

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

**QUATERNARY GEOLOGY OF CONTRA COSTA COUNTY,
AND SURROUNDING PARTS OF ALAMEDA, MARIN,
SONOMA, SOLANO, SACRAMENTO, AND SAN JOAQUIN
COUNTIES, CALIFORNIA: A DIGITAL DATABASE**

By

E.J. Helley¹ and R.W. Graymer¹

Open - File Report 97-98

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

This database, identified as "Quaternary geology of Contra Costa County, and surrounding parts of Alameda, Marin, Sonoma, Solano, Sacramento, and San Joaquin Counties, California: A digital database," has been approved for release and publication by the Director of the USGS. Although this database has been subjected to rigorous review and is substantially complete, the USGS reserves the right to revise the data pursuant to further analysis and review. Furthermore, it is released on condition that neither the USGS nor the United States Government may be held liable for any damages resulting from its authorized or unauthorized use.

1997

¹Western Region Mapping Group, U.S. Geological Survey, 345 Middlefield Rd., M/S 975, Menlo Park, CA 94025

Introduction

This Open-File report is a digital geologic map database. This pamphlet serves to introduce and describe the digital data. There is no paper map included in the Open-File report. The report does include, however, PostScript plot files containing images of a geologic map sheet and an explanation sheet, as well as the accompanying text describing the Quaternary geology of the area. For those interested in a paper plot of information contained in the database or in obtaining the PostScript plot files, please see the section entitled "For Those Who Don't Use Digital Geologic Map Databases" below.

This digital map database, compiled from previously unpublished data, and new mapping by the authors, represents the general distribution of surficial deposits in Contra Costa County and surrounding areas. Together with the accompanying text file (ccqgeo.txt or ccgeo.ps), it provides current information on the Quaternary stratigraphy of the area covered. The database delineates map units that are identified by general age and lithology following the stratigraphic nomenclature of the U.S. Geological Survey. The scale of the source maps limits the spatial resolution (scale) of the database to 1:24,000 or smaller. The content and character of the database, as well as three methods of obtaining the database, are described below.

For Those Who Don't Use Digital Geologic Map Databases

For those interested in the Quaternary geology of Contra Costa County who do not use an ARC/INFO compatible Geographic Information System (GIS), two PostScript plot files containing images of much of the data in the digital database, as well as PostScript plot files of the explanatory text, have been included in the database package (please see the section "PostScript Plot Files" below). Those interested who have computer capability can access the PostScript plot files in any of the three ways described below to access the digital data (please see the section "Obtaining the Digital Data") including the Western Region Web Page (please see the section "Web Pages"). For those without computer capability, we have made the plot files available to an outside vendor or we can provide users with the PostScript plot files on digital tape that can be used by other vendors (please see the section "Obtaining Plots from an Outside Vendor").

Database Contents

The digital database package consists of the geologic map database itself, and the supporting data, including base maps, map explanation, geologic description, and references. A second data package consists of PostScript plot files of a geologic map, explanation sheet, and geologic description.

DIGITAL DATABASE PACKAGE

The first database package includes a separate geologic map database file for each of the 23 quadrangles with Quaternary deposits in Contra Costa County. The digital maps, or coverages, along with their associated INFO directory have been converted to uncompressed ARC/INFO export files. ARC export files promote ease of data handling, and are usable by some Geographic Information Systems in addition to ARC/INFO (see below for a discussion of working with export files). The ARC export files and the associated ARC/INFO coverages and directories, as well as the additional digital material included in the database, are described below:

| ARC/INFO export file ----- | Resultant Coverage ----- | Description of Coverage ----- |
|----------------------------------|--------------------------------|--|
| an_sp-py.e00 | an_sp-py/ | Quaternary geology in Antioch North quadrangle |
| as_sp-py.e00 | as_sp-py/ | Antioch South quadrangle |
| be_sp-py.e00 | be_sp-py/ | Benicia quadrangle |
| bh_sp-py.e00 | bh_sp-py/ | Byron Hot Springs quadrangle |
| bi_sp-py.e00 | bi_sp-py/ | Bouldin Island quadrangle |
| bv_sp-py.e00 | bv_sp-py/ | Briones Valley quadrangle |
| bw_sp-py.e00 | bw_sp-py/ | Brentwood quadrangle |
| cf_sp-py.e00 | cf_sp-py/ | Clifton Court Forebay quadrangle |
| cl_sp-py.e00 | cl_sp-py | Clayton quadrangle |
| di_sp-py.e00 | di_sp-py/ | Diablo quadrangle |
| du_sp-py.e00 | du_sp-py/ | Dublin quadrangle |
| hb_sp-py.e00 | hb_sp-py/ | Honker Bay quadrangle |
| ji_sp-py.e00 | ji_sp-py/ | Jersey Island quadrangle |
| lt_sp-py.e00 | lt_sp-py/ | Las Trampas Ridge quadrangle |
| lv_sp-py.e00 | lv_sp-py | Livermore quadrangle |
| mi_sp-py.e00 | mi_sp-py/ | Mare Island quadrangle |
| oe_sp-py.e00 | oe_sp-py | Oakland East quadrangle |
| ri_sp-py.e00 | ri_sp-py/ | Richmond quadrangle |
| sq_sp-py.e00 | sq_sp-py | San Quentin quadrangle |
| ta_sp-py.e00 | ta_sp-py/ | Tassajara quadrangle |
| vh_sp-py.e00 | vh_sp-py/ | Vine Hill quadrangle |
| wc_sp-py.e00 | wc_sp-py/ | Walnut Creek quadrangle |
| wi_sp-py.e00 | wi_sp-py/ | Woodward Island quadrangle |

The database package also includes the following ARC coverages, and files:

ARC Coverages, which have been converted to uncompressed ARC/INFO export files:

| ARC/INFO export file ----- | Resultant Coverage ----- | Description of Coverage ----- |
|----------------------------------|--------------------------------|---|
| ccq_quad.e00 | ccq_quad/ | Index map of quadrangles in Contra Costa County. |
| ccq_corr.e00 | ccq_corr/ | Correlation table for the units in this map database. |
| cc_dr-sp.e00 | cc_dr-sp/ | Drainage base map (from 1:100,000 scale originals). |
| cc_cu-sp.e00 | cc_cu-sp/ | Cultural base map (from 1:100,000 scale originals). |
| cc_topo-sp.e00 | cc_topo-sp/ | Topographic contours base map (from 1:100,000 scale originals). |

ASCII text files, including explanatory text, ARC/INFO key files, PostScript plot files, and a ARC Macro Language file for conversion of ARC export files into ARC coverages:

| | |
|------------------------|---|
| ccqgeo.ps | A PostScript plot file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited. |
| ccqgeo.txt | A text-only file containing an unformatted version of ccqgeo.ps. |
| ccqdb.ps | This file. |
| ccqdb.txt | A text-only file containing an unformatted version of ccqdb.ps. |
| ccqkey.un ccqkey.ln | Together, these key files produce a plottable or displayable map explanation and key. |
| import.aml | ASCII text file in ARC Macro Language to convert ARC export files to ARC coverages in ARC/INFO. |

The following supporting directory is not included in the database package, but is produced in the process of reconvertng the export files into ARC coverages:

| | |
|-------|---|
| info/ | INFO directory containing files supporting the databases. |
|-------|---|

POSTSCRIPT PLOTFILE PACKAGE

A second digital data package is also available, which contains the PostScript images described below:

| | |
|-----------|--|
| ccqmap.ps | A PostScript plottable file containing an image of the Quaternary geologic map and base maps of Contra Costa County and surrounding areas at a scale of 1:100,000 (Sheet 1). |
|-----------|--|

- ccqexpl.ps A PostScript plottable file containing an image of the map keys, and index maps for Contra Costa County (Sheet 2).
- ccqgeo.ps A PostScript plot file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited.

Database Release Format

The database was compiled in ARC/INFO, a commercial Geographic Information System (Environmental Systems Research Institute, Redlands, California), and is stored in uncompressed ARC export format (ARC/INFO version 7) in a compressed UNIX tar (tape archive) file. Tar and uncompress utilities are therefore required to extract the database from the tar file. These utilities are included in most UNIX systems, and can be obtained free of charge via the Internet from Internet Literacy's Common Internet File Formats Web page (<http://www.matisse.net/files/formats.html>). ARC/INFO export files (files with the .e00 extension) can be converted into ARC/INFO coverages (see below) and can be read by some other Geographic Information Systems, such as MapInfo via ArcLink. The digital compilation was done using version 7.0.3 of ARC/INFO with version 3.0 of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991, Fitzgibbon, 1991, Wentworth and Fitzgibbon, 1991).

Obtaining the Digital Data

The digital data can be obtained in any of three ways:

- a. Sending a tape with request
- b. Anonymous ftp over the Internet
- c. From the Western Region Geologic Information Web Page.

A 17.3 MB compressed tar file of the database and related files can be obtained by sending a tape with request and return address to:

Contra Costa County Quaternary Geologic Database
 c/o Database Coordinator
 U.S. Geological Survey
 345 Middlefield Road, M/S 975
 Menlo Park, CA 94025

Do not omit any part of this address!

The compressed tar file will be returned on the tape. The acceptable tape types are:
 1/4 inch, 150 MB cartridge tape
 2.3 or 5.0 GB, 8 mm Exabyte tape.

To obtain the tar file by ftp, log in to your UNIX system and do the following:

- | | |
|-----------------------|---|
| cd local_directory | -go to a directory to receive the tar file |
| ftp wrgis.wr.usgs.gov | -make ftp connection with the USGS computer WRGIS |
| Name: anonymous | -use "anonymous" as your user name |
| Password: your name | -use your own user name as |

| | |
|-----------------|--|
| cd pub/geologic | password |
| cd ca/of97-98 | -go down to the pub/geologic directory |
| type binary | -go down to the open file directory |
| get cc_q1.tar.Z | -change transfer type to binary |
| | -copy the compressed tar file |
| | across Internet to your directory |
| quit | -close the ftp connection |

Web Pages

The U.S. Geological Survey now supports a set of graphical pages on the World Wide Web. Digital publications (including this one) can be accessed via these pages. The location of the main web page for the entire U.S. Geological Survey is "<http://www.usgs.gov>". The web server for digital publications from the Western Region is "<http://wrgis.wr.usgs.gov>"; go to the California page to access this publication. In addition to providing easy access to the entire digital database, the Western Region web page also provides simple access to the PostScript plot files of the map and explanation sheet containing much of the data in the digital database for those interested in the geology of Contra Costa County who do not use digital databases (see below).

Extracting the Database from the Tar file

If you obtained the database on tape:

| | |
|--|--|
| put the tape in your tape drive | |
| cd local_directory | -go to a directory to receive the tar file |
| tar xvfb /dev/rstn 20 | -/dev/rstn is the tape device with an integer, this puts the tar file in local_directory |
| uncompress cc_q1.tar.Z | -makes a 79 MB uncompressed tar file cc_q1.tar |
| cd local_directory2 | -go to the directory that will hold the directory ccqgeo (if different from local_directory) |
| tar xvfb {path to tar file}/cc_q1.tar 20 | -extract the ccqgeo directory from the tar file. |

If you obtained the database by anonymous ftp or from the web page:

| | |
|--|--|
| uncompress cc_q1.tar.Z | -makes a 79 MB uncompressed tar file cc_q1.tar |
| cd local_directory2 | -go to the directory that will hold the directory ccqgeo (if different from local_directory) |
| tar xvfb {path to tar file}/cc_q1.tar 20 | -extract the ccqgeo directory from the tar file. |

This process will create a directory "/ccqgeo" that contains the ARC export files and supporting files as described above.

PostScript Plot Files

The database is in ARC export format, and therefore requires use of ARC/INFO or another compatible GIS system to access the information contained within it. For those interested in the geology of the Alameda County who don't use an ARC/INFO compatible GIS system we have included a separate data package with three PostScript plot files. One contains a color plot of the geologic map database at 1:100,000 scale (Sheet 1, ccqmap.ps). The second contains a color plot of the map keys and index map (Sheet 2, ccqexpl.ps). Because this release is primarily a digital database, the plot files (and plots derived therefrom) have not been edited to conform to U.S. Geological Survey standards. Small units have not been labeled with leaders and in some instances map features or annotation overlap. Sample plots by the authors have proven to be quite legible and useful, however. In addition, a third PostScript file containing the geologic description and discussion is provided (alqgeo.ps). These plot files are available, both within the complete digital database package and as separate files, in any of the three ways described above, including the World Wide Web pages. However, the plot files are stored in compressed UNIX tar files requiring uncompress and tar utilities to access the files. These utilities are included in most UNIX systems, or can be obtained free of charge via the Internet from Internet Literacy's Common Internet File Formats Web page (<http://www.matisse.net/files/formats.html>). The PostScript images are 44 inches wide by 34 inches high, so they require a large plotter to produce paper copies at the intended scale. The image of Sheet 2 is 15 by 20 inches. In addition, some plotters, such as those with continual paper feed from a roll, are oriented with the long axis in the vertical direction, so the PostScript image will have to be rotated 90 degrees to fit entirely onto the page. Some plotters and plotter drivers, as well as many graphics software packages, can perform this rotation. The geologic description is on 8.5 by 11 inch pages.

Obtaining Plots from an Outside Vendor

For those interested in the Quaternary geology of Contra Costa County who do not use computers, we have made the PostScript plot files available to Capitol Color (phone: (800) 700-2656 or (408) 727-7560, FAX: (408) 727-0737). They will provide plots of the PostScript images of the geologic map sheet and explanation sheet for a fee (around \$25 per sheet, with discounts for orders of multiple copies). We will also provide the PostScript plot files on digital tape for use by other vendors. A 10 MB compressed tar file (ccqps.tar.Z, 33.6 MB when uncompressed) of the PostScript plot files can be obtained by sending a tape with request and return address to:

Contra Costa County Quaternary Geology PostScript Plotfiles
c/o Database Coordinator
U.S. Geological Survey
345 Middlefield Road, M/S 975
Menlo Park, CA 94025

Do not omit any part of this address!

The compressed tar file will be returned on the tape. The acceptable tape types are:
1/4 inch, 150 MB cartridge tape
2.3 or 5.0 GB, 8 mm Exabyte tape.

Make sure your vendor is capable of reading these tape types and PostScript plot files. Important information regarding tape file format is included in the section "PostScript Plot Files" above, so be certain to provide a copy of this document to your vendor.

Extracting the PostScript plotfile package from the Tar file

If you obtained the plotfile package on tape:

```
put the tape in your tape drive
cd local_directory          -go to a directory to receive the
                             tar file
tar xvfb /dev/rstn 20       -/dev/rstn is the tape device with
                             n an integer, this puts the tar file
                             in local_directory
uncompress ccqps.tar.Z      -makes a 33.6 MB uncompressed
                             tar file ccqps.tar
cd local_directory2         -go to the directory that will hold
                             the directory ccqplot (if different
                             from local_directory)
tar xvfb {path to tar
file}/ccqps.tar 20          -extract the ccqplot directory from
                             the tar file.
```

If you obtained the database by anonymous ftp or from the web page:

```
uncompress ccqps.tar.Z      -makes a 33.6 MB uncompressed
                             tar file ccqps.tar
cd local_directory2         -go to the directory that will hold
                             the directory ccqplot (if different
                             from local_directory)
tar xvfb {path to tar
file}/ccqps.tar 20          -extract the ccqplot directory from
                             the tar file.
```

This process will create a directory "/ccqplot" that contains the PostScript plot files as described above.

Converting ARC export files

ARC export files are converted to ARC coverages using the ARC command IMPORT with the option COVER. In order to ease conversion and to maintain naming conventions, we have included an ASCII text file in ARC Macro Language that will convert all of the export files in the database into coverages and create the associated INFO directory. From the ARC command line type:

```
Arc: &run import.aml
```

ARC export files can also be read by some other Geographic Information Systems. Please consult your GIS documentation to see if you can use ARC export files and the procedure to import them.

Digital Compilation

The geologic map information was digitized from stable originals of the geologic maps at 1:24,000 scale. The author manuscripts (pencil on mylar) were scanned using a Altek monochrome scanner with a resolution of 800 dots per inch. The scanned images were vectorized and transformed from scanner coordinates to projection coordinates with digital tics placed by hand at quadrangle corners. The scanned lines were edited interactively by hand using ALACARTE, color boundaries were tagged as appropriate, and scanning artifacts visible at 1:24,000 were removed.

Base Maps

Base Map layers were prepared from scale-stable printing negatives of the U.S. Geological Survey San Francisco (1978 edition), Stockton (1989 edition), Napa (1983 edition), and Lodi (1993 edition) 1:100,000 topographic maps, which have a 50 meter contour interval. Scanned and vectorized images were transformed from scanner coordinates to projection coordinates with digital tics placed by hand at map corners. The images were then trimmed interactively by hand using ALACARTE to conform to the area of the geologic coverages, and the four portions were combined. Small mismatches at the boundaries caused by slight differences in the original scans remain in the three base map coverages. These base map layers are digital images but no information other than location is attached to the lines. The base maps are provided for reference only.

Faults and Landslides

This map is intended to be of general use to engineers and land-use planners. However, its small scale does not provide sufficient detail for site development purposes. In addition, this map does not take the place of fault-rupture hazard zones designated by the California State Geologist (Hart, 1988). Similarly, the database cannot be used to identify or delineate landslides in the region. For a depiction of landslide distribution, see Nilsen and others (1979).

Spatial Resolution

Uses of this digital geologic map should not violate the spatial resolution of the data. Although the digital form of the data removes the constraint imposed by the scale of a paper map, the detail and accuracy inherent in map scale are also present in the digital data. The fact that this database was edited at a scale of 1:24,000 means that higher resolution information is not present in the dataset. Plotting at scales larger than 1:24,000 will not yield greater real detail, although it may reveal fine-scale irregularities below the intended resolution of the database. Similarly, where this database is used in combination with other data of higher resolution, the resolution of the combined output will be limited by the lower resolution of these data. Note that in contrast to the geologic coverages, the base map layers have a resolution of 1:100,000, so significant discrepancies with the geologic coverages are possible. The base map layers are provided for reference only.

Database Specifics

The map databases consist of ARC coverages and supporting INFO files, which are stored in a Stateplane (California coordinate system) projection (Table 1). Digital tics define a 2.5 minute grid of latitude and longitude in the geologic coverages corresponding with quadrangle corners and internal tics. In the base map layers, the tics define a 7.5 minute grid, corresponding with quadrangle corners.

Table 1 - Map Projection

The maps are stored in Stateplane projection

| | |
|-----------------------|--|
| PROJECTION STATEPLANE | |
| UNITS METERS | -on the ground |
| ZONE 3326 | -Arc/Info Stateplane zone corresponding to California coordinate system zone 3 |
| PARAMETERS | |
| END | |

The content of the geologic database can be described in terms of the lines and the areas that compose the map. Descriptions of the database fields use the terms explained in Table 2.

Table 2 - Field Definition Terms

| | |
|-----------|---|
| ITEM NAME | name of the database field (item) |
| WIDTH | maximum number of digits or characters stored |
| OUTPUT | output width |
| TYPE | B-binary integer, F-binary floating point number, I-ASCII integer, C-ASCII character string |
| N. DEC. | number of decimal places maintained for floating point numbers |

LINES -

The lines (arcs) are recorded as strings of vectors and are described in the arc attribute table (Table 3). They define the boundaries of the map units, the boundaries of open bodies of water, and the map boundaries. These distinctions, including the geologic identities of the unit boundaries, are recorded in the LTYPE field according to the line types listed in Table 4.

Table 3 - Content of the Arc Attribute Tables

| ITEM NAME | WIDTH | OUTPUT | TYPE | N. DEC | |
|---------------|-------|--------|------|--------|--|
| FNODE# | 4 | 5 | B | | starting node of arc (from node) |
| TNODE# | 4 | 5 | B | | ending node of arc (to node) |
| LPOLY# | 4 | 5 | B | | polygon to the left of the arc |
| RPOLY# | 4 | 5 | B | | polygon to the right of the arc |
| LENGTH | 4 | 12 | F | 3 | length of arc in meters |
| <coverage># | 4 | 5 | B | | unique internal control number |
| <coverage>-ID | 4 | 5 | B | | unique identification number |
| LTYPE | 35 | 35 | C | | line type (see Table 4) |
| SEL | 1 | 1 | I | | user defined field used to save a selected set |
| SYMB | 3 | 3 | I | | user defined field used to save symbol assignments (such as color) |

Table 4 - Line Types Recorded in the LTYPE Field

contact, certain
 contact, concealed
 contact, approx. located
 contact, inferred
 water boundary
 map boundary

The geologic linetypes are ALACARTE line types that correlate with the geologic line symbols in the ALACARTE line set GEOL61.LIN according to the ALACARTE lines lookup table (GEOL61.LUT).

AREAS -

Map units (polygons) are described in the polygon attribute table (Table 5) The identities of the map units from compilation sources are recorded in the PTYPE field by map label (Table 6). Map units are described more fully in the accompanying text file ccqgeo.txt or ccqgeo.ps. Note that ARC/INFO coverages cannot contain both point and polygon information, so only coverages with polygon information will have a polygon attribute table, and these coverages will not have a point attribute table.

Table 5 - Content of the Polygon Attribute Tables

| ITEM NAME | WIDTH | OUTPUT | TYPE | N. DEC | |
|---------------|-------|--------|------|--------|---|
| AREA | 4 | 12 | F | 3 | area of polygon in square meters |
| PERIMETER | 4 | 12 | F | 3 | length of perimeter in meters |
| <coverage># | 4 | 5 | B | | unique internal control number |
| <coverage>-ID | 4 | 5 | B | | unique identification number |
| PTYPE | 35 | 35 | C | | unit label |
| SEL | 1 | 1 | I | | user defined field used to save a selected set |
| SYMB | 3 | 3 | I | | user defined field used to save symbol assignments (such as color) |

Table 6 - Map Units
(See ccqgeo.txt or ccqgeo.ps for descriptions of units)

| | | |
|-------|-------|-------|
| | Qhasc | Qpaf |
| af | Qhb | Qpaf1 |
| alf | Qhbm | Qpaf2 |
| br | Qhfp | Qpoaf |
| GP | Qhl | QTI |
| H2O | Qhpm | QTu |
| Qds | Qhsc | |
| Qhaf | Qls | |
| Qhaf1 | Qmt | |

Acknowledgments

Carl M. Wentworth, Todd T. Fitzgibbon, and Geoffrey A. Phelps graciously provided assistance with Alacarte and ARC/INFO. The scanning and initial editing of the digital map of the Livermore quadrangle was done by Marjorie Lucks. Earl E. Brabb provided much helpful advice and feedback, as well as arranging for material support for the project.

References Cited

- Fitzgibbon, T.T., 1991, ALACARTE installation and system manual (version 1.0): U.S. Geological Survey, Open-File Report 91-587B.
- Fitzgibbon, T.T., and Wentworth, C.M., 1991, ALACARTE user interface - AML code and demonstration maps (version 1.0): U.S. Geological Survey, Open-File Report 91-587A.
- Hart, E.W., 1988, Fault-rupture hazard zones in California; Alquist-Priolo Special Studies Zones Act of 1972 with index to special studies zones maps: California Division of Mines and Geology Special Publication 42.
- Nilsen, T.H., Wright, R.H., Vlastic, T.C., and Spangle, W.E., 1979, Relative slope stability and land-use planning in the San Francisco Bay region, California: U.S. Geological Survey Professional Paper 944, 96 p.
- Wentworth, C.M., and Fitzgibbon, T.T., 1991, ALACARTE user manual (version 1.0): U.S. Geological Survey, Open-File Report 91-587C.