

Annual Project Summary

3D QUATERNARY STRATIGRAPHY AND GEOMORPHIC EVOLUTION OF
THE SAN GABRIEL VALLEY, SOUTHERN CALIFORNIA

NEHRP Grant No. 00HQGR0011

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Program Element II.5: Identify active faults, define their geometry, and determine the characteristics and dates of past earthquakes.

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INVESTIGATIONS UNDERTAKEN

This project is designed to capitalize on recent research to produce an integrated 3-dimensional characterization of the subsurface properties that may control the strength of ground shaking in future earthquakes in the San Gabriel Valley. The catalyst is the recent production of digitized, 1:24,000-scale surficial geologic maps for the seven 7.5' quadrangles that comprise the San Gabriel Valley. That mapping, which subdivides Quaternary deposits into 6 facies, 10 age groups, and 5 grain size categories, contains 102 distinct Quaternary map units over the 7-quad area. This detailed surficial mapping can now be combined with the existing geotechnical borehole data base, also in digital format, to generate subsurface cross-sections "on the fly" with desktop GIS software. That ability, in turn, permits a more comprehensive correlation between surface geology and subsurface geology (particularly of the upper 30 m) than has previously been practical.

In addition to these new analytical and data visualization opportunities, the tectonic framework of the area is now better understood in light of recent tectonic and tectonic geomorphology work on the Whittier fault, the Raymond fault, and the Sierra Madre fault. Movement on these structures dictates in large part the location and character of depositional systems that have filled the valley, so in a way tectonics controls sediment distribution, which then controls ground response. Using facies models for alluvial fans and plains, I am constructing a 3D interpretive model that integrates the surface geology, the observed geomorphic processes, and the subsurface geology in the upper 30 m or more. This facies-based model will be tested as a way to define the spatial limits of NEHRP soil class boundaries.

A major spin-off of this project is publication of a monograph on the geomorphic evolution and Quaternary stratigraphic development of the San Gabriel Valley. A first draft of this monograph was written by the author in 1978 after I completed the surficial geologic mapping of the 7 quadrangles. However, I left the USGS before this monograph could be successfully transformed into an Open-File Report. In the ensuing 20 years much has been learned about the Valley's tectonics, about tectonic geomorphology in general, the surface geology and subsurface data have been digitized, and I have gained more understanding of how tectonics affects depositional systems. So, the time is now ripe to finally combine this data into a synthesis, and to see if a facies-based model can explain the variation in subsurface geotechnical properties better than existing, more empirical methods.

The FY 2000 proposal to NEHRP contained 5 tasks, to be spread out over FY 2000 and 2001, as listed below:

- Task 1; Finish Digital Surficial Geologic Map of San Gabriel Valley (FY 2000)
- Task 2; Import Existing Borehole Data Into MapInfo (FY 2000)
- Task 3; Compare Subsurface Geology with Surficial Map Units (FY 2000)
- Task 4; Write Monograph on Quaternary Geology and Geomorphic Evolution (FY 2001)
- Task 5; Make Map of NEHRP Soil Classes Based on Deposits in Upper 30 m (FY 2001)

However, the NEHRP review panel voted to fund the proposal at a reduced level. Year 1 funding (described in this report) was awarded at the level proposed, with the work to consist only of Tasks 1 and 4. Year 2 funding was recommended at a reduced level, to consist of only publication funds for the monograph (Task 4). The panel recommended that a new proposal be submitted to accomplish Tasks 2, 3, and 5.

Accordingly, effort in FY 2000 has been limited to Tasks 1 and 4, as described below.

RESULTS

Task 1; Finish Digital Surficial Geologic Map of San Gabriel Valley

The surficial geologic maps for the 7 1:24,000 quadrangles (Pasadena, Mt. Wilson, Azusa, Glendora, Baldwin Park, El Monte, San Dimas) have been mosaicked and all mis-matches at map boundaries have been corrected (see accompanying map G0011_map.pdf). This correction required going back to original map sources to determine the reason for the mis-match. Next, we mosaicked the 7 30 m DEMs from those quadrangles to construct a valley-wide, 30 m DEM. Then, the digital surficial geology was draped over the composite 30 m DEM to examine patterns of deposit/landform interaction. This 3D geology map showed several correlations between deposits and landforms that were not previously recognized.

Task 4; Write Monograph on Quaternary Geology and Geomorphic Evolution

At the time of this writing (Oct. 22, 2000) I am still compiling information for updating the original 1976 manuscript for the monograph. The following sources have been identified:

Dr. James Dolan, Univ. of Southern California—recent work on tectonic geomorphology in the LA Basin, including trenching of blind thrusts

Dr. Charles Rubin, Eastern Washington Univ.—tectonic geomorphology of the Sierra Madre range front, Quaternary geology of the San Gabriel Valley piedmont

Dr. Scott Lindvall, Lettis & Associates—paleoseismic trenching of the Sierra Madre fault
USGS, Menlo Park

-- FOQUS-LA Project (FOCUS ON QUATERNARY STRATIGRAPHY
IN THE LOS ANGELES REGION)

-- source of 1920s-era topographic maps with a contour interval of 5 ft (scale 1:24,000)

Timeframe for Remaining Work in FY 2000

In the remaining 2 months of the grant I will be traveling to Menlo Park to confer with USGS geologists who have been active in mapping Quaternary deposits and studying active faults in the LA Basin, with particular reference to the San Gabriel Valley. At that time I will provide USGS personnel with the completed composite surficial geologic map of the San Gabriel Valley at 1:50,000 scale, and ask for comments. Based on that feedback, along with comments from academic and industry personnel in Los Angeles, I will write the monograph during the winter months of 2000-2001.

REFERENCES- none for this period