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Initiation and growth of strike-slip faults in an effectively intact granodiorite (Neves area, South Tyrol, Italy). Information by laserscan mapping a decametric contractional stepover along the Mesule Fault.

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Exhumed strike-slip faults exposed in the Neves area of the Tauern Window (Eastern Alps, South Tyrol, Italy) formed in the lower brittle crust under hydrous conditions within effectively intact granodiorite. Faults initiated as segmented en-echelon shear fractures delineating conjugate sets, with segmentation occurring over scales of millimeters to hundred of meters. Slip accumulation on these initial segments was accommodated at contractional stepovers by more distributed faulting of the host rock. Laserscan mapping of a decametric contractional stepover along a fault (Mesule Fault), exposed on a glaciated surface with a rough topography, has allowed the reconstruction of the structural details and of the kinematic evolution of structures with increasing slip along the segmented fault. In the initial low slip stages, transfer of displacement was accommodated on a set of antithetic faults in the stepover, allowing a decrease in offset toward the tips of the overstep faults. This mechanism was only effective for relatively small fault slip. Further displacement was accommodated by the development of synthetic, sigmoidal by-pass faults providing a hard linkage between overstepped faults, which consistently crosscut deactivated earlier antithetic fault set within the relay ramp. This second stage of evolution is documented in the Mesule Fault, which has a current maximum offset of ca. 20 m. Hard linkage allowed the propagation of seismic fractures, as recorded by pseudotachylyte localized at by-pass contractional bends.