

# **MexicoMap:**

## **A mineral occurrence database for Mexico**

### **Instructions for MapInfo and ArcGIS users**

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#### **Introduction**

MexicoMap, a GIS database for Mexico, is available in MapInfo or in ArcGIS format. The *Geography* module provides a shaded relief map along with vector files for infrastructure (rivers, roads, highways, political boundaries, airports, cities, and ports). *Geology* provides a 1:2,000,000 scale geologic map in vector format. The *Radiometric dates* module compiles over 3000 published radiometric ages. *TS Units* provides a tectono-stratigraphic interpretation for the entire region based on published research. *Prospect* locates mineral occurrences including mines, prospects, quarries, hot springs, geothermal areas, and oil and gas fields and assembles current figures on past production, known resources and published reserves. *Land Status* shows areas of restricted mineral entry such as national parks and biosphere reserves.

A separate Mexico Multielement Geochemical Database, also described here, assembles geochemical data for 45,000 stream sediment samples collected by government-sponsored programs in northern and central Mexico.

MexicoMap is available in MapInfo or in ArcGIS format; pricing is covered on the final page of this database description. MexicoMap is revised and updated as new resources are announced for an ever-increasing number of metallic mineral occurrences. The geologic map is updated 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 MexicoMap, open “MXProspects” to display mineral occurrences on a tectono-stratigraphic base map. Open “MXInfrastructure” to display roads, highways, political boundaries, cities, towns, ports, airports and rivers.

## **Geography Module**

The *Geography* portion of MexicoMap is displayed by opening the “MXGeography” or “MXInfrastructure” files. Vector files are opened for airports, cities, ports, states, railways, highways, drainages, coastline, lakes and reservoirs and plotted on a shaded relief base map.

## **Geology and TS Units Modules**

The *Geology* module is displayed by opening the “MXGeology” file. A 1:2,000,000 scale geologic map, originally published by the Servicio Geologico de Mexico (SGM) in 2013 and modified by Recursos del Caribe to reflect recent research, is provided along with shaded relief and accompanying infrastructure. *TS Units* is a metallogenically-oriented map compiled using the *Geology* module as a base but colored with tectono-stratigraphic rock unit assignments (e.g. back arc basin basalt of MORB composition) rather than location-specific lithologic descriptions (e.g. Rio Verde basalt). The *Geography*, *Geology* and *TS Units* modules have broad application beyond the mining industry.

## **Radiometric Dates Module**

The *Radiometric Dates* module compiles over 3000 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.

## **Prospects Module**

The *Prospect* module, which includes the *Geography*, *Geology*, *Radiometric Dates* and *TS Units* modules, can be displayed by opening the “MXProspects” 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, 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. Locations were captured

from published quadrangle maps, monographs published by the Servicio Geologico Mexicano (SGM), and US Government databases (MRDS, RASS, Pluto, USBM). Duplicate entries, where they exist, are the result of differences in the location of prospects captured from different sources. The Prospect database includes locations for quarries, geothermal areas and oil and gas fields.

MexicoMap 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 Mexico, or
- all mineral occurrences hosted by calc-alkaline plutonic rocks.

### **Land Status Module**

The *Land status* module is displayed by opening the “MXLandStatus” file. Areas displayed include national parks, forest reserves, and national monuments where mineral exploration and development is restricted or prohibited.

### **Subdirectories**

#### ***Concessions subdirectory:***

Concession locations and ownership information are not part of the MexicoMap database. Given the number of concessions in Mexico and the level of exploration activity, a map of concession ownership and location is beyond the scope of this database.

#### ***Geology subdirectory:***

The Geology subdirectory contains the 1:2,000,000 scale geologic map of Mexico originally published by the SGM in 2013 and modified by Recursos del Caribe to reflect recent research. The published 2013 version of this map is also available on the SGM website: <https://www.gob.mx/sgm>.

#### ***Parks subdirectory:***

The parks subdirectory contains national parks, forest reserves and other areas where mineral development is prohibited or restricted.

#### ***Radiometric Dates:***

The Radiometric Dates subdirectory compiles radiometric dates for over 3000 samples. Each sample is attributed with sample number, location, lithology, sample description, analytical method, rock type, material dated, age, error, interpretation and source reference.

***Prospect subdirectory:***

Prospect information is stored in a Microsoft Access database (CBPros1.mdb) located in the prospect subdirectory. Only non-confidential information (published or generally available to the public) is provided.

The prospect database 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 in the table below. Classifications (deposit types) are taken largely from Camprubi, 2013 (SEG Special Publication 17, p. 201-243). Symbols can be added and classifications can be modified at the user's discretion.

**Metallic Mineral Deposit Classification**

<b>Deposit Type</b>	<b>Symbol</b>
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

***Survey Indices subdirectory:***

This subdirectory shows the location of stream sediment surveys conducted by a joint program of the United States Geological Survey and the Consejo de Recursos Minerales. The index lists the number of samples collected, the area covered, the sample density, a list of elements run, and the source of the data.

***Geochemistry subdirectory:***

Multielement geochemical survey data was collected during joint surveys conducted by the United States Geological Survey and the Consejo de Recursos Minerales. This data has been digitized and is available in vector format for a total of 45,000 samples. Elements analyzed include Au, Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sc, Se, Sn, and Sr. This stream sediment survey data is designed to work with MexicoMap but is sold separately. See the last page of this handout for pricing.

***Shaded Relief subdirectory:***

A shaded relief map is provided in the shaded relief subdirectory. Ninety-meter (3 arc-second) resolution data used to create the shaded relief map comes from version 2 (2005) of the Shuttle Radar Topography Mission (SRTM), available at <http://seamless.usgs.gov>.

***TS Units subdirectory:***

This subdirectory contains a tectono-stratigraphic (TS) map for Mexico. The TS map is constructed from the *Geology* module. Then, using published references 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 colors polygons by their geotectonic setting (Pacific ocean floor, Proto-Caribbean ocean floor, intraoceanic island arc or back arc basin). This provides a map that is both easier to understand and more appropriately applied to exploration. Copies of publications used to make the TS assignments are provided in a References subdirectory.

***References:***

The References subdirectory contains pdf copies of the publications that were used in the preparation of the MexicoMap database.

***Infrastructure and Grids and Index Maps subdirectories:***

The Infrastructure subdirectory includes borders, cities and towns, roads, major drainages, airports, ports and highways. Indices to published 1:250,000 scale topographic maps are provided in the Grids and Index Maps subdirectory.

***Titles and legends subdirectory:***

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

***Plots subdirectory:***

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

**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 MexicoMap database and erase the old database. Copy the new MexicoMap 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 MexicoMap 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 MexicoMap root directory into the folder where "MAPINFOW\_FNT.OLD" is located.

## ***Picklists***

MexicoMap map uses a MapInfo Discover picklist to assign colors to tectono-stratigraphic units. Although neither Discover nor the picklist is required to run MexicoMap, 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 MexicoMap database and paste it 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 MexicoMap database and erase the old directory. Copy the new MexicoMap database to the root directory (C:\) of your hard drive. Rename the folder CBMap (C:\CBMap).

If the MexicoMap 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 MexicoMap. 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 MexicoMap 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**

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

Information on pricing is provided below. Updates are provided for free for a year and are half price for four additional years. Purchasers are encouraged to update within the five year period.

MexicoMap 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 MexicoMap database is accurate and up-to-date. Carl Nelson and Recursos del Caribe, S.A. do not warrant the accuracy of information provided in the MexicoMap database.

### **Pricing**

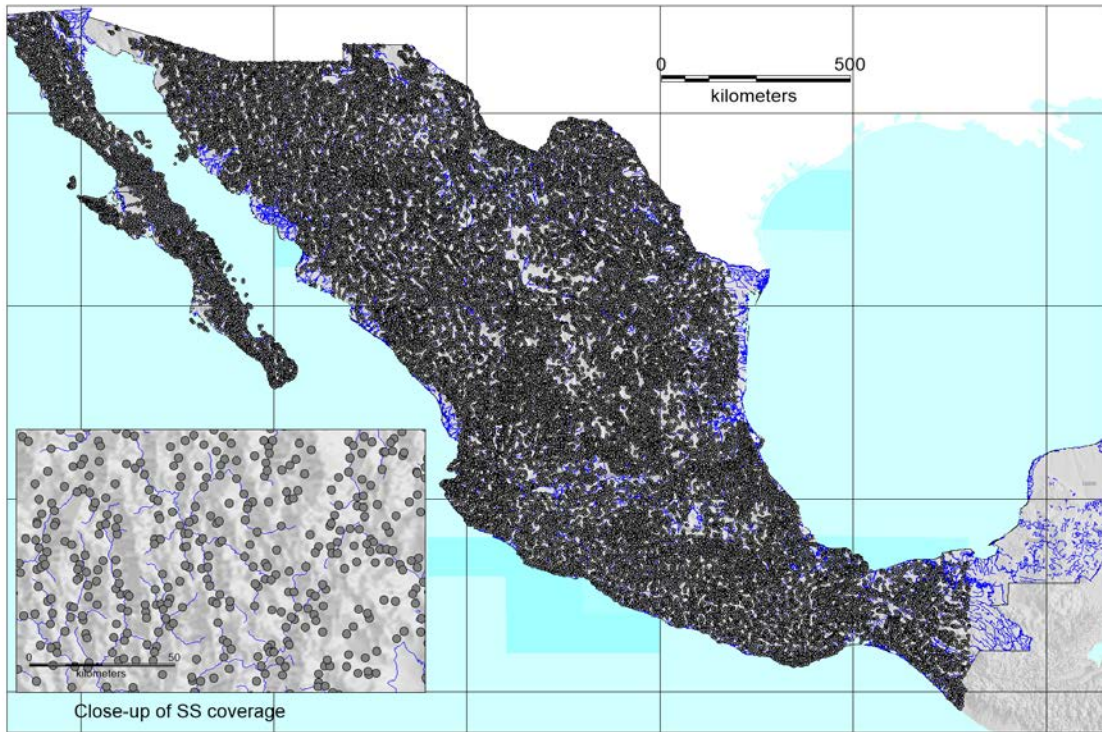
**MexicoMap:** (including the *Geography, Geology, TS Units, Prospects, Land Status* and *Radiometric Dates* modules for Mexico): US\$30,000

Also available in modules as follows:

<i>Geography</i> (infrastructure and shaded relief):	\$ 5,000
<i>Geology</i> ( <i>Geography</i> plus 1:2,000,000 scale geology):	\$ 5,000
<i>Radiometric Dates</i> (radiometric dates only, with locations):	\$ 5,000
<i>TS Units</i> ( <i>Geography, Geology</i> and <i>Radiometric Dates</i> plus a regional tectono-stratigraphic interpretation):	\$20,000
<i>Prospects</i> ( <i>TS Units</i> plus metallic mines and prospects):	\$30,000
<i>Land Status</i> ( <i>Geography</i> and protected areas such as parks):	\$10,000
<i>References</i> (pdf copies of references used in MexicoMap):	\$ 5,000
<i>Plots</i> (a high resolution tiff image of the metallogenic map):	\$ 5,000

### **Mexico Multielement Geochemical Database:**

Multielement stream sediment geochemical data for 45,000 samples collected during joint surveys conducted by the United States Geological Survey and the Consejo de Recursos Minerales. Multielement geochemical data, provided in digital format (as vector files), includes analyses for Au, Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sc, Se, Sn, and Sr. The Mexico Multielement Geochemical Database is designed to work with MexicoMap but is sold separately for \$23,000. Sample coverage is shown on the following page.



Map showing the area covered by 45,793 stream sediment samples.