

CentralAmericaMap:

A mineral occurrence data set for Central America

Instructions for MapInfo and ArcGIS users

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Introduction

CentralAmericaMap is a GIS data set for Guatemala, Belize, El Salvador, Nicaragua, Honduras, Costa Rica and Panama. The *Geography* module provides files for infrastructure (cities, roads, political boundaries, etc.), digital topography (DEM), shaded relief, and bathymetry. The *Geology* module provides up-to-date, published geologic maps and legends for each country in vector format. *TS Units* provides a unified, tectonostratigraphic map and legend for the entire region based on publications from government, industry and academia. The *Radiometric Dates* module compiles over 2000 published ages for intrusive and extrusive igneous rocks, metamorphism, hydrothermal alteration, mineralization, inherited ages and exhumation (cooling). *Prospect* locates over 1100 metallic mineral mines and prospects, classifies them according to 18 deposit types, and assembles current information for past production, resources and reserves. The *Land Status* module locates 2900 metallic and non-metallic mineral concessions (attributed with ownership and contract date) and plots the locations of 70 national parks, forest reserves, and other areas of restricted mineral entry.

Multielement geochemical data sets, available separately, assemble rock, soil and stream sediment geochemical data for each Central American country.

CentralAmericaMap is constantly being revised and updated as new resources are announced for an ever-increasing number of metallic mineral deposits. Geologic and tectonostratigraphic maps are updated or modified to reflect ongoing research. Pricing is covered on the final page of this data set description.

New users should pay special attention to the “Installation” section of this Readme file.

Geography, Geology and TS Unit Modules

The *Geography* and the *Geology* modules of the CentralAmericaMap data set are displayed by opening “CAGeography” and “CAGeology.” *Geography* includes shaded relief and bathymetry and is accompanied by digital topography (DEM), infrastructure, topographic map indices and Landsat satellite imagery. *Geology* provides, in addition, a mosaic of published geologic maps and legends (one for each country) all in vector format. *TS Units*, a unified tectonostratigraphic map for the entire region, was compiled using published geologic maps as a base but colored with tectonostratigraphic rock unit assignments (e.g. plateau basalt of the Caribbean Large Igneous Province) rather than location-specific lithologic descriptions (e.g. Dumisseau basalt). *TS Units* assignments are based on published research and provide a base appropriate for metallogenic interpretation. *Geography*, *Geology* and *TS Units* modules 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. Two additional fields record the original and the current interpretation for each date, e.g. the age of: intrusion, volcanism, metamorphism, sedimentation, exhumation, hydrothermal alteration or mineralization.

Prospect Module

The *Prospect* module, which includes the *Geography*, *Geology*, *TS Units* and *Radiometric Dates* modules, is displayed by opening “CAProspects.” Metallic mineral occurrences are plotted using shapes that correspond to deposit types, colors for each metal, and sizes that reflect gross contained metal value. Selecting a specific mineral occurrence 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 fields for total size (in tons or ounces) and contained metal value in US\$.

Land Status Module

The *Land status* module is displayed by opening “CALandStatus.” 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 data set also shows national parks, forest reserves, Indian reservations, national monuments and other areas where mineral exploration and development is restricted or prohibited.

Subdirectories

Concessions subdirectory:

Concession maps for all seven Central American countries are stored in the Concessions subdirectory. 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 data set. For up-to-date concession information, the user is referred to the Mines Department in each country.

Geology subdirectory:

The Geology subdirectory contains the most recent published geologic map and legend for each country. Many of these maps are difficult to obtain or out of print. All of the maps and legends have been digitized and are provided as vector files. Their scale and publication date vary as follows: 1:750,000 for Belize (2008); 1:500,000 for Guatemala (1970), Honduras (1990), Nicaragua (1995), Panama (1991), and Costa Rica (2007); 1:100,000 for El Salvador (1978). These geologic maps have been modified and updated to incorporate more recent published geologic mapping (e.g. Rogers, 2003 in 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 an MS Access database (CB_Pros.accdb). Only published, non-confidential information is provided. The Prospect subdirectory 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, overall size (in ounces or tons) and contained metal value.

Mineral occurrences are classified according to 18 deposit types, listed in the following table. MapInfo cannot read MS Access queries, consequently each deposit type has a stand-alone table in the Prospect subdirectory.

Metallic Mineral Deposit Classification

Deposit Type	Symbol
Epithermal veins and stockworks (Au, Ag, Cu, Pb, Zn)	1
Epithermal disseminated (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
Sediment-hosted (U, Th, V) deposits	27
Banded iron formation (Au, Fe, Mn) deposits	21
Porphyry (Cu, Mo, Au, Ag) deposits	5
Skarn (Au, Ag, Cu, Pb, Zn) deposits	3
Iron skarn (Fe) deposits	24
Carbonate replacement (Au, Ag, Cu, Pb, Zn) deposits	22
Iron replacement (Fe) deposits	23
Greisen (Sn, W) deposits	17
IOCG (Iron-oxide copper gold) deposits (Au, Ag, Cu, Mo)	16
IOCG (U, REE, Fe) deposits	25
Alkaline Rocks and Carbonatites (U, Th, V)	18
Alkaline Rocks and Carbonatites (Sc, REE)	26
Orogenic (shear-hosted, mesothermal) deposits (Au, Ag)	4
Magmatic segregation (Cr, Pt, Pd) deposits	11
Lateritic (Ni, Co) deposits	6
Bauxite (Al, REE, Sc) deposits	12
Alluvial (Au, Ag, Pt, Pd) deposits	7
Alluvial (U, Th, REE, Sc) deposits	28
Alluvial (Fe, Sn, W) deposits	29
unassigned	99

Parks subdirectory:

The Parks subdirectory contains national parks, forest reserves, and Indian reservations for each of the seven Central American countries. 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 record the number of samples collected, area covered, sample density, list of elements run, and the original 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:

Airborne geophysical survey results including grid files are available for selected areas. Pricing information for these supplemental geophysical data sets is available from Recursos del Caribe (nelson@cbmap.net).

Geochemistry subdirectory:

Multielement geochemical survey indices are provided for all of Central America. Sample locations, analytical data and accompanying reports (as pdf files) have been assembled for each Central American country and have been digitized (captured as vector files) for Panama and Nicaragua, so far. The geochemical data sets, designed to work with CentralAmericaMap, are sold separately. For an index of geochemical surveys by country, go to: <http://www.cbmap.net/images/caribbean-stream-sediment-surveys-summary.pdf>.

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 bathymetry (as DEM grd 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 using a process 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 200 meters (up to 240 meters depending on location). DEM grd files are provided.

Geography, Satellite images 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 subdirectory:

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 and source of information. The data set also includes fields both the original and the current interpretation (e.g. inherited age, intrusion/crystallization age, volcanism/crystallization age, age of metamorphism, age of exhumation, etc.)

TS Units subdirectory:

This subdirectory contains files used to create a tectonostratigraphic (TS) map. The TS map uses the published geologic maps from the Geology subdirectory as a base. Then, based on government, industry and academic publications, geologic map polygons are assigned attributes and colors according to their tectonostratigraphic setting. For instance, rather displaying map units according to their age and lithology (e.g. Tertiary Coyol basalt), the TS_PGONS file is attributed with origin and tectonic setting (e.g. Pacific or Proto-Caribbean ocean floor, intra-oceanic island arc, or back arc basin). The result is a tectonostratigraphic map that is easy to understand and directly applicable to mineral 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.

Ancillary Files subdirectory:

The Ancillary Files subdirectory contains files that modify or supplement the user's GIS software. For ArcGIS users, this subdirectory includes ArcGIS layer files and files for use with ArcToolbox. For MapInfo users, this subdirectory includes picklists, "MapInfoW.fnt" with special fonts and a file with additional projection information called "add_to_MapInfo_prj.txt." All are described in the following section on Installation.

A file called "deposit_size_calculations_2018.xlsx" lists the formulas that are used in calculating deposit size and gross contained metal value. For instance:

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.

Plots subdirectory:

The Plots subdirectory contains high resolution tiff images for the metallogenic map and the land status map of Central America.

MapInfo Installation

Start by checking that Microsoft Access and MapInfo version 15.0 (or higher) are installed on your computer. If this is an update, backup your previous version before erasing the old data set. Copy the new CentralAmericaMap data set to the root directory (C:\) of your hard drive. Rename the folder CBMap (C:\CBMap).

Fonts

CentralAmericaMap map uses several customized fonts that are not delivered with standard MapInfo software. Follow these steps to replace your "MapInfo 3.0 Compatible font" with the customized version provided in the Ancillary_Files subdirectory.

- 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\MapInfo\Professional\1500
(for MapInfo version 15)
- Rename MAPINFOW.FNT; call it MAPINFOW_FNT.OLD
- Copy "MAPINFOW.FNT" from the Ancillary_Files subdirectory 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 data set 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 Ancillary_Files subdirectory, 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.

Picklists

CentralAmericaMap map uses MapInfo Discover picklists to assign colors to tectono-stratigraphic units, parks and concessions. Although neither Discover nor the picklists are required to run CentralAmericaMap, users who want to edit the picklists (to change colors or add categories) will need to copy the .xml files from the Ancillary_Files subdirectory and paste them to the following subdirectory:
C:\Users\username\AppData\Roaming\Encom\Discover\Picklists

Microsoft Access Database

Mineral occurrence information for MapInfo users is stored in a Microsoft Access database, CB_Prof.accdb, located in the Prospect subdirectory. Prospects, 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 CB_Pro Pros database. CB_Pro Pros.accdb also contains a series of queries that select all deposits for each of the deposit types listed on the table under Prospect subdirectory.

A form in CB_Pro Pros.accdb, "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.

When adding records to the MSAccess database (CB_Pro Pros.accdb), 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.

Open Database Connectivity - ODBC Issues

MapInfo connects to the Prospects database (CB_Pro Pros.accdb) via a dsn file (CB_Pro Pros.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 CB_Pro Pros.tab 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 the linked MapInfo tables, including CB_Pro Prospects.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.

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

ArcGIS Installation

Install ArcGIS version 10.6 (or higher) on your computer. If this is an update, backup your previous version before erasing the old CBMap directory. Copy your new data set to the root directory of your hard drive (C:\CBMap).

ESRI Geodatabase management

All mineral occurrence information is stored in CB_Pro.s.gdb, an ArcGIS geodatabase located in the Prospects subdirectory. Additions or changes to mineral occurrence information are made directly to the Prospects table in CB_Pro.s.gdb.

Most users will not need to make changes to the information that is stored in CB_Pro.s.gdb. However, if changes are made to production, reserves or resources, then deposit size and value fields should also be updated. These updates are made by running the Python script "UpdateProspects.pyt." The following instructions explain how to add "UpdateProspects.pyt" to ArcToolbox.

- Copy the file "UpdateProspects.pyt" from C:\CBMap\Ancillary_Files\ into the "My Toolboxes" folder. A common path to this folder, for ArcMap 10.6, is:
C:\Users\[your username]\AppData\Roaming\ESRI\Desktop10.6\ArcToolbox\My Toolboxes\
- Start ArcMap, and click on the ArcToolbox button
- In the ArcToolbox window, right-click in open space below the list of toolboxes, and select "Add Toolbox"
- Navigate to the "My Toolboxes" directory and select (single-click) UpdateProspects.pyt, and then click Open.
- Select UpdateDepositSizeandValue > right click in the open space underneath > save settings > to default
- Note that the UpdateProspects.pyt file only needs to be installed once, even if you have more than one data set (e.g. CBMap and ECTMap) installed.

Now that "UpdateProspects.pyt" is installed, follow these instructions to update deposit size and value fields in CBPros.gdb:

- Open any ArcGIS mxd file.
- In the ArcToolbox window, if the UpdateDepositSizeandValue toolbox is not present, right click on open space and load settings > from default.
- In the ArcToolbox window, double-click the UpdateDepositSizeAndValue toolbox. A list of update scripts will be displayed.
- Double-click the script appropriate for the database table you have installed (e.g. if you have installed CBMap, double-click on CBProsUpdate). A window will appear.
- Click OK to begin running the script. Calculations may take some time ... a couple of minutes for a thousand prospect records is typical. For more records, a proportionately longer time period is needed.
- Save the mxd

Source File Connections

If the CentralAmericaMap data set is copied to a location other than the root directory, some mxd files will not open properly. Broken links can be repaired by resetting the links. Select (click on) the “list by source” icon. Right click on the file that is not opening properly, select properties > source > “set data source,” and browse to the source location, for example: C:\CBMap\Prospect\CB_Pro.s.gdb.

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

Ordering information, copyright and disclaimer

The CentralAmericaMap GIS data set, including the *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 data set 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. Prospective clients are invited to “test drive” the data sets via a screen sharing session before making a purchase. Examples of the maps that can be generated using the data sets 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 data set 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 data set is accurate and, with the exception of concessions, is updated regularly. Carl Nelson and Recursos del Caribe, S.A. do not warrant the accuracy of information provided in the CentralAmericaMap data set.

Pricing

CentralAmericaMap: a GIS data set for *Geography, Geology, TS Units, Prospects, Land Status and Radiometric Dates* covering Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. Available as a package in **either** MapInfo or ArcGIS format for: US\$30,000
Or in **both** MapInfo or ArcGIS format for: US\$37,500

CentralAmericaMap is also available as stand-alone modules as follows:

<i>Geography</i> (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, Geology and 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

A data set for an individual country includes *Geography, Geology, Prospects, Radiometric Dates, TS Units, and Land status:* \$10,000

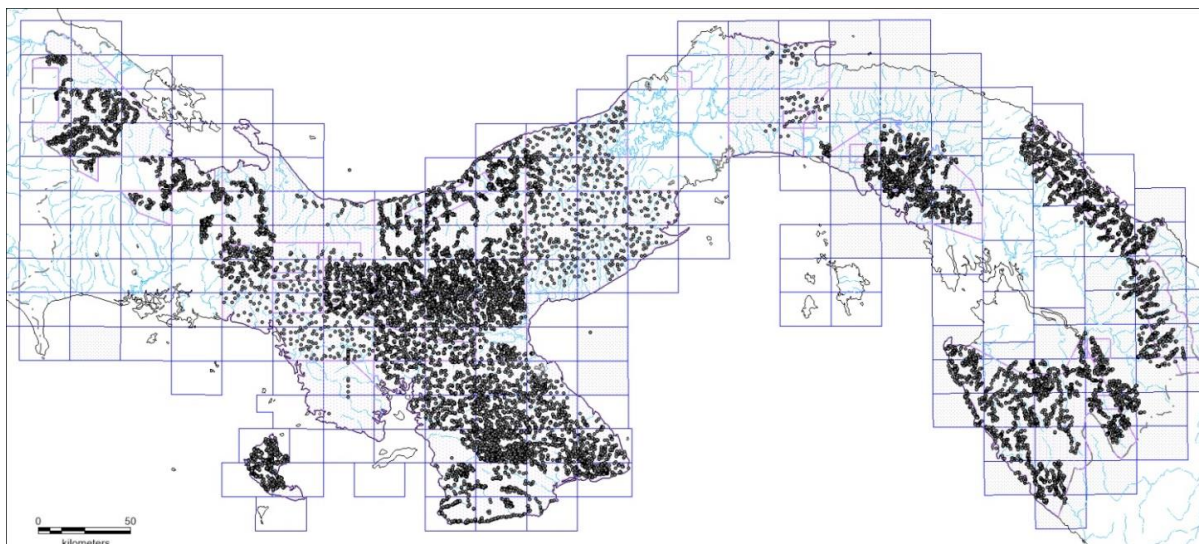
Central America multielement geochemical data sets:

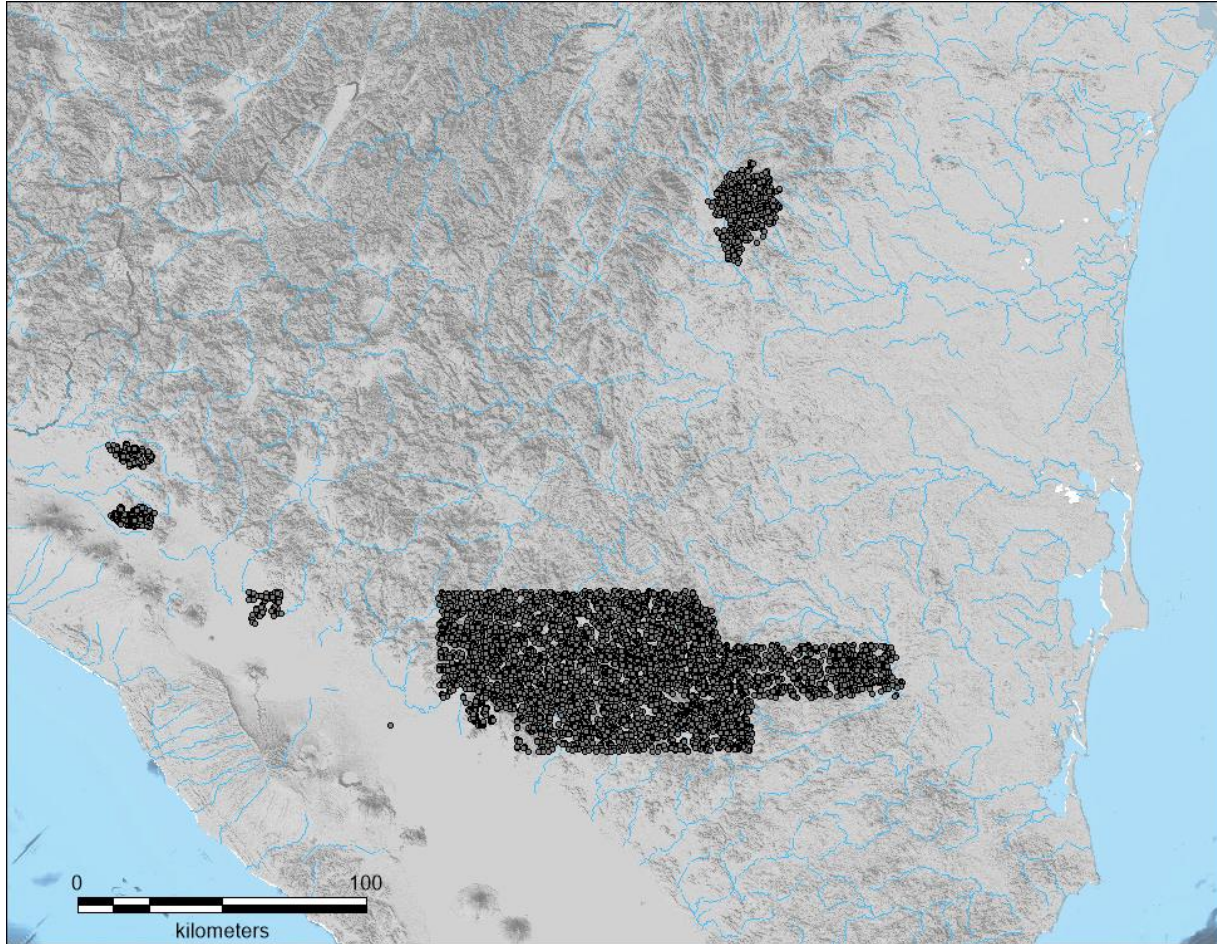
These data sets contain multielement geochemical data, with an emphasis on stream sediment samples, for each Central American country. The data has been captured in vector format for Panama (22,000 samples) and Nicaragua (7,700 samples). Copies of original reports and sample location maps (as pdf files) are provided for those who wish to check the accuracy of the database. Sample coverage is shown on the maps below. Detailed descriptions of the Panama and Nicaragua stream sediment data sets are available at: www.cbmap.net.

Multielement geochemical data sets, currently in pdf format, are available for Guatemala (13,000 samples), Honduras (20,000 samples), Costa Rica (8000 samples) and El Salvador (8000 samples).

For a list of assembled surveys for which data is available, go to: <http://www.cbmap.net/wp-content/uploads/caribbean-stream-sediment-surveys-summary.pdf>.

Contact nelson@cbmap.net for more information the current availability of geochemical data in vector format.





Central America Geophysical Surveys:

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