DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GENERAL DISTRIBUTION OF GEOLOGIC MATERIALS IN THE SOUTHERN SAN FRANCISCO BAY REGION, CALIFORNIA: A DIGITAL MAP DATABASE

digitally compiled by

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INTRODUCTION

This digital map database, which is compiled from 1970's vintage sources, represents the general distribution and identity of geologic materials in the southern San Francisco Bay region, California, west of the Calaveras fault (figure 1). It is not a geologic map, because it does not address the geologic structure or the stratigraphic organization of the map units in a systematic way. Instead, it is directed at the distribution and character of the geologic materials following the pattern of its progenitors, Wentworth and others (1985) and Ellen and Wentworth (in press). Consultation of these reports and the other compilation sources will aid in using the database.

The database delineates map units that are identified by general age and lithology and by the map labels used in the compilation sources. Stratigraphic names are included for those units named in the sources as a further means of characterization. The scales of the source maps limit the spatial resolution (scale) of the database to 1:125,000 or smaller. It can be used alone or, where more specific information about the units is needed, in concert with the unit descriptions in the compilation sources or other means of unit characterization. It is useful for regional considerations that involve geologic materials, but does not replace the more detailed and up-to-date information required for evaluation of local areas.

The content and character of the database are described herein. The digital database itself, consisting of an ARC coverage (ssfb_m1) and associated INFO database, can be obtained over Internet or by magnetic tape copy as described below.

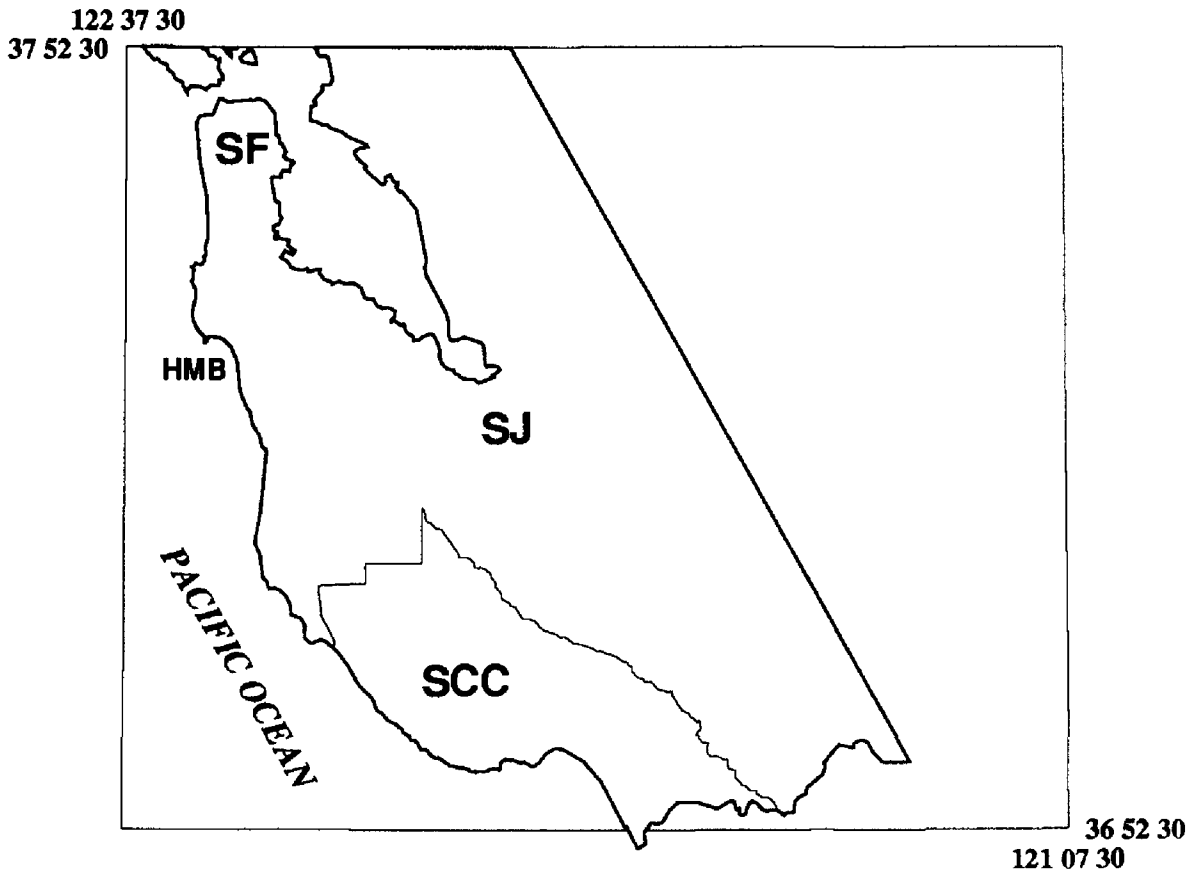

Figure 1. Area covered by the ditigal map database ssfb_m1 (heavy boundary). The outer boundary is that of the base map (sheet 3 of U.S. Geological Survey, 1970), for which the latitude and longitude of opposite corners are shown. SF - City of San Francisco, SJ - City of San Jose, SCC - Santa Cruz County, HMB - Half Moon Bay.

The database was compiled in ARC/INFO, a commercial Geographic Information System (Environmental Systems Research Institute [ESRI], Redlands, California), and is stored in ARC coverage format (ARC/INFO version 6) in a UNIX tar file. A UNIX computer system is thus required to extract the database from the tar file and ARC/INFO is required for its use, or at least for conversion of the database to an alternative digital format.

The digital compilation was done initially in version 4 of ARC/INFO using an early development version of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991; Fitzgibbon, 1991; Wentworth and Fitzgibbon, 1991) and has been completed using version 6.1.1 of ARC/INFO with version 1.1 of ALACARTE.

OBTAINING THE DIGITAL DATA

A 3.7 MB compressed tar file of the database and this descriptive text can be obtained by anonymous ftp over Internet or by sending the compiler a tape on which the tar file will be copied and returned.

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 sierra.wr.usgs.gov	- make ftp connection to the computer sierra.wr.usgs.gov
Name: anonymous	- use anonymous as your user name
Password:	- enter your own user name as password
cd pub	- go down to the pub directory
type binary	- change transfer type to binary
get ssfb_m1.tar.Z	- copy the compressed tar file across Internet to your current directory
quit	- close the ftp connection

To obtain a copy of the compressed tar file on magnetic tape, send a tape with request and return address to:

South San Francisco Bay Database
c/o Carl M. Wentworth
U.S. Geological Survey
345 Middlefield Road MS 975
Menlo Park, CA 94025

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 extract the database from the tar file:

if the ssfb_m1 file was obtained on tape, put the tape in your tape drive
cd local_directory - go to the directory that contains (is to contain) the compressed tar file

tar xvfb /dev/rstn 20 - ONLY IF tar file is on tape: /dev/rstn is the tape device with n an integer; this puts ssfb_m1.tar.Z in local_directory

uncompress ssfb_m1.tar.Z - this makes a 5.42 MB uncompressed tar file ssfb_m1.tar

cd local_directory2 - go to the directory that will hold the ssfbay workspace (if different from local_directory)

tar xvfb [path to tar file]/ssfb_m1.tar 20 - extract the ssfbay workspace from the tar file

This process will create a workspace (directory containing an INFO directory) that contains the ssfb_m1 database as follows:

/ssfbay - workspace

info/ - ARC/INFO database directory containing the FM2FORM table (info file) and other files that support the ssfb_m1 coverage.

m1.text - an ASCII file containing this text

ssfb_m1 - an ARC coverage directory containing the digital map (ssfb_m1)

DIGITAL COMPILATION

The digital map was compiled on a 1:125,000 topographic base[1] (scanned and vectorized version of sheet 3, U.S. Geological Survey, 1970) from three regional compilations of 1970's data. Two of the sources were compiled in the 1970's on the 1:125,000 base and address the surficial deposits (flatland deposits, Helley and others, 1979) and the bedrock (hillside materials, Ellen and Wentworth, in press) of the 9-county San Francisco Bay region. (The San Mateo County part of the hillside materials map is based, in turn, on Wentworth and others, 1985.) The geologic map of Santa Cruz County (Brabb, 1989), also based largely on 1970's and older data, was compiled on the same base enlarged to a scale of 1:62,500. Inked or scribed linework for these sources was scanned (400 or more lines per inch), converted from raster to vector format, imported into ARC/INFO (version 4), and hand edited and combined into a single coherent map.

The original material used to digitize the surficial linework was author manuscript (ink on mylar) and for the hillside materials and Santa Cruz County geologic maps was print publication files that had previously been prepared for color separation by scribing and scanning, together with scribed fault plates that were separately scanned and vectorized. The faults and color boundaries were combined interactively by hand for each source separately using ALACARTE (the color boundaries were tagged as contacts or replaced by faults, as appropriate). The fault plate for Santa Cruz County required a slight xy shift and rotation in the computer to produce a reasonable fit with the color boundaries.

Combining of the surficial and hillside maps involved much adjustment of common boundaries and, in many places, creation of a colluvium unit (UNIT[2] = col) to occupy the space between the downslope margin of mapped bedrock and the upslope margin of mapped surficial deposits. South of Half Moon Bay and northwest of Santa Cruz County, the simplified surficial boundaries of the hillside map are retained; these surficial areas are identified as UNIT = S, after the usage of Wentworth and others

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1 The digital base is not included in this report.

2 See Database Specifics below for explanation of the database fields shown in capital letters.

(1985). Scanning artifacts significant for display at a scale of 1:125,000 were corrected and some surficial boundaries were adjusted to better fit the base. The boundary of Santa Cruz County is included in the map to retain the integrity of units on either side and because of misfits across that boundary, which result from differing sources and compilation objectives in the three compilation sources. Small adjustments were made to fit lines across the boundary, but larger misfits were retained. The detail of the Santa Cruz County geologic map has not been simplified to match the higher level of generalization of the surficial and hillside maps: a few corrections have been made to lines and unit identities in consultation with E.E. Brabb.

The geologic identities of lines specified in the LTYPE field are largely those of the compilation sources, except that all contacts from the surficial map are coded as approximately located. Long reaches of concealed faults are not included.

The identities of the map units in the compilation sources are recorded in the UNIT field by the map labels of the source maps (numbers for the hillside map, conventional geologic labels for the surficial and Santa Cruz County maps). Landslides are largely omitted except in San Mateo County, where the larger landslides and their bedrock identities are included (Wentworth and others, 1985). Stratigraphic identities of the units reported in the compilation sources are recorded as an aid in characterizing the units for those familiar with the stratigraphy of the region (coded in the FM field, see table 10).

The physical properties of the map units are not described in detail in this database (see the unit descriptions in the compilation sources), but the units are categorized by general lithology (LITH) and age (AGE), and are organized by physical character (PTYPE). Because the degree of consolidation or hardness of most geologic materials in the region increases with age, lithology and age together provide a good first approximation of physical character (AGELITH). Note that some units do not fit easily into these categories, particularly because their age or lithology straddles the category boundaries.

The PTYPE categorization provides a consistent organization of the units based on the hillside map units of Ellen and Wentworth (in press) and of Wentworth and others (1985), which are organized by such physical properties as lithology, bedding, hardness, and fracture spacing. These categories range from subdivisions of mapped rock units to composites of several rock units (the latter particularly in San Mateo County). Here this scheme is extended to encompass all the units in the map area by (1) correlating the bedrock units in Santa Cruz County with hillside units to the northwest according to Brabb's unit descriptions, and (2) erecting new categories (PTYPE range of 1-99) for the surficial units. Each PTYPE unit is relatively homogeneous in its range of physical properties (or at least in its degree or kinds of heterogeneity) and can be characterized by reference to the compilation sources or other observations. Various PTYPE units may indeed be different or may be equivalent, depending on the properties of interest for any particular application.

FAULTS AND LANDSLIDES

Faults are distinguished in the database only as part of the physical character of the geologic materials and the database cannot be used to identify or delineate active faults in the region. Similarly, the database cannot be used to identify or delineate most landslides in the region. Larger landslides are included as part of the physical character of the materials in San Mateo County, but only a few selected landslides are shown elsewhere in the region.

SPATIAL RESOLUTION

Uses of this digital 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 compiled from maps at a scale of 1:125,000 (1:62,500 in Santa Cruz County) means that higher resolution information is not present in the dataset. Plotting at scales larger than 1:125,000 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 this data.

DATABASE SPECIFICS

The map database consists of the digital map ssfb_m1 (ARC coverage) and its supporting INFO files, which are stored in the projection of the source maps (table 1). Digital tics define a 7.5 minute grid of latitude and longitude. The content of the database can be described in terms of the lines and areas that compose the map. Descriptions of the database fields use the terms of table 2.

Table 1. Map Projection

The map is stored in the Lambert projection of the topographic base.

projection lambert	- Lambert Conformal Conic
units meters	- on the ground
parameters	
37 04 00	- 1st standard parallel
38 26 00	- 2nd standard parallel
-120 30 00	- central meridian
36 30 00	- latitude of projection's origin
0	- false easting
0	- false northing

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- ACSII 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 that are described in the arc attribute table (table 3). They define the boundaries of the map units, the boundaries of open bodies of water, the map boundaries, and scratch boundaries, including parts of the boundary of Santa Cruz County. 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. The compilation sources of the lines are recorded in the SOURCE field (table 5).

Table 3. Content of the Arc Attribute Table (SSFB_M1.AAT)

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
SSFB_M1#	4	5	B	-	unique internal control number
SSFB_M1-ID	4	5	B	-	unique identification number
LTYPE	35	35	C	-	line type
SOURCE	2	2	I	-	compilation source of line

Table 4. Line Types Recorded in the LTYPE Field

The geologic line types (exclusive of the various boundaries) are ALACARTE line types that correlate with geologic line symbols in the ALACARTE line set ALCWRG.LIN according to the ALACARTE lines lookup table.

contact, certain
contact, approx. located
contact, inferred
contact, inferred, queried
contact, concealed
fault, certain
fault, approx. located
fault, inferred, queried
fault, concealed
scratch boundary
scratch boundary, countyline
water boundary
map boundary

Table 5. Sources of the Lines

The compilation sources of the lines are recorded in the SOURCE field by numeric codes that indicate the following sources:

CODE	SOURCE
1	Helley and others, 1979
2	Ellen and Wentworth, in press
3	Brabb, 1989
4	water boundaries extracted from the vectorized base scan
5	county boundaries extracted from the vectorized base scan

Areas - The map units (polygons) are described in the polygon attribute table (table 6). The identities of the map units from the compilation sources are recorded in the UNIT field by map label (numbers for the hillside map, conventional geologic labels for the surficial and Santa Cruz County maps). These 232 UNITs are organized into 182 PTYPEs according to material character, using the categorization of Ellen and Wentworth as a starting point. Santa Cruz County bedrock units are included or correlated with Ellen and Wentworth hillside PTYPEs and new categories are erected for the surficial units throughout the map area (PTYPE 1-99). The geologic age of the map units is crudely categorized in the AGE field (table 7) and the lithology of the units in the LITH field (table 8). Combinations of these two characteristics are recorded in the AGELITH field (table 9). The stratigraphic identities of the map units reported in the compilation sources are recorded numerically in the FM field and the meaning of these numeric codes in INFO table FM2FORM (tables 10 and 11). A numeric equivalent of the PTYPE is provided in the NPTYPE field to permit more efficient database searches.

Some special cases should be noted:

Landslides are categorized in San Mateo County both by bedrock unit (PTYPE and UNIT) and by identity as a landslide (LSLIDE = LS); elsewhere those few landslides shown are categorized by LS in all three fields.

PTYPEs 323 and 460 are subdivided by AGE (Tu and Tl).

Twenty small areas, each less than 7 hectares in area, are assigned PTYPE = br. These are areas isolated by mapped surficial deposits for which bedrock identity cannot be inferred from the surrounding geology.

Significant gaps between hillside and surficial units led to the delineation of 500 areas here considered to be colluvium, which are assigned UNIT = col. These are combined with mapped colluvium in Santa Cruz County into PTYPE = 20.

Two of the many dams in the region are mapped and assigned PTYPE = dam.

UNIT hcg, which is gabbro, is assigned LITH = gr and is included in PTYPE = 907.

Areas of open water (905 polygons) are assigned PTYPE = H2O.

Tics - The regular grid of digital tics in ssfb_m1 consists of 7.5 minute latitude/longitude tics that were calculated as a latitude/longitude grid in ARC and reprojected to the Lambert projection of the database. Tic number 1, at the southeast corner of the map, is located at latitude 36° 52′ 30″, longitude -121° 07′ 30″. The four tics used to register the base layers and the surficial deposits and hillside materials sources are tics 17, 26, 95, and 104. The tics used to register the Santa Cruz County map are tics 208, 209, 109, and 114 (tics 208 and 209 are located at latitude 31° 17′ 40″).

Table 6. Content of the Polygon Attribute Table (SSFB_M1.PAT)

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
SSFB_M1#	4	5	B	-	unique internal control number
SSFB_M1-ID	4	5	B	-	unique identification number
PTYPE	35	35	C	-	materials category
LSLIDE	35	35	C	-	landslide = LS
UNIT	35	35	C	-	unit label from compilation source
AGE	3	3	C	-	age category

LITH	3	3	C	-	lithology category
AGELITH	7	7	C	-	combinations of AGE and LITH
FM	2	2	I	-	code for stratigraphic name
NPTYPE	4	4	I	-	numeric PTYPE

Table 7. Age Categories

CODE	AGE
h	Holocene
p	Pleistocene
Q	Quaternary undivided
QT	Pliocene and/or Quaternary
Tu	upper Tertiary
Tl	lower Tertiary
Mz	Mesozoic

Table 8. Lithology Categories

CODE	LITHOLOGY
bv	mafic volcanic rocks
fv	felsic volcanic rocks
gr	granitic rock
ls	limestone
m	mud and silt
md	mudstone and shale, some sandstone
mm	sheared sandstone and shale (melange)
ms	low-grade metasandstone and shale
mv	low-grade metavolcanic rocks (greenstone)
s	sand, gravel, silt, and mud
sc	silica-carbonate rock
sch	schist
sl	porcelaneous or siliceous mudstone and shale; chert
sm	sandstone and mudstone or shale
sp	serpentinite
ss	sandstone and conglomerate, some mudstone or shale
wm	soft, water-saturated mud, some silt

Table 9. Age and Lithology Combinations

CODE	AGE	LITHOLOGY
	Holocene	
h-wm		soft, water-saturated mud, some silt
h-m		mud and silt
h-s		sand, gravel, silt, and mud
	Pleistocene	
p-s		sand and gravel

	QUATERNARY
Q-ms	sand, gravel, silt, and mud
	PLIOCENE and/or QUATERNARY
QT-md	mudstone, some sandstone
QT-sm	sandstone and mudstone
QT-ss	sandstone, some mudstone
	UPPER TERTIARY
Tu-md	mudstone and shale, some sandstone
Tu-sl	porcelaneous and siliceous mudstone and shale
Tu-sm	sandstone and mudstone or shale
Tu-ss	sandstone, some mudstone or shale
Tu-fv	felsic volcanic rocks
Tu-bv	mafic volcanic rocks
Tu-sc	silica-carbonate rock
	LOWER TERTIARY
Tl-md	mudstone and shale, some sandstone
Tl-sm	sandstone and mudstone or shale
Tl-ss	sandstone, some mudstone or shale
	MESOZOIC
Mz-md	mudstone and shale
Mz-sm	sandstone and shale
Mz-ss	sandstone and conglomerate, some shale
Mz-mm	sheared sandstone and shale (melange)
Mz-ms	metasandstone, some shale
Mz-mv	metavolcanic rocks (greenstone)
Mz-sl	chert
Mz-ls	limestone
Mz-bv	mafic volcanic rocks
Mz-fv	felsic volcanic rocks
Mz-sp	serpentinite
Mz-sch	schist and marble
Mz-gr	granitic rock

Table 10. Table of Stratigraphic Names (FM2FORM)

The equivalence between the numeric codes in the FM field of the polygon attribute table for the map and the stratigraphic names reported in the compilation sources are listed in the FM2FORM table in INFO:

ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	
FM	2	2	I	-	= FM field in the polygon attribute table
FORM	50	50	C	-	equivalent stratigraphic name

Table 11. Stratigraphic Names

The stratigraphic names listed in the FM2FORM table are as follows:

CODE	NAME
1	unnamed or no name reported
2	Alum Rock Rhyolite
3	Aromas Sand
4	Bay mud
5	Briones Sandstone
6	Butano Sandstone
7	Cierbo Sandstone
8	Claremont Shale
9	Colma Fm
10	Franciscan Complex
11	Great Valley sequence
12	Hambre Sandstone
13	Joaquin Miller Fm
14	Knoxville Fm
15	Lambert Shale
16	Lambert Shale and San Lorenzo Fm, undiv.
17	Leona Rhyolite
18	Locatelli Fm
19	Lompico Sandstone
20	Markley Fm
21	Merced Fm
22	Merritt Sand
23	Mindego Basalt
24	Monterey Fm
25	Monterey Group
26	Monterey Shale
27	Moraga Fm
28	Mullholland Fm
29	Neroly Sandstone
30	Oakland Conglomerate
31	Orinda Fm
32	Oursan Sandstone
33	Page Mill Basalt
34	Pigeon Point Fm
35	Pinehurst Shale
36	Purisima Fm
37	Redwood Canyon Fm
38	Rices Mudstone Member, San Lorenzo Fm
39	Rodeo Shale
40	San Lorenzo Fm
41	San Pablo Group
42	San Ramon Sandstone
43	Santa Clara, Livermore, or Packwood Gravels
44	Santa Cruz Mudstone

45	Santa Margarita Sandstone
46	Shephard Creek Fm
47	Siesta Fm
48	Sobrante Sandstone
49	Temblor Sandstone
50	Tice Shale
51	Tolman Fm
52	Twobar Shale Member, San Lorenzo Fm
53	Vaqueros Sandstone
54	Zayante Sandstone

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