In situ optical study of H_2O-CO_2-CO system at high pressures

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Externally heated diamond anvil cell (DAC) technique provides optical access to the sample, homogeneously heated to high temperatures, and is widely used for *in situ* observations and spectroscopic measurements. Nevertheless, the pressure range achievable with the conventional externally heated hydrothermal DAC is limited by low resistance of diamond anvils to thermal stress at high temperatures. In this study we used a modified external heating system combined with the lever type DAC (Whale cell) in order to reach simultaneous high temperatures and high pressures for *in situ* measurements.
Visual observations and Raman spectroscopy were carried out for $C_2H_2O_4$ composition in the temperature range to 720 degree C and pressure range to 6.4 GPa. Above 105 degree C and 1 GPa a dissociation of starting material with the formation of CO_2 solid, H_2O and CO fluid phases was observed. At temperatures above 377 degree C and pressures above 2 GPa a polycrystalline phase was stable, which transformed to a solid carbon phase above 565 degree C and 5.5 GPa. Raman spectra of the solid carbon phase contain two broad peaks, consistent with the *D* breathing mode and *G* bond-stretching mode of C atoms. Therefore, solid phases are stable in this system in the broad region of temperatures and pressures. Obtained results have interesting implications for transportation mechanism of water and CO_2 into the Earth’ s interior in cold subduction zones.

Keywords: Externally heated diamond anvil cell, Raman spectroscopy, C-O-H fluid

