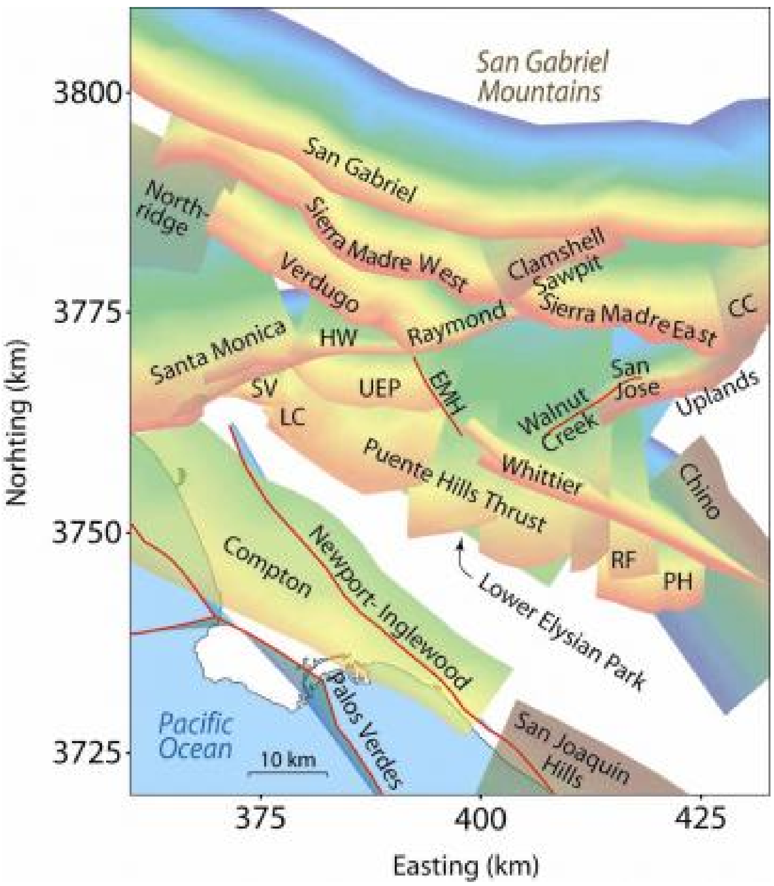
New Earthquake Model for Los Angeles Finds Some Faults Moving Faster Than Expected

November 14 2006



Cooke and Marshall's model suggests that the Verdugo-Eagle rock fault is moving about .8 mm per year and should be further studied and trenched. Credit: University of Massachusetts Amherst

An analysis of slip rates for 26 active faults in the Los Angeles metropolitan area validates a new approach to modeling fault tectonics and finds that some faults may be moving faster than earlier models estimated, University of Massachusetts Amherst scientists report.

The new model incorporates interactions that occur deep in the Earth's crust, and should offer more accurate data to earthquake probability models, which are used by the state of California to set insurance rates. The work is published in the Nov. 21 issue of *Geophysical Research Letters*.

To estimate earthquake risk, scientists like to start with direct measurements such as slip rates—the speed with which one side of a fault moves in relation to another. But for many faults—such as the Verdugo fault that runs through Glendale and Burbank in the eastern San Fernando valley—such data aren't available.

To fill in the gaps where direct measurements are impossible or difficult to obtain, scientists will often use models that simulate geologic deformations. But previous models of the L.A. metropolitan area—a network of interacting active faults in several directions—have oversimplified fault geometry and thus predicted unusually high slip rates, says Michele Cooke, a structural geologist at UMass Amherst.

So Cooke and her doctoral student Scott Marshall set out to devise a model that would preserve the complexity of the L.A. basin fault system topology, but wouldn't take years of measurements and number-crunching to complete. Using a technique known as the Boundary Element Method, or BEM, they developed a three-dimensional model based on detailed fault surface data compiled in the Community Fault Model of the Southern California Earthquake Center.

In the new model, faults move due to stresses and strains arising from regional deformation, but they also may move due to neighboring fault activity. This is important, says Cooke, because how faults are connected has a lot do with how they will behave.

The scientists incorporated such activity by extending the faults in their model about 17 miles (27.5 km) down to where the lower crust meets the mantle, an area known as the Mohorovičić discontinuity, or Moho region. A range of geodynamic processes are influenced by what goes on in the Moho, where rocks may flow in molten streams and temperatures can exceed 500 degrees Celsius.

“In older models the faults just ended in the upper crust, now we’ve tied everything to the Moho,” she says. “Extending the faults of our model further down should allow them to interact and deform more accurately—flow in the lower crust is an important area of fault interaction.”

Sure enough, when the researchers gave the whole system a squeeze and watched how the faults moved, the model nicely matched actual slip rates for several faults for which direct measurements had been obtained. This suggests that the model is also accurately predicting slip rates for faults for which there isn’t as much data, says Cooke.

Cooke approaches fault movement from an expansive view that tries to include how all the faults in a system interact, rather than just focusing on local stresses on the blocks of rock. Her main premise is that faults evolve to minimize the energy in a system and therefore will grow along the path of least resistance. By looking at the entire system one can often understand fault formations that don’t make sense when you just look locally, she says.

The new model suggests that fault geometry plays an important role in slip rates and deformation. It also suggests that there are faults in the

L.A. basin that deserve a closer look. Scientists tend not to worry greatly about slip rates that are less than half a millimeter per year, but if they are greater than one, they deserve to be “trenched,” says Cooke, this is geologist speak for digging a trench at a fault so the record of what’s happened there can be read in the sediment. Cooke and Marshall’s model suggests that the Verdugo-Eagle rock fault is moving about .8 mm per year, they recommend that this fault be further studied and trenched.

“In addition to filling a knowledge gap of slip rates on faults that have not yet been investigated, the success of this three-dimensional model to match the available slip rates demonstrates that getting the geometry right is 90 percent of the challenge,” says Cooke. “This success paves the way for future models using this approach.”

Source: University of Massachusetts Amherst

Citation: New Earthquake Model for Los Angeles Finds Some Faults Moving Faster Than Expected (2006, November 14) retrieved 27 April 2024 from https://phys.org/news/2006-11-earthquake-los-angeles-faults-faster.html