U.S. Department of the Interior
U.S. Geological Survey

Preliminary Geologic Map of the San Francisco South 7.5′ Quadrangle and Part of the Hunters Point 7.5′ Quadrangle, San Francisco Bay Area, California: A Digital Database

By

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Open - File Report 98-354

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Introduction

This Open-File report is a digital geologic map database. This pamphlet serves to introduce and describe the digital data. No paper map is included in the Open-File report, however this report includes a PostScript and a Portable Documet Format plot file containing an image of a geologic map sheet and an explanation. For those interested in obtaining the PostScript or Portable Document Format plot file or a paper plot, please see the section entitled "For Those Who Aren't Familiar With Digital Geologic Map Databases" below.

The terms San Francisco South 7.5' Quadrangle and the prefix sfs are used throughout this text and stand for the San Francisco South 7.5' Quadrangle and the western part of the Hunters Point 7.5' Quadrangle. The digital map database is based on the 1952-1957 mapping that was released in the earlier paper maps (Bonilla, 1965, 1971), modified as described below.

The revisions of the 1971 map are of four general types: 1) increase in area of artificial fill near San Francisco Bay shoreline; 2) changes in representation of structural geology; 3) correction of errors in the earlier map; and 4) changes to accommodate the digital format. Water boundaries on the San Francisco Peninsula have changed owing to addition of artificial fill since 1971, both at the shoreline and inland, necessitating changes in the database. The bayward boundaries of artificial fill were taken from the 1980 topographic base map. A recent study of geophysical, geomorphic, and geological data found no evidence supporting the existence of the hypothetical San Bruno fault as a mappable structure (U.S. Geological Survey, 1997), and the fault has been deleted. Fold axes, mostly within the Merced Formation have been added (Bonilla, 1996); axes classed as probable or possible in the latter report are shown as "approximately located" in this database. Errors and omissions in earlier versions of the map (Bonilla, 1965, 1971) have been corrected, including changing the unit designation of the rock exposure north of San Francisco International Airport from KJs to KJsk, adding a few areas of bedrock that had been omitted, and correcting some structural attitudes. A cartographic error that placed the Serra fault too far east near Sneath Lane has been corrected. The zone of shearing along the San Andreas fault and isolated shear zones, both formerly shown by a symbol, and old tidal flats, formerly shown by an overprint, are all treated as map units in the digital version.

This digital map database represents the geology of the San Francisco South 7.5’ quadrangle and the western part of the Hunters Point 7.5’ quadrangle. Together with the unit descriptions and diagram showing correlation of units (with the PostScript and Portable Document Format files of the geologic map) , it provides basic information on the stratigraphy and structure 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; enlargement to larger scales will not provide greater accuracy. The content and character of the database, as well as three methods of obtaining the database, are described below.

For Those Who Aren't Familiar With Digital Geologic Map Databases

For those interested in the geology of the San Francisco South 7.5’ Quadrangle who do not use an ARC/INFO compatible Geographic Information System (GIS), a PostScript and a Portable Document Format plot file containing the map image and explanatory text of much of the data in the digital database have been included in the database package (please see the section "Obtaining the Digital Data" below). Those interested who have computer capability can access the plot files in any of the three ways described below. To access the digital data, please see the section "Obtaining the Digital Data". For those without computer capability, we have made the plot files available to an outside vendor or we can provide users with the 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. The plotfile packages consist of a PostScript and Portable Document Format plot file of the geologic map with explanation and geologic description.

Postscript Plotfile Package

The plotfile packages contain the images described below:

sfsouth.ps	A PostScript plottable file containing an image of the geologic map, base map, correlation chart, and unit descriptions of the San Francisco South 7.5' Quadrangle at a scale of 1:24,000.
sfsouth.pdf	A Portable Document Format plottable file containing an image of the geologic map, base map, correlation chart, and unit descriptions of the San Francisco South 7.5' Quadrangle at a scale of 1:24,000.

Digital Database Package

The database package includes two coverages and seven base layers. 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 package, are described below:

ARC/INFO export file	Resultant Coverage	Description of Coverage
sfs-geol.e00	sfs-geol	Depositional contacts, faults, lineations, fault dips, and unit labels.
sfs-strc.e00	sfs-strc	Strike and dip information and fold axes.
ss-drain.e00	ss-drain	San Francisco South and Hunters Point drainage base map.
sfs-index.e00	sfs-index	San Francisco South topographic index contours base map.
sfs-inter.e00	sfs-inter	San Francisco South topographic intermediate contours base map.
sfs-cult.e00	sfs-cult	San Francisco South cultural and map boundary base map.
hp-index.e00	hp-index	Hunters Point topgraphic index contours base map.
hp-inter.e00	hp-inter	Hunters Point topgraphic intermediate contours base map.
hp-cult.e00	hp-cult	Hunters Point cultural and map boundary base map

ASCII text files, PostScript, Portable Document Format files, and a ARC Macro Language files:

sfs_db.pdf	Portable Document Format file of the data base description.
sfs_db.ps	PostScript file of the data base description.
sf_db.txt	A text-only file containing an unformatted version of sfs-db.pdf.
import.aml	ASCII text file in ARC Macro Language to convert ARC export files to ARC coverages in ARC/INFO.
lineation.aml	ASCII text file in ARC Macro Language used to associate structural information with the nodes in the sfs-geol coverage. Should be used as reference when choosing and using markersets and plotfiles.
plotsfs.aml	ASCII text file used to plot the San Francisco South quadrangle using Arc/Plot. This aml is necessary to accurately plot the dip information stored in the nodes.

Note: this aml calls nonstandard symbol sets and lookup tables that have not been included with this data set. It is intended as a referance to the user to show how the plot was produced.

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

info/	INFO directory containing files supporting the databases. This directory is not included in the database release, but is created in the process of converting the export files into ARC coverages.

Database Release Format

The databases in this report were compiled in ARC/INFO, a commercial Geographic Information System (Environmental Systems Research Institute, Redlands, California), with version 3.0 of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991, Fitzgibbon, 1991, Wentworth and Fitzgibbon, 1991). The files are in either GRID (ARC/INFO raster data) format or COVERAGE (ARC/INFO vector data) format. Coverages are stored in uncompressed ARC export format (ARC/INFO version 7.x). ARC/INFO export files (files with the .e00 extension) can be converted into ARC/INFO coverages in ARC/INFO (see below) and can be read by some other Geographic Information Systems, such as MapInfo via ArcLink and ESRI's ArcView (version 1.0 for Windows 3.1 to 3.11 is available for free from ESRI's web site: http://www.esri.com). The digital compilation was done in version 7.0.4 of ARC/INFO with version 3.0 of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991, Fitzgibbon, 1991, Wentworth and Fitzgibbon, 1991). The PostScript plotfiles for maps were produced by the ‘postscript’ command with compression set to zero in ARC/INFO version 7.0.4. The PostScript plotfiles for pamphlets were produced in Microsoft Word 6.0 using the Destination PostScript File option from the Print command.

Tar files

The three data packages described below are stored in tar (UNIX tape archive) files. A tar utility is required to extract the database from the tar file. This utility is included in most UNIX systems, and can be obtained free of charge via the Internet from Internet Literacy's Common Internet File Formats Webpage (http://www.matisse.net/files/formats.html). The tar files have been compressed, and may be uncompressed with **gzip**, which is available free of charge via the Internet from the gzip Home Page (http://w3.teaser.fr/~jlgailly/gzip). And also via links from the USGS Public Domain Software page (http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/public.html). When the tar file is uncompressed and the data is extracted from the tar file, a directory is produced that contains the data in the package as described below. The specifics of the tar files are listed below

Name of compressed tar file	Size of compressed tar file (uncompressed)	Directory produced when extracted from tar file	Data package contained
sfs_psmap.tar.gz	5.6 MB (18.5 MB)	/sfs_psmap	PostScript Plotfile Package
sfs_pdfmap.tar.gz	4.2 MB (4.2 MB)	/sfs_pdfmap	Portable Document Format Plotfile Package
sfs_data.tar.gz	6.0 MB (19 MB)	/sfs_data	Digital Database Package

Obtaining the Digital Data

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

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

To obtain tar files of database or plotfile packages from the usgs 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 USGS is

http://www.usgs.gov

The Web server for digital publications from the Western Region is

http://wrgis.wr.usgs.gov

Go to

http://wrgis.wr.usgs.gov/open-file/of98-354

to access this publication. Besides providing easy access to the entire digital database, the Western Region Web page also affords easy access to the PostScript plot files for those who do not use digital databases (see below).

To obtain tar files of database or plotfile packages by ftp:

The files in these reports are stored on the U.S. Geological Survey Western Region FTP server. The Internet ftp address of this server is:

ftp://wrgis.wr.usgs.gov

The user should log in with the user name ‘anonymous’ and then input their e-mail address as the password. This will give the user access to all the publications available via ftp from this server.

The files in this report are stored in the subdirectory:

pub/open-file/of98-354

To obtain tar files of database or plotfile packages on tape:

Database files, PostScript plotfiles, and related files can be obtained by sending a tape with request and return address to:

Preliminary Geologic Map of the San Francisco
South 7.5' Quadrangle
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!

NOTE: Be sure to include with your request the exact names, as listed above, of the tar files you require. An Open-File Report number is not sufficient, unless you are requesting both the database package and plotfile package for the report.

The compressed tar file will be returned on the tape. The acceptable tape types are:

2.3 or 5.0 GB, 8 mm Exabyte tape.

PostScript and Portable Document Format Plot Files Package

For those interested in the Preliminary Geology of the San Francisco South 7.5' Quadrangle who don't use an ARC/INFO compatible GIS system, but would like to obtain a paper map with explanation, we have included two separate data package (sfs_psmap.tar.gz) with a PostScript plot file and (sfs_pdfmap.tar.gz) with a Portable Document Format plot file. Because this release is primarily a digital database, the plot file (and plot 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 may overlap. Sample plots by the authors have proven to be quite legible and useful, however. The plot file is available in any of the three ways described below, including the World Wide Web pages. However, the plot files are stored in gzip UNIX tar files requiring gzip and tar utilities to access the file. 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). To read the Portable Document Format files, it is necessary to have Adobe Acrobat Reader. To obtain Acrobat Reader, free of charge, go to the Adobe web page at (http://www.adobe.com).

The images are 44 inches wide by 34 inches high, so it requires a large plotter to produce paper copies at the intended scale. In addition to size constraints, 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.

Obtaining plots from a commercial vendor

Those interested in Preliminary Geologic Map of the San Francisco South 7.5’ Quadrangle, but who use neither a computer nor the Internet, can still obtain the information. We will provide the PostScript or Portable Document Format plot files on digital tape (details below) for use by commercial vendors who can make large-format plots. Send a blank tape with request and return address to:

Preliminary Geologic Map of the San Francisco
South 7.5’ Quadrangle 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 type is:

2.3 or 5.0 GB, 8 mm Exabyte tape.

Make sure your vendor is capable of reading this tape type and PostScript or Portable Document Formatplot files. Important information regarding tape file format is included in the sections “Database Release Format,” “Tar Files,” and "PostScript Plot Files" above, so be certain to provide a copy of this document to your vendor.

Obtaining plots from USGS Open-File Services

NOTE: As of this writing, plot-on-demand is **not available** from USGS. It is anticipated later in 1998.

U.S. Geological Survey is planning to provide a plot-on-demand service for map files, such as those described in this report, through Open-File Services. In order to obtain plots, contact Open-File Services at:

USGS Information Services
Box 25286
Denver Federal Center
Denver, CO 80225-0046

(303) 202-4200
1-800-USA-MAPS

FAX: (303) 202-4695

e-mail: infoservices@usgs.gov

Be sure to include with your request the Open-File Report number **and** the exact names, as listed in the Database Contents section above, of the plotfiles you require. An Open-File Report number and its letter alone may not be sufficient, unless you are requesting plots of all the plotfiles for that report.

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.

Additional Information

Digital Compilation

The geologic map information was digitized from stable originals of the geologic map at 1:20,000 scale. A mylar copy of the earlier map (Bonilla 1965) was 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 corrected.

Base Maps

Base Map layers were prepared from scale-stable printing negatives of the U.S. Geological Survey San Francisco South (1980 photorevision), and Hunters Point (1980 photorevision) 1:24,000 topographic maps, which have a 25 foot contour interval. 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, land-use planners and others. 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 and Bryant, 1997). The map shows mappable landslides as they existed about 1959. Although many of the landslides still exist, many others have been removed during urban development or by natural processes, and post-1959 landslides are not shown. Landslides and other ground failures that occurred since 1959 were caused primarily by heavy rainfall in 1968 through 1982 (Nilsen, and others, 1976; Ellen and Wieczorek, 1988), the 1989 earthquake (Sitar, 1991; Tinsley and others, 1998), and the heavy rainfall of 1997-1998.

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. The base map layers have a resolution of 1:24,000, so only slight 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 State Plane (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 map is stored in Stateplane projection

PROJECTION STATEPLANE	
UNITS METERS	• on the ground
ZONE 3326	• Arc/Info Stateplane zone corresponding to California coordinate system zone 3
DATUM NAD27	
PARAMETERS	• none
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 defining types of lines and areas 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* (SFS-GEOL.AAT and SFS-STRC.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	8	18	F	5	• length of arc in meters (**SFS-GEOL.AAT**)
LENGTH	4	12	F	3	• length of arc in meters (**SFS-STRC.AAT**)
<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* (sfs-geol)

'1800s shoreline', certain
'1800s stream channel', certain
contact, approx. located
contact, certain
contact, concealed
contact, gradational or inferred
f.a., anticline, approx. located
f.a., anticline, certain
f.a., monocline, approx. located
f.a., syncline, approx. located
fault, approx. located
fault, certain
fault, concealed
fault, concealed, queried
fault, inferred
map boundary, certain
topographic escarpment
water boundary, certain

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 under Geologic Unit Descriptions, below. 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* (SFS-GEOL.PAT)

ITEM NAME	WIDTH	OUTPUT	TYPE	N. DEC	
AREA	8	18	F	5	• area of polygon in square meters
PERIMETER	8	18	F	5	• 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 (see Table 6)
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* (SFS-GEOL)
(See below for descriptions of units)

water
KJc
KJg
KJm
KJs
KJs?
KJsk
KJu
QTm
Qaf
Qaf/tf
Qafs
Qal
Qb
Qc
Qd
Ql
Ql(?)
Qm
Qsr
Qt
Qu
fr
sp

Nodes-

Some nodes in the sfs-geol coverage contain structural information so that the structural information could be kept associated with a particular arc. Fault planes contain nodes which represent the dip of the fault plane. See Table 7 for a description of the node database field. The database items "strike" and "dip" contain geologically correct information. Both "nangle" and "dipplotangle" are only used in reference to the correct visual representation of the structural information, as ARC/Info uses a different coordinate system than geologists.

Table 7 - *Content of the Node Attribute Tables* (SFS-GEOL.NAT)
(See lineation.aml for descriptions of the database items)

ITEM NAME	WIDTH	OUTPUT	TYPE	N. DEC	
ARC #	4	5	B		• arc associated with the particular node
<coverage>#	4	5	B		• unique internal control number
<coverage>-ID	4	5	B		• unique identification number
NTYPE	35	35	C		• type of node (see Table 8)
NANGLE	8	8	N	2	• angle of the ntype using internal ARC coordinates where 0 is East
DIPPLOTANGLE	8	8	N	2	• angle at which to plot the marker used; differs depending on marker and markerset
STRIKE	3	3	I		• strike of the plane using standard 0 as North
DIP	3	3	I		• dip of the plane

Table 8 - *Node Types* (SFS-GEOL)

dip of fault plane

Points-

Point information (strikes and dips) is recorded as coordinate and related information and is described in the Point Attribute Table (Table 9). The identities of point types recorded in the PTTYPE field of the SFS-STRC.PAT table are shown in Table 10.

Table 9 - *Content of the Point Attribute Tables* (SFS-STRC.PAT)

ITEM NAME	WIDTH	OUTPUT	TYPE	N. DEC	
AREA	4	12	F	3	• not used
PERIMETER	4	12	F	3	• not used
<coverage>#	4	5	B		• unique internal control number
<coverage>-ID	4	5	B		• unique identification number
PTTYPE	35	35	C		• point type (see Table 10)
DIP	3	3	I		• dip angle in degrees
STRIKE	3	3	I		• strike angle in degrees
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 10 - *Point Types* (SFS-STRC)

The lookup table used to associate point types with symbols did not allow for accurate representation of the points. For example, no symbol exists for shear planes, so the point tag ‘crumpled bedding’ was used because it looked similar to the symbol used on the 1971 paper map. All lineations are placed such that they are associated with fault planes and dip information held in the node in the same location as that lineation.

bedding
approx bedding
flat bedding
vertical bedding
joint
foliation
foreset beds
fault attitude
shear planes
_l_lineation_i_
vertical joint

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