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Spherulites growth in trachytic melts: a textural quantitative study from synchrotron X-ray microtomography and SEM data

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This study shows the first textural data on synthetic alkali-feldspar spherulites grown in trachytic melts during cooling and decompression experiments with water-saturated conditions. Previous textural studies have shown the shape evolution and the growth process of spherulites as a function of undercooling (ΔT) and water content, although just in basaltic and rhyolitic melts [1-3]. Spherulites are spherical clusters of polycrystalline aggregates that occur commonly in rhyolitic melts under highly non-equilibrium conditions [3-4].
Cooling and decompression experiments have been carried out on trachytic melts in order to investigate crystallization kinetics of alkali feldspars and the implications for magma dynamics during the ascent towards the surface. Experiments have been conducted using cold seal pressure vessel apparatus at pressure range of 30 - 200 MPa, temperature of 750 - 850 °C and time of 2 - 16 hours, thereby reproducing pre- and syn-eruptive conditions of the Campi Flegrei volcanoes.
This study presents quantitative data on spherulite morphologies obtained both by scanning electron microscopy (SEM) and synchrotron X-ray microtomography. Size, aspect ratio, number and crystallographic misorientation of alkali feldspar crystals will be measured. Furthermore, experiments performed at different durations could allow us to follow the growth and the evolution of spherulites.
The shape of spherulites changes as a function of ΔT and experimental durations. Two kind of spherulites occured during experiments: open spherulites and close spherulites. The open spherulites are characterized by an structure with large (generally rectangular prismatic), widely spaced fibers with main axis converging towards a central nucleus, in agreement with previous observations [5-6]. Instead, the close spherulites consist of acicular and tiny fibers radially aggregated around a nucleus and single crystals are hardly distinguishable.
First preliminary results show:
a) spherulites grow between 70-200 MPa, thus the nucleation process was favored at higher water contents;
b) open spherulites seem to be favored at low ΔT, whereas close spherulites were favored in experiments at higher ΔT and long durations;
c) estimated growth rates of spherulites were of 10-7 cm/s.

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