Experimental verification for the effect of thermal expansion of a rock on fluid flow in a fracture

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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 carried out laboratory experiments using a cylindrical specimen. There exists an artificial fracture passing through the specimen in the axial direction, and the experiments were proceeded as follows; (i) apply a confining stress to the specimen, (ii) inject water with a specific temperature into the fracture by a constant pressure, and measure the injection rate, (iv) change the water temperature, and observe the variation of the injection rate with the water temperature. The results show that the injection rate decreases drastically with increasing the water temperature, even though the temperature was changed in a relatively small range from 20 degC to 70 degC. Thus we confirmed that the fracture permeability is obviously affected by thermal deformation of rock surrounding the fracture as predicted by the previously-carried out numerical simulations.