MICROPHASE TRANSFORMATIONS IN CARBONACEOUS FAULTS: INDICATORS OF FLUID-ROCK INTERACTION AND DIAGENESIS DURING SLIP

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ABSTRACT

During diagenesis, many organic-rich carbonaceous faults are subjected to thermal maturation, fluid-rock interactions, and/or shear-induced phase transformations, often yielding various fault weakening agents. Reorganization of organic molecules may result in progressive polymorphic transformation of amorphous carbon to weak localized graphite, while fluid-rock interactions within carbonates generate decomposition products (i.e. CaO-lime, MgO-periclase) with lubricating properties. The strength of a fault zone is governed primarily by mechanical and chemical processes that occur at microscopic asperity contacts within the fault gouge. As a result, majority of displacement in faults is accommodated on principal slip surfaces, which can be on orders of nanometers to millimeters thick. We intend to characterize microphase transformations within principal slip surfaces of major carbonaceous faults spanning a wide range of locations along strike, at varying depths, and different protolith compositions. Through integrated use of optical microscopy, scanning electron microscopy, transmission electron microscopy, Total-Organic-Carbon measurements, Raman spectroscopy, fluid inclusion analysis, and stable isotope geochemistry, we will examine these principal slip surfaces to: (i) discern microtextures, (ii) map detailed surface chemical composition, (iii) detect changes in degree of crystallinity of organic matter, (iv) obtain maximum temperatures achieved at asperity contacts and, (v) determine paleotemperatures, salinity, and fluid-vapor phase compositions to understand evolution of mineralizing fluids during deformation. Constraining physiochemical processes at the microscopic scale will provide insight into frictional properties of carbonaceous faults. Understanding evolution of strength and slip behavior of carbonaceous fault zones may help understand the roles faults play in the evolution of structural traps and seals.

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