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Viscosity data for hydrous peraluminous granitic melts: Comparison with a metaluminous model

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ABSTRACT

We performed 27 viscosity determinations on dry and water-bearing peraluminous haplogranitic melts. The dry melt compositions cover the range of normative corundum to be expected in peraluminous granitic melts in nature. The compositions are based on addition of Al_2O_3 to a haplogranitic melt (HPG8) whose composition is near that of the projection of the 2 kbar H_2O-saturated minimum melt composition into the system $NaAlSi_3O_8$-$KAlSi_3O_8$-SiO_2. The H_2O contents of the hydrous melts were analyzed using Karl Fischer titration ranging from 1 to 3 wt%. The viscosity determinations were performed using a modified micropenetration method in the viscosity range of 10^{10} to 10^{11} Pa·s, at 1 atm pressure, and in the temperature ranges of 880–940 °C and 470–640 °C for the dry and wet melts, respectively. For the dry peraluminous melts in this high viscosity range, addition of the first few percent of normative corundum to a metaluminous granitic melt increases the viscosity, which remains nearly constant despite further addition of Al_2O_3. Thus a viscosity maximum is inferred for dry slightly peraluminous granitic melts. The hydrous melt viscosity data were compared with the recent calculational model of Hess and Dingwell (1996), which was based on and designed for metaluminous melt viscosities. That model is capable of describing the viscosities of hydrous peraluminous granitic melts within the uncertainties stated for its application in metaluminous melts.