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Numerical modelling for fracture prediction in intrusions

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Prediction of fractures in the sub-surface is critical to many industries for understanding fluid flow and rock stability. Numerical modelling is key to understanding fracturing, as directly recording and analysing every fracture within the sub-surface is currently impossible. Fracture patterns observed in the field can be related to strains experienced by the rock mass through physical analogues and numerical modelling. Strains reflect the regional geology, and local tectonic and thermal stresses and fluid pressures. Kinematic modelling can be used to track the strain evolution of geological structures. Modelling therefore allows fracture orientations and intensities to be predicted in areas without direct fracture measurements. Strain-based attribute maps for fracture modelling are well established in geological software; however maps of thermal strains have not been used for fracture modelling. Thermal strains are critical for understanding intrusive strain histories and therefore fracturing in igneous rocks. A strain based approach for fracture prediction requires that fracturing events are assigned to geological events. This can be tricky unless key markers can be found, as fracture patterns in intrusive rocks are often the result of overprinting of several processes through time. We investigate how fractures can be assigned to geological events, including cooling, in intrusive rocks, and how numerical modelling can be used to link fractures to specific geological events in the field.