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# Comparing fault zones in nature, laboratory experiments and numerical simulations using grain size and shape characteristics

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To better understand fault zone dynamics we need an improved understanding of the underlying micro-mechanics of the fault evolution process. Our basic data is gleaned from quantitative observations of structural fabrics associated with natural fault systems. However, such datasets generally record the final state of evolution, from which it is often difficult to discern the dynamic micro-scale processes involved or the macro-mechanical behaviour of a fault. Laboratory experiments give valuable insights into links between microscale processes and macro-mechanical behaviour. Similarly, numerical simulations are very useful tools for visualising dynamic grain-scale interactions not readily visible from nature. Together these tools can help us identify and isolate first order parameters that are relevant for the faulting process. Although, much work has been carried out independently on field, laboratory and numerical studies, results are rarely quantitatively combined.

Here, we will present a direct comparison between field observations of faults, laboratory shearing experiments and new 3D simulations that implement realistic gouge evolution during shear. Our particle based simulation includes breakable elastic bonds between individual particles allowing fracture of aggregate grains that are composed of many bonded particles. With accumulated strain, aggregate grains gradually evolve in size and shape to produce a textural signature reminiscent of natural faults. We use a new image analysis tool to characterise grain shape and size distributions from thin sections obtained from natural and experimental fault rocks. This tool utilises a greyscale thresholding method to identify and characterise individual grains. We use similar techniques to quantify synthetic 2D sections from our 3D numerical model out-

comes. This approach allows us to build on existing observations and permits closer investigation of dynamic processes that may be operating in evolving fault zones.