Geophysical Research Abstracts
Vol. 15, EGU2013-6252, 2013
EGU General Assembly 2013

Evolving Mechanical Efficiency of Restraining Bends

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Restraining bends are regions of mechanical inefficiency along strike-slip faults where faults may propagate to improve the system's efficiency. Analog experiments using wet kaolin show that 15° bends continue to slip while systems with greater bends develop new faults. PIV analysis of these analog fault systems reveals their evolving efficiency and shed insight into the stability of natural restraining bend systems. The wet kaolin produces restraining bend deformation patterns, fault sequence and mechanical efficiency similar to both dry sand experiments and natural restraining bends, such as the southern San Andreas fault. The San Andreas Fault has recently abandoned one fault strand and taken up activity on another within a restraining bend at the San Bernardino Mountains.

The propagation of new faults in the wet kaolin improves the mechanical efficiency of the fault system by increasing the ratio of fault slip to off-fault deformation. Wider restraining bend stepovers have lower mechanical efficiency than closer stepovers and sharp restraining bends have lower mechanical efficiency than shallow restraining bends. The propagation and linkage of faults increases in efficiency of the fault system. Once the new faults are linked up around the restraining bend, further increases in mechanical efficiency are minimal. This study demonstrates that restraining bend fault systems evolve towards greater mechanical efficiency through the propagation of new faults and highlights the conditions for stable restraining bend fault configuration.