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The structural water in hydrothermally synthesized monazite

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Introduction: The U-Th-Pb dating of accessary minerals such as zircon and monazite is widely applied for various types of rocks [1,2,3]. There has been proposed another method to obtain geochronological information from these minerals: quantifying the degree of metamictization (destruction of crystal structure by radioactive components). It is reported for zircon that the water content (up to 10 wt%) is in proportion to the degree of metamictization, thus to the concentration of radioactive nuclei and geological age[4]. Monazite on the other hand usually undergoes much less metamictization than zircon due to the higher bond strength of P and O compared to that of Si and O; this results in the lower water content in the metamictized monazite. Determination of the structural water content in monazite without radioactive damage is thus necessary to constrain the ”initial” water content prior to hydration. The water content bears significance also for better understanding the crystal chemistry of monazite. In this study, we synthesized monazite single crystals at hydrothermal condition and determined the content of structural water as a function of pressure.

Experimental method: The hydrothermal synthesis of monazite was conducted at a temperature of 800 degC and pressures of 1.5, 10 and 15 kbar using a cold-seal pressure vessel and a piston cylinder apparatus. The $CePO_4$ reagent was encapsulated with H_2O or H_2O-NaCl solution and run for ca. 100 hours. The FT-IR analyses of the obtained monazite single crystals were conducted to determine the concentration of structural OH on the basis of Lambert-Beer’s Law. The molar absorption coefficient was estimated by linear calibration curve against the OH stretching vibration wavenumber [5].

Results and Discussion:The broad absorption band was observed at 3100-3600 cm^{-1} in the crystals synthesized in all the experimental conditions. The water content of synthesized monazite was estimated approximately to be 20-70 ppm, showing no large pressure dependence. FT-IR analyses of pleochroic absorption are on-going to determine the OH dipole orientation within the crystal structure.

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