Textural evolution and fluid-rock interaction during upper crustal, seismic deformation: Insights from the carbonate-dominated fault rock suite of the Belluno Thrust, Italian Southern Alps

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A multi-scaler, multi-methodological approach has been used to characterize the deformation mechanisms and fluid-rock interaction processes within the Belluno Thrust (BT), a regional-scale thrust cutting through Mesozoic carbonates of the eastern Southern Alps of Italy. We report the first results of a systematic analysis of the deformation mechanisms that steered strain localization within the BT fault zone during seismogenic faulting. The WSW-ENE-striking BT contributed to development of the south-verging thrust-and-fold belt of the Southern Alps during the Late Oligocene – present time interval. We studied an outstanding exposure of the BT in the greater Feltre region, where the BT juxtaposes an Early Jurassic oolitic and micritic limestone (the Calcari Grigi Group) in the hanging wall against an Upper Jurassic-Early Cretaceous pelagic and cherty limestone (the Maiolica Fm.). The BT is defined by a 2 m-thick damage zone formed at the expense of both the hanging wall and footwall blocks. Atop the damage zone is a millimetric principal slip surface (PSS) that strikes WSW-ENE and dips 40° to the NNW. Kinematic analysis confirms the top-to-the SSE transport along the BT. Several structural facies have been identified by means of detailed structural mapping and sampled from the damage zone (from within both the hanging- and the footwall blocks) and the PSS. The outcrop structural characterization has revealed a number of physically juxtaposed, yet different, structural facies: i) cohesive, weakly foliated proto- to ultracataclasite; ii) uncohesive, clay-rich gouge; iii) foliated domains with SC-C’ structures. Relatively unstrained host rock lithons are wrapped by these variably strained domains. Petrographic and microstructural analyses show evidence of pervasive pressure solution, with abundant stylolites, slickolites and foliated domains indicating an overall ductile behaviour. Calcite veins are also common in all recognised structural facies showing mutual cross-cutting relationships with the pressure-solution seams. This structural characterization has provided the basis for detailed image analysis of selected cataclastic textures to calculate fractal parameters for the particle size distribution (Ds) and morphology (Dr) of the clasts aiming at better understanding the cataclastic flow active in the BT fault rocks. Results from a range of representative samples suggest corrosive wear to be the main cataclastic process (Ds 1,41 ÷ 2,00; Dr 1,51 ÷ 1,88). Cathodoluminescence imaging revealed multiple generations of cement and permitted discriminating the first-order chemical characteristics of parental fluids and constraining the relationships between calcite veining and cementation. Two syn-tectonic cements have been
identified: i) a bright-orange cement, preferentially surrounding carbonate clasts with highly irregular margins, indicative of the involvement of carbonate-reactive fluids; ii) a dull, homogeneous brown/black cement coexisting with a siliceous matrix, mantled clasts and local sigmoidal structures. The latter is at times observed as thin injections and fluidized structures. Our preliminary results suggest that overall deformation was accommodated by creep and low-T crystal-plastic deformation possibly during inter-seismic phases as indicated by the presence of pressure-solution seams and foliated fabrics. Transient spikes of coseismic rupturing possibly promoted by multiple batches of overpressured fluids were accompanied by significant cataclasis and brittle strain localization.