

## **Timescales of spherulite crystallization in obsidian inferred from water concentration profiles**

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### **ABSTRACT**

We determined the kinetics of spherulite growth in obsidians from Krafla volcano, Iceland. We measured water concentration profiles around spherulites in obsidian by synchrotron Fourier transform infrared spectroscopy. The distribution of OH<sup>-</sup> groups surrounding spherulites decreases exponentially away from the spherulite-glass border, reflecting expulsion of water during crystallization of an anhydrous paragenesis (plagioclase + SiO<sub>2</sub> + clinopyroxene + magnetite). This pattern is controlled by a balance between the growth rate of the spherulites and the diffusivity of hydrous solute in the rhyolitic melt.

We modeled advective and diffusive transport of the water away from the growing spherulites by numerically solving the diffusion equation with a moving boundary. Numerical models fit the natural data best when a small amount of post-growth diffusion is incorporated in the model. Comparisons between models and data constrain the average spherulite growth rates for different temperatures and highlight size-dependent growth among a small population of spherulites.

**Keywords:** Spherulite, diffusion, obsidian, crystallization