WORKSHOP ON ORIGIN AND DEPTH EXTENT OF PULVERIZED ROCK: POSSIBLE INSIGHTS TO BE GAINED FROM SHALLOW BOREHOLES

Although crushed rock has been documented along the active traces of faults in the past, recent work along the San Andreas fault in southern California has led to a new appreciation of the extent and significance of this type of fault rock. Broad, hundred-meter-thick zones of intensely fractured rock, referred to as pulverized rock, are present at many locations along the historically active trace of the southern San Andreas fault. In numerous cases, this pulverization preferentially occurs along the northeast side of fault. This asymmetry, and the suggestion that the pulverization reflects specific aspects of dynamic rupture, have led to the hypothesis that the observed asymmetry is a record of a preferred direction of earthquake rupture along some sections of the San Andreas fault. The possibility that pulverized zones reflect seismic slip events and record characteristics of dynamic rupture have been a topics of vigorous scientific discussion within the earthquake science community over the past few years.

At the 2006 Southern California Earthquake Center Annual Meeting in Palm Springs, a pre-meeting workshop was funded by SCEC and DOSECC to discuss developing a proposal to perform a shallow (~1. 5 km) drilling and borehole geophysical investigation of fault zones in southern California. The focus of this new initiative would be to determine the depth extent and origin of pulverized rock along the active trace of the San Andreas fault and the implications of these faulting products to rupture propagation, rupture direction and the earthquake energy balance.

Convened by Judi Chester, Jim Evans, Yehuda BenZion, and Tom Rockwell, the workshop began with a one-day field trip to key surface exposures of pulverized rock along the Mojave section of the San Andreas fault led by University of Southern California graduate student Ory Dor. The field trip was followed by a day of discussion and oral presentations covering field observations and particle size analyses of pulverized rocks along the southern San Andreas fault (T. Rockwell, J. Brune) and the Arima-Takatsuki Tectonic Line (T. Shimamoto), mechanisms of grain size reduction (C. Sammis), insight from previous and ongoing fault zone drilling projects (W. Ellsworth, and Z. Shipton), and resources and the role of DOSECC (D. Zur).

The workshop attracted 65 scientists who participated in developing key scientific questions that needed to be addressed in future research, and how these questions could be tackled through shallow drilling and borehole geophysical investigations. Discussions focused on the conditions and mechanisms of pulverization, whether pulverization is a indicator of seismic rupture, and the depth extent of the pulverized zone. Additional topics included the origin of the observed asymmetry about the principal fault surface, how much energy is consumed by the pulverization process, and the in situ elastic and seismic attenuation properties of pulverized rocks.

Initial conclusions from the workshop included the need to: 1) more completely characterize the texture of pulverized rock; 2) determine a strategy for coring this fragile fault rock, 3) take initial samples at important sites using conventional augering techniques, and 4) to determine if mechanical and chemical weathering processes in the near-surface environment enhance the breakdown of fractured rock and promote the development of a pulverized character. After gaining more data through surface studies, the plan is to reconvene to discuss possible future drilling and site characterization.