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Variations in Structural Symmetry, Damage Distribution, and Textural Characteristics surrounding Strike-Slip Faults

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Elucidation of the internal structure of fault zones by understanding the spatial distribution, geometric and textural characterization of damage around faults at various scales can help to predict fault growth processes, subsequent mechanics, bulk hydraulic and seismological properties of a fault zone. In general, the primary controls on fault zone architecture are the depth of faulting, the protolith, the fault displacement and the interaction with other faults and/or pre-existing structures. Damage surrounding fault cores of various sizes and complexity is represented by deformation on a range of scales from microfracturing of the rock matrix to macroscopic fracture networks. Damage surrounding faults has been attributed to fault growth processes, damage due to the juxtaposition of geometric irregularities, and earthquake rupture.

Here, we present a summary of quantitative and qualitative data on the scaling, symmetry and spatial variations in damage distribution and textural characteristics of a variety of crustal-scale strike slip fault zones. Faults studied are hosted with a range of lithologies and include the San Andreas Fault (USA), Arima Takatsuki Fault (Japan,) Caleta Coloso Fault (Chile) and the Carboneras Fault (SE Spain). We show how different damage elements around these faults (such as fault core and associated damage zones) can scale with fault displacement and is in some cases predictable. We demonstrate that fault damage distribution can show symmetrical or asymmetrical damage profiles around the fault with respect to the fault core. In particular, we focus on sections of the San Andreas and Arima Takatsuki faults which display significant asymmetric fault damage, and host unique ‘pulverized’ textural characteristics which may potentially be used to infer earthquake rupture in the absence of pseudotachylytes.