American Mineralogist, Volume 83, pages 213–219, 1998

Experimental determination of the reaction: Magnesite + enstatite = forsterite + CO_2 in the ranges 6–25 kbar and 700–1100 °C

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ABSTRACT

The *P-T* equilibrium curve of the reaction of magnesite + enstatite = forsterite and CO_2 was determined in the ranges 6–25 kbar and 700–1100 °C by 53 reversed experiments carried out in 1.91 cm diameter piston-cylinder apparatus with NaCl pressure medium. Silver oxalate was used as a CO_2 source and charges were buffered at hematite-magnetite oxygen fugacity. Reaction progress was monitored by weight changes upon puncturing of CO_2-inflated quenched charge capsules and was confirmed by comparing X-ray diffractograms of charges made before and after the experiments. The data satisfy the relation: $P_{EQ} = -3.215 - 4.784 \times 10^{-3}\ T + 2.542 \times 10^{-5}\ T^2$ with P in kbar and T in °C. A *P-T* curve calculated with the 1994 version 2.3 THERMOCALC program agrees well with our results except in the highest pressure range. Our data, together with three existing tight experimental brackets on the decarbonation reaction of magnesite to periclase and CO_2, give ΔH_f^0 (298 K) (forsterite) = -61.20 ± 0.87 kJ/mol from the oxides. This value is in agreement with the value adopted by Berman (1988). An analysis of various proposed equations of state for CO_2 shows that only those of Mäder and Berman (1991) and Frost and Wood (1997) meet the constraints imposed by this study near 1000 °C and 10–20 kbar. The modified Redlich-Kwong (MRK)-based equations of state overestimate CO_2 fugacity in this pressure range.