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# Distribution and growth of fractures in the damage zone of a fault in outcrop

David C. Tanner (1), Steffi Burchardt (2), and Charlotte M. Krawczyk (1)

(1) Leibniz Institute for Applied Geophysics, Hannover, Germany (davidcolin.tanner@liag-hannover.de), (2) Solid Earth Geology, Department of Earth Sciences, Uppsala University, Sweden (steffi.burchardt@geo.uu.se)

The damage zone of a fault is often visualised as a zone of small fractures that decrease in frequency symmetrically away from the fault core. While the fault core is postulated to be sealing, the damage zone is thought to offer good permeability for fluid flow parallel to the fault. Very little is known about the sequential evolution of fractures within the damage zone.

We therefore undertook a detailed examination of the architecture of an excellently-exposed fault and its damage zone that is completely exposed on the west coast of Ireland. The fault core is composed of a three-metres thick homogeneous fault gouge. The fault zone walls are characterised by a sinuous geometry that dips steeply both east and west. Quartz fibres in tension gashes in the fault-core walls show that the fault is an dip-slip thrust with a small component of dextral slip. Only the hanging-wall is damaged; the footwall is folded, but unfractured. The hanging-wall is deformed by two distinct shear fracture systems; an early-formed antithetic set and a latter synthetic set. Using four, horizontal, metre-spaced scan-lines, we show that a simple relationship of fracture density and throw decrease with distance from the fault does not exist. Instead, the density of antithetic fractures controls the distribution of later synthetic fractures. This evidences strain-weakening processes. We postulate that fracturing of the hanging-wall is due entirely to forces that result from fault bends. Therefore fracturing of the hanging-wall is primarily dependant on fault-surface topography, but subsequent damage distribution is a function of the distribution of the first increment of deformation.