Experimental determination of the thermal expansivity of silicate liquids in the glass transition range.

MJ Toplis
CRPG-CNRS, BP20, 54501 Vandoeuvre, France

P Richet
IPGP, 4, place Jussieu, Paris Cedex 05, France.

To a first approximation, the density of silicate liquids may be considered a linear function of temperature. However, for certain applications it is the expansivity and not simply the volume which is the important parameter. At the present time there is controversy in the literature concerning the possible temperature dependence of the thermal expansivity of silicate liquids. This controversy is largely the result of a lack of experimental data concerning the volume of fully relaxed silicate liquids at low temperature. In the light of this situation we have determined equilibrium volumes and expansivities of three liquids in the system anorthite ($CaAl_2Si_2O_8$)-diopside ($CaMgSi_2O_6$) using dilatometric measurements of the equilibrium length of samples in the glass transition range. The typical temperature range of 40 K for the measurements is limited at low temperature by the very long times necessary to reach structural equilibrium and at high temperature by the penetration of the rod used to measure sample dilatation. Despite such narrow intervals, the expansivities are determined to better than 3% thanks to the high precision with which length changes are measured. The coefficient of volume thermal expansion ($1/V\ dV/dT$) of the fully relaxed liquid just above the glass transition is found to decrease linearly from diopside composition to anorthite composition. The measured values are greater than those determined for the same liquids at superliquidus temperatures, demonstrating that expansivities of silicate melts may decrease markedly with increasing temperature. A predictive model for temperature dependent liquid volumes and application of our results will be discussed.