Geology of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles, California: A Digital Map Database

By

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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. 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 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This digital map database, compiled from previously published and unpublished data, and new mapping by the authors, represents the general distribution of bedrock and surficial deposits in the mapped area. Together with the accompanying text file (cdbegeo.txt or cdbegeo.ps), it provides current information on the geologic structure and 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 geology of the mapped area who do not use an ARC/INFO compatible Geographic Information System (GIS), we have provided two sets of plotfiles containing images of much of the information in the database. Each set contains an image of a geologic map sheet and explanation, and an explanatory pamphlet. There is a set of images in PostScript format and another in Adobe Acrobat PDF format (see the sections “PostScript plot files” and “PDF plot files” below).

Those interested who have computer capability can access the plot file packages in any of the three ways described below (see the section “Obtaining the digital database and plotfile packages”). However, it should be noted the plot file packages do require gzip and tar utilities to access the plot files. Therefore additional software, available free on the Internet, may be required to use the plot files (see section “Tar files”).

Those without computer capability can obtain plots of the map files through USGS plot-on-demand service for digital geologic maps (see section “Obtaining plots from USGS Open-File Services”) or from an outside vendor (see section “Obtaining plots from an outside vendor”).

Digital Open-File contents

This Open-File report consists of three digital packages. The first is the PostScript Plotfile Package, which consists of PostScript plot files of a geologic map, explanation sheet, and geologic description. The second is the PDF Plotfile Package, and contains the same plotfiles as the first package, but in Portable Document Format (PDF). The third is the Digital Database Package, and contains the geologic map database itself, and the supporting data, including base maps, map explanation, geologic description, and references

Postscript plotfile package

This package contains the images described here in PostScript format (see below for more information on PostScript plot files):

cdbemap.ps	A PostScript plottable file containing an image of the geologic map and base maps of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles at a scale of 1:24,000, along with the map keys, and index maps
cdbegeo.ps	A PostScript plot file of a report containing detailed unit descriptions and geological information, plus references cited.

PDF plotfile package

This package contains the images described here in PDF format (see below for more information on PDF plot files):

cdbemapu.pdf	A PDF file containing an image of the upper 45 inches of the geologic map and base maps of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles at a scale of 1:24,000, along with the map keys, and index maps.
cdbemapl.pdf	A PDF file containing an image of the lower 45 inches of the geologic map and base maps. The split into two PDF files is neccessary because PDF files have a maximum size of 45 inches.

cdbegeo.pdf	A PDF file of a report containing detailed unit descriptions and geological information, plus references cited.

Digital database package

The database package includes geologic map database files for the Cordelia and the northern part of the Benicia 7.5 minute quadrangles. 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
cd_sp-py.e00	cd_sp-py/	Faults, depositional contacts, and rock units in the Cordelia 7.5 minute quadrangle
cd_sp-sr.e00	cd_sp-sr/	Strike and dip information and fold axes in the Cordelia 7.5 minute quadrangle
be_sp-py.e00	be_sp-py/	Faults, depositional contacts, and rock units in the northern part of the Benicia 7.5 minute quadrangle
be_sp-sr.e00	be_sp-sr/	Strike and dip information and fold axes in the northern part of the Benicia 7.5 minute 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
cd_sp-flt.e00	cd_sp-flt/	Index map of faults in the Cordelia 7.5 minute quadrangle with annotation showing the names of major faults.
be_sp-flt.e00	be_sp-flt/	Index map of faults in the northern part of the Benicia 7.5 minute quadrangle with annotation showing the names of major faults.
cdbe_corr.e00	cdbe_corr/	Correlation table for the units in this map database. This database is not geospatial.
cdbe_so.e00	cdbe_so/	Sources of data index map for this map database. Arcs only.
cdbe_as.e00	cdbe_as/	Index map of Assemblages in the Cordelia and the northern part of the Benicia 7.5 minute quadrangles. (Assemblages are described in cdbegeo.txt, cdbegeo.pdf, or cdbegeo.ps) Arcs only.
cdxs_sp-ln.e00	cdxs_sp-ln	Map showing location of cross-sections. Arcs only.
cdxsa.e00	cdxsa	Cross-section A. This database is not geospatial.
cdxsb.e00	cdxsb	Cross-section B. This database is not geospatial.

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:

cdbegeo.ps	A PostScript plot file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited.
cdbegeo.pdf	A PDF version of cdbegeo.ps.

cdbegeo.txt	A text-only file containing an unformatted version of cdbegeo.ps.
cdbedb.ps	This file.
cdbedb.pdf	A PDF version of cdbedb.ps.
cdbedb.txt	A text-only file containing an unformatted version of cdbedb.ps.
import.aml	ASCII text file in ARC Macro Language to convert ARC export files to ARC coverages in ARC/INFO.
cdbekey.txt cdbekey2.txt cdbekeysym.txt	Together, these three ASCII text files contain the information given in the description of map units and symbols on the map sheet (cdbemap.ps or cdbemap.pdf)
cdbeso.txt	ASCII text file containig information about sources of data as shown in the sources of data index map (cdbe_so) described above.

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.

Tar files

The three data packages described above 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 over the Internet from Internet Literacy's Common Internet File Formats Webpage (http://www.matisse.net/files/formats.html). Both tar files have been compressed, and may be uncompressed with **gzip**, which is available free of charge over the Internet 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 above. 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
o99-162a.tgz	18.3 MB (518 MB)	cdbeps	PostScript Plotfile Package
o99-162b.tgz	18.5 MB (18.5 MB)	cdbepdf	PDF Plotfile Package
o99-162c.tgz	0.9 MB (3.9 MB)	cdbegeo	Digital Database Package

Revisions

From time to time, circumstances occur which require minor revisions to digital files published in digital Open-File Reports. These revisions are minor, and so do not warrant issuing a new report. In order to document these changes as they happen, starting in 1998 digital Open-File Reports are accomanied by a revision file that contains up to date information about any and all revisions to the digital files that make up the report.

The revision list is not part of any data package, but is available seperately. It is an ASCII text-only file. The revision list may be obtained in any of the three ways described below. The file name of the revision list for this report is:

o99-162r.txt

PostScript plot files

For those interested in the geology of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles who don't use an ARC/INFO compatible GIS system we have included a separate data package with two PostScript plot files. One contains a color plot of the geologic map database at 1:24,000 scale (cdbemap.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 almost publication quality, however. In addition, a second PostScript file containing the geologic description and discussion is provided (cdbegeo.ps).

The PostScript image of the geologic maps and map explanation are 34 inches wide by 61 inches high, so it requires a large plotter to produce paper copies at the intended scale. In addition, some plotters, such as those with continual paper feed from a roll, are oriented with the long axis in the horizontal 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.

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.

PDF plot files

We have also included a second digital package containing PDF versions of the PostScript map sheet and pamphlet described above. Adobe Acrobat PDF (Portable Document Format) files are similar to PostScript plot files in that they contain all the information needed to produce a paper copy of a map or pamphlet and they are platform independent. Their principal advantage is that they require less memory to store and are therefore quicker to download from the Internet. In addition, PDF files allow for printing of portions of a map image on a printer smaller than that required to print the entire map without the purchase of expensive additional software. However, because PDF files have a maximum page size of 45 inches, it was neccessary to break the map image up into **two** overlapping PDF files, one containing the upper 45 inches of the map sheet, and a second containing the lower 45 inches. Note that there is about 27 inches of overlap.

All PDF files in this report have been created from PostScript plot files using Adobe Acrobat Distiller. In test plots we have found that paper maps created with PDF files contain almost all the detail of maps created with PostScript plot files. We would, however, recommend that those users with the capability to print the large PostScript plot files use them in preference to the PDF files.

To use PDF files, the user must get and install a copy of Adobe Acrobat Reader. This software is available **free** from the Adobe website (http://www.adobe.com). Please follow the instructions given at the website to download and install this software. Once installed, the Acrobat Reader software contains an on-line manual and tutorial.

There are two ways to use Acrobat Reader in conjunction with the Internet. One is to use the PDF reader plug-in with your Internet browser. This allows for interactive viewing of PDF file images within your browser. This is a very handy way to quickly look at PDF files without downloading them to your hard disk. The second way is to download the PDF file to your local hard disk, and then view the file with Acrobat Reader. **We strongly recommend that large map images be handled by downloading to your hard disk**, because viewing them within an Internet browser tends to be very slow.

To print a smaller portion of a PDF map image using Acrobat Reader, it is necessary to cut out the portion desired using Acrobat Reader and the standard cut and paste tools for your platform, and then to paste the portion of the image into a file generated by another software program that can handle images. Most word processors (such as Microsoft Word) will suffice. The new file can then be printed. Image conversion in the cut and paste process, as well as changes in the scale of the map image, may result in loss of image quality. However, test plots have proven adequate.

Digital database 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).

Obtaining the Digital Database and Plotfile Packages

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/of99-162

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/of99-162

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:

Cordelia and the northern part of the Benicia 7.5 minute quadrangles 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!

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.

Obtaining plots from a commercial vendor

Those interested in the geologic map of the Cordelia and the northern part of the Benicia 7.5 minute quadrangles, but who use neither a computer nor the Internet, can still obtain the information. We will provide the PostScript 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:

> Cordelia and the northern part of the Benicia 7.5 minute quadrangles Geologic Map 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:

> 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 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 in mid-1999.

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. To ease conversion and 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 Digital Raster Graphic (DRG) versions of standard U.S. Geological Survey 7.5 minute quadrangles obtained from the U.S. Geological Survey Mapping Division Website for the San Francisco Bay region (http://bard.wr.usgs.gov). Please see the website for more detailed information about the original DRGs. The DRGs were converted to ARC/INFO GRIDs using the imagegrid command. The GRIDS were then edited by us to remove area fill colors (for example urban pink and purple, forested green, and water blue). The edited GRIDs were then combined with GRIDs produced from the geologic map coverages and overlain with vector data to produce the final cartographic product presented in cdbeplt.ps and cdbeplt.pdf. Because the base map digital files (DRGs) are already available at the website mentioned above, they are not included in the digital database package.

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 and Bryant, 1997). Similarly, because only some of the landslides in the mapped area are shown, the database cannot be used to completely identify or delineate landslides in the region. For a more complete depiction of landslide distribution, see Nilsen and others (1979), Wiezorick and others (1988), and Ellen and others (19??)

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.

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)

Table 4 - *Line Types Recorded in the LTYPE Field*

cd_sp-py and be_sp-py cd_sp-flt and be_sp-flt	cd_sp-sr and be_sp-sr	cdxsa and cdxsb cdbe_corr
contact, certain	f.a., anticline, certain	bedform
contact, approx. located	f.a., anticline, concealed	contact, certain
contact, inferred	f.a., anticline, approx. located	contact, inferred
fault, certain	f.a., syncline, certain	fault, arrow
fault, concealed	f.a., syncline, concealed	fault, certain
fault, concealed, queried	f.a., syncline, approx. located	fault, approx. located
fault, approx. located		map boundary
fault, inferred		scratch boundary
reverse fault, certain		surface
reverse fault, concealed		
scratch boundary		
water boundary		
map boundary		
leader		

Note, not every line type listed is present in every coverage. For example, no contacts are present in the fault maps, cd_sp-flt and be_sp-flt.

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). For more information on ALACARTE and its linesets, see Wentworth and Fitzgibbon (1991).

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 cdbegeo.txt or cdbegeo.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

Table 6 - *Map Units*
(See cdbegeo.txt, cdbegeo.pdf, or cdbegeo.ps for descriptions of units)

H2O	Qhl	Tss
Jb	Qhsc	Tss?
Jgb	Qpaf	Tsv
Jsv	Qpoaf	Tv
KJfm	Tc	Tvh
KJk	Td	Tvh?
Ku	Td?	af
Ku?	Tlj	alf
Qcl	Tmk	ls
Qhaf	Tmkj	sp
Qhasc	Tmr	
Qhbm	Tmr?	
Qhfp	Tnv	

Note, not every unit label listed is present in every coverage. For example, queried units are not present in the correlation table, cebe_corr.

Points

Data gathered at a single locality (points) are described in the point attribute table (Table 7) The identities of the points from compilation sources are recorded in the PTTYPE field by map label (Table 6). Note that ARC/INFO coverages cannot contain both point and polygon information, so only coverages with point information will have a point attribute table, and these coverages will not have a polygon attribute table.

Table 7 - *Content of the Point 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
PTTYPE	35	35	C		unit label
DIP	3	3	I		dip of bedding or foliation (structure coverages only)
STRIKE	3	3	I		strike of bedding or foliation (structure coverages only)

Table 8 - *Point Types Recorded in the PTTYPE Field*

cd_sp-sr and be_sp-sr
approx bedding
bedding
bedding w/tops
foliation
ot bedding
ot bedding w/tops
vert bedding

The geologic point types are ALACARTE line types that correlate with the geologic point symbols in the ALACARTE point set ALCGEOL.MRK according to the ALACARTE point lookup table. For more information on ALACARTE and its pointsets, see Wentworth and Fitzgibbon (1991).

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