



Experimental solidification of anhydrous latitic and trachytic melts at different cooling rates: the role of nucleation kinetics

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Two sets of cooling experiments were run at atmospheric conditions for two anhydrous starting latitic and trachytic compositions: 1) five cooling rates (25, 12.5, 3, 0.5, and 0.125 °C/min) between 1300° and 800 °C, and 2) a 0.5 °C/min cooling rate from 1300°C with quench temperatures at 1200°, 1100°, 1000° and 900°C. Trachytic run-products are invariably glassy. Nucleation is also suppressed in the latitic run-products at the three highest cooling rates. Conversely, in the 0.5 and 0.125 °C/min runs, latites have a crystal content of ~ 90 vol.%. The phases are: plagioclase, clinopyroxene, glass and iron-bearing oxide (in order of abundance). The variable quench temperatures, investigated by coupling experiments with Pt-wire and Pt-capsule sample containers in the set 2), again did not determine crystallization of trachyte, whereas latitic samples are characterized by ~ 10 vol.% of oxides, pyroxenes and plagioclase (in order of appearance), at temperature < 1000°C. Effects of (preferential) heterogeneous nucleation on sample holders, of superheating degree, and chemical species loss during cooling are absent for both melt compositions. The difference of solidification paths between these two silicate melts can be ascribed only to their small chemical differences. In comparison with calculated equilibrium conditions all the experimental latitic and trachytic run-products revealed a strong kinetic effects, interpretable in the light of the nucleation theory. The glass-forming ability (GFA) of trachyte is higher, whereas their critical cooling rate (R_c) is lower (< 0.125 °C/min), in comparison to latitic melts ($R_c > 0.5$ °C/min). The experimental results carried out in this study can be applied to lava flows and domes; trachytic lavas are able to flow for longer period respect to

latitic ones in a metastable condition. Glass-rich terrestrial lavas, i.e. obsidians, can be the result of sluggish nucleation kinetics due to the relative high content of Na, K, Al and Si and relative low amounts of Mg, Fe and Ca of a silicate melts.