American Mineralogist, Volume 84, pages 1176–1180, 1999

LETTERS

Thermal expansion of silicate liquids: Direct determination using container-based dilatometry

JOACHIM GOTTSMANN,* DONALD B. DINGWELL, AND CONRAD GENNARO

Bayerisches Geoinstitut, Universität Bayreuth, D-95440 Bayreuth, Germany

ABSTRACT

The expansivity of a silicate melt in the relaxed liquid state was obtained by direct dilatometric measurement for the first time. During the measurement, the liquid sample resides within a metal container composed of a hollow cylinder and two solid cylindrical end pieces. The sample is loaded at room temperature as a precisely machined glass cylinder. Heating the assembly beyond the glass transition results in an intimate space-filling seal of the liquid to the container surfaces. At temperatures above the glass transition, the linear expansion of the combined assembly is measured using a push rod resting on the upper end piece. The change in length of the assembly contains contributions due to the liquid volume expansion, as well as two correction terms, one each for the expansion of the enclosing hollow cylinder and the end pieces. The precision of expansivity data so obtained is ±3.5%. The method was tested, using NIST SRM 710 standard soda-lime glass against the previously used method of combined dilatometry and calorimetry. Comparison of these two methods reveals a good agreement for the liquid expansivity. The agreement of the new and old methods supports the assumption built into the latter that volume and enthalpy relaxation follow identical kinetics in these silicate melts. The new method makes no assumptions regarding the relaxation processes of enthalpy and volume relaxation and opens up many further experimental possibilities including applications at higher pressures.