Rim Growth Experiments in the System SiO2 - MgO - Al2O3 in a Creep Apparatus

Götze, Lutz C.[1] Rybacki, Erik[2] Abart, Rainer[1] Georg, Dresen[2]
[1]Institut für Geologische Wissenschaften, Freie Universität Berlin [2]GeoForschungsZentrum Potsdam

To investigate the diffusion of Si, Mg and Al in the system SiO_2 - MgO - Al_2O_3 we performed diffusion-controlled rim growth experiments in a uniaxial creep apparatus under controlled thermodynamic conditions.
As starting materials we used polished rectangular samples of 3 * 3 * 3 mm in size, prepared from single crystals of both synthetic and natural quartz and forsterite, synthetic periclase, and synthetic polycrystalline corundum. Experimental conditions were 1150 to 1350°C temperature and 0,1 to 66 MPa axial stress for a duration of one day to one week, resulting in rim thicknesses from 1 to 100 μm. The new phases consist of enstatite grown between quartz and forsterite, an enstatite-forsterite double rim between quartz and periclase, and spinel between periclase and corundum. At similar conditions the enstatite rim thickness between San Carlos olivine and novaculite was remarkably larger than between synthetic forsterite and synthetic quartz (12 to 1 μm), possibly related to impurities, primarily Fe and Ca, and a likely increased atomic disorder of the natural samples. In comparison, the biggest rims formed between periclase and corundum are up to 100 μm thick, whereas the thickness of the double rim between periclase and corundum was 16 μm at the same run conditions (1350°C for one week). Preliminary results indicate a minor influence of stress on the growth rate in the investigated range. But, differential stress may affect the crystallographic preferred orientations of the newly formed crystals that will be investigated with electron back scatter diffraction and transmission electron microscopy in future.

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