



## **Complex fragmentation and silicification structures in fault zones: quartz crystallization and repeated fragmentation in the Rusey fault zone (Cornwall/UK)**

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Silicified fault rocks typically show structures resulting from various stages of fragmentation and quartz crystallization. Both processes interact episodically and result in complex structures on various scales, which require a wide spectrum of analysis tools.

Based on field and microstructural data, the spatial-temporal connection between deformation, quartz crystallization and fluid and material flow along the Rusey fault zone was investigated. The fault can be examined in detail in three dimensions on the north Cornwall coast, UK. It occurs within Carboniferous sandstones, siltstones, mudstones and slates of the Culm basin, and is likely to have had a long history. The fault rocks described here formed during the younger events, possibly due to Tertiary strike-slip reactivation. Frequent fragmentation, flow and crystallization events and their interaction led to various generations of complex-structured quartz units, among them quartz-mantled and partly silicified wall-rock fragments, microcrystalline quartz masses of different compositions and structures, and quartz vein patterns of various ages. Lobate boundaries of quartz masses indicate viscous flow. Fragments are separated by quartz infill, which contains cm-sized open pores, in which quartz crystals have pyramidal terminations. Based on frequent occurrence of feathery textures and the infill geometry, quartz crystallization from chalcedony appears likely, and an origin from silica gel is discussed. Fragmentation structures are generally fractal. This allows differentiation between various processes, such as corrosive wear, wear abrasion and hydraulic brecciation.

Material transport along the brittle shear zone, and displacement of the wall-rocks, were at least partly governed by flow of mobile fluid-quartz-particle suspensions. The complex meso- to microstructures were generated by repeated processes of fragmentation, quartz precipitation and grain growth. In general, the brittle Rusey fault zone represents a zone of multiple fragmentation, fluid flow, crystallization and quartz dissolution and precipitation, and is regarded as key example of large-scale cyclic interaction of these processes. The geological evidence of interactions between processes implies that feedbacks and highly non-linear mechanical behaviour generated the complex meso- and microstructures. The fault zone rheology may also therefore have been complex.