13.30 – 14.15 Introduction to PHT3D: Coupling of Transport and Chemistry

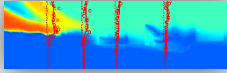
14.15 – 15.15 PHT3D Exercise 1: Mineral Buffering

- Background pH buffering by mineral reactions
- Spatial distribution of reactions

15.15 – 15.30 Tea/Coffee Break

15.30 – 17.30 PHT3D Exercise 2: Acid Mine Drainage

- Background
- Simulation of buffering reaction sequence



Wednesday 12th June 2019

8.30 – 9.30

Ion Exchange

- Principles
- Types of exchanger reactions
- Modelling of ion exchange reactions with PHREEQC

9.30 – 9.45

Tea/Coffee Break

9.45 – 11.00

PHT3D Exercise 3: Role of Cation Exchange on Ammonium Mobility in an Ammoniacal Liquor Plume

- Background - case study Rexco site (UK)
- Modelling ion exchange with PHT3D

11.00 – 12.30

Surface Complexation I

- Theoretical background
- Types of sorption and surface complexation models
- Illustrative lab- and field-scale model applications

12.30 – 13.30

Lunch Break

13.30 – 15.15

Surface Complexation II

- Modelling of surface complexation reactions with PHREEQC
- Relevance for assessing and quantifying metal(loid) and radionuclide mobility
- Development of site-specific surface complexation models

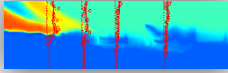
15.15 – 15.30

Tea/Coffee Break

16.30 – 17.30

PHREEQC/PHT3D Exercise 4: Reactive Transport of Arsenic

- Reductive dissolution of Fe-oxides
- Iron mineral transformations and their impact on As mobility
- Incorporation of lab-derived surface complexation reaction models



Thursday 13th June 2019

8.30 – 9.30 Modelling Kinetic Reactions

- Theoretical background
- Incorporation of rate expressions

9.30 – 9.45 Tea/Coffee Break

9.45 – 12.30 PHREEQC / PHT3D Exercise 5: Micropollutant Fate at a River Bank Filtration Site

- Modelling kinetic reactions at the batch scale
- Temporal and spatial variations in redox zonation at the groundwater/surface water exchange zone

12.30 – 13.30 Lunch Break

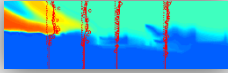
13.30 – 14.30 Biodegradation

- Microbial dynamics
- Role of natural organic matter
- Spatial and temporal evolution of redox zonation

14.30 – 15.00 Tea/Coffee Break

15.00 – 17.30 PHT3D Exercise 6: Basin Scale Nitrate Dynamics

- Modelling topography (QGIS interface)
- Nitrogen cycle and reactions
- Sources of nitrate



Friday 14th June 2019

08.30 – 10.00 Team Exercises

- Isotope fractionation during contaminant degradation
- Managed aquifer recharge
- Uranium transport: sorption with aqueous complexation effects
-
- Your own case study

10.00 – 10.30 Tea/Coffee Break

10.30 – 12.30 Team Exercises

12.30 – 13.30 Lunch Break

13.30 – 14.30 Team Exercises

14.30 – 15.00 Tea/Coffee Break

15.00 – 16.30 Team Exercises