Effect of thermal deformation on a cross-sectional shape of fracture driven by magma flow

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For dike propagation in a host rock, magma in the dike should be at a high temperature to keep its melt phase. Contrary to this, the host rock is at a lower temperature than the magma, and the temperature difference causes heat loss from the magma. The lost heat does not disappear but transfers to the host rock, and it will induce thermal expansion of the host rock associated with temperature increase. To estimate this effect quantitatively, in this work, we consider a two-dimensional fracture which is filled with magma at a uniform pressure and also at a uniform temperature. The analysis is carried out by using a 2D FEM code which can treat the coupled problem of fluid flow in fractures, elastic and thermal deformation of rock, and heat transfer. The result shows that the fracture closes with time due to the effect of thermal deformation of rock surrounding the fracture. The time required for the fracture closing becomes longer with the fracture length and the magma temperature approaching the initial rock temperature.