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Viscosity changes during crystallization in a shoshonitic magma from Vulcanello: new insights on the lava flows

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Viscosity experiments were carried out on a shoshonitic lava from Vulcanello peninsula (Aeolia Islands, south Tyrrhenian Sea) by a concentric cylinder in a temperature range from 1539 to 1381 K and ambient pressure. Results showed an increase in effective viscosity from 131 to 15,320 Pa s as the crystals content varies from 0 to ~ 14 vol%. The crystallization processes, in a nominally dry shoshonite, start at 1420 K with the formation of clinopyroxene followed by plagioclase and olivine at 1401 K. Difference from Einstein-Roscoe equation using the Marsh (E-R-M) parameter is noticeable starting for crystal contents higher than 8 vol%. We obtained relative viscosities by estimating the melt viscosity by the equation of Giordano et al. (2008), and relative viscosities become up to 8.1 at 1381 K, which departs from the E-R-M by a factor of 4.3. The large departure of the present results from the E-R-M equation is caused by interaction of elongated pyroxene crystals, which is consistent with the theoretical models. The measured viscosity data are used to evaluate the emplacement of the shoshonitic lavas.

Keywords: relative viscosity, crystal suspension, shoshonite, Vulcanello, Einstein-Roscoe equation, lava flow emplacement