Nano-coatings grease earthquake zones

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Samples of rock from deep inside the San Andreas Fault could shake up scientists' notions about why some fault zones move slowly and steadily while others balk for a time and then shift suddenly and violently, producing major earthquakes.

'There's been strong interest in finding signatures in rocks that would characterize a fault as creeping or seismic,' said University of Michigan geological sciences professor Ben van der Pluijm, who will discuss recent findings today (Oct. 30) in a symposium during the 119th annual meeting of the Geological Society of America in Denver.

Some scientists have speculated that fluids facilitate slippage; others have focused on bits of serpentine—a greenish mineral that can crystallize as slippery talc under certain conditions—which were found in core samples retrieved from the San Andreas Fault.

But van der Pluijm and coworkers at U-M and the University of Strasbourg in France aren't convinced of those explanations for slippery fault behavior. 'We think the answer is in clay,' he said.

He bases his opinion on analyses of material brought up from a depth of two miles below the fault's surface as part of the San Andreas Fault Observatory at Depth (SAFOD) project. SAFOD, which is establishing the world's first underground earthquake observatory, is a major research component of EarthScope, an ambitious, $197-million federal program to investigate the forces that shape the North American continent and the physical processes controlling earthquakes and volcanic eruptions.

Earth scientists are especially interested in the San Andreas Fault—that notorious fracture running 800 miles along the length of California—because major earthquakes occur on such plate boundaries. The SAFOD site, near Parkfield, Calif., sits on a creeping section of the fault that moves regularly and incrementally, but does not produce large earthquakes.

Van der Pluijm's samples are 'not glamorous to look at. They're not spectacular to showcase; they just look like dirt.' But it's how the 'dirt' forms and behaves in active fault zones that makes it noteworthy. Through a combination of chemical and mechanical processes, the grains making up the rock develop 'nano-coatings' of clay on their surfaces, which act something like grease on ball bearings.

'We can show that these nano-coatings, which are only a few hundred nanometers thick, occur all around broken-up, fractured grains, and they occur exactly in the places where they can affect the 'weakness' of the fault,'—how easily it moves. We think that as these grains move past one another, the coatings facilitate the displacement.'

By dating the first suite of samples collected in 2005, the researchers show that these coatings are relatively recent. 'They form in actively creeping fault zones,' van der Pluijm said, 'creating a dynamic environment where rocks change while faulting occurs,' Finding signatures that reveal whether a fault is creeping or seismic won't immediately aid in earthquake prediction, van der Pluijm said. 'But it will help us understand what processes govern this behavior.'

Source: University of Michigan