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Graphitic material in fault zones: Implication for strain localization and rheological weakening

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Graphitic carbon exhibits a large range of structures and chemical compositions, from amorphous-like compounds to crystalline graphite. The graphitic carbon-bearing rocks are widely occurred in low- to high- grade metamorphic massif and fault zone. The carbonaceous material in the rock will gradually transform from an amorphous into an ordered crystalline structure by thermal metamorphism, which is called graphitization. The degree of graphitization is believed to be a reliable indicator of peak temperature conditions in the metamorphic rock. In many low-grade metamorphic rocks, graphitic carbon (e.g., soot, low-grade coal) is often associated with brittle fault gouge whereas in high-grade metamorphic rocks, graphitic carbon (crystalline granite) are most commonly seen in marble, schist or gneiss. In recent years, graphitic carbon-bearing rocks have been reported from natural fault zones (reviwers paper see Cao and Neubauer 2019 and references therein). The graphitic carbon grains in our samples tend to enrich in slip-surface or micro-shear zone with strain localization in fault, performed as dislocation glide of deformation. The graphite LPO shows slip system in the direction of basil <a> combined basil <a> slip and weak prism <a> slip systems, suggesting a low-temperature to a medium to high temperature deformation conditions, which is in consistent with the results of Raman Spectra of Carbonaceous material (RSCM) thermometry. We also proposed that the graphitic carbon formed in the rocks can significantly affect the mechanical properties of the fault during the process of faulting. This process can effectively cause reaction weakening and strain localization, which is thought to play an important role as solid lubrication in fault weakening.