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Three-dimensional characterization of a crustal-scale fault zone: the Pusteria and Sprechenstein fault system (Eastern Alps). Part 2: implications for the mechanical evolution of crustal-scale strike-slip faults

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The Pusteria Fault is the eastern segment of the Periadriatic Lineament, the >600 km tectonic boundary between Europe and Adria-vergent portions of the Alps. The western edge of the Pusteria Fault is marked by the Mules foliated tonalitic "lamella" and represents the tectonic divide between the Austroalpine basement to the N (mainly paragneiss) and the Bressanone Granite to the S. Pusteria Fault, in turn, is cut by the later Sprechenstein-Mules Fault, which is characterized by a complex network of fault segments interconnected by contractional step-overs. It is shown that the Pusteria and Sprechenstein–Mules fault zones provide the opportunity to study fault rocks and damage distribution as a function of fault geometry and host-rock lithology. For this purpose a 3D geological model of the fault network has been reconstructed from borehole data and a detailed 1:5000 geological map, where the degree of damage is represented using an innovative classification called Damage Index. The model allows fault zone architecture, including fault network geometry and topology, fault rock distribution along the main slip surfaces, and fracturing in damage zones, to be quantitatively evaluated at the km-scale The study highlights that a first-order influence on the evolution of fault rocks and fracturing in damage zones is exerted by the composition and inherited fabric of protoliths. This results in a marked asymmetry of damage zones when different tectonic units are juxtaposed across a fault segment. The model also

highlights lobe-shaped high-damage volumes centred on step-overs, and lower levels of damage along rectilinear fault segments. This is consistent with predictions from analytic and numerical models.