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Microstructural, textural and thermal evolution of an exhumed strike-slip fault and insights into localization and rheological transition

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The presence of deep exhumed crustal rocks with a dominant but contrasting mineralogy results in shear concentration in the rheological weakest layer, which exhibits contrasting patterns of fabrics and thermal conditions during their formation. We tested a combination of methodologies including microstructural and textural investigations, geochronology and geothermometry on deformed rocks from exhumed strike-slip fault, Ailao Shan-Red River, SE, Asian. Results indicate that the exhumed deep crustal rocks since late Oligocene (ca. 28 Ma) to Pliocene (ca. 4 Ma) typically involve dynamic microstructural, textural and thermal evolution processes, which typically record a progressive deformation and syn-kinematic reactions from ductile to semi-ductile and brittle behavior during exhumation. This transformation also resulted in dramatic strength reduction that promoted strain localization along the strike-slip and transtensional faults. Detailed analysis has revealed the co-existence of microfabrics ranging from high-temperatures (granulite facies conditions) to overprinting low-temperatures (lower greenschist facies conditions). The high-temperature microstructures and textures are in part or entirely altered by subsequent, overprinting low-temperature shearing. In quartz-rich rocks, quartz was deformed in the dislocation creep regime and records transition of microfabrics and slip systems during decreasing temperature, which lasted until retrogression related to final exhumation. As a result, grain-size reduction associated by fluids circulating within the strike-slip fault zone at brittle–ductile transition leads to rock softening, which resulted in strain localization, weak rock rheology and the overall hot thermal structure of the crust. Decompression occurred during shearing and as a result of tectonic exhumation. All these results demonstrate that the ductile to ductile-brittle transition involves a combination of different deformation mechanisms, rheological transition features and feedbacks between deformation, decreasing temperature and fluids.