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# Growth of large (1 mm) $MgSiO_3$ perovskite single crystals: A thermal gradient method at ultrahigh pressure

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## Abstract

Large single crystals of $MgSiO_3$ perovskite were successfully synthesized by a thermal gradient method at 24 GPa and 1500 °C. This was achieved by an improvement of high-pressure synthesis technique that allowed us to grow single crystals under such ultrahigh-pressure conditions in relatively large volumes (e.g., 10 $mm^3$). Since crystal growth is hindered by neighboring crystals, the nucleation density was suppressed by reducing the thermal gradient to 20 °C/mm, permitting an increase in free space for large crystal growth. $KHCO_3$-$Mg(OH)_2$ solvent can be used to grow perovskite crystals. However, the carbonate solvent produces melt inclusions. Silicate sources with $MgSiO_3$ composition produce stishovite inclusions, which in turn cause splitting of perovskite crystals. The formation of these inclusions is avoided by using $H_2O$ as a solvent and $85MgSiO_3$-$15Mg_2SiO_4$ as a silicate source. The $H_2O$ also allows homogeneous crystal growth, probably because of its low viscosity and high silicate solubility. High-quality single crystals larger than 1 mm were successfully synthesized through these technical developments.

**Keywords:** $MgSiO_3$, perovskite, single-crystal growth, high pressure, temperature gradient method, growth from solution