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Discrete and continuous conceptual models of fault zones.

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Faults can control the large-scale properties of rock volumes through their behaviour as flow conduits and/or barriers or by localising geomechanical effects. Hence, often the fidelity of a numerical model of faulted site relies on the accuracy with which the fault zone is represented. There are two distinct factors that must be considered in a modelling study: first, does the model contain the most relevant characteristics of the fault that influence the behaviour of interest; and second, are these characteristics assigned realistic and representative values that capture both their natural variability and the uncertainty with which they can be determined for the specific case of interest. These two factors are contained in the conceptual fault model and choice of modelling proxy-properties, respectively.

In recent years, two classes of conceptual fault zone model have dominated the description of fault zones, broadly characterised by either a continuous or a discrete approach. Continuous fault zone properties (e.g. fault core and damage zone thickness, displacement partitioning statistics) often show high variability which many modelling studies attempt to capture by running multiple model containing property values sampled from the distribution. Discrete descriptions focus on the presence of individual fault zone elements (e.g. shale smears, relay zones), and models guided by a discrete conceptual model attempt to place representative frequencies of elements. A single discrete model might contain the same property distributions as an ensemble of continuous models yet, because it contains a representative frequency of different elements, its behaviour might lie beyond the extreme behaviour of the continuous ensemble. Hence, the manner in which a geologist's conceptual model is represented in a modeller's numerical model can be hugely important for the outcome of the study, and it is in the interest of both modellers and geologists to ensure that they have a correct understanding of the other's part of the process.