

3D Digital Rocks (C003727)

Course size (nominal values; actual values may depend on programme)

Credits	3.0	Study time	88 h	Contact hrs	37.0 h
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Course offerings and teaching methods in academic year 2017-2018

A (semester 2)	English	practicum	12.5 h
		lecture	17.5 h

Lecturers in academic year 2017-2018

Bultreys, Tom	WE13	lecturer-in-charge
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Offered in the following programmes in 2017-2018

	crdts	offering
Master of Science in Geology	3	A
Exchange programme in Geology (master's level)	3	A

Teaching languages

English

Keywords

3D data, process-based modelling, pore network modelling, fluid flow behaviour on the pore scale, simulations, material and dynamic properties, laboratory validation techniques

Position of the course

Understanding how fluids occupy and migrate through porous media is of great importance in many geological fields like petroleum engineering, hydrology and environmental engineering. Additionally, the search to better understand the inner workings of rocks that challenge traditional laboratory testing has led to a new approach known as digital rock physics. Based on 3D images (deriving from X-ray CT data, FIB/SEM data, synthetic 3D images of rocks based on information obtained from microscopical 2D techniques or 3D imaged rocks based on simulation of the sedimentation, compaction and diagenesis) can be used as an input for material and dynamical properties (including fluid flow behavior). Using pore network modelling or Lattice Boltzmann modelling, fluid flow behaviour can be modelled.

Contents

- Introduction to digital rocks
- Creating virtual rock models based on 2D images
- Creating virtual rock models based on mimicking the formation process of sedimentary rocks
- Creating a 3D pore network
- Introduction towards the relation between sample size versus resolution versus scale issues
- Analysing 3D pore networks
- Simulation of material and dynamic properties
- Overview of validation techniques

Initial competences

Bachelor geology: the student has a basic knowledge in geology, sedimentology, mineralogy, petrology and optical mineralogy & petrography + attended the course "Rock imaging techniques"

Final competences

- 1 The student has acquired the following competences: competences in geology and related sciences, general scientific competences, competences in collaboration and communication, social competences and professional competences.
- 2 The student has gained a general understanding of the concepts and processes which are occurring, when creating 3D pore models.
- 3 The student is able to develop a research plan for the fluid flow behaviour of porous rocks.
- 4 The student is able to report critically the results of the simulations and validation data from laboratory into a scientific report.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, integration seminar, practicum

Learning materials and price

Powerpoint, documentation and relevant study material on minerva + references to text books and literature.

References

Russ, J.C., 2011. The Image Processing Handbook, Sixth Edition
Brandon D., Kaplan, W., 2008. Microstructural Characterization of Materials

Course content-related study coaching

Theory: interaction during lectures. Possibility to ask lecturer questions in person and by e-mail
Practice and seminars: guidance and feed-back during the practice and seminars.
Interactive support by Minerva (emails)
Personal contact after appointment

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination with open questions

Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions

Examination methods in case of permanent evaluation

Assignment, job performance assessment

Possibilities of retake in case of permanent evaluation

not applicable

Calculation of the examination mark

Written examination with open questions: 75%
Assignment + evaluation during the year: 25%