

Geologic Map of the Monterey 30'x 60' Quadrangle and Adjacent Areas, California

Compiled by

David L. Wagner¹, H. Gary Greene², George J. Saucedo¹ and Cynthia L. Pridmore¹

Digitized by

Sarah E. Watkins¹, Jason D. Little¹ and Joseph J. Bizzarro²

2002



Copyright ©2002 by the California Department of Conservation, California Geological Survey. All rights reserved. No part of this publication may be reproduced without the consent of the California Geological Survey. The Department of Conservation makes no warranties as to the suitability of this product for any particular purpose.

GRAY DAVIS, Governor
STATE OF CALIFORNIA

MARY D. NICHOLS, Secretary
THE RESOURCES AGENCY

DARRYL YOUNG, Director
DEPARTMENT OF CONSERVATION

JAMES F. DAVIS, State Geologist
CALIFORNIA GEOLOGICAL SURVEY

¹California Department of Conservation, California Geological Survey

²Moss Landing Marine Laboratories and Monterey Bay Aquarium
Research Institute



CALIFORNIA GEOLOGICAL SURVEY
JAMES F. DAVIS
STATE GEOLOGIST

Copyright © 2002 by the California Department of Conservation.
All rights reserved. No part of this publication may be reproduced
without written consent of the California Geological Survey.

The Department of Conservation makes no warranties as to the
suitability of this product for any particular purpose.

Introduction

The *Geologic Map of the Monterey 30'x60' Quadrangle and Adjacent Areas, California* was compiled from geologic maps covering the Monterey 1:100,000-scale quadrangle, part of the Palo Alto 1:100,000-scale quadrangle, and Monterey Bay between latitudes 36° 30' and 37° 00' north to approximately 122° 20' 00" west longitude. This project was supported in part by the U.S. Geological Survey STATEMAP award no. 98HQA2049. Most of the map was compiled and digitized from existing maps, although some new mapping was conducted and is presented on this map for the first time. There are three plates in this package: a geologic map on a shaded-relief base, which was generated from a digital elevation model (DEM), a geologic map on a topographic base without a DEM, and an explanation of the map units.

This product is also available in digital form, *Geologic Map of Monterey 30' x 60' Quadrangle and Adjacent Areas, California: A Digital Database* on CD-2002-04. The digital files on the CD-ROM include postscript files of the maps, a Portable Document File (.pdf) of the two maps that can be read with an Adobe reader, and map "layers," which were prepared in ARC/INFO®.

Compilation

This project was initiated in 1988 when D.L. Wagner and C.L. Pridmore compiled an analog geologic map of the quadrangle. H. Gary Greene, of the Moss Landing Marine Laboratories, compiled the offshore geology of the continental slope and Monterey Canyon system. Steve Eittreim of the U.S. Geological Survey (USGS) interpreted the geology of the continental shelf (water depths less than 150 meters) on screen at a scale of 1:6,000 from acoustic imagery of 2.4 meter resolution.

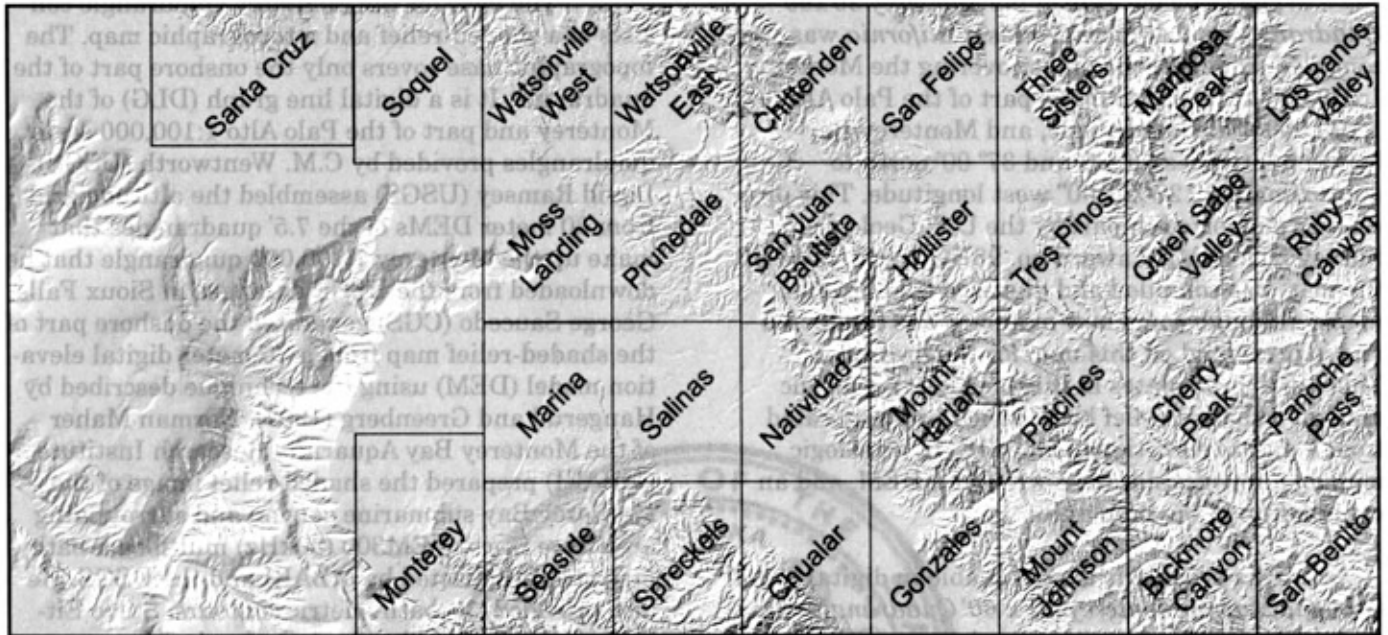
Base material

The base for the Monterey Quadrangle consists of a shaded-relief and a topographic map. The topographic base covers only the onshore part of the quadrangle. It is a digital line graph (DLG) of the Monterey and part of the Palo Alto 1:100,000 scale quadrangles provided by C.M. Wentworth (USGS). David Ramsey (USGS) assembled the altitude grid from 30 meter DEMs of the 7.5' quadrangles that make up the Monterey 1:100,000 quadrangle that he downloaded from the USGS database in Sioux Falls. George Saucedo (CGS) generated the onshore part of the shaded-relief map from a 30-meter digital elevation model (DEM) using the technique described by Haugerud and Greenberg (1997). Norman Maher of the Monterey Bay Aquarium Research Institute (MBARI) prepared the shaded-relief image of the Monterey Bay submarine canyon and surrounding area from Simrad EM300 (30kHz) multibeam bathymetric data collected by MBARI and the USGS. He also provided the bathymetric contours. Steve Eittreim (USGS) provided imagery for the Monterey Bay shelf (water less than 150 meters deep).

Acknowledgements

This compilation was the result of a collaborative effort of the California Geological Survey, the U.S. Geological Survey, the Monterey Bay Aquarium Research Institute and Moss Landing Marine Laboratories. Wagner is grateful to Carl M. Wentworth (USGS) for his guidance and advice concerning digital compilation. Earl E. Brabb (USGS) provided stable base geologic maps for compilation of much of the western part of the onshore map and provided advice on stratigraphic problems. Joseph C. Clark (Indiana University of Pennsylvania) reviewed the explanation of geologic units, which improved it greatly. Clark, Brabb, and Lewis Rosenberg mapped the Spreckels 7.5' Quadrangle for this project.

Sources of geologic data used in the compilation



Bickmore Canyon Quadrangle

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Bickmore Canyon Quadrangle, San Benito and Monterey counties, California: U.S. Geological Survey Open-File Report 79-701, scale 1:24,000.

Wilson, I.F., 1943, Geology of the San Benito Quadrangle, California: Division of Mines, California Journal of Mines and Geology, vol. 39, no. 2, p.183-270, plate III, scale 1:62,500.

Cherry Peak Quadrangle

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Cherry Peak Quadrangle, San Benito County, California: U.S. Geological Survey Open-File Report 79-703, scale 1:24,000.

Wilson, I.F., 1943, Geology of the San Benito Quadrangle, California: Division of Mines, California Journal of Mines and Geology, vol. 39, no. 2, p.183-270, plate III, scale 1:62,500.

Chittenden Quadrangle

Allen, J.E., 1946, Geology of the San Juan Bautista Quadrangle, California: Division of Mines Bulletin 133, p.1-75, plate 1, scale 1:62,500.

Armstrong, C.F., 1980, Environmental geologic analysis of the Tar Creek south study area, Santa Clara County, California: California Division of Mines and Geology Open-File Report 80-11SF, plate 1, scale 1:12,000.

Bishop, C.C., 1971, Geologic map of the Chittenden-San Juan Bautista area, California: California Division of Mines and Geology, unpublished map, scale 1:24,000.

Bryant, W.A., Smith, D.P. and Hart, E.W., 1981, Sargent, San Andreas, and Calaveras fault zones: Evidence for recency of faulting in the Watsonville East, Chittenden, and San Felipe quadrangles, California: California: Department of Conservation, Division of Mines and Geology Open-File Report 81-7SF, scale 1:24,000. (Selected faults of the Sargent Fault Zone).

Dibblee, T.W., Jr. and Brabb, E.E., 1980, Preliminary geologic maps of the Chittenden and Watsonville East quadrangles: U.S. Geological Survey Open-File Report 87-453, scale 1:24,000.

Graymer, R.W., 1997, Geology of southernmost Santa Clara County, California: A digital database: U.S. Geological Survey Open-File Report 97-710, sheet 1.

Wagner, D.L., 2000, Geologic map of part of the Tar Creek area, Santa Clara County, California: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources Open-File Report No. 5 2002, plate I, scale 1:24,000.

Chualar Quadrangle

Bowen, O.E., 1973, Geology of the Monterey and Salinas 15-minute quadrangles, California: California Division of Mines and Geology, unpublished maps, scale 1:62,500.

Dibblee, T.W., Jr., 1999, Geologic map of the Monterey Peninsula and vicinity, Monterey County, California: Dibblee Geological Foundation Map #DF-71, scale 1:62,500.

Tinsley, J.C., III, 1975, Quaternary geology of northern Salinas Valley, Monterey County, California: Stanford University, unpublished Ph.D. dissertation, scale 1:62,500.

Gonzales Quadrangle

Dibblee, T.W., Jr. and Ross, D.C., 1973, Geologic map of the Gonzales Quadrangle, California: U.S. Geological Survey Open-File Report 74-1021, scale 1:62,500.

Tinsley, J.C., III, 1975, Quaternary geology of northern Salinas Valley, Monterey County, California: Stanford University, unpublished Ph.D. dissertation, scale 1:62,500.

Hollister Quadrangle

Dibblee, T.W., Jr. and Rogers, T.H., 1975, Geologic map of the Hollister Quadrangle, California: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500.

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito, Santa Clara, and Monterey counties, California: California Department of Conservation, Division of Mines and Geology Open-File Report 93-01, 26 p., plate 1, scale 1:24,000.

Rosenberg, L.I., 1998, Liquefaction susceptibility of the Hollister area, San Benito County, California: Final Technical Report for the U.S. Geological Survey National Earthquake Hazards Reduction Program, USGS award No. 1434-HQ-97-GR-03125, plate 3, scale 1:24,000.

Los Banos Valley Quadrangle

Dibblee, T.W., Jr., 1975, Geologic map of the Quien Sabe Quadrangle, California: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500.

Lettis, W.R., 1982, Late Cenozoic stratigraphy and structure of the western margin of the San Joaquin Valley, California: U.S. Geological Survey Open-File Report 82-526, 219 p., plate 10, scale 1:24,000. (Quaternary deposits).

Marina Quadrangle

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500.

Mariposa Peak Quadrangle

Drinkwater, J.L., Sorg, D.H. and Russell, P.C., 1992, Geologic map showing ages and mineralization of the Quien Sabe Volcanics, Mariposa Peak Quadrangle, west-central California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2200, scale 1:24,000.

Monterey Quadrangle

Clark, J.C., Dupre, W.R. and Rosenberg, L.I., 1997, Geologic map of the Monterey and Seaside 7.5-minute quadrangles, Monterey County, California: A digital database: U.S. Geological Survey Open-File Report 97-30, scale 1:24,000.

Moss Landing Quadrangle

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz

counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500.

Mount Harlan

Dibblee, T.W., Jr. and Ross, D.C., 1973, Geologic map of the Gonzales Quadrangle, California: U.S. Geological Survey Open-File Report 74-1021, scale 1:62,500.

Ross, D.C., 1972, Reconnaissance geologic map of pre-Cenozoic basement rocks of the Gabilan Range, Monterey and San Benito counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-357, scale 1:125,000.

Mount Johnson

Dibblee, T.W. Jr. and Ross, D.C., 1973, Geologic map of the Gonzales Quadrangle, California: U.S. Geological Survey Open-File Report 74-1021, scale 1:62,500.

Ross, D.C., 1972, Reconnaissance geologic map of pre-Cenozoic basement rocks of the Gabilan Range, Monterey and San Benito counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-357, scale 1:125,000.

Natividad Quadrangle

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500. (Quaternary deposits).

Bowen, O.E., 1973, Geology of the Monterey and Salinas 15-minute quadrangles, California: California Division of Mines and Geology unpublished maps, scale 1:62,500.

Ross, D.C., 1972, Reconnaissance geologic map of pre-Cenozoic basement rocks of the Gabilan Range, Monterey and San Benito counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-357, scale 1:125,000.

Paicines Quadrangle

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Paicines Quadrangle, San Benito and Monterey counties, California: U.S. Geological Survey Open-File Report 79-290, scale 1:24,000.

Panoche Pass Quadrangle

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the San Benito Quadrangle, San Benito County, California: U.S. Geological Survey Open-File Report 79-376, scale 1:62,500.

Wilson, I.F., 1943, Geology of the San Benito Quadrangle, California: Division of Mines, California Journal of Mines and Geology, vol. 39, no. 2, p. 183-270, plate III, scale 1:62,500.

Prunedale Quadrangle

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500.

Quien Sabe Valley Quadrangle

Anderson, P.C., 1983, Geology of the southwest portion of the Quien Sabe Valley 7.5 minute Quadrangle, San Benito County, California: San Jose State University, unpublished M.S. thesis, 88 p., plate 1, scale 1:12,000.

Dibblee, T.W., Jr., 1975, Geologic map of the Quien Sabe Quadrangle, California: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500.

Prowell, D.C., 1974, Geology of selected Tertiary volcanics in the central Coast Range Mountains of California and their bearing on the Calaveras and Hayward fault problems: University of California, Santa Cruz, unpublished Ph.D. dissertation, 182 p., plate III, scale 1:24,000.

Ruby Canyon Quadrangle

Dibblee, T.W., Jr., 1975, Geologic map of the Quien Sabe Quadrangle, California: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500.

Salinas Quadrangle

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500.

San Benito Quadrangle

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the San Benito Quadrangle, San Benito County, California: U.S. Geological Survey Open-File Report 79-376, scale 1:62,500.

Enos, Paul, 1965, Geology of the western Vallecitos Syncline, San Benito County, California: California Division of Mines and Geology Map Sheet 5, scale 1:31,680.

Wilson, I.F., 1943, Geology of the San Benito Quadrangle, California: Division of Mines, California Journal of Mines and Geology, vol. 39, no. 2, p. 183-270, plate III, scale 1:62,500.

San Felipe Quadrangle

Armstrong, C.F. and Wagner, D.L., 1978, Environmental geologic analysis of the Diablo Range study area 1, southern Santa Clara County, California: California Division of Mines and Geology Open-File Report 78-11, plate 1, scale 1:12,000.

Bryant, W.A., Smith, D.P. and Hart, E.W., 1981, Sargent, San Andreas, and Calaveras fault zones: Evidence for recency of faulting in the Watsonville East, Chittenden, and San Felipe quadrangles, California: California: Department of Conservation, Division of Mines and Geology Open-File Report 81-7SF, scale 1:24,000. (Selected faults).

Dibblee, T.W., Jr. and Rogers, T.H., 1975, Geologic map of the Hollister Quadrangle, California: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500.

Graymer, R.W., 1997, Geology of southernmost Santa Clara County, California: A digital database: U.S. Geological Survey Open-File Report 97-710, sheet 1.

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito,

Santa Clara, and Monterey counties, California: California Department of Conservation, Division of Mines and Geology Open-File Report 93-01, 26 p., plate 1, scale 1:24,000.

Rosenberg, L.I., 1998, Liquefaction susceptibility of the Hollister area, San Benito County, California: Final Technical Report for the U.S. Geological Survey National Earthquake Hazards Reduction Program, USGS award No. 1434-HQ-97-GR-03125, plate 1, scale 1:24,000.

San Juan Bautista Quadrangle

Allen, J.E., 1946, Geology of the San Juan Bautista Quadrangle, California: Division of Mines Bulletin 133, p. 1-75, plate 1, scale 1:62,500.

Bishop, C.C., 1971, Geologic map of the Chittenden-San Juan Bautista area, California: California Division of Mines and Geology, unpublished map, scale 1:24,000.

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the San Juan Bautista Quadrangle, San Benito and Monterey counties, California: U.S. Geological Survey Open-File Report 79-375, scale 1:24,000.

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500. (Quaternary deposits).

Santa Cruz Quadrangle

Clark, J.C., 1981, Stratigraphy, paleontology, and geology of the central Santa Cruz Mountains, California Coast Ranges: U.S. Geological Survey Professional Paper 1168, 51 p., plate 2, scale 1:24,000.

Stanley, R.G. and McCaffery, Robert, 1983, Extent and history of the Ben Lomond Fault, Santa Cruz County, California, in Anderson, D.W. and Rymer, M.J., editors, Tectonics and sedimentation along faults of the San Andreas System: Pacific Section of Economic Paleontologists and Mineralogists, Los Angeles, May 18, 1983, p. 79-90. (Ben Lomond Fault).

Seaside Quadrangle

Clark, J.C., Dupre, W.R. and Rosenberg, L.I., 1997, Geologic map of the Monterey and Seaside 7.5-minute quadrangles, Monterey County, California: A digital database: U.S. Geological Survey Open-File Report 97-30, sheet 1, scale 1:24,000.

Soquel Quadrangle

Brabb, E.E., 1989, Geologic map of Santa Cruz County, California: U.S. Geological Survey Miscellaneous Investigations Series Map I-1905, scale 1:62,500.

Spreckels Quadrangle

Clark, J.C., Brabb, E.E., Dupre, W.R. and Rosenberg, L.I., 1999, Geologic map of the Spreckels Quadrangle, Monterey County, California: unpublished map, 1:24,000.

Three Sisters Quadrangle

Bryant, W.A., 1985, Faults in the southern Hollister area, San Benito County, California: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report FER-164, 17 p. (Selected faults).

Osuch, L.H., 1970, Geology of the Three Sisters Quadrangle, California: University of California, Berkeley, unpublished M.A. thesis, 59 p., scale 1:24,000.

Wagner, D.L., 1989, Geologic map of the north half of the Three Sisters Quadrangle, Santa Clara and San Benito counties, California: California Department of Conservation, Division of Mines and Geology, unpublished map, scale 1:24,000.

Tres Pinos Quadrangle

Bryant, W.A., 1985, Faults in the southern Hollister area, San Benito County, California: California Department of Conservation, Division of Mines and Geology Fault Evaluation Report FER-164, 17 p. (Selected faults).

Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Tres Pinos Quadrangle, San Benito County, California: U.S. Geological Survey Open-File Report 79-702, scale 1:24,000.

Watsonville East Quadrangle

Brabb, E.E., 1989, Geologic map of Santa Cruz County, California: U.S. Geological Survey Miscellaneous Investigations Series Map I-1905, scale 1:62,500.

Bryant, W.A., Smith, D.P. and Hart, E.W., 1981, Sargent, San Andreas, and Calaveras fault zones: Evidence for recency of faulting in the Watsonville East, Chittenden, and San Felipe quadrangles, California: California: Department of Conservation, Division of Mines and Geology Open-File Report 81-7SF, scale 1:24,000. (Zayante Fault Zone).

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500. (Quaternary deposits).

Dibblee, T.W., Jr., 1978, Preliminary geologic map of the Watsonville East Quadrangle, Santa Cruz, Santa Clara, and Monterey counties, California: U.S. Geological Survey Open-File Report 78-453, scale 1:24,000. (Minor modifications by D.L. Wagner, 1999 and Graymer, R.W., written communication, 1999).

Hall, N.T., Sarna-Wojcicki, A.M. and Dupre, W.R., 1974, Faults and their potential hazards in Santa Cruz County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-626, scale 1:62,500. (Zayante Fault Zone).

Graymer, R.W., 1997, Geology of southernmost Santa Clara County, California: A digital database: U.S. Geological Survey Open-File Report 97-710, sheet 1.

Watsonville West Quadrangle

Brabb, E.E., 1989, Geologic map of Santa Cruz County, California: U.S. Geological Survey Miscellaneous Investigations Series Map I-1905, scale 1:62,500.

Dupre, W.R. and Tinsley, J.C., III, 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1199, sheet 1, scale 1:62,500. (Quaternary deposits).

Hall, N.T., Sarna-Wojcicki, A.M. and Dupre, W.R., 1974, Faults and their potential hazards in Santa Cruz County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-626, scale 1:62,500. (Zayante Fault Zone).

Offshore area

Continental slope and Monterey submarine canyon system:

Greene, H.G., 1977, Geologic map of the Monterey Bay region, California: U.S. Geological Survey Open-File Report 77-718, scale 1:125,000.

Greene, H.G., 1999, Geology of Monterey Bay, unpublished data, Moss Landing Marine Laboratory and Monterey Bay Aquarium Research Institute, scale 1:100,000.

McCulloch, D.S. and Greene, H.G., 1990, Geologic map of the central California continental margin, in Greene, H.G. and Kennedy, M.P., editors, Geology of the central California continental margin: California Department of Conservation, Division of Mines and Geology Continental Margin Map Series, map no. 5A, scale 1:250,000.

Continental Shelf (less than 150 meters water depth):

Eittreim, S.L., Anima, R.J. and Stevenson, A.J., 2001, Seafloor geology of the Monterey Bay area continental shelf, Marine Geology, in press.

Eittreim, S.L., Anima, R.J., Stevenson, A.J. and Wong, F.L., 2000, Seafloor rocks and sediments of the continental shelf from Monterey Bay to Pt. Sur, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2345, scale 1:125,000.

<http://geopubs.wr.usgs.gov/map-mf/mf2345>