OH defects in quartz in Li-bearing systems at high pressure

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Quartz is the second most abundant mineral in the Earth's crust and occurs as a main phase in igneous, metamorphic and sedimentary rocks. It has been known since long that quartz can incorporate several trace elements such as H, Li, Na, K, B, Al, P, and Fe, depending on the formation conditions at different geological environments. In particular, quartz that formed in water-bearing systems can incorporate hydrogen as OH-point defects. Recent experiments on hydrogen incorporation in quartz exhibit a pressure dependent OH incorporation behaviour that may be used as information source of the formation conditions. In this work quartz crystals were grown from a spodumene-granite starting material (i.e., a Li-rich system) with 13-26 wt% water at 900-1050°C and 5-20 kbar in a piston cylinder apparatus. The quenched run products were analyzed by IR spectroscopy and electron microprobe and consisted of a free aqueous fluid, quartz, and amorphous quench material. On a first glance, it was noticed that the size of the quartz crystals tends to increase with pressures, producing non-elongated crystals of 100μm size at 5 kbar to progressively larger and more elongated crystals at 10 kbar, and finally euhedral mm-sized crystals at ≥15 kbar. BSE images of the run products showed quartz crystals included in water saturated melt and confirmed that the grain size of quartz increases with pressures. Preliminary results for Al-concentration in quartz cluster around 200-300 wt ppm for most selected crystals, but may reach values up to 1600 wt ppm. IR absorption spectra revealed absorption features that can be assigned in particular to AlOH- (3310, 3378 and 3430 cm^{-1}), LiOH. (3483 cm^{-1}) and (4H)Si-defects (3583 cm^{-1}). A negative correlation between LiOH-defects and pressures was observed between 5 and 15 kbar, where LiOH basically dropped to zero. Future plans include more electron microprobe work and LA-ICP-MS analyses in order to determine the concentration of trace elements in quartz and evaluate the coupling of hydrogen to Li and other trace elements such as Al, P, and K.