PhD position in Rock Deformation - Structure Analysis

The Rock Deformation Group (Geological Institute, Departement of Geosciences, Basel University, Switzerland) has a grant for a PhD position for one of the following projects:

- Single and bicrystal deformation of quartz
- Deformation of quartz in polymineralic rocks

One of these projects will be funded by the Swiss National Science Foundation; the choice of project will depend on the strength of the applicants.

Duration:
April 2006 to April 2009, with a possible extension of 1 year.

Principal investigators: Prof. Dr. Renée Heilbronner, Basel University
Co-Investigators: PD Dr. Holger Stünitz, Basel University, and PD Dr. Karsten Kunze, ETH Zürich.
Collaboration: Prof. Jan Tullis of Brown University, U.S.A. and Dr. John FitzGerald, ANU, Australia.

Additional information:
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Applications (including CV, research statement, references):
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(We do not accept e-mail applications)

Description:

Single and bicrystal deformation of quartz

This PhD project is in the field of experimental rock deformation and involves two different types of experiments: (a) Single crystal experiments on natural quartz - to study the temperature effect on the activation of different slip systems in quartz. (b) Bi-crystal experiments using two different crystal orientations - to study aspects of recovery and recrystallization and the CPO development. All experiments will be carried out in our Griggs-type solid medium apparatus.

The microstructures and the texture of the deformed samples will be studied in detail. The misorientation analysis of recovery and recrystallization of all samples will be performed by computer-integrated-polarization (CIP) microscopy. The method allows for a fast data acquisition of orientation imagining and shape- and grain- (crystallographic domain) size analysis. Additional to the CIP-analysis, other crystallographic directions than the <c>-axis and their misorientation due to deformation will be determined by electron backscattered diffraction (EBSD) in the SEM.

The aim of the study is to better understand the fundamental processes active in quartz deformation and the importance of these processes for dislocation glide and recovery and recrystallization. The knowledge of these processes is the prerequisite for accurate physical models of deformation, such as those existing for olivine. We also want to obtain quantitative data on quartz slip system activation and recrystallization and their dependence on temperature and/or H_2O content.

We are looking for a student with a keen interest in the physical processes that operate during mineral and rock deformation. Applicants should have a talent for experimental work and a good background in structural geology.

<u>Deformation of quartz in polymineralic rocks</u>

This PhD project is addressed to naturally deformed granitic rocks in comparison with synthetically produced and experimentally deformed quartz-containing polyphase rocks.

The project includes mapping and sampling of naturally deformed tonalites and granitoids in the Bergell and Adamello intrusions along different temperature and strain profiles. The quartz content of these rocks is only on the order of 20%, however, its rheological behaviour is important and its microstructure very varied. Using a combination of SEM backscatter imaging (to separate the phases) and CIP analysis (masking out all of the non-quartz phases) and EBSD, the microstructure and texture of the quartz occurring in polyphase rocks will be characterized and compared to the microstructure and texture of pure quartzites.

The natural samples are then to be compared with exerimentally deformed samples of polyphase material (collaboration with Jan Tullis, Brown University) using the same analytical methods on the experimental material as on the natural one. Depending on the range of microstructures found, additional field areas will be investigated.

The aim of this study is to enhance our ability to interprete the deformation conditions of naturally deformed granitic rocks. We hope that the deformed quartz in granitoids may serve as a key mineral, as it has done in the case of quartz veins and fibres in previous studies. We therefore expect that through detailed analysis of deformed quartz in polyphase materials we may derive the physical conditions of the rock at the time of deformation.

Also, we expect that we may contribute to our understanding of changing (inverted) viscosity contrasts of minerals in polymineralic rocks as a function of increasing temperature, decreasing strain rate or flow stress. This would be important for the extrapolation of the rheology of polyphase materials from experiments to nature.

We are looking for a student who is interested in working both in the field and in front of the computer screen. Successful applicants should have good mapping skills, a strong background in structural geology, and a talent for digital image processing.