American Mineralogist, Volume 87, pages 69–78, 2002

Analysis of natural $H_2O + CO_2 + NaCl$ fluid inclusions in the hydrothermal diamond anvil cell

ROBERT S. DARLING[1,*] AND WILLIAM A. BASSETT[2]

[1] Department of Geology, State University of New York, College at Cortland, Cortland, New York 13045, U.S.A.
[2] Department of Geological Sciences, Snee Hall, Cornell University, Ithaca, New York 14853, U.S.A.

ABSTRACT

A hydrothermal diamond anvil cell (HDAC) was used to heat natural $H_2O + CO_2 + NaCl$ fluid inclusions in quartz. Heating in the HDAC allows external pressure (the fluid pressure on the host mineral) to be regulated so the total homogenization of the aqueous and carbonic phases at high temperature can be observed and recorded with minimal risk of decrepitation.

The total homogenization temperature, the CO_2-clathrate melting temperature, and the homogenization temperature of the carbonic phase can be used precisely to calculate the pressure of total homogenization (on the solvus) and the corresponding isochore. The equation of state of Duan et al. (1995) was used to calculate the solvus pressure by an iterative technique of varying the mole fraction CO_2 and the solvus pressure with a given total homogenization temperature and NaCl:H_2O molar ratio. Bulk molar volume values of the calculated fluids were iterated into a mixing equation for the aqueous and carbonic phases at low temperature until the fluid compositions, predicted by both equations, were identical.

Quartz samples from the Adirondack Mountains, New York, were used in the heating experiments. Seven $H_2O + CO_2 + NaCl$ fluid inclusions from post-metamorphic, hydrothermal cavities near Moose River yielded homogenization temperatures of 185–232 °C and homogenization pressures of 863 to 1870 bars. Two $H_2O + CO_2 + NaCl$ fluid inclusions from a drill core at the Willsboro wollastonite mine yielded homogenization temperatures of 310 °C and 324 °C and homogenization pressures of 3893 and 5333 bars, respectively. These inclusions are interpreted to have formed along a retrograde path characterized by early isobaric cooling and later isothermal decompression following Ottawan-age metamorphism.