

CentralAmericaMap:

A mineral occurrence database for Central America

Instructions for MapInfo and ArcGIS users

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Introduction

CentralAmericaMap is a GIS database for Guatemala, Belize, El Salvador, Nicaragua, Honduras, Costa Rica and Panama. The *Geography* module contains files for digital topography (DEM), shaded relief, and bathymetry. *Geology* provides an up-to-date geologic map for each country in vector format. *TS Units* provides a tectono-stratigraphic interpretation for the entire region based on published research. *Prospect* assembles current figures on past production, resources and reserves for over 1100 known metallic mineral occurrences. *Land Status* locates 2900 metallic and non-metallic mineral concessions (attributed with ownership and contract date) and plots the locations of 370 national parks, forest reserves, and other areas of restricted mineral entry.

A separate Central America Multielement Geochemical Database, also described here, assembles rock, soil and stream sediment geochemical data for the entire region.

CentralAmericaMap is available in MapInfo or in ArcGIS format; pricing is covered on the final page of this database description. CentralAmericaMap is constantly being revised and updated as new resources are announced for an ever increasing number of metallic mineral occurrences. Geologic maps are updated regularly and tectono-stratigraphic units are modified to reflect ongoing research.

New users should pay special attention to the “Installation” and “Microsoft Access Database” sections of this Readme file. After installing CentralAmericaMap, open “CAProspects” to display mines and mineral occurrences on a tectono-stratigraphic base map prepared from a mosaic of published country-scale geologic maps. Open “CALandStatus” to display metallic and non-metallic concessions along with national parks, national forests, and other areas of restricted mineral entry.

Geography, Geology and TS Unit Modules

The *Geography* and the *Geology* modules of the CentralAmericaMap database are displayed by opening the “CAGeography” and “CAGeology” files. *Geography* includes shaded relief and bathymetry and is accompanied by Digital Chart of the World (DCW) files, topographic map indices and Landsat satellite imagery. *Geology* provides a mosaic of published geologic maps and legends (one for each country) all in vector format. These maps display rock units colored according to age and lithology. *TS Units* is a metallogenically-oriented regional geologic map compiled using published geologic maps as a base but colored with tectono-stratigraphic rock unit assignments (e.g. plateau basalt of the Caribbean Large Igneous Province) rather than location-specific lithologic descriptions (e.g. Dumisseau basalt). *Geography*, *Geology* and *TS Units* have broad application beyond the mining and exploration industry.

Radiometric Dates Module

The *Radiometric Dates* module compiles over 2000 published radiometric ages along with sample number, sample location, description, analytical method, mineral dated, error and a reference to the literature. Additional fields allow the the database to be sorted by interpretation: inherited age, intrusion/crystallization age, volcanism/crystallization age, age of metamorphism or age of sedimentation.

Prospect Module

The *Prospect* module, which includes modules for *Geography*, *Geology*, *TS Units* and *Radiometric Dates*, is displayed by opening the “CAProspects” file. Metallic mineral occurrences are plotted using shapes that correspond to deposit types, colors for each metal, and sizes that reflect gross contained metal value. Clicking on a prospect with the info tool will call up attached information including location, source of data, deposit type, owners, partners, past production, current resources, current reserves, status (active mine, inactive mine, prospect), drill results, geologic observations, recent sales and joint ventures, and references to the literature as well as calculated values for total precious metal content in ounces, total base metal content in tons, and total contained metal value in US dollars.

CentralAmericaMap can be queried. For instance, one can select:

- all gold deposits with over 500,000 ounces in past production, or
- all porphyry copper occurrences located in Panama and Costa Rica, or
- all mineral occurrences hosted by calc-alkaline volcanic rocks.

Land Status

The *Land status* module is displayed by opening the “CALandStatus” file. Metallic and non-metallic mineral concessions, color-coded and plotted on a shaded relief base map, are attributed with concession type, ownership, status, contract date, and expiration date. Only official government records are used to generate the concession maps. These maps provide a “snapshot” of land status as of the last compilation date. For specific areas of interest, a thorough review of current land status is always necessary.

The land status database also shows areas of restricted mineral entry. These are areas such as national parks, forest reserves, Indian reservations, and national monuments where mineral exploration and development is restricted or prohibited.

Subdirectories

Concessions subdirectory:

Concession location information for Central America is stored in the concessions subdirectory but is not updated regularly. Each concession is attributed with the contract date, ownership, and the expiration date (the contract date plus the maximum number of years that a concession can be held). Expired concessions are not eliminated until they disappear from the official government database. In some countries, expired concessions are active until a new or the old concession holder applies for cancellation. For up-to-date concession information, the user is referred to the Mines Department in each country.

Geology subdirectory:

The Geology subdirectory contains a 1:2.5 million scale regional geologic map for the entire Caribbean region (from Case and Holcombe, 1980) as well as more detailed geologic maps for each country. Many of these maps are difficult to obtain or out of print. All have been digitized and are provided as vector files. The scale (and age) of the source maps varies from 1:750,000 for Belize (2008) to 1:500,000 for Guatemala (1970), Honduras (1990), Nicaragua (1995), Panama (1991), and Costa Rica (2007) to 1:100,000 for El Salvador (1978). Each of these maps has been modified to include more recent published geology for specific areas (e.g. Rogers, 2003 Ph.D thesis for Honduras and Nicaragua; Ratschbacher et al., 2009 for Guatemala; and, Buchs et al., 2011 for Panama).

Prospect subdirectory:

Information pertaining to individual mines and mineral occurrences is stored in a Microsoft Access database (CBPros1.mdb). Only published, non-confidential information is provided. MapInfo workspaces, one for each country, provide subsets of the Prospect information for that country.

CBPros1.mdb includes the following information for each mineral occurrence: name, alternate names, location, reference for location, deposit type, district name, owners, partners, deals, production, production period, production reference, reserve, reserve reference, resource, resource reference, status (active mine, inactive mine, resource, prospect), drilling (best intercepts), geologic observations, size in ounces of gold and silver, size in tons of base and other metals, and gross contained metal value.

Mineral occurrences are classified as follows. Symbols can be added and classifications can be modified at the user's discretion.

Metallic Mineral Deposit Classification

Deposit Type	Symbol
Epithermal veins and stockworks (Au, Ag, Cu, Pb, Zn)	1
Epithermal high sulfidation deposits (Au, Ag, Cu, Zn)	13
Epithermal veins and stockworks of Hg and Sb	8 (Hg), 10 (Sb)
Volcanogenic massive sulfide (VMS) deposits	2
Sediment-hosted (Sedex) deposits	14
Volcanogenic (Seafloor) manganese deposits	9
Porphyry (Cu, Mo, Au, Ag) deposits	5
Skarn and carbonate replacement deposits (Cu, Pb, Zn, Fe)	3
IOCG deposits	16
Orogenic (shear-hosted, mesothermal) deposits	4
Magmatic segregation (chromite) deposits	11
Lateritic nickel-cobalt deposits	6
Bauxite (aluminum) deposits	12
Alluvial gold, diamond and Pt group mineral deposits	7
unassigned	99

Parks subdirectory:

The Parks subdirectory contains national parks, forest reserves, and Indian reservations by country. These are areas where mineral development is prohibited or restricted.

Survey Indices subdirectory:

The files in this subdirectory show the location of stream sediment surveys and geophysical surveys conducted by companies, governments and international aid organizations. Stream sediment survey indices include the number of samples collected, area covered, sample density, list of elements run, and the source of the data. Geophysical survey indices include the type of survey (magnetic and/or radiometric), area covered, and the source of the image or data.

Geophysics subdirectory:

The Geophysics subdirectory is designed to work with the CentralAmericaMap database but is sold separately. Airborne geophysical images including raw data, as grd files, are available for selected areas. Pricing information for these supplemental databases is available from Recursos del Caribe (nelson@cbmap.net).

Geochemistry subdirectory:

Multielement geochemical survey data for Central America has been assembled and is being digitized (as vector files) for each country. These geochemical databases are designed to work with CentralAmericaMap but are sold separately. Sample locations and multielement geochemical data, with an emphasis on stream sediment data, is currently available for Panama and Nicaragua. For an index of geochemical surveys by country, go to: <http://www.cbmap.net/images/caribbean-stream-sediment-surveys-summary.pdf>.

In addition to multielement geochemical data in vector format, these databases include copies of original sample location maps (as georeferenced tiff images) and pdf copies of original reports. Pricing information is provided on the final page of this document.

Shaded Relief and Bathymetry subdirectories:

Shaded relief and bathymetric maps for Central America are provided in the Shaded relief and Bathymetry subdirectories. Ninety-meter (3 arc-second) resolution data used to create shaded relief maps for each country

comes from version 2 (2005) of the Shuttle Radar Topography Mission (SRTM) (<http://seamless.usgs.gov>).

Regional bathymetric data (DEM files) was downloaded from the Marine Geoscience Data System: Global Multi-resolution Topographic Data portal (MGDS: GMRT) at <http://www.marine-geo.org/portals/gmrt/>. The bathymetric map is created from (shipboard) sonar supplemented, between tracks, by gravity and satellite altimetry data. (The sea surface is higher over subsurface topography.) The process is described by Ryan et al., 2009: <http://onlinelibrary.wiley.com/doi/10.1029/2008GC002332/full>. MGDS: GMRT data was re-gridded to produce maps at an approximate resolution of 200m (up to 240m depending on location). DEM grd files are provided.

DCW, Satellite and 50K topo index subdirectories:

The DCW subdirectory includes borders, cities and towns, roads, major drainages, and principal topographic contours from the Digital Chart of the World. Landsat satellite images, compressed using Mr. Sid software, are assembled in the Satellite subdirectory. Indices to published 1:50,000 scale topographic maps are provided in the 50K topo index subdirectory.

Radiometric Dates:

The Radiometric Dates subdirectory compiles ages for 2000 samples. Each sample is attributed with sample number, location, lithology, sample description, analytical method, rock type, material dated, age, error, interpretation and a source reference. The database also includes fields for original and current interpretation (inherited age, intrusion/crystallization age, volcanism/crystallization age, age of metamorphism, etc.)

TS Units subdirectory:

This subdirectory contains files used to create a TS (tectono-stratigraphic) map. The TS map uses the published geologic maps as a base. Then, based on publications and graduate school theses, geologic map polygons are assigned colors according to their tectono-stratigraphic setting. For instance, rather than coloring rock units according to age and lithology (e.g. Cretaceous basalt), the TS map identifies the geotectonic setting of that basalt as Pacific ocean floor, Proto-Caribbean ocean floor, intraoceanic island arc or back arc basin. This step provides a map that is both easier to understand and more appropriately applied to exploration.

Titles and legends subdirectory:

Title blocks, legends, grids, labels, and scale bars are stored here.

UTM subdirectory:

A UTM index is provided for all of Central America along with grids for each UTM zone. Grids are provided for the following projections: 1) Latitude/Longitude (Equidistant Cylindrical) projection using the WGS 1984 datum, 2) Lambert Conformal Conic projection (origin latitude 39 degrees north, origin longitude 96 degrees west, standard parallels 33 and 45 degrees north) with the NAD 1927 datum, and 3) MapInfo's Latitude Longitude (Equidistant Cylindrical) projection using no datum.

Plots subdirectory:

The Plots subdirectory contains a high resolution tiff image for the metallogenic map of Central America.

Installation (MapInfo Users)

Start by checking that Microsoft Access 2000 (or higher) and MapInfo version 10.0 (or higher) are installed on your computer. If this is an update, backup your previous version of the CentralAmericaMap database and erase the old database. Copy the new CentralAmericaMap database to the root directory (C:\) of your hard drive. Rename the folder CBMap (C:\CBMap).

Fonts

Follow these steps to replace your "MapInfo Compatible font" with a customized font file provided with the CentralAmericaMap database.

- Exit MapInfo if it is running.
- Be sure that you are displaying hidden files and folders.
 - On a machine that is running Windows 10, open Windows Explorer and go to File > "Change Folder and Search Options." Select the "View" tab. Then, under "Hidden files and folders" select the option to "show hidden files, folders and drives".
- Locate the file MAPINFOW.FNT on your computer.
 - On a machine that is running Windows 10, it is found in:
C:\Users\YOURUSERNAME\AppData\Roaming\MapInfo\Professional\1000
- Rename MAPINFOW.FNT; call it MAPINFOW_FNT.OLD
- Copy "MAPINFOW.FNT" from the CentralAmericaMap root directory into the folder where "MAPINFOW_FNT.OLD" is located.

Datums

CentralAmericaMap map uses several local datums that are not delivered with standard MapInfo software. Although the database will continue to function without making changes, it is preferable to add the custom datums provided with CentralAmericaMap to the MapInfo projection file. To do so:

Use any text editor to open “MapInfow.prj” from:
C:\Program Files(x86)\MapInfo\Professional (for Windows 10)

This file contains all of the projections that ship with your MapInfo software. From the CentralAmericaMap database, copy the text contained in “add_to_mapinfow_prj_file.txt” and paste it into MapInfow.prj (at the end of the file will work just fine). MapInfow.prj will now provide all local datums called by CentralAmericaMap.

You are now ready to run CentralAmericaMap. Open the prospects database and metallogenic map by opening CAProspects. Open the land status database and concession map by opening CALandStatus. You can also create your own workspaces (MapInfo) or project files (ArcGIS).

Picklists

CentralAmericaMap map uses a MapInfo Discover picklist to assign colors to tectono-stratigraphic units. Although neither Discover nor the picklist is required to run CentralAmericaMap, users who want to edit the picklist (to change colors or to add TS units) will need to copy “r_TectStrat_picklist.xml” from the TS Units\Picklist subdirectory of the CentralAmericaMap database to the following subdirectory:
C:\Users\username\AppData\Roaming\Encom\Discover\Picklists

Installation (ArcGIS Users)

Install Microsoft Access 2000 (or higher) and ArcGIS version 10.0 (or higher) on your computer. If this is an update, backup your previous version of the CentralAmericaMap database and erase the old directory. Copy your new CentralAmericaMap database to the root directory (C:\) of your hard drive. Rename the folder CBMap (C:\CBMap).

If the CentralAmericaMap database is copied to a location other than the root directory, then some of the project files will not open properly. Broken links can be re-established using the procedure described in a following section, Open Database Connectivity - ODBC Issues (for ArcGIS Users).

You are now ready to run CentralAmericaMap. Open the prospects database and metallogenic map by opening CAProspects.mxd. Open the land status database and concession map by opening CALandstatus.mxd. Use the mxd files provided with the CentralAmericaMap database or create new ones.

Microsoft Access Database (MapInfo and ArcGIS Users)

All prospect information is stored in a Microsoft Access database, CBPros1.mdb, located in the Prospect subdirectory. CBPros1, a table in the Access database, compiles relevant information for each mineral occurrence including: location, deposit type, owners, partners, past production, current resources, current reserves, published sources for past production, resource and reserve figures, status (active mine, inactive mine, prospect), salient drill results, geologic observations, ownership, terms of recent sales and joint ventures, and references to the literature. Calculated fields show the total precious metal content in ounces, base metal content in tons, and total contained metal value in US dollars.

New mineral occurrences can be added and changes can be made to existing mineral occurrence information by using MSAccess to modify the CBPros1 table. CBPros1.mdb also contains a series of queries that select all deposits for each of the deposit types shown on page 4.

A Microsoft Access Form, "Update Deposit Size and Value" must be used to update gross contained metal values whenever changes are made to production, resources or reserves. This form can also be used to change the metal prices used in the calculation of gross contained metal value.

The file called "readme_calculatedfields.txt" (located in the Prospects subdirectory,) lists the fields which are used in calculation of deposit size and gross contained metal value.

When adding records to the MSAccess database (CBPros1.mdb), any nulls (empty fields) should be replaced with zeros (0's) in the entries for production, resource and grade since the calculation of deposit size and value draws numeric values from those fields.

Deposit size and gross contained metal value are calculated using the following formulas:

Au and Ag deposit size = past production in ounces + (resource in metric tonnes * resource grade in ppm * 1/31.1034768) + (reserve in metric tonnes * reserve grade in ppm * 1/31.1034768)

Base metal, Aluminum, Nickel, Cobalt and Chromium deposit size = past production in tons + (resource in tonnes * 2204.623 / 2000 * resource grade in percent / 100) + (reserve in tonnes * 2204.623 / 2000 * reserve grade in percent / 100)

Deposit value = deposit size (in ounces for precious metals, in tons for base metals, aluminum, nickel and cobalt) * metal price. Polymetallic deposit values represent the sum of each of the contained metals.

Open Database Connectivity - ODBC Issues (MapInfo Users)

MapInfo connects to the Prospects database (CBPros1.mdb) via a dsn file (CBPros1.dsn) which resides in the Prospect subdirectory. All changes made to the database in MapInfo automatically flow through to the Access database when the MapInfo table CBPros1.tab is saved. You can also make changes directly to CBPros1.mdb, the Prospects database, via MS Access.

Open Database Connectivity - ODBC Issues (ArcGIS Users)

ArcGIS connects to the Prospects database (CBPros1.mdb) via an Object Linking and Embedding data base (OLE DB) link that is embedded in each mxd file. The OLE DB file, CBPros1.odc, resides in the ODCfile subdirectory of the Prospect subdirectory.

If any mxd files contain OLE DB links that are broken, those links can be re-established using ArcCatalog. Open ArcCatalog, right click on the mxd file that is not opening properly, select “set data source(s),” and set the data source as: C:\CBMap\Prospect\ODCfile\CBPros1.odc. ArcCatalog will then save the modified mxd as a “Copy of” the old filename.

Database Management System - DBMS (MapInfo Users)

All mineral occurrence information is stored in CBPros1.mdb, a Microsoft Access database located in the Prospects subdirectory. Changes made to CBPros1.mdb from within MapInfo are written to the MSAccess database when the MapInfo table is saved. (MapInfo may ask you to browse to the location of the MSAccess database.) Once changes have been saved to the MSAccess database, MapInfo will give you the option to “refresh” the linked MapInfo table. Answer “yes.” If inconsistencies arise between the data in the Access database and the data in the MapInfo tables, MapInfo will issue a warning message that prompts the user to resolve the conflict.

It is best to refresh all of the MapInfo tables, including CBPros1.tab, whenever changes are made to the mineral occurrence information whether from within MapInfo or from within Microsoft Access. After refreshing the MapInfo linked tables, close any open DBMS connections using “file > close DBMS connection” or the “disconnect DBMS” button.

MapInfo cannot read MSAccess queries. For this reason, deposit type selections are saved not only as queries in the MSAccess database but also

as linked MapInfo tables in the Prospects subdirectory. Workspaces read the linked tables and create MapInfo queries (with a “cb_” prefix). This allows the user to make changes to both the position of prospects and their attached information from within MapInfo.

Database Management System - DBMS (ArcGIS Users)

All mineral occurrence information is stored in CBPros1.mdb, an MSAccess database located in the Prospects subdirectory. Changes to the mineral occurrence information must be made directly to CBPros1.mdb from within MSAccess. Size and gross contained metal value can then be updated using the “Update_size_and_value” form in CBPros1.mdb.

Ordering information, copyright and disclaimer

The CentralAmericaMap GIS database, including *Geography, Geology, TS Units, Prospect, Radiometric Dates and Land Status* modules (in MapInfo or in ArcGIS format), is available through Recursos del Caribe, S.A. To order the database or for any questions, write to Carl Nelson at: nelson@cbmap.net.

Information on pricing is provided below. Updates are free for a year and half price for four additional years. Purchasers are encouraged to update their databases regularly.

Examples of the maps that can be generated using the databases are displayed on the web site at www.CBMap.net.

CentralAmericaMap is the property of Carl E. Nelson and Recursos del Caribe, S.A. It is intended for the sole use of the purchaser. The database cannot be copied, sold, transferred, or distributed without express written permission from Carl E. Nelson.

Reasonable efforts are made to ensure that the information contained in the CentralAmericaMap database is accurate and, except for the land status module (metallic mineral concessions), is kept up-to-date. Carl Nelson and Recursos del Caribe, S.A. do not warrant the accuracy of information provided in the CentralAmericaMap database.

Pricing

CentralAmericaMap: a GIS database (in MapInfo or ArcGIS format) for Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. Available as a package for: US\$30,000

CentralAmericaMap is available in modules as follows:
Geography (infrastructure, DEM, and shaded relief): \$ 5,000

<i>Geology</i> (<i>Geography</i> plus vector geology for all 7 countries):	\$10,000
<i>Radiometric Dates</i> (radiometric dates only, with locations):	\$ 5,000
<i>TS Units</i> (<i>Geography</i> , <i>Geology</i> and <i>Radiometric Dates</i> plus a regional tectono-stratigraphic interpretation):	\$20,000
<i>Prospects</i> (<i>TS Units</i> plus metallic mineral mines and prospects):	\$30,000
<i>Land status</i> (<i>Geography</i> plus metallic mineral concessions, national parks, forest reserves and other protected areas):	\$10,000
<i>Plots</i> (high resolution tiff images of the metallogenic map):	\$ 5,000

CentralAmericaMap data for individual countries includes *Geography*, *Geology*, *Prospects*, *Radiometric Dates*, *TS Units*, and *Land status* and is available for: \$10,000 per country

Central America Multielement Geochemical Database: This database contains multielement geochemical data, with an emphasis on stream sediment samples, for each Central American country. Geochemical data is provided in vector format and are accompanied by pdf copies of original reports and by georeferenced sample location maps. These databases are sold by country and cover Guatemala (13,000 samples), Honduras (20,000 samples), Nicaragua (10,000 samples), Panama (15,000 samples), Costa Rica (8000 samples) and El Salvador (8000 samples). For a list of surveys by country go to: <http://www.cbmap.net/images/caribbean-stream-sediment-surveys-summary.pdf>. Contact nelson@cbmap.net for more detailed information, for a map of sample coverage for individual countries and for the availability of data in vector format.

Geophysics: Airborne geophysical images including raw data, as grd files. Contact nelson@cbmap.net for coverage and pricing information.