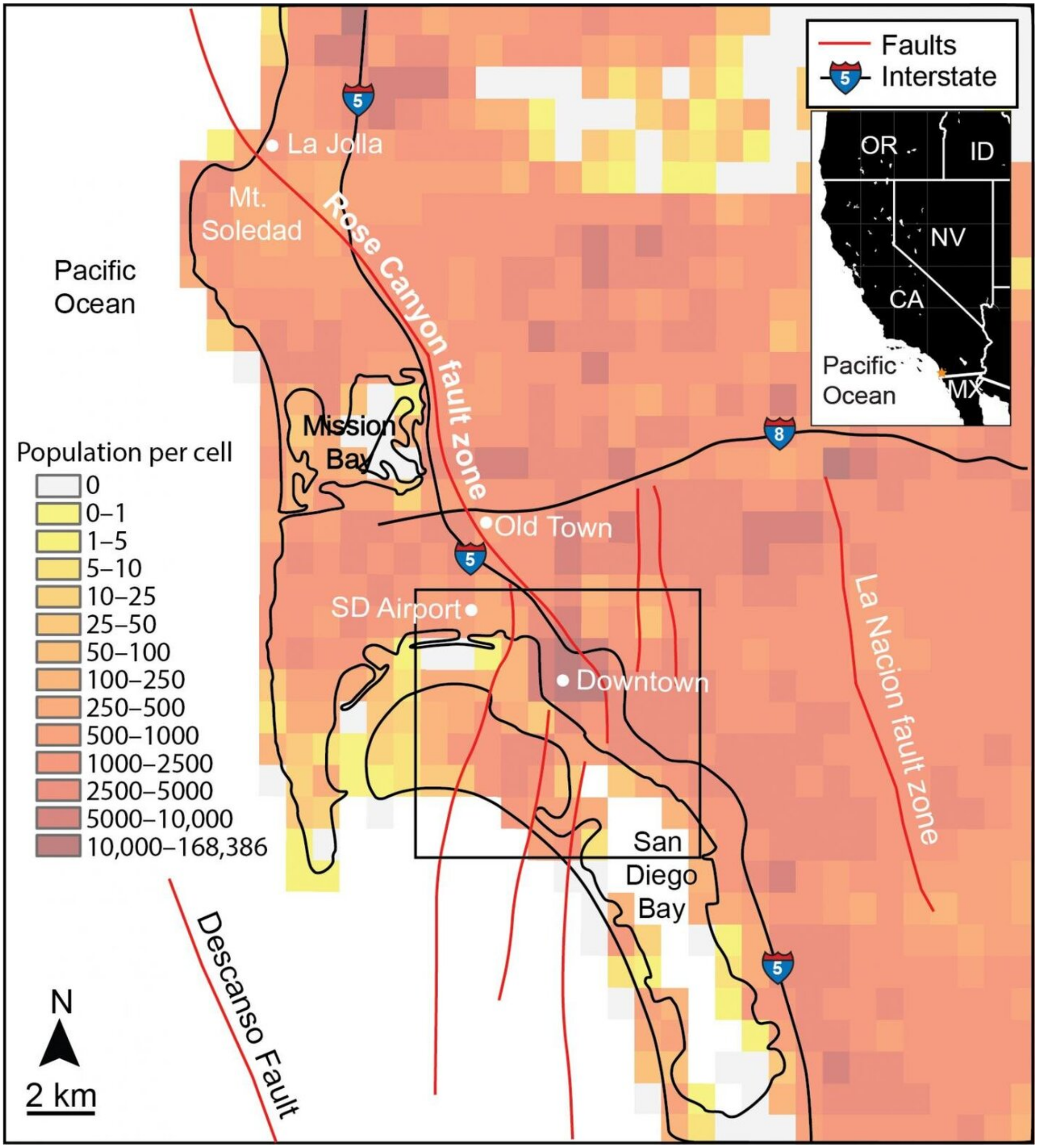
GIS-based analysis of fault zone geometry and hazard in an urban environment

October 24 2019



Map of the Rose Canyon fault zone (RCFZ) through San Diego (SD), California (USA) and across the San Diego Bay pull-apart basin. Grid shows population count per grid cell (~1 km2) (source: LandScan 2017, Oak Ridge National Laboratory, UT-Battelle LLC, https://landscan.ornl.gov/). DF--Descanso fault; SBF--Spanish Bight fault; CF--Coronado fault; SSF--Silver Strand fault; LNFZ--La Nacion fault zone. Credit: LandScan 2017, Oak Ridge National

Laboratory, UT-Battelle LLC, https://landscan.ornl.gov/

Typical geologic investigations of active earthquake fault zones require that the fault can be observed at or near the Earth's surface. However, in urban areas, where faults present a direct hazard to dense populations, the surface expression of a fault is often hidden by development of buildings and infrastructure. This is the case in San Diego, California, where the Rose Canyon fault zone trends through the highly developed downtown.

Due to regulations on development in areas of active faulting, hundreds of individual, city block-sized fault investigations have been conducted by geotechnical consulting firms in downtown San Diego since the late 1970s. The reports produced from these investigations include information on geology and faulting beneath the urban landscape that is valuable to government agencies, the geotechnical community, and earthquake scientists.

Luke Weidman, Jillian M. Maloney, and Thomas K. Rockwell compiled data from 268 of these individual reports to create the first centralized geodatabase for study of the Rose Canyon fault zone through downtown San Diego. The geodatabase includes 2020 georeferenced datapoints with links to the original data logs. The team then used the interactive geodatabase to examine the geometry of the Rose Canyon fault zone beneath the city.

Fault mapping revealed a complex geometry, likely related to a step in the fault zone towards the west and offshore. More work is needed, however, to assess changes in fault activity through time and how those changes may relate to fault zone evolution. The team also identified several places where fault segments mapped in geotechnical reports do not match with other publicly available fault databases.

These contradictions should be resolved for more accurate hazard assessment for the region. Overall, the geodatabase proved to be an effective way to map complex fault zone geometry that is otherwise obscured by development at Earth's surface.

The data held within the geodatabase could also be used for future research on patterns of earthquake occurrence and for models of ground shaking caused by potential future earthquakes along the fault zone. The geodatabase was made publicly available to facilitate these types of projects. A similar approach may be useful in other major cities world-wide where fault zones are located beneath developed regions, such as Los Angeles and San Francisco (USA), Izmit (Turkey), Wellington (New Zealand), and Kumamoto (Japan).

More information: Luke Weidman et al. Geotechnical data synthesis for GIS-based analysis of fault zone geometry and hazard in an urban environment, *Geosphere* (2019). DOI: 10.1130/GES02098.1

Provided by Geological Society of America