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center for earth sciences
geodynamik&sedimentologie - lithosphärenforschung - umweltgeowissenschaftler

DMG - Short Course on

”DIFFUSION IN GEOLOGICAL MATERIALS”

Date: September 10th to September 14th 2012
Location: University Centre Althanstrasse, 1090 Wien
Organizer: R. Abart, University of Vienna
e-mail: rainer.abart@univie.ac.at
Web: <http://lithosphere.univie.ac.at/petrology/news/>

ORGANIZATION

This five days short course is organized within the framework of DMG Doktorandenkurse of the German Mineralogical Society. It is meant to give a broad perspective on diffusion and diffusion-related processes in minerals, rocks and their synthetic analogues. It primarily addresses graduate students and researchers. Undergrads, who have a particular interest in diffusion, are very welcome as well. The course will be comprised of a series of lectures, practical exercises and informal discussions. To account for the complexity of the subject, students will be encouraged to dwell on specific problems presented in an informal manner. Lectures will be given by researchers from different fields of expertise.

Lectures and practical exercises will be held at University Centre Althanstrasse (UZA II), Althanstrasse 14, A-1040 Wien. The course will start Monday September 10th at 10:00 am, and it will end on Friday September 13rd at 15:00 pm. A detailed program is given below.

We envisage a maximum of 30 participants. Successful participation will be acknowledged with three European Credit Transfer System points.

SCIENTIFIC PROGRAM

Based on major topical fields the course will be divided into three parts

Part A: *Diffusion – basic concepts*

To begin with, a broad view of diffusion processes will be given. The relations between microscopic/atomistic and macroscopic/ phenomenological concepts for the description of diffusion processes will be addressed. The mathematical concepts will be introduced that serve to formally describe diffusion processes. Mathematically closed form (analytical) solutions of the diffusion equation will be obtained, and numerical techniques to model diffusion controlled processes will be presented. Numerical schemes based on the Monte Carlo approach and on the finite difference method will be developed during PC exercises using MATLAB.

Part B: *The microphysics of diffusion in geological materials*

The mechanisms of diffusion in single crystals, in polycrystals, and in polyphase materials will be addressed. An atomistic view on diffusion will be presented. We will further address defect thermodynamics and the experimental approach towards the quantification of diffusion in single crystals. Diffusion coefficients will be extracted from experimental data during PC exercises. We will deal with the implications of stoichiometric constraints on multicomponent diffusion in minerals. Finally we will assess grain- and inter-phase boundaries as distinctive features of polycrystals and multiphase material and investigate their potential as pathways for fast diffusion.

Part C: *Diffusion in geological processes*

In this part we assess the role of diffusion in a variety of geological processes. We will treat the concept of closing temperatures in the context of radiometric dating and stable isotope thermometry. We will discuss the concept of geo-speedometry based on diffusion limited cation exchange. Case studies on natural samples will be presented that shed light on the role of grain boundaries in diffusion and the implications for the chemical zoning patterns of minerals will be addressed. The links between diffusion and stress will be addressed and the role of diffusion during rock deformation will be investigated. Finally the application of a generalized diffusion theory (non-linear diffusion) to phenomena of phase separation will be discussed.

AIMS AND OBJECTIVES

The aim of this course is to build a sound understanding of diffusion controlled processes and to provide the participants with a basic competence in analyzing diffusion problems. The participants should learn to identify the features which are diagnostic for distinct processes. They will acquire the ability to develop valid physical models that describe the observed phenomena adequately. It is beyond the scope of this course to educate experts in the field, but we hope that crucial information will be transported to such an extent that participants can critically read and evaluate literature on diffusion problems and can cope with diffusion related problems independently.

COURSE FEE

We will charge a course fee of 30 € this will include a hard copy of the lecture notes and coffee and soft drinks during breaks. DMG Student members who are not based in Vienna will be supported by DMG with up to 50 €

REGISTRATION

Registration should be made by sending the attached registration form to Mrs. A.K. Schäffer by e-mail to anne-kathrin.schaeffer@univie.ac.at or by fax to 0043-1-4277-9534. Registration should be handed in by June. 30th:

LECTURE PROGRAM (provisional)

Monday 10.9.2012

Part A: Diffusion – basic concepts

Lecture 10.00 -10.45 R. Abart (UNI Wien)
A general view of diffusion

Lecture 11.15 - 12.15 R. Abart (UNI Wien)
Mathematical treatment of diffusion problems

Lunchbreak

Lecture 13.45-14.30 E. Petrishcheva (UNI Wien)
Diffusion modeling with MATLAB

Exercise 15.00–17.00 E. Petrishcheva (UNI Wien)
1D analytical solutions and Monte Carlo simulation for diffusion problems

Tuesday 11.9.2012

Part B: The microphysics of diffusion in geological materials

Lecture : 9.15- 10.30 R. Abart (UNI Wien)
Defects and diffusion, Basic relationships between transport properties

Lecture : 11.00 - 12.30 S. Jahn (GFZ Potsdam)
An atomistic view of diffusion in minerals and melts

Lunchbreak

Exercise 13.30-15.00 S. Jahn (GFZ Potsdam)
Atomistic modelling of self diffusion in fluids

Exercise 15.30-17.00 E. Petrishcheva (UNI Wien)
Fitting of diffusion profiles from experiment and nature using analytical solutions
Finite difference scheme for 1 D diffusion I

Wednesday 12.9.2012

Lecture 9.15- 10.45 R. Abart (UNI Wien)
Interdiffusion

Lecture 11.15-12.45 R. Abart (UNI Wien)
Multicomponent diffusion

Lunchbreak

Lecture : 13.30-15.00 R. Milke (FU Berlin)
Diffusion in single crystals – the experimental approach

Exercise 15.30-17.00 E. Petrishcheva (UNI Wien)
Finite difference scheme for 1 D diffusion II

Thursday 13.9.2012

Part C: Diffusion in geological processes

Lecture 7: 9.15 – 10.30 R. Abart (UNI Wien)
Closing temperature and geospeedometry

Lecture 8: 11.00 – 12.30 R. Milke (FU-Berlin)
The role of grain boundaries and diffusion in polycrystals

Lunchbreak

Lecture 13.30 – 14.15 E. Petrishcheva (UNI Wien)
Mathematical models for grain-boundary diffusion

Discussion 14.30 – 17.00
Presentation and discussion of participants projects

Friday 14.9.2012

Lecture 9.15-10.45 G. Dresen (GFZ-Potsdam – Uni Potsdam)
Diffusion and rock deformation

Lecture 11.00-12.30 R. Abart (UNI Wien)
Diffusion induced stress

Lunch break

Lecture 13.30-15.00 E. Petrishcheva (UNI Wien)
Non-linear diffusion and spinodal decomposition

Farewell party

Short Course on
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10. to 14. September 2012

REGISTRATION FORM

Registration Deadline: 30.6.2012

Name:
Affiliation:
Address:
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Telephone:
FAX:
E-Mail:

- I pertain to the following group
- undergraduate student
 - graduate student
 - postdoc
 - senior researcher
 - other, please specify

Please send to: **Department of Lithospheric Research**
 A.K. Schäffer
 Althanstrasse 14
 A-1090 Wien

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