

A partial molar volume for ZnO in silicate melts

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ABSTRACT

The densities of 8 Zn-bearing silicate melts have been determined, in equilibrium with air, in the temperature range of 1363 to 1850 K. The compositional joins investigated [sodium disilicate (NS2)–ZnO; anorthite–diopside 1 bar eutectic (AnDi)–ZnO; and diopside–petedunnite] were chosen based on the pre-existing experimental density data set, on their petrological relevance, and in order to provide a test for significant compositionally induced variations in the structural role of ZnO. The ZnO concentrations investigated range up to 25 mol% for sodium disilicate, 20 mol% for the anorthite–diopside 1 atm eutectic, and 25 mol% for petedunnite.

Molar volumes and expansivities have been derived for all melts. The molar volumes of the present liquids decrease with increasing ZnO content. The partial molar volume of ZnO derived here from the volumetric measurements for each binary system is the same within error. A multicomponent fit to the volumetric data for all compositions yields a value of 13.59(0.55) cm³/mol at 1500 K. We find, herewith, no volumetric evidence for compositionally induced coordination number variations for ZnO in alkali-bearing vs. alkali-free silicate melts nor for Al-free vs. Al-bearing silicate melts.

Keywords: Melt properties, partial molar volume of ZnO, experimental petrology, igneous petrology, trace elements and REE, high-temperature studies