GEODYNAMICS COURSE DESCRIPTION

This course is worth 7.5 ECTS credits at the Master's level and will be in English. The course runs through period 4 of the 2016 autumn term.

2. INSTRUCTOR INFORMATION

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3. PRE-REQUISITES

First year ground course, Geology I (Petrology), Geology II (Petrogenesis & Tectonics); or instructor's consent.

4. COURSE CONTENTS

This course introduces advanced topics relevant to geodynamics such as the evolution of the mantle and lithosphere, its geochemical evolution, crustal growth processes, and the structure and mechanics of collisional orogens. The course introduces a wide range of concepts necessary for integrating mantle and lithospheric processes into a plate tectonic framework, such as the i) theoretical basis for conceptualizing mantle flow and circulation; ii) theoretical basis for understanding heat flow in the crust; iii) exhumation mechanisms of deep-seated crust related to orogeny; and iv) historical development of paired crust-mantle geochemical evolution. The course also provides an introduction to the use and application of software tools needed for the numerical and analogue modelling of these parameters.

5. COURSE FORMAT

The course is equivalent to a full-time study load for a five week period. Teaching is conducted through lectures, laboratories, seminars, and via a field component. Weekly seminars will be based on reading and discussion of articles, as well as presentation of written and oral summaries.

6. LEARNING OUTCOMES

After completion of this course, students should be able to:

- Apply and critically evaluate the key physical theories used to constrain the properties of the mantle and lithosphere and their mechanical behavior;
- Use Rayleigh's equation to model different mantle flow regimes in a plate-tectonic framework;
- Outline the thermodynamical constraints associated with heat-flow in the Earth's crust, and apply numerical modeling to constrain realistic thermal evolutionary scenarios;
- Describe and interpret the geochemical evolution of the Earth's mantle and lithosphere as a paired system within the plate-tectonic paradigm.
- Construct and numerically analyze realistic plate tectonic scenarios through analogue modelling.

7. REQUIRED TEXT

The following articles are required reading for each weekly seminar. Please do the reading prior to the week's lecture. You will find these articles on the course Mondo site about 1 week before class begins.

Week 1. Furlong & Chapman, 2013. Heat flow, heat generation, and the thermal state of the lithosphere. Annual Reviews of Earth & Planetary Sciences 41, 385-410.

Week 2. Poblet & Lislel, 2012. Kinematic evolution and structural styles of fold-and-thrust belts. Geological Society, London, Special Publications 349, 1-24.

Week 3. Ring et al., 1999. Exhumation processes. In: Ring, U., Brandon, M. T., Lister, G., Willetts. S. D. (eds) Exhumation Processes: Normal Faulting, Ductile Flow and Erosion. Geological Society, London, Special Publications, 154, 1-27.

Week 4. Ring,U., 2010. The Hellenic Subduction System: High-Pressure Metamorphism, Exhumation, Normal Faulting, and Large-Scale Extension. Annual Reviews of Earth & Planetary Sciences 38, 45-76.

8. COURSE ASSESSMENT AND EXAMINATION

The course is designed to provide the theory which enables numerical modelling of specific aspects of Earth crust and lithosphere evolution. The course therefore requires:

- Reading of course literature. This includes a topical manuscript(s) per week and providing a written synopsis (1 A4 page) per article.
- Weekly numerical or analogue modelling assignment. These laboratories are linked to the weekly lecture and reading assignments, and include using specific software to numerically model or analogue model geologically plausible scenarios. Each modelling assignment includes delivery of your conclusions in a written report.
- Student-lead seminar. Each student will (co)lead the weekly discussion of the seminar topic based on the required reading. Success leading a seminar includes providing a short overview of the paper, summarizing its major points, and highlighting its strengths/weaknesses, and identifying points which require further clarification during seminar discussion.
- Seminar participation. Participation in seminar discussion is required - a demonstrated understanding of the discussion topic via dialogue (critical assessment, query, clarification, etc.) will be used to assess your participation.

There is no final exam for this course. The final grade will be based on the following:

Seminar presentations 20% - an oral summary of the assigned article will be assessed with group and instructor feedback. A point system will be used.

Seminars 35% - consisting equally of i) a written summary of each article (1 A4 page maximum) due at the beginning of each seminar, ii) demonstrated knowledge and comprehension of reading assignments via active participation in discussion and direct queries, and iii) leading the seminar demonstrating preparation, e.g.- pre-defined questions/points of discussion. A point system will be used.

Laboratories 45% - reports of the numerical or analogue modelling laboratories will be graded with points and should demonstrate your understanding of the exercise, identify the important variables, and include a discussion of its limitations and advantages

The bologna grading scheme will be applied:

A (90-100%) = Excellent. To achieve this grade the student should be able to accurately account for course content, understand the theory behind, and apply, numerical and analogue modeling techniques related to the subject matter, and critically assess the outcome of such modeling. The student should be able to use the course material to define realistic testable hypotheses, provide numerically rigorous, structured analyses of such hypotheses, and to provide an insightful summary with well-documented supporting evidence.

B (80-89%) = Very good. To achieve this grade the student should be able to accurately account for course content, understand the theory behind, and apply, numerical and analogue modeling techniques related to the subject matter, and critically assess the outcome of such modeling. The student should be able to use the course material to provide numerically rigorous, structured analyses of given hypotheses, and to provide well-documented supporting evidence.

C(70-79%) = Good. To achieve this grade the student should be able to accurately account for course content, understand the theory behind, and apply, numerical and analogue modeling techniques related to the subject matter, and critically assess some of the outcomes of such modeling. The student should be able to use the course material to provide numerical analyses of a given hypothesis with documented supporting evidence.

D (60-69%) = Satisfactory. To achieve this grade the student should be able to accurately account for course content, understand the theory behind, and apply, numerical and analogue modeling techniques related to the subject matter. The student should be able to use the course material to provide a numerical analyses of a given hypothesis with documented supporting evidence.

E (50-59%) = Sufficient. To achieve this grade the student should be able to accurately account for course content. The student should be able to use the course material to provide a numerical analyses of a given hypothesis with supporting evidence.

Fx (40-49%) = Insufficient. To achieve this grade the student should be able to accurately account for course content. This grade is given when there is a clear lack in understanding the theory behind, and application of, numerical and analogue modeling techniques related to understanding lithosphere evolution. The student has not demonstrated the ability to apply these modeling techniques to address a specific hypothesis, to assess the outcome of such a model, or to provide the supporting evidence resulting from such a model.

F (<40%) = Fail. This grade is given when the student cannot account for course content and when the work provides an unfocused, limited, and irrelevant understanding of numerical and analogue modeling as it relates to mantle and lithospheric processes.

E is needed to pass the course. Fx indicates that the student will be offered the opportunity to upgrade his/her exam in order to achieve at least grade E. Re-examination will occur within 2 months of the exam or when the course is next offered. A student with E is not entitled to another examination to raise his/her grade. Students who receive grade Fx or F on exams twice from the same examiner can request to be evaluated by another examiner. Such a request should be sent to the Director of Studies.