Module: Environmental Modeling 2: Geochemical and Reactive Transport Modeling

Module number / code: MG 16

UNIVERSITÄT BONN

1. Content and qualification objectives

Contents

This module builds on MG15 Environmental Modeling I: Groundwater Modeling and introduces the basic principles and methodological approaches related to geochemical modeling and reactive transport modeling in groundwater systems. The particular emphasis is on model-based assessment of groundwater quality issues in the context of contaminant transport and remediation, biogeochemical processes, chemical weathering, and interpretation or prediction of subsurface system behavior. As main teaching tools, the course uses PHREEQC for geochemical modeling and PHT3D for reactive transport modeling, whereas other in-house codes and scripts will also be used. The key topics that are covered:

- Fundamentals of various geochemical processes and the associated modeling approaches
- Basic mathematical and numerical concepts and methodologies in conservative and reactive transport modeling
- Step-by-step modeling workflows for conceptualization of reactive processes and setting up geochemical and reactive transport models
- Thermodynamic databases and postprocessing of model results

The module consists of weekly lectures, hands-on computer exercises, and guided self-learning tutorials. In addition to the regular coursework, students will complete a final group project, which includes a written report and an in-class presentation.

Qualification objectives

Upon successful completion, students will be able to:

- Identify the relevant biogeochemical processes to develop a conceptual model of a reactive system
- Translate geochemical process understanding and the conceptual model into a numerical reactive transport model
- Effectively navigate tools like PHREEQC and PHT3D to simulate a well-developed conceptual model
- Systematically interpret and visualize model output data

2. Teaching and learning methods

LV-Art	Theme	Language of instruction	Group size	SWS	Workload [h]
V	Basics of geochemical and reactive transport modeling	en	20	2	120
Ü	Basics of geochemical and reactive transport modeling	en	20	2	60

3. Requirements for participation in the module

Causing obligation to prove	-
Recommended	MG15, Basic knowledge of hydrogeology or hydrogeochemistry (e.g., BP11 from BSc Geosciences), familiarity with other software or visualization tools (e.g., MG14).

4. Usability of the module

Study program/sub-study program	Compulsory/elective	Semester
M.Sc. Geology	Elective	1st, 2nd or 3rd semester
M.Sc. Geochemie/Petrologie	Elective	1st, 2nd or 3rd semester

5. Requirements for the award of credit points according to the ECTS — 6 ECTS credits

Academic achievement(s)	Successful completion of the exercises	6
Examinations and examination language	Project (en)	

7. Frequency	8. Workload	9. Duration

As of: 19.09.2019

Winter semester ☐ Summer semester ☒	Winter and summer semesters ☐	180 hours	1 semester
Module organization			
Teacher	Muniruzzaman		
Module coordinator	Prof. Dr. Muhammad Muniruzzaman		
Offering organizational unit	Institute for Geosciences		
Miscellaneous			
Literature	Will be presented at the beginning of the event.		