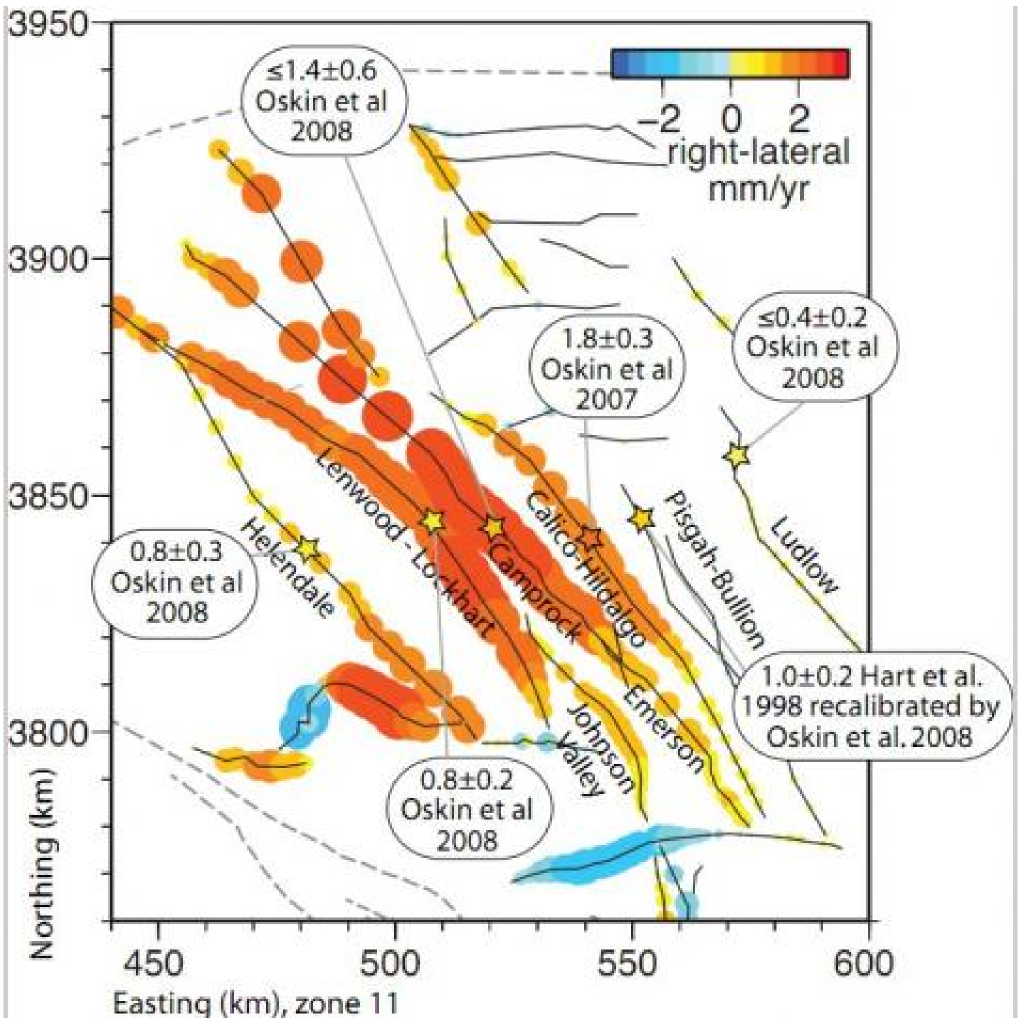
Geoscientists improve modeling of San Andreas fault

April 22 2011



San Andreas Fault diagram

(PhysOrg.com) -- In the aftermath of recent earthquakes in New Zealand

and Japan, people who follow world news have been learning just how little scientists know about even the major fault systems and tectonic plate interactions that underlay the earth's earthquake-prone zones.

Now a University of Massachusetts Amherst geosciences research team has developed and tested a new, more accurate, three-dimensional model of the fault systems under the San Andreas Fault, one of the most closely-watched seismic zones in the world because of its proximity to Los Angeles. Michele Cooke and Laura Dair say their model should be helpful in answering questions such as how faults grow and evolve and why some fault strands become abandoned and new ones develop instead.

Cooke says the southern Big Bend of the San Andreas Fault in southern California has a complex but distinct record of changing fault geometry. In the past 1 million years alone, for example, the active strand of the southern big bend of the San Andreas Fault has changed configuration at least twice. Over the same period, it has abandoned two strands, at Mission Creek and Mill Creek, before taking its present-day configuration.

"Investigating these transitions may help us to understand how fault systems evolve," Cooke explains. "Why did the San Andreas jump ship twice? Maybe it's trying to handle the strain better, that is, improve its mechanical efficiency. Our new approach could help to predict where a fault will be tomorrow, or more usefully, 500 years from now," she adds.

"We demonstrate that our models replicate the distribution of slip on the San Andreas better than any others out there. This approach can be applied to any fault in the world to improve our understanding of seismic risk." Details are in the current issue of the *Journal of Geophysical Research* published this week.

In the two-part study, she and Dair first validated that the model represents recent and present-day deformation by comparing with available geologic data. They simulate active three-dimensional fault surfaces that were identified from geologic mapping, seismicity and geophysical data at a level of detail far surpassing previous efforts to investigate regional deformation in California. The benefit is a more complete and refined understanding of the present slip rate and geometry. This basic research is in itself quite useful because slip rate is time consuming to measure and critical for estimating seismic hazard, Cooke points out. The models allow us to interpolate between the sites where slip rates have been directly measured.

In the second part of the work, Cooke and Dair explored the hypothesis that fault systems abandon certain strands to increase mechanical efficiency, which would decrease the work required to accommodate strain on the fault. They simulated fault evolution of the southern Big Bend of the San Andreas using Boundary Element Method (BEM) software that allows three-dimensional modeling of deformation at three stages of the famous fault's evolution over the past 1 million years. One of the few researchers in the world to study fault abandonment, she adds that the San Andreas makes a good test case because its past has been unraveled by the careful mapping of Jon Matti of the U.S. Geological Survey, who spent years investigating this area and walking the faults, Cooke says.

Cooke and Dair's efficiency analysis of the San Andreas Fault support the premise that the Mill Creek fault developed to increase the overall efficiency of the San Andreas Fault system from the inefficient sharp kink of the older Mission Creek strand. The new tool is promising and with more testing could well help to make new types of earthquake predictions.

Provided by University of Massachusetts Amherst