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# On the scale-invariance of fractures and fracture patterns in the Transscandinavian Igneous Belt, Southeast Sweden

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Fracture dimensions and their spatial distribution are of primary importance in many fields of applied geology, e.g. they determine the quality of sites for the long-term storage of hazardous waste and fractured reservoirs for e.g. hydrocarbons, $CO_2$ sequestration, and geothermal energy. Unfortunately, the observation of fracture systems is commonly limited by the outcrop size or the resolution of the measuring method.

Fractures and fracture properties are often assumed to be scale-invariant, albeit within a certain range. Therefore, knowing the fractal dimension of fracture properties allows conclusions to be drawn from one particular scale to another.
We investigated fracture trace lengths and patterns at map-, outcrop- and handspecimen scale, covering a large area in the Transscandinavian Igneous Belt. The dataset comprises 11 fracture maps at three different scales containing 8641 fracture trace lengths. Analysis of the fracture trace lengths was carried out using cumulative frequency distributions, while the fracture patterns were analysed with the standard box-counting technique.
Combining the three analysed scales, our results indicate that the fracture trace lengths can be considered to be scale-invariant with a fractal dimension of about 1.8. In contrast, the fractal dimension at one particular scale could not be determined, probably due to censoring and truncation effects.

Analyses with the box-counting method show that the fracture patterns, in contrast to fracture trace lengths, are not scale-invariant. The box-counting dimension increases with increasing scale. It is a measure of the complexity and maturity of a fracture system, which increases with scale. Consequently, the complexity of fracture pattern is scale-variant.