Colombia Multielement Geochemical GIS Database

July 2018

Recursos del Caribe, S.A.
www.cbmap.net
Carl E. Nelson, president
email: carlericnelson@gmail.com

Colombian government agencies and mineral exploration companies have, over the years, carried out many regional geochemical sampling surveys. Survey results were difficult to obtain, confidential to the sponsoring company or, in the case of government-sponsored surveys, available only via purchase and/or license agreement with the Servicio Geológico Colombiano (SGC).

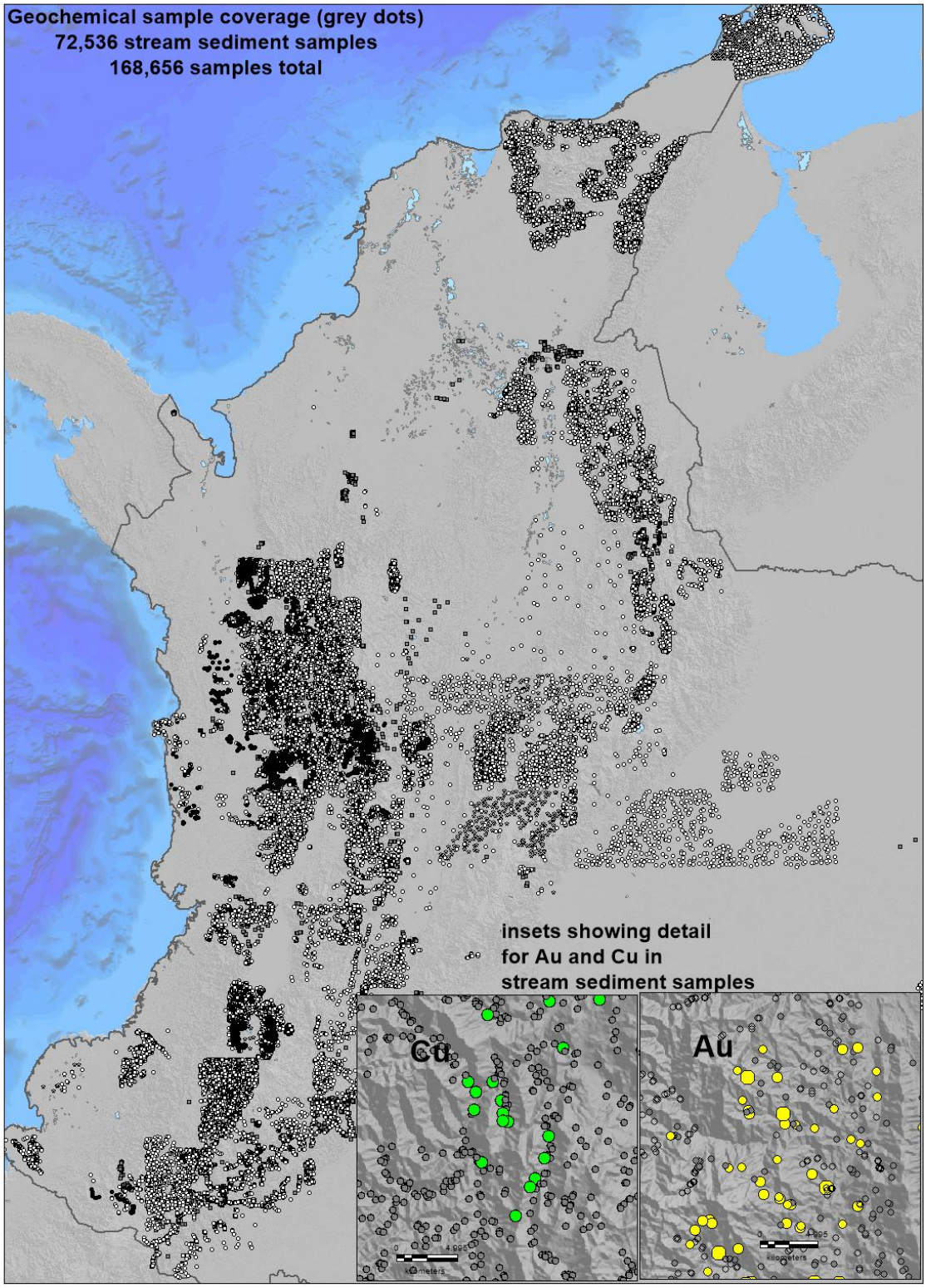
In 2015, the SGC released a compilation of multielement geochemical data for 150 surveys conducted through 2010. The database contains 168,656 samples, including 72,536 stream sediment samples, and is available for free download at: http://geoportal.sgc.gov.co/geoportalsgc/catalog/quicklink/basesDatosPublicacion.page).

Unfortunately, the downloadable SGC database is contains no geochem data at all for 65,542 of its samples and is riddled with errors. Recursos del Caribe, S.A. (RdC) took the downloadable database as a starting point, converted data provided as text to numeric fields, eliminated 772 duplicate entries, corrected 702,320 data entry errors and filled in 54,553 missing sample locations. After 31,538,672 edits, described in the text that follows, the database can be used with confidence.

The table below summarizes the contents of the database; a figure on page 2 shows the area of sample coverage.

Sample Type	Number	Elements analyzed
Pan Concentrate	4,547	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, Mg, Mn, Mo, N, Na, Nb, Ni, P, Pb, Pd, Pt, S, Sb, Sc, Se, Sn, Sr, Th, Ti, Tl, U, V, W, Y, Zn, Zr
Rock	65,598	Ag, Al, As, Au, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, N, Na, Nb, Ni, P, Pb, Pd, Pr, Pt, Rb, S, Sb, Sc, Se, Si, Sm, Sr, Ta, Tb, Te, Th, Ti, Tl, U, V, W, Y, Yb, Zn
Soil	21,265	Ag, Al, As, Au, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, I, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, N, Na, Nb, Nd, Ni, Os, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
Stream Sediment	72,536	Ag, Al, As, Au, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Dy, Er, Eu, F, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, N, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, U, V, W, Y, Yb, Zn, Zr
Water	3774	Ag, Al, As, Au, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, Pb Pd Pr Pt Rb Re Ru Sb Sc Se Si Sm Sn Sr Ta Tb Te Th Ti Tl U V W Y Yb Zn Zr

The distribution of sample locations (grey dots) is shown below along with an inset showing how the database can be used to identify Cu and Au anomalies.



Colombia Multielement Geochemical GIS Database offered by RDC

Recursos del Caribe S.A. (RdC) conducted a thorough review of the SGC database; converted geochemical data from text to numeric format; made 54,553 corrections to incomplete and/or mistaken sample locations (32% of the database); made 702,330 corrections to incorrectly recorded analytical data; resolved 772 duplicate data entries; put the cleaned and corrected database into GIS format; added drainages, digital elevation models and shaded relief; added infrastructure, a topographic map index and departmental boundaries; and, finally, created project files (ArcGIS) and workspaces (MapInfo) to facilitate display of the data.

The Colombia Multielement Geochemical Database is a stand-alone GIS database but is designed to work with ColombiaMap, a separate GIS database for Colombian mineral occurrences and land status (www.cbmap.net).

The Colombia Multielement Geochemical GIS Database is available from RdC in MapInfo or ArcGIS format. The GIS database includes COGeochem.mdb, an MS Access database prepared by RdC. Each of the tables in COGeochem.mdb, described in detail on the following pages, records steps in the process of cleaning and correcting locations and analytical data from the original SGC database.

The original, uncorrected SGC database is available for free download at: http://geoportal.sgc.gov.co/geoportalsgc/catalog/quicklink/basesDatosPublicacion.page). The SGC has also published a Geochemical Atlas for Colombia (2016) that provides plots for each element in map form at a scale of 1:6,000,000. The maps can be viewed online at: http://srvags.sgc.gov.co/JSViewer/Atlas_geoquimico_2016/.

Pricing

Colombia multielement geochemical database: a multi-element geochemical database in vector format for 168,656 samples including: 72,536 stream sediment samples, 4547 pan concentrate samples, 21,265 soil samples, 65,598 rock samples and 3774 water samples: $36,000

For selected areas: $1 per sample

The Colombia Multielement Geochemical Database is a stand-alone product that can be easily “plugged into” ColombiaMap, a separate GIS database for mineral occurrences and land status (www.cbmap.net).

Tables in the Colombia Multielement Geochemical GIS Database

MAPINFO_MAPCATALOG: A table that MapInfo uses to display "mappable" tables in the COGeochem database. This table is used to plot points from ODBC (Open Database Connectivity) tables that are described below.

MUESTRAS_ORIG_ASSAY: This table, in text format, replicates the 2015 SGC database, including minor changes made by the SGC through November 2017. The changes include a total of 776 new values for As (4), Ag (50), Ti (2), Ta (111), Sr (4), Na (1), Mn (1), Mg (120), Fe (478) and Ca (1).

MUESTRAS_PROCESSED (data entry errors): This text table contains a "processed" version of the 'muestras_orig_assay' table. First, null values in the original SGC assay fields are converted to -999, indicating that no analysis is available. Then, the following changes are made to the SGC analytical data:

1) A total of 772 instances for which a single sample contains two conflicting analytical values (e.g. Ag appears both as <0.2 ppm and as <0.2 ppb) are corrected (see the table: '1_TWO_ASSAYS_PER_ELEMENT_EDITS').

2) A total of 31,538,672 additional text edits, described below, are listed in the table: '2_FIND_AND_REPLACE_EDITS.'
   a) Cell values of -X and <X are treated as below a lower detection limit of X and are assigned a cell value equal to 1/2 of the lower detection limit;
   b) Cell values of >Y and GY are treated as greater than an upper detection limit of Y and are assigned a cell value of Y+1;
   c) Blanks (zero length strings) and entries such as trz, N, and ND are converted to -999 to indicate no data for 30,223,825 cellvalues.
   d) Spaces in the data (e.g. 1 234) are replaced with commas (e.g. 1,234) and commas, marking the decimal point, are replaced with periods for 1,314,847 cellvalues.

The Find and Replace Edits table includes the following columns: **uid**: unique, auto-numbered ID (primary key); **cellvalue**: analytical data present as text in an assay field in the original SGC database and in the table 'muestras_analisis2012;' **thefieldname**: the assay field in which the cellvalue was found in 'muestras_analisis2012'; **thetablename**: the name of the table in which the cellvalue was found. For analytical data from the SGC database, thetablename is

always 'muestras_analisis2012'; **valuetype1**: categorizes types of cellvalues. Used in organizing bulk edits to the data; **valuetype2**: categorizes types of cellvalues. Used in organizing bulk edits to the data; **newval**: a new cellvalue in the table 'muestras_processed' that replaces all instances of a particular cellvalue in the table 'muestras_analisis2012;' **updated_status**: indicates whether a cellvalue in a particular field has been changed. If set to 'OK', the cellvalue in the 'muestras_analisis2012' table has been searched for and changed to newval in the 'muestras_processed' table. To make additional changes to the "muestras_processed" table and, at the same time record those changes, first make the change to newval and replace 'OK' in the updated_status field with a zero-length string. Then use the form 'Update Assay Fields' to replace each newly edited cellvalue in the 'muestras_processed' table; **last_updated_to**: which newval was last used in replacement of cellvalue in the indicated field of 'muestras_processed'; **last_updated_date**: the date of last replacement of this cellvalue in the indicated field of 'muestras_processed', using the 'Update Assay Fields' form; **note**: explanation regarding the choice of newval for replacement of the original cellvalue; **temporder**: a field that was used during hand edits of the 'processing_edits_log' table.

3) Corrections, still in text format, in the '3_DIVIDE_BY_1000_EDITS' table include conversions for analytical data (to ppb) for analyses improperly recorded in the SGC database as ppm. A total of 702,320 emission spec values were corrected.

4) The table '4_2017_UPDATES' includes a total of 882 edits made to gold values that are listed in the SGC database as less than a high detection limit (<20, <10, <5, <2, <1, <0.5 and <0.1 ppm Au). All of these less-than-a-high-detection-limit values were changed to -888 to avoid spurious gold anomalies that would result if less-than-a-high-detection-limit (dl) values were retained or changed to 1/2 of the dl. Similarly, for 6406 Ag analyses listed as less-than-a-detection-limit of 1, 5, 10 or 20 ppm, cellvalues were changed to -888. A total of 2114 Cu and 5933 Mo values listed as less-than-a-detection-limit of 5 ppm or higher were also changed to -888 along with 18 Pb, 9526 Zn and 319 Ni values listed as less-than-a-detection-limit of 20 ppm or higher. These add up to a total of 25,204 changes made to eliminate spurious anomalous values for Au, Ag, Cu, Pb, Zn and Ni related to high detection limits. Finally, a series of 138 data entry errors for cobalt (all with uniformly high values of 5%) were changed to 5 ppb (detection limit).

MUESTRAS_PROCESSED (sample location errors):
The ‘muestras_processed’ table includes sample location coordinates in decimal latitude and longitude format (WGS 84 datum). These locations incorporate all of the corrections made by RdC to the original SGC sample locations. For instance, latitude longitude coordinates are missing for a total of 54,553 samples (32%) in the original SGC database. Consequently, latitude longitude coordinates from the SGC database were not used to locate samples. Instead, new decimal latitude and longitude coordinates (WGS84 datum) were generated using coordinates from the ‘coord_este_original’ and ‘coord_norte_original’ fields and the appropriate zone as recorded in the ‘origen_coord_original’ field. This step provided locations for two-thirds of the samples (114,387).

For the remaining (54,269) samples, the ‘coord_original’ fields were either empty or were incorrect. Most of these samples were successfully located by using one of remaining Bogota datum coordinate sets. All of these locations were then verified using location information provided in the fields for ‘departamento’ and ‘plancha’. This process revealed 1132 data entry errors, now corrected, in the zone listed in the original SGC database.

Finally, a total of 1571 sample locations (1% of the database) plot within quadrangles that do not closely coincide with the quadrangles recorded in the original SGC database. These locations are plotted, for now, near latitude 0 and longitude 0 until their actual locations can be resolved.

ASSAYS_PAN_CONCENTRATE: This table contains analytical results for 4547 pan concentrate samples.

ASSAYS_ROCK: This table contains analytical results for 65,598 rock samples.

ASSAYS_SOIL: This table contains analytical results for 21,265 soil samples.

ASSAYS_STREAM_SEDIMENT: This table contains analytical results for 72,536 stream sediment samples.

ASSAYS_WATER: This table contains analytical results for 3774 water samples.

Queries in the Colombia Multielement Geochemical GIS Database

ASSAY_QUERY: takes cellvalues for each element in the 'muestras_processed' table and converts them from text into numeric entries. Data reported in different units is merged in the process. For instance, Cu recorded for some samples as Cu_percent, for others as Cu_ppm and for still others as Cu_ppb is merged into a single column (reported in units of ppb, ppm or pct as indicated).

PAN_CONCENTRATE_ASSAYS_QUERY: a subset of Assay_Query containing analytical results for 4547 pan concentrate samples.

ROCK_ASSAYS_QUERY: a subset of Assay_Query containing analytical results for 65,598 rock samples.

SOIL_ASSAYS_QUERY: a subset of Assay_Query containing analytical results for 21,265 soil samples.

STREAM_SEDIMENT_ASSAYS_QUERY: a subset of Assay_Query containing analytical results for 72,536 stream sediment samples.

WATER_ASSAYS_QUERY: a subset of Assay_Query containing analytical results for 3774 water samples.

INFORME_LIST: a subset of Assay_Query containing a list of analytical reports.

PROJECT_LIST: a subset of Assay_Query containing a list of projects; listed projects refer to reports that contain the raw analytical data.

MAKE_ASSAYS_PAN_CONCENTRATE_TABLE_QUERY: takes the **PAN_CONCENTRATE_ASSAYS_QUERY** and remakes the **ASSAYS_PAN_CONCENTRATE** table.

MAKE_ASSAYS_ROCK_ TABLE: takes the ROCK_ASSAYS_QUERY and remakes the ASSAYS_ROCK table.

MAKE_ASSAYS_SOIL_ TABLE: takes the SOIL_ASSAYS_QUERY and remakes the ASSAYS_SOIL table.

MAKE_ASSAYS_STREAM_SEDIMENT_ TABLE: takes the STREAM_SEDIMENT_ASSAYS_QUERY and remakes the ASSAYS_ATREAM_SEDIMENT table.

MAKE_ASSAYS_WATER_ TABLE: takes the WATER_ASSAYS_QUERY and remakes the ASSAYS_WATER table.