

**EFFECT OF PLAGIOCLASE CRYSTALLIZATION ON LIQUID AND MAGMA
VISCOSITY IN THE ANORTHITE-DIOPSIDE-FORSTERITE-QUARTZ
SYSTEM**

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ABSTRACT

In order to compare the chemical effect of changing composition on residual liquid viscosity to the physical effect of entrained crystals, seventeen CaO-MgO-Al₂O₃-SiO₂ (CMAS) glasses were synthesized as analogs for dacitic and basaltic lavas. Liquid viscosities were measured between 10¹ and 10¹³ Pa s, over the temperature range of approximately 1600 to 700°C, using concentric cylinder and parallel plate viscometry. Phase diagrams combined with calculations of the crystal fraction during cooling were used to calculate the viscosity of the magma as a function of temperature.

The results demonstrate that magma viscosities increase during cooling and crystallization as expected. However, in basaltic systems the residual liquid viscosities change little during cooling, due to removal of the anorthite component and the depolymerization of the melt with progressive crystallization. Changing liquid composition counteracts decreasing temperature and increasing crystal content, until the physical effect of crystals begins to dominate at crystal fractions greater than about 40%, assuming crystals remain in the magma. In contrast to basalts, liquid and magma viscosity in dacitic systems always increases during cooling. This suggests that the viscosity of cooling basaltic magma chambers may change little over extended temperature intervals.