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Finite element modeling of elastic volume changes in fluid inclusions: Comparison with experiment

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Abstract

We have used finite element modeling (FEM) to successfully reproduce elastic volume changes of synthetic fluid inclusions in quartz pressurized in a hydrothermal diamond-anvil cell (HDAC) at external pressures up to 250 MPa. At higher pressures, the synthetic inclusions are somewhat stiffer than would be predicted by linear elasticity due to the effect of pressure on the elastic moduli. The finite element models were created to reproduce the inclusion's approximate shape, and crystallographic orientation within the host, which is elastically anisotropic. The models successfully predict changes in fluid inclusion volume measured using the HDAC, which gives us confidence that FEM may be used to predict the elastic behavior of inclusions in other situations.

Keywords: Mechanical properties, elastic volume change, high-pressure studies, hydrothermal diamond anvil cell, metamorphic petrology, fluid inclusion, finite element modeling, elastic deformation, volume change