MICROSTRUCTURAL MODELLING WITH ELLE - INTRODUCTION AND APPLICATIONS

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The numerical code ELLE is designed to model a variety of tectonic and metamorphic processes that act on a microstructure. The open-source code has a modular design, which allows developers to add individual modules. By using a flexible data description, a growing number of processes are incorporated. The main advantage of ELLE is that multiple processes can operate in a single simulation. This way their competition and mutual influences can be modelled. The ELLE code has so far found a range of applications, such as simulations of grain growth with and without the presence of an interstitial melt, deformation of composites to very high strains, Fe-Mg exchange between garnet and biotite, recrystallisation of polar ice, stylolite formation, etc.

In the first part of the lecture, the need for modelling of coupled processes, and hence a software platform like ELLE is discussed, followed by an introduction into the ELLE code itself. An overview of the applications of the ELLE code will be given. The second part of the lecture will be dedicated to two examples of the application of ELLE:
(1) Simulation of grain growth in partially molten grain aggregates. ELLE simulations show how certain disequilibrium structures may form, which have also been observed in experiments. ELLE simulations also help to constrain regimes where either surface energy or deformation control the shape and distribution of melt pockets.
(2) Simulation of the deformation of two-phase aggregates to very high strains. The Elle code makes allows for deformation to strains of gamma 5 or more. This makes it possible to study the microstructural development in mylonites. The simulations show how different types of strain localisation develop and may help to define structures that indicate the rheology of the deforming material.

During the practical, students will learn how to operate the ELLE code, using example experiments from the book Microdynamics Simulation (Bons et al. Eds. 2008. Lecture Notes in Earth Sciences 106, Springer).