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Numerical study on the rheological properties of the multi-phase rocks under lower crust conditions

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Studying the rheological properties of the lower crust is extremely important to understand a series of issues, such as the mechanical behavior of crust, earthquake generating, the properties of crust-mantle transition and the tectonic motion. The essence of the lower crust rheological properties is the rheological behavior of its composed multi-mineral rocks. However, previous studies on rheological properties of lower crust mainly focused on its mono-mineral rock. Due to the complex rheological behavior of multi-phase rocks, it is very difficult to study their properties by rock deformation or creep experiment at lower crust conditions and their results are still limited and in controversy. Therefore, numerical simulation becomes a very useful way to further address those problems. In order to understand the development of stress and strain within the grains of different phases, in this simulating study, the distributions of both stress and strain within the grains are focused on. The typical minerals (pyroxene, feldspar) of the lower crust were selected to establish multi-mineral rock models. The rheological equations of mono-mineral both from experiments and dislocation creep theory were considered. The primary simulating rheological test for two-phase rock was based on a two-dimensional regular shape (square) grain model. Our results showed that the heterogeneity within grains is rather complexity. The stress accumulation in harder phase mainly occurs near the grain boundaries. In the central part of the harder phase, the stress decreased in a relatively faster speed (with the creep time increasing).Furthermore, unstable creep may occur due to the unstable variations of stress. As a contrast, within the grains of the strain accumulating softer phase, the stress in the central part seemed to try to keep its initial level. However, at the parts near the grain boundaries, the stresses decrease relatively faster than the central part. The results, even those may be affected by our assigned grain models, indicated a very complex creep way of multi-phase rocks. More models would be tested in our near future studies.