Structural, chemical and thermal evolution of detachment fault rocks: Implications for slip on ‘weak’ faults

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Slip on low-angle normal faults (LANFs) is a mechanical paradox that cannot be explained by classical fault mechanic theory. Faults that slip in this manner (at a high angle to the regional maximum compressive stress direction) are often considered weak and include large displacement systems such as the San Andreas fault. Several hypotheses exist to explain slip on the San Andreas and LANFs, but many have not been examined using field data. These hypotheses for slip on weak faults include a stress rotation, high pore-fluid pressures and low-friction materials allowing displacement. A detailed study of the structural, chemical and temporal evolution of two LANFs in the western US will be used to determine the mechanical properties and constituents of a weak fault zone. To determine the structural evolution of the fault zone to find the stress field at the time of slip, a paleostress inversion of minor faults and fractures will performed using at least two methods. Using data collected in a systematic manner and with relation to depth below the fault, these data will allow us to quantify the differential stress and the stress directions in the fault zone. We hypothesize that this analysis will indicate a stress rotation within the fault core and that combined with a chemical or physical anisotropy along the fault zone allows slip to occur on a low angle plane.