The equilibrium diaspore-corundum at high pressures

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Abstract: The equilibrium curve $2 \text{diaspore} = \text{corundum} + \text{H}_2\text{O}$ was experimentally investigated by reversal runs in a piston-cylinder apparatus in the pressure range 15 kbar-50 kbar. Its position is determined by reversal brackets at 15 kbar (488-519°C), 25 kbar (581-600°C), 30 kbar (629-648°C), 40 kbar (675-696°C), and 50 kbar (695-719°C), thus lying between the curves reported by Kennedy (1959) and Matsushima et al. (1967). In addition, the behaviour of diaspore during heating at one atmosphere was determined using a Guinier camera with heating device. The resulting regression function for the volume has a higher slope in temperature than the function estimated by Berman (1988). Using this newly determined function to describe the thermal expansion of diaspore, the measurements of the isothermal compressibility of this phase performed by Xu et al. (1994), and the other thermodynamic data provided by Berman (1988), the calculated curve fits the reversals presented in this paper rather well.

Key-words: diaspore, corundum, reversal experiments, thermodynamic calculations, thermal expansion.

Introduction

Diaspore, AlOOH, occurs mainly in bauxites and emery deposits (Deer et al., 1992), such as in the outer parts of the Menderes Massif, Turkey, and as a hydrothermal alteration product of aluminous minerals, e.g. sillimanite, kyanite, andalusite, pyrophyllite or corundum (cf. Theye et al., in press).

Up to now the equilibrium curve

$$\text{2 diaspore (Dsp)} = \text{corundum (Co)} + \text{H}_2\text{O} \quad (1)$$

has been studied using various methods by Ervin & Osborn (1951), Kennedy (1959), Fyfe & Hollander (1964), Matsushima et al. (1967), Haas (1972), Chopin (1985), and Vidal et al. (1994) at pressures up to 40 kbar, but only Matsushima et al. (1967), Chopin (1985), and Vidal et al. (1994) performed reversal experiments with both solid phases present in the starting material.

On the basis of some of these experimental results, as well as calorimetric measurements (Robie et al., 1979; Perkins III et al., 1979), thermodynamic data of diaspore were extracted by Berman (1988) and Holland & Powell (1990). Using these data, equilibrium curve (1) can be extrapolated up to pressures of 50 kbar and more (Fig. 1), but up to now no experimental results are available at these very high pressures. Therefore, we performed reversal experiments for the diaspore/corundum reaction curve at water pressures up to 50 kbar in order to compare the results with earlier experimental data and with the theoretically extrapolated range of the curve (e.g. Berman, 1988; Holland & Powell, 1990).

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