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A natural example of sub-seismic deformation in the hanging-wall of a fault, County Kerry, Ireland

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On the Atlantic coast of County Kerry, Ireland, a large fault and its hanging- and footwall are exposed within Lower Carboniferous shaley limestones. The 3–4 metres wide fault zone is composed of highly-brecciated fault gouge, which has a sharp transition to the less deformed strata. The fault zone has been eroded by the sea and thus we were able to map the zone in three dimensions. The hanging wall is well exposed by a large (12 m high and 30 m long), planar outcrop that is perpendicular to the fault. The hanging-wall beds are highly fractured (more than 50 fractures/metre) by synthetic and antithetic fractures with respect to the main fault. By use of scanlines and observing cross-cutting relationships, we determine that the antithetic fractures formed first, followed by two phases of synthetic fracturing. The resulting sub-seismic fracture pattern highly increased the cross-strata porosity of the hanging-wall, as evidenced by quartz mineralisation along the fractures. Fault kinematics are shown by slickenslides in the fault zone, and quartz-filled tension gashes that are perpendicular to the former. Within the tension gashes, quartz crystals also grew with their c-axes parallel to the kinematic vector.

A number of hanging-wall fractures have developed into faults themselves. As such, we are able to observe the process of ongoing brittle deformation in this outcrop and the breakdown of undeformed strata into ever-decreasing smaller faults, each with their own domain of related fracturing.