Geophysical Research Abstracts
Vol. 14, EGU2012-4376, 2012
EGU General Assembly 2012

The role of second phases for controlling microstructural evolution in polymineralic rocks

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Microstructures in nature and experiment are important to unravel a rock's history as well as the associated mechanisms and physico-chemical conditions. It turned out in the past years, that particularly polymineralic rocks have a great potential to preserve early stages of an evolution sequence, while they may have been overprinted in the case of monomineralic aggregates. This difference results form the effect of minor phases, so-called second phases, on the mobility of the grain boundaries of the dominating matrix phase. In this way, surface energy and differences in internally stored energy, as major driving forces of grain boundaries of the matrix phase, are counteracted by dragging and pinning forces imposed by the second-phases. Consequently, the amount, size and dispersion of the second-phases combined with the ability to undergo mineral reactions are the key parameters for the microstructural control. In the context of this contribution, we will demonstrate how increasing amounts of second phases subsequently take over microstructural control and what their effect during static conditions, regional metamorphism or viscous shearing are. In this sense, the study of second-phase controlled microstructures may provide an important new tool to unravel complex multistage deformation histories in different geodynamic settings.