Evidence of transient increases of fluid pressure in SAFOD phase III cores

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Abstract

The San Andreas Fault Observatory at Depth (SAFOD) in Parkfield, central California, has been drilled through a fault segment that is actively deforming through creep and microearthquakes. Creeping is accommodated in two fault strands, the Southwest and Central Deforming Zones, embedded within a damaged zone of deformed shale and siltstone. During drilling, no pressurized fluids have been encountered, even though the fault zone acts as a permeability barrier to fluid circulation between the North American and Pacific plates. Microstructural analysis of sheared shales associated with calcite and anhydrite-bearing veins found in SAFOD cores collected at 1.5m from the Southwest Deforming Zone suggests that transient increases of pore fluid pressure have occurred during the fault activity, causing mode I fracturing of the rocks. Such build-ups in fluid pressure may be related to permeability reduction during fault creep and pressure-solution processes, resulting in localized failure of small fault zone patches and providing a potential mechanism for the initiation of some of the microearthquakes registered in the SAFOD site.