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Anomalous rheology of peraluminous melts

S.L. WEBB,* E. MÜLLER, AND H. BÜTTNER

Mineralogy Department, GZG, Georg-August-University of Göttingen, Germany

ABSTRACT

The viscosity of peraluminous Na_2O-Al_2O_3-SiO_2 melts of constant SiO_2 content is essentially independent of Al_2O_3 content. The addition of more Al^{3+} to the peraluminous melts does not result in a decrease in viscosity. This finding indicates that the Al^{3+} in these melts does not enter the structure as a viscosity reducing network-modifier. The most probable charge-balanced structural unit in these melts is a tri-cluster that involves one Al-tetrahedron sharing an O atom with two Si-tetrahedra. Both viscosity and activation energy for viscous flow in the investigated viscosity range in these peraluminous melts are largely unaffected by the Al^{3+} content, indicating that increasing the proportion of tri-clusters does not significantly affect the mechanism of viscous flow. Comparison of data for melts of different SiO_2 contents shows that the viscosity of melts in the Na_2O-Al_2O_3-SiO_2 system form the same trend ± 1 $\log_{10}$ unit as a function of Na:Al ratio within the 10^8–10^{14} Pa·s range.