Earthquakes of the East Bay

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If you live in the East Bay you can run but you can't hide. The San Francisco Bay Area occupies the boundary zone between the Pacific and North American plates, which slide past each other in this region at ~40 mm/yr. This plate boundary slip is currently distributed on the major faults including the San Andreas and San Gregorio west of the bay, and the Hayward-Rodgers Creek, northern Calaveras, Greenville, Mt. Diablo, and Concord-Green Valley faults in the East Bay. The East Bay faults accommodate about 50 percent of the total plate motion across a 45-50 km-wide zone. Historically, the 1868 Hayward earthquake remains the largest East Bay earthquake with an estimated magnitude of M~6.8. To the east of the East Bay Hills, the largest historical events are: the 1861 M~6(?) Calaveras earthquake south of San Ramon that may be associated with surface rupture; the 1954 M5.5 Concord fault earthquake; the 1980 M5.8 Greenville fault event, which is associated with small coseismic surface slip and afterslip (afterslip also occurred on the conjugate Las Positas fault); and the 1986 M5.7 Mt. Lewis sequence, which may be part of a broad zone of N-S shear between the Calaveras and Greenville faults. With the exception of consistent microseismicity along the East Bay's creeping faults, seismicity is broadly distributed with magnitudes

on the small side (commonly M1-3) and with typical shallow crustal depths of ≤10±2 km; however, a 25-km-long NW-trending zone of diffuse seismicity east of Mt. Diablo is characterized by small events occurring at depths of 14-19 km, reflecting a thicker crust associated with Mt. Diablo folding. Additionally, the San Ramon Valley is unique in the Bay Area as the home to earthquake swarms, with seven occurring since 1970. These swarms may be a response to stresses in a complex structural zone between the NW-striking right lateral

Calaveras and west-verging compressional structures of Mt. Diablo— and associated with the eastward stepping of plate boundary slip from the Calaveras to the Concord-Green Valley fault. Some small amount of Calaveras slip may also extend north and drive earthquake

occurrence along the West Napa fault zone. None of the major active East Bay faults has historically produced what's considered to be its maximum earthquake, and the concept of what that magnitude is has changed over time. The 1999/2002 Bay Area Probability Working Group and the 2007 Uniform California Earthquake Rupture Forecast (UCERF 2) identified distinct segments or sections of faults—sometimes single, sometimes multiple —based on changes in fault zone properties such as slip rate, geometry (bends and steps), and timing of past earthquake ruptures. The area of these segments, with lengths varying from about 40-150 km, was used to calculate magnitudes that generally ranged from the high M6s to low-mid M7s. The most recent source characterization, UCERF 3 in 2013, relaxed the concept of fault segmentation and through a new, and controversial to many, rupture-making model allows faults to link up. As examples, the northern Calaveras can fail with ruptures extending from the south end of the San Jacinto or San Andreas faults to the north end of the West Napa fault zone; similarly, the southern Hayward can fail with ruptures extending from the San Jacinto and southern San Andreas to the north end of the Maacama fault. While these long ruptures are infrequent in the model they are considered plausible. The UCERF 3 model raises many questions about future earthquake size and probability. The talk will discuss earthquake behavior past and present with regard to the magnitude and probability of future earthquakes in the East Bay.

Biography: David Schwartz is a leading earthquake geologist. He received his BA and MA from Queens College, City University of New York, and his Ph.D. from the State University of New York, Binghamton. After 33 years at the US Geological Survey he retired from his full-time position in October 2017 but remains an active voice in Bay Area earthquake hazard circles as an Emeritus Scientist with the Survey. He is credited with having pushed forward the fields of earthquake geology and paleoseismology (the study of prehistorical seismic events). One of his major contributions is the characteristic earthquake recurrence model, which has become a cornerstone of many seismic hazard analyses. He headed the San Francisco Bay Area Earthquake Hazards Project, co-chaired the Working Group on California Earthquake Probabilities that issued the first major Bay Area 30-year earthquake forecast, and was as a member of the Science Review Panels for the 2008 and 2013 Uniform California Earthquake Rupture Forecasts and the most recent (2014) earthquake probability estimate for the Bay Area. In addition, he twice served as the Northern California Regional Coordinator for the USGS National Earthquake Hazard Program. He has traveled extensively outside the U.S. studying faults that have produced large, historical earthquakes including Mongolia, Tierra del Fuego, northern Peru, Italy, Guatemala, and central Alaska. His current research remains focused on active faults and seismic hazards in the Bay Area, Alaska, and the Intermountain West.