Organic compounds as fluid sources in the DAC experiments involving volatiles

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Organic compounds are often used in the experiments aimed at the investigation of natural geological systems with C-O-H fluids. Oxalic acid dihydrate is considered in such experiments as a source of H_2O and CO_2 components upon thermal decomposition at relatively oxidizing conditions close to fayalite-magnetite-quartz buffer (Holloway and Reese, 1974). At the same time, the change of redox conditions to Mo-MoO_2 buffer leads to the appearance of methane and hydrogen species in the 160 mM aqueous solution of oxalic acid upon heating to 800 degree C (McCubbin et al., 2014). In this work, we apply spectroscopic techniques in combination with externally heated diamond anvil cell to investigate decomposition process of crystalline oxalic acid dihydrate under controlled oxygen fugacity.
Experiments were carried out in the Mao-type symmetric and Bassett-type hydrothermal diamond anvil cells in the temperature range to 800 degree C. Infrared and Raman spectroscopy were applied for the analysis of C-O-H species, which formed in the sample chamber during heating. Separation of hydrous fluid was observed at 98-99 degree C, followed by the appearance of O=C=O vibrations in the infrared and Raman spectra above 150 degree C. In the experiment with Mo buffering material, a homogeneous fluid was observed in the temperature interval from 400 degree C to 800 degree C with the vibrational signals from C–H, CO_2 and H_2O molecules. Upon quenching to room temperature, segregation of H_2O -rich phase from the fluid took place. Obtained data contributes to our understanding of fluids state and speciation at different redox conditions.

Keywords: Oxalic acid dihydrate, C-O-H fluid, Optical spectroscopy

