Earthquakes: Water as a lubricant

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Geophysicists from Potsdam (Germany) have established a mode of action that can explain the irregular distribution of strong earthquakes at the San Andreas Fault in California. As the science magazine *Nature* reports in its latest issue, the scientists examined the electrical conductivity of the rocks at great depths, which is closely related to the water content within the rocks. From the pattern of electrical conductivity and seismic activity they were able to deduce that rock water acts as a lubricant.

Los Angeles moves toward San Francisco at a pace of about six centimeters per year, because the Pacific plate with Los Angeles is moving northward, parallel to the North American plate which hosts San Francisco. But this is only the average value. In some areas, movement along the fault is almost continuous, while other segments are locked until they shift abruptly several meters against each other releasing energy in strong earthquakes. After the San Francisco earthquake of 1906, the plates had moved by six meters.

The San Andreas Fault acts like a seam of the earth, ranging through the entire crust and reaching into the mantle. Geophysicists from the GFZ German Research Centre for Geosciences have succeeded in imaging this interface to great depths and to establish a connection between processes at depth and events at surface. "When examining the image of the electrical conductivity, it becomes clear that rock water from depths of the upper mantle, i.e. between 20 to 40 km, can penetrate the shallow areas of the creeping section of the fault, while these fluids are detained in other areas beneath an impermeable layer", says Dr. Oliver Ritter of

the GFZ. "A sliding of the plates is supported, where fluids can rise."

These results suggest that significant differences exist in the mechanical and material properties along the fault at depth. The so-called tremor signals, for instance, appear to be linked to areas underneath the San Andreas Fault, where fluids are trapped. Tremors are low-frequency vibrations that are not associated with rupture processes as they are typical of normal earthquakes. These observations support the idea that fluids play an important role in the onset of earthquakes.

More information: M. Becken et al., "Correlation between deep fluids, tremor and creep along the central San Andreas fault", Nature No. 480, Dec. 2011, pp. 87-90, dx.doi.org/10.1038/nature10609

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