# Temporal change of zonal sequence in a reaction rim in the system quartz-dolomite-$H_2O$

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Mass transfer generally plays an important role in rock-forming processes and intergranular diffusion is especially important for reaction textures in rocks. One typical texture in rocks formed by intergranular diffusion is a reaction rim. Studies about a reaction rim were conducted theoretically by Joesten(1978, 1991), Nishiyama(1983), Johnson & Carlson(1991), Fukuyama *et al*.(2006), etc, and experimentally by Brady(1983), Luttge & Metz(1991), Milke & Heinrich(2002), Tominaga(2004MS), Nishiyama *et al*.(2007), etc. By these studies, mechanism of mass transfer in metamorphic rock-forming process and nature of metamorphic fluid involved in it have been understood. However, little is known about temporal evolution of zonal sequence in the reaction rim. This study conducted the reaction experiments in the system quartz-dolomite-$H_2O$ to clarify time dependence of zonal sequence in a reaction rim between dolomite and quartz. Two dolomite single crystals in quartz powder with pure water and a quartz single crystal in dolomite powder with pure water, both sealed separately in gold capsules were prepared as starting materials. Runs at 800 degree C, 100 MPa with internally heated gas vessels were conducted for 48 hours, 109 hours, 357 hours. These three runs gave the following results. 1) The zonal sequence in the reaction rims Dol / Cal + Dol / Fo + Cal / Fo / Mon / Di / Wo / Qtz was mainly observed in the runs for all duration although enstatite was locally formed only in the 48 hours run and Di + Cal bi-mineralic zone was observed in the 109 hours and 357 hours runs. 2) Reaction rims were formed only on dolomite surface and not on quartz surface. In these runs, there was little remarkable change in zonal sequence throughout runs from 48 hours to 357 hours. However, we observed that the kind of zone growing both sides changes depending on run duration. Diopside zone was the one in the 48 hours run and monticellite zone was in the 109 hours run and forsterite or Fo + Cal zone was in the 357 hours run. A steady diffusion model was applied to the representative zonal sequence to discuss its stability and growth mode. The model shows that Cal + Dol zone is unstable with respect to diffusion (Nishiyama *et al*., 2007). Application of the model to the zonal sequence Dol / Fo + Cal / Mon / Di / Wo / Qtz shows that diopside zone, monticellite zone, Fo + Cal zone in this order grow both sides as phenomenological coefficients ratios ($L_{SiSi}$ / $L_{MgMg}$ & $L_{SiSi}$ / $L_{CaCa}$ : L-ratios) decreases. This modeling result is consistent with the experiment that width of diopside zone, monticellite zone, and forsterite(or Fo + Cal) zone in this order were the largest as the duration increases. Therefore, the temporal change of growth mode of the zonal sequence in this study occurred due to decrease of L-ratios. Change of L-ratios was probably caused by void formation that gradually developed between Cal + Dol and Fo + Cal zones as time progressed. This void formation is the result of volume loss due to consumption of dolomite zone and production of Fo + Cal zone. Moreover, this phenomenon also occurred at the boundary between wollastonite zone and quartz and caused apparent non-reactivity on quartz surface.