2013 SCEC Workshop Report

The Ventura Special Fault Study Area: Towards an understanding of the potential for and possible effects of large-magnitude thrust earthquakes in the central-western Transverse Ranges

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SCEC Workshop

Ventura Special Fault Study Area

August 15-16, 2013

Ventura Beach Marriott, CA

Agenda:

August 15, 2013

07:00-08:00	Breakfast
08:00-17:00	Working Field Trip to view and discuss major active faults and folds and seismic and tsunami hazards of the Ventura SFSA (Field Trip Guide available online at: http://www.scec.org/workshops/2013/sfsa/2013VenturaFieldGuide_share.pdf)
18:00-21:00	Working Dinner: Participants present results and/or expertise pertinent to future research in the Ventura SFSA (two-minute, two-slide talks by each)

August 16, 2013

07:00-08:00	Breakfast
08:00-12:00	Discussion to develop research strategy and specific research goals for the SCEC Ventura SFSA (available online at: http://www.scec.org/workshops/2013/sfsa/ventura.html)
12:00	Adjourn

The Ventura Special Fault Study Area (SFSA)

The Ventura fault underlies the Ventura Avenue anticline, which is one of the fastest rising structures in southern California, rising at a rate of ~5 mm/yr [Rockwell et al., 1988]. Holocene terraces on the anticline suggest that it deforms in discrete events with 5-10 m of uplift, with the latest event occurring ~900 years ago (Rockwell, 2011). Moreover, recent excavations across the Ventura fault scarp, which runs through the city of Ventura, show evidence for large displacement paleo-earthquakes in the Holocene (McAuliffe et al., 2011; 2014 in prep.).

Based on conventional empirical scaling relationships, the amount of uplift recorded by the terraces and in the trenches would require large earthquakes (M7.5-8.0), suggesting that the Ventura fault ruptures in conjunction with other faults in the Transverse Ranges. Subsurface studies suggest that the Ventura fault is linked at seismogenic depths with the San Cayetano fault to the east (Hubbard et al., 2011; 2014 in press) and the Pitas Point and Red Mountain fault to the west (Sarna-Wojcicki et al., 1976, 1982; Yerkes and Lee, 1987; Yerkes et al., 1987; Huftile and Yeats, 1995; Kamerling et al., 1999; 2003; Hubbard et al., 2011; 2014 in press). Thus, the Ventura fault represents an important linkage between some of the largest, fastest-slipping reverse faults in the Western Transverse Ranges.

Given the availability of geological, geophysical, seismological, and geodetic
data in the region, the Ventura fault offers an excellent natural laboratory to investigate the potential for multi-segment thrust fault earthquakes and the hazards that they pose. These hazards include the prospect of severe ground shaking due to the extreme depth of the Ventura basin (>12 km), as well as the potential for strong regional tsunamis when the ruptures extend offshore.

The SCEC Ventura Special Fault Study Area (SFSA) was established to promote interdisciplinary science that seeks to better understand the prospects for large, multi-segment thrust fault earthquakes in southern California, and to assess and address the hazards that these potentially devastating earthquakes may pose. The goals of the August 15-16, 2013 workshop were bring together a highly interdisciplinary group of SCEC scientists to discuss Ventura SFSA research plans and recommend specific tasks that need to be accomplished to reach these goals in the fields of geology, paleoseismology, exploration geophysics, seismology, tectonic geodesy, rupture dynamics, strong ground motion forecasting, and tsunami studies. Within the time frame of SCEC4, the overall goals for the Ventura SFSA Project are to determine if a record of large, multi-segment thrust fault earthquakes exists in southern California, and to quantify the hazards associated with such events.

Results of Discussion at August 15-16, 2013 Ventura SFSA Workshop and Specific Recommendations to the SCEC Community

Basic Goals – The Ventura SFSA seeks to:

(1) Test and refine the record of large multi-segment ruptures on the Ventura fault system along strike, and extend the record back in time.

(2) Determine how slip and deformation are distributed in these large, multi-segment ruptures, and how might this vary over multiple earthquake cycles.

(3) Characterize the inter-seismic strain accumulation along the Ventura thrust system.

(4) Define a viable set of multi-segment rupture scenarios with dynamic rupture modeling, and evaluate these using the paleo-earthquake record.

(5) Define the intensity, duration, and distribution of strong ground shaking and tsunami run-up that might be anticipated for these events.

(6) Establish if there is a tsunami record associated with these events, and assess these hazards.

Short-Term Objectives – Specific goals and tasks that are recommended for the near future:

(A) Extend the paleo-earthquake record in space and time – confirming if results from terrace analyses, borehole excavations, and offshore seismic event records are consistent.

(B) Develop and test sets of alternative 3D fault representations for the possible linkages between the Ventura-Pitas Point and other thrust systems in the WTR. Make these available to the SCEC Community for use in dynamic rupture modeling, fault system studies, and strong ground motion simulations. Alternative fault models should be made available to the SCEC community by the end of 2013 and thus available for proposed 2014 research efforts.

(C) Expand the current geodetic data set to include more GPS stations and InSAR scenes.

(D) Use more advanced noise models to determine more realistic geodetic error bars.

(E) Expand upon kinematic rupture simulations using more detailed finite source representations and alternative slip models and explore the implications of these for

strong ground motion forecasts.

(F) Perform preliminary, simplified dynamic models of one or two scenario earthquakes for use as reference models for later, more precise work. Use these models to predict tsunami characteristics (e.g. inundation, impact on coastal infrastructure).

(G) Characterize the hypothesized 1812 tsunami bed in Carpinteria Slough (e.g., vertical and lateral trends in grain size, additional chronology, XRF studies, analysis of diatoms) and use the results of this analysis as an analogue for identifying older tsunami beds in longer cores. Repeat the experiment in other locations (e.g. the Goleta Slough near Santa Barbara).

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