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Permeability Changes in Reaction Induced Fracturing

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The process of fracture formation due to a volume increasing chemical reaction has been studied in a variety of different settings, e.g. weathering of dolerites by Røyne et al.[**?**], serpentinization and carbonation of peridotite by Rudge et al.[**?**] and replacement reactions in silica-poor igneous rocks by Jamtveit et al.[**?**]. It is generally assumed that fracture formation will increase the net permeability of the rock, and thus increase the reactant transport rate and subsequently the total reaction rate, as summarised by Kelemen et al.[**?**]. Røyne et al.[**?**] have shown that transport in fractures will have an effect on the fracture pattern formed. Understanding the feedback process between fracture formation and permeability changes is essential in assessing industrial scale CO_2 sequestration in ultramafic rock, but little is seemingly known about how large the permeability change will be in reaction-induced fracturing under compression, and it remains an open question how sensitive a fracture pattern is to permeability changes.

In this work, we study the permeability of fractures formed under compression, and we use a 2D discrete element model to study the fracture patterns and total reaction rates achieved with different permeabilities. We achieve an improved understanding of the feedback processes in reaction-driven fracturing, thus improving our ability to decide whether industrial scale CO_2 sequestration in ultramafic rock is a viable option for long-term handling of CO_2.

References

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