Rapid subsolidus reaction under the presence of trace H_2O inferred from jadeite replacement with spodumene

NAOKO TAKAHASHI[1,2], TAKAYUKI NAKATANI[2],
TATSUKI TSUJIMORI[1,2] AND MICHIHIKO NAKAMURA[2]

[1] CNEAS, Tohoku Univ., Aoba, Sendai 980-8576, Japan (*correspondence: naoko.takahashi.t1@dc.tohoku.ac.jp, tatsukix@tohoku.ac.jp)
[2] Graduate School of Science, Tohoku Univ., Aoba, Sendai, 980-8578, Japan (takayuki.nakatani.b6@tohoku.ac.jp, michihiko.nakamura.e8@tohoku.ac.jp)

Recent studies on metamorphic rocks and some experimental systems have revealed that chemical reactions at subsolidus temperature may be enhanced in the presence of free H_2O [1, 2]. In natural settings of crustal rocks, however, it is not clear how much free fluid exists and thus to what extent subsolidus reactions are accelerated by the presence of fluid. In order to investigate the effect of trace amount of H_2O on subsolidus reaction kinetics, we experimentally investigated the equilibration mechanism of jadeite ($NaAlSi_2O_6$: Jd) and spodumene ($LiAlSi_2O_6$: Spd). Gem quality Jd crystal from the New Idria serpentinite body was used. The Jd was placed in natural Spd powder from Madagascar without adding water and heated at 700℃ for 72 hours and 800℃ for 48 hours at 2GPa using a piston-cylinder apparatus. Polished cross sections of the run products were investigated with a SEM-EDS. At the reaction interface, we found a layer ~25 μm and ~200 μm in width at 700℃ and 800℃, respectively. This layer is porous and has intermediate compositions between Jd and Spd (~$Jd_{40}Spd_{60}$–$Jd_{20}Spd_{80}$ and ~$Jd_{60}Spd_{40}$–$Jd_{10}Spd_{90}$ at 700 ℃ and 800 ℃, respectively), instead of a gradual compositional profile. This is interpreted as a result of dissolution and precipitation reaction rather than diffusive chemical exchange, since fluid inclusions are observed in the starting crystals. The Jd crystals contain trace hydrous components of up to 1000 μg/g as hydroxyl and fluid inclusions [3]. The existence of porous reaction zone and small polyhedral shaped pores in the reaction front also supports this interpretation. The present results imply that even trace amount of water works as a solvent and enhances rapid mineral replacement reaction.

[1] Plümper and Putnis (2009). *Journal of Petrology* **50**(5), 967-987. [2] Hövelmann *et al.* (2010). *Contributions to Mineralogy and Petrology* **159**(1), 43-59. [3] Su *et al.* (2004). *Earth and Planetary Science Letters* **222**(1), 85-100.