

SERVICIO
GEOLOGICO
COLOMBIANO



EXPLORING THE COLOMBIAN TERRITORY

PDAC 2014

Toronto, Canada, March 2014



AGENDA

GEOLOGICAL SURVEY OF COLOMBIA MINERAL EXPLORATION

1. GENERAL OVERVIEW
2. EXPLORATION IN STRATEGIC MINING AREAS 2012 - 2014
 - ANTECEDENTS
 - AEROGEOPHYSICS
 - GEOLOGY AND GEOCHEMICAL EXPLORATION
3. EXPLORATION IN OTHER AREAS
4. SPECIAL TOPICS OF RESEARCH



AGENDA

GEOLOGICAL SURVEY OF COLOMBIA **MINERAL EXPLORATION**

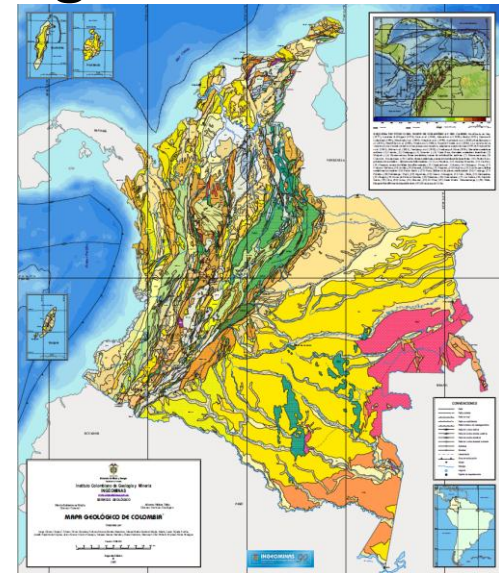
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GEOLOGICAL SURVEY OF COLOMBIA

The Geological Survey as a Colombian Institution of Science and Technology is committed to the social and economic development of the country, through:

- ✓ Basic research in geosciences
- ✓ **Research of the potential of subsoil resources: Minerals, hydrocarbons, groundwater, geothermal**
- ✓ Research, evaluation and monitoring of geohazards.
- ✓ Research and application of nuclear technology.

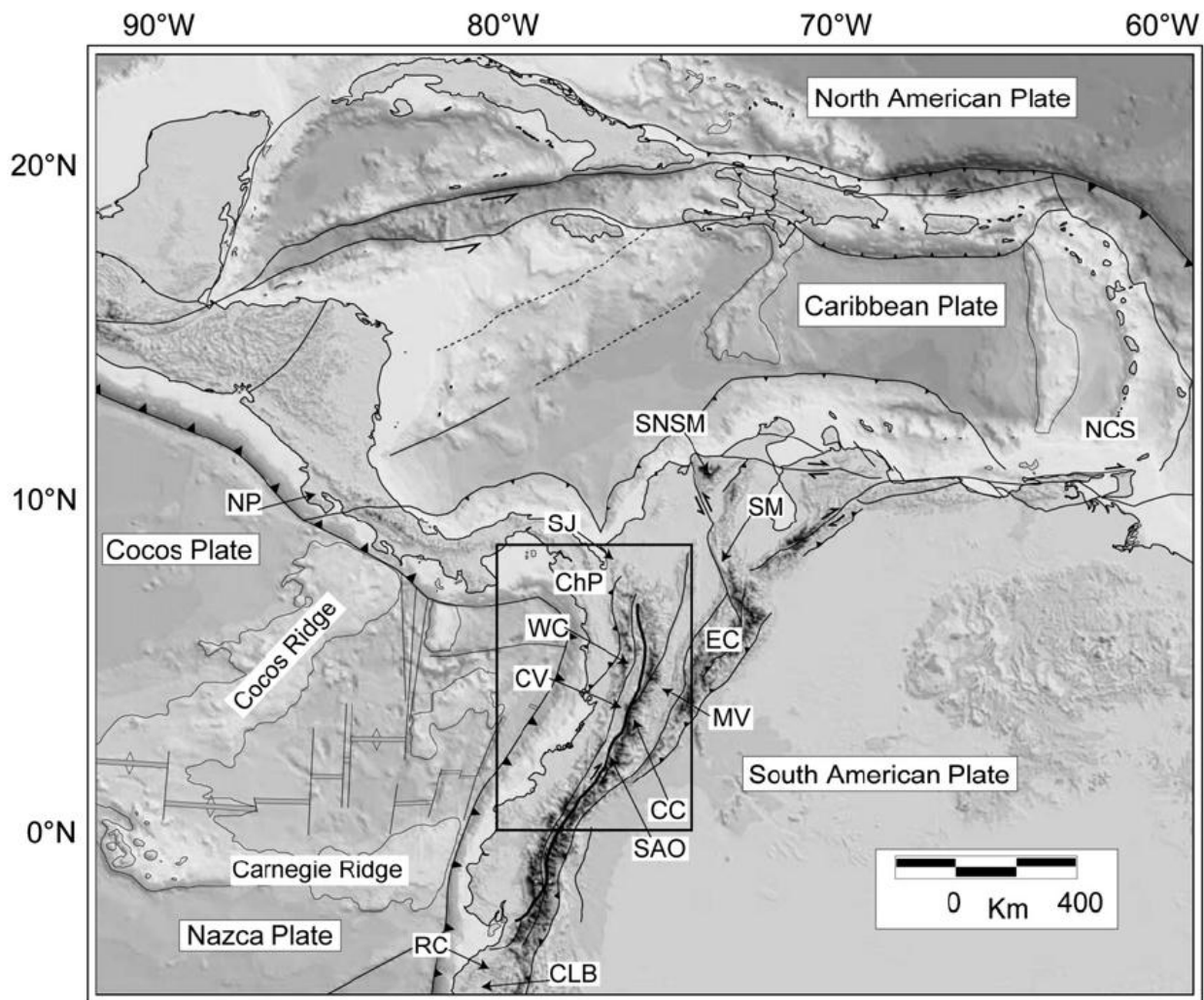


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GEOLOGICAL SURVEY OF COLOMBIA MINERAL EXPLORATION

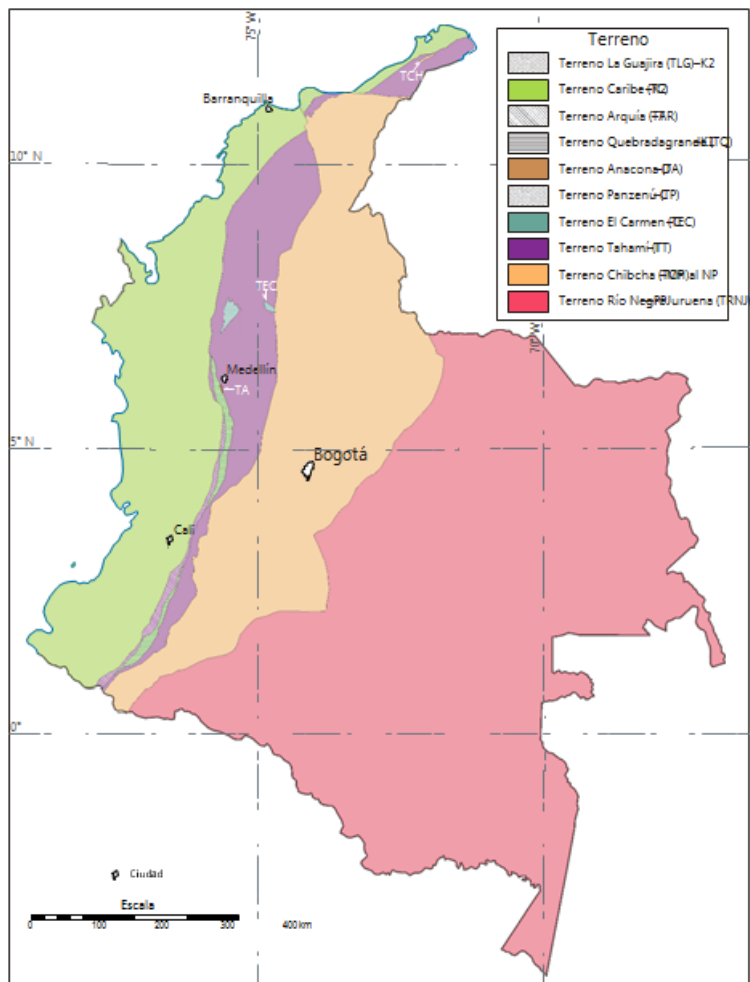
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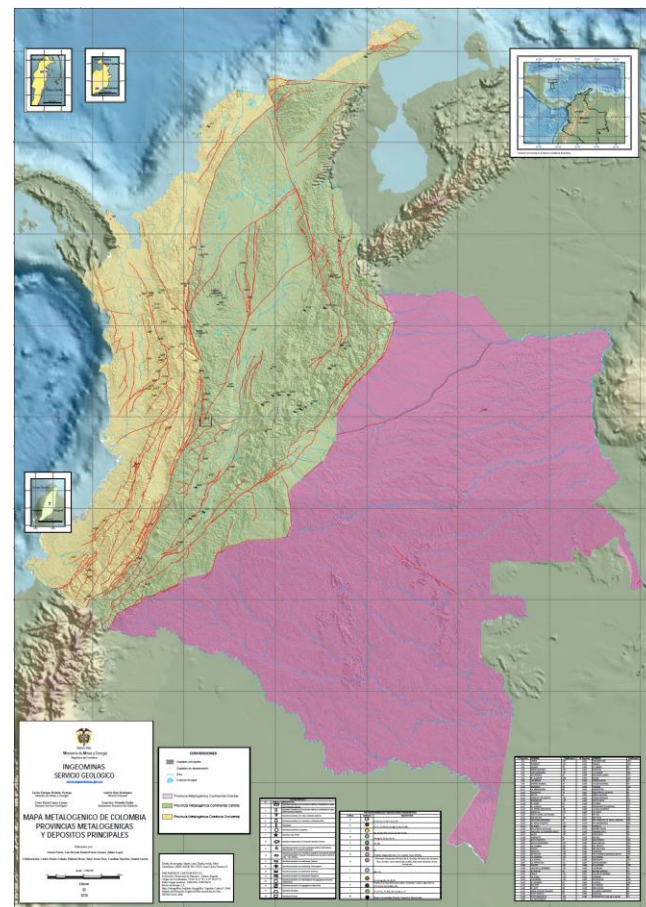


REGIONAL TECTONIC SETTINGS

METALLOGENETIC LANDSCAPE

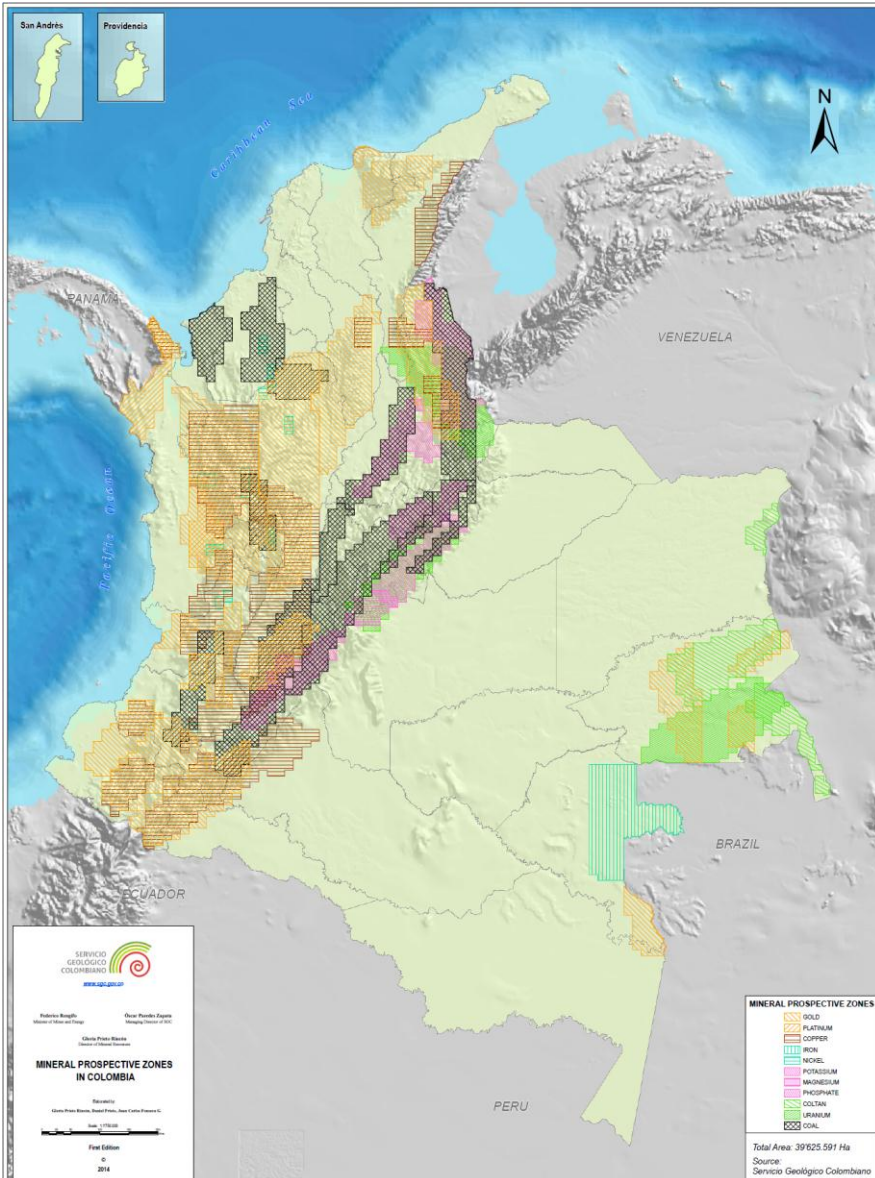


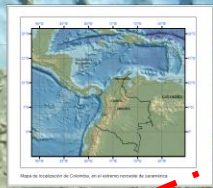
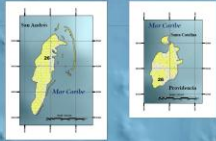
Geological terrains of Colombia
Source: Geological Map of Colombia



Metallogenetic Provinces of Colombia

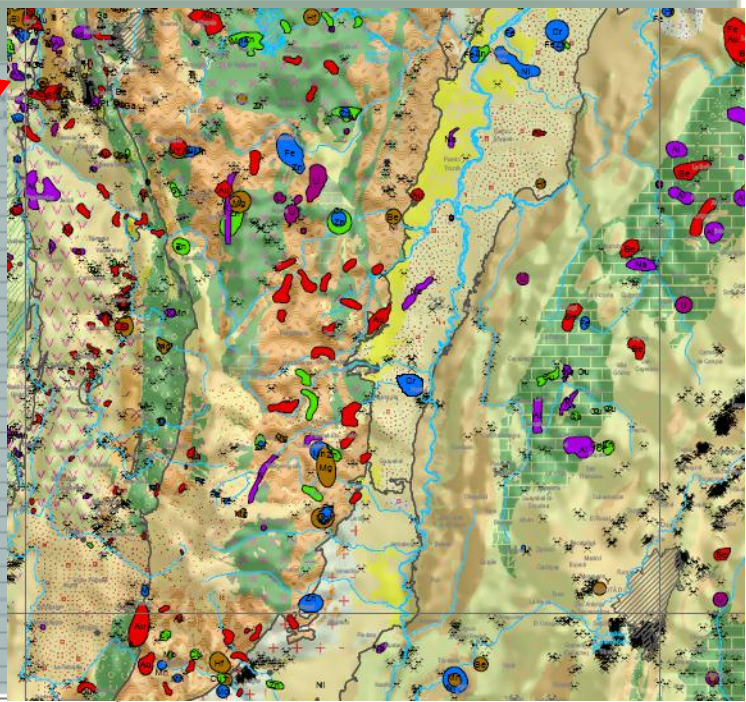
MINERAL PROSPECTIVE ZONES





1686 New Geochemical Anomalies

ANOMALÍA	AGD	GEOL
1_10N	Cu	
1_11N	Cu	
1_12N	Au	
1_13N	Au	
1_14N	Au	
1_15N	Au	
1_16N	Au	
1_17N	Ag	
1_18N	Ag	
3_01N	Zn	
3_02N	Cu	
3_03N	Cu	
3_04N	Cu	
3_05N	Au	
3_01N	VARIOS	
3_01N	U	
3_02N	Au	
3_01N	U	
3_02N	U	
3_03N	U	
3_04N	U	
3_01N	U	
1_02N	K	
1_03N	Fe	
1_04N	Fe	
1_05N	Fe	
2_01N	Mn	
2_02N	Cu	
2_03N	Cu	
2_04N	Au	
2_05N	Au	
2_06N	Au	
2_07N	Au	
2_08N	Au	
2_09N	Ag	
2_10N	Ag	
2_11N	Ag	
2_12N	Ag	
2_13N	Ag	
2_14N	Ag	
2_15N	Ag	
2_16N	Ag	
	Ag	
	Zn	
	Ni	
	Cu	
	Cu	



MINERAL GROUP	ANOMALIES
PRECIOUS METALS AND MINERALS	492
BASE METALS	244
STEEL INDUSTRY METALS	221
SPECIAL METALS	197
INDUSTRIAL MINERALS	183
ENERGY MINERALS	349

ANOMALIAS GEOQUÍMICAS PARA POTENCIAL DE RECURSOS MINERALES

- GRUPO 1 - METALES Y MINERALES PRECIOSOS (Au, Ag)
- GRUPO 2 - METALES BASICOS (Cu, Zn)
- GRUPO 3 - METALES DE LA INDUSTRIA DEL ACERO (Fe, Ni)
- GRUPO 4 - METALES ESPECIALES (Ti, Tierras Raras, Sb,)
- GRUPO 5 - MINERALES INDUSTRIALES (Al, Na, K)
- GRUPO 6 - MINERALES ENERGETICOS (U)

Ministerio de Minas y Energía
INGEOMINAS
SERVICIO GEOLOGICO
 www.ingegominas.gov.co

Calle 80 de la Vía Expresión
 Ciudad Bolívar, Bogotá D.C.

MAPA DE ANOMALIAS GEOQUÍMICAS DE COLOMBIA ANOMALIAS NUEVAS

Escala: 1:100,000
 © Estado 2011

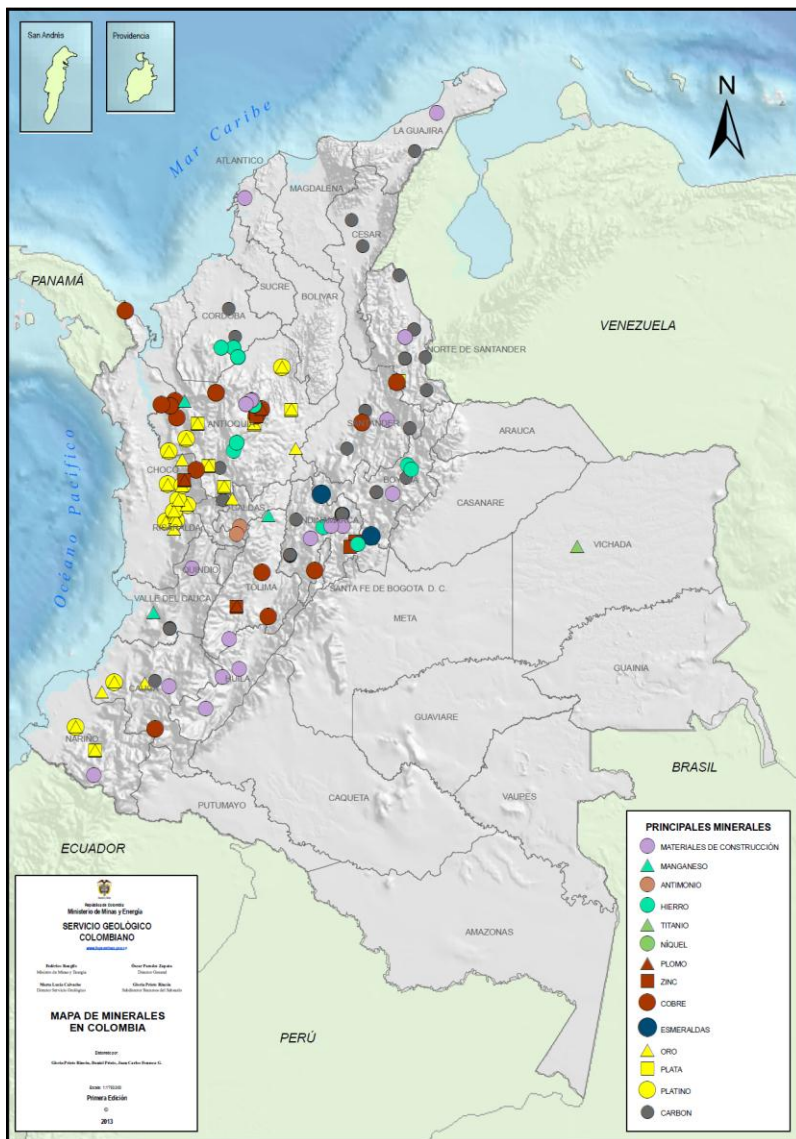
CONVENCIONES

- Capitales principales
- Capitales de departamento
- Río
- Cuerpo de agua
- Mapas topográficos

COORDENADAS CARTOGRAFICAS

Datum: WGS 84
 Sistema de Coordenadas: UTM
 Zona: 18N
 Proyección: Transversal de Mercator
 Escala: 1:100,000
 Fecha de actualización: 2011

Anomalías generadas partir de procesamiento geostatístico e interpretación geológica de datos geoquímicos. Ingeominas 2009



MINERAL DEPOSITS

AGENDA

GEOLOGICAL SURVEY OF COLOMBIA MINERAL EXPLORATION

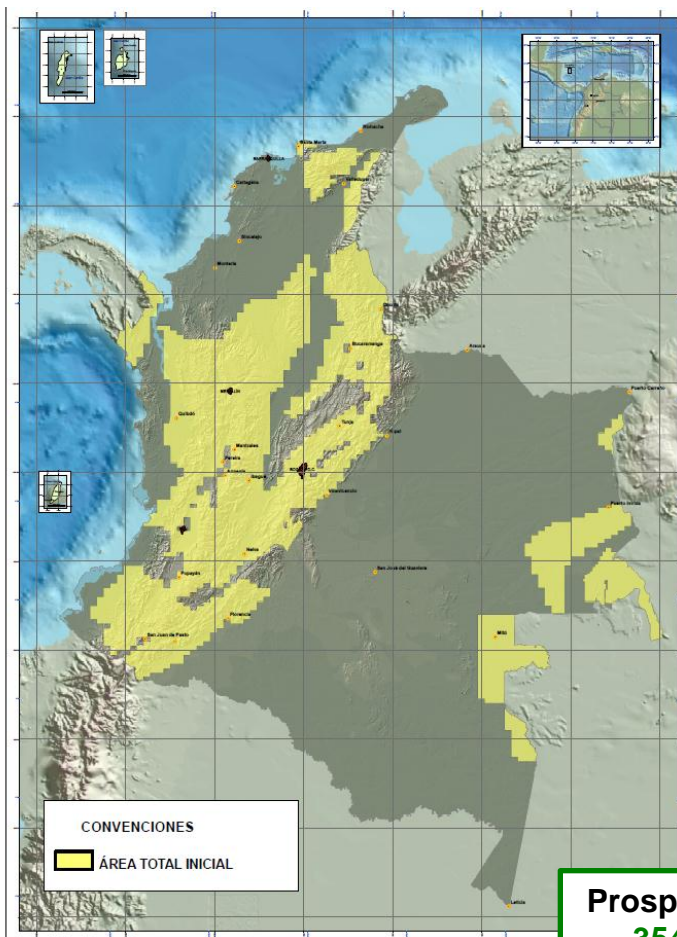
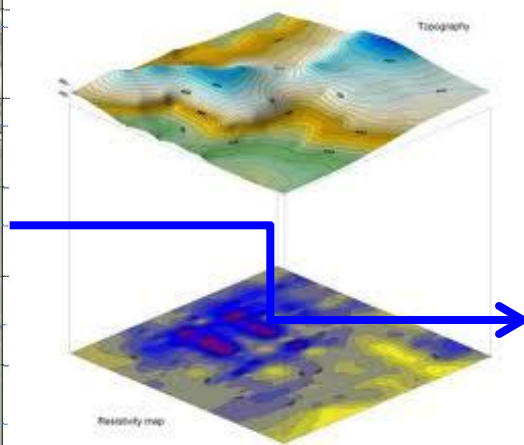
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IDENTIFICATION OF STRATEGIC MINING AREAS

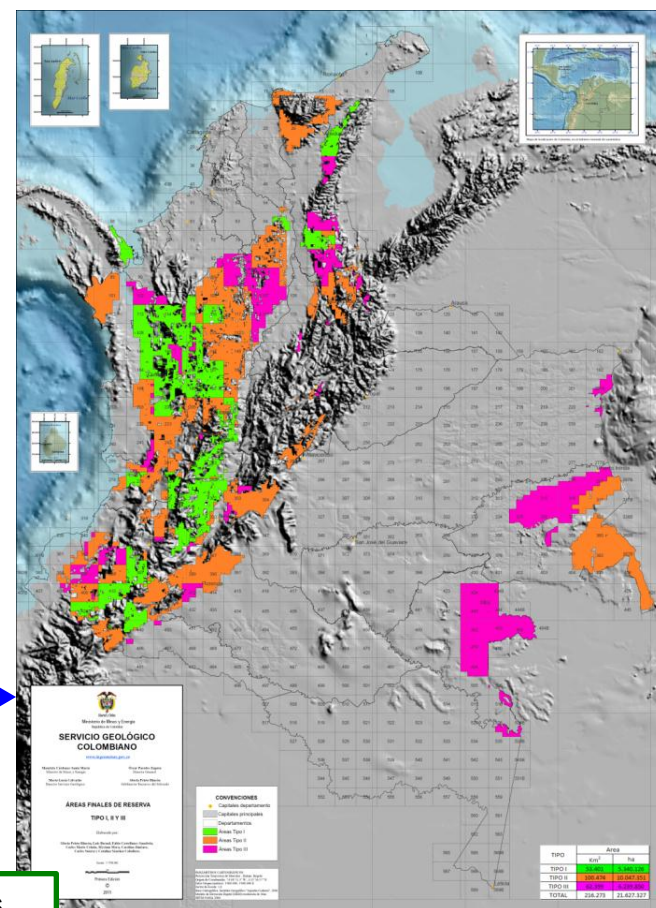
Strategic Minerals (Au, Pt, Cu, Fe, Coltan, K, Phosphates (P_2O_4), Mg, C-metallurgic, U)

- Geology
- Geochemistry
- Geophysics
- Mining Inventory

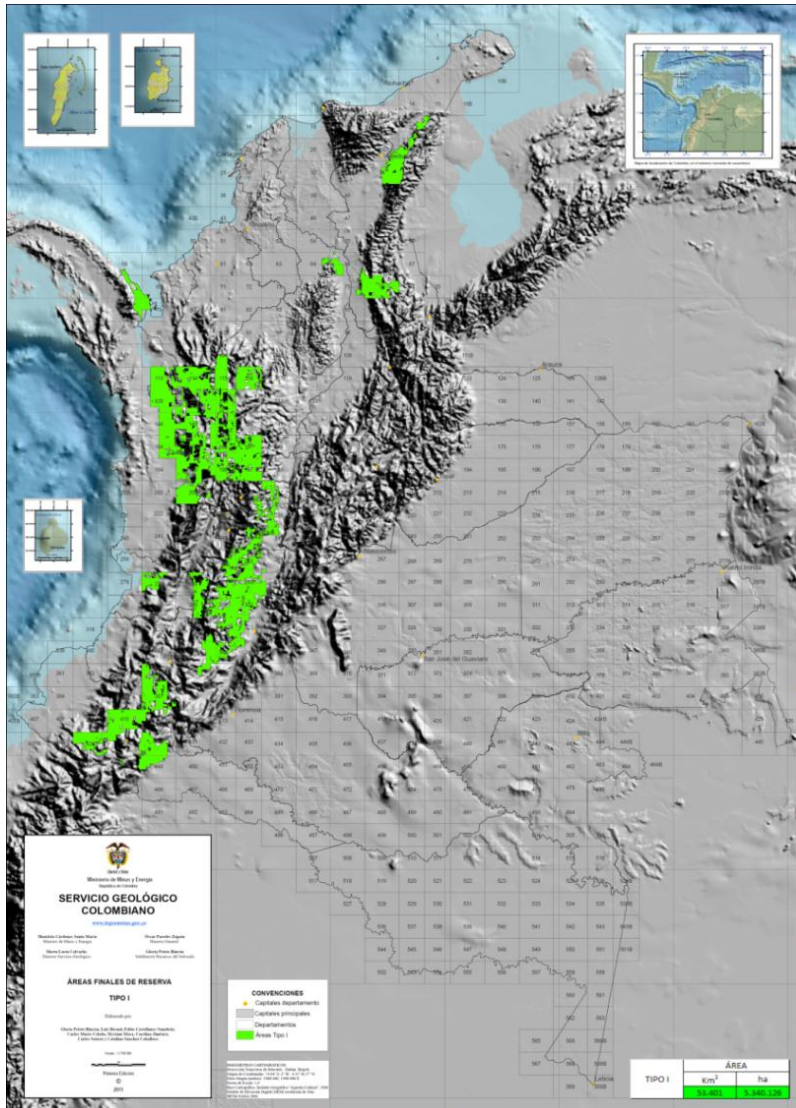


Prospective areas
354.978 km²,
35.497.800 ha

Selected areas
216.273.27 km²,
21.627.327 ha



STRATEGIC MINING AREAS (SMA)



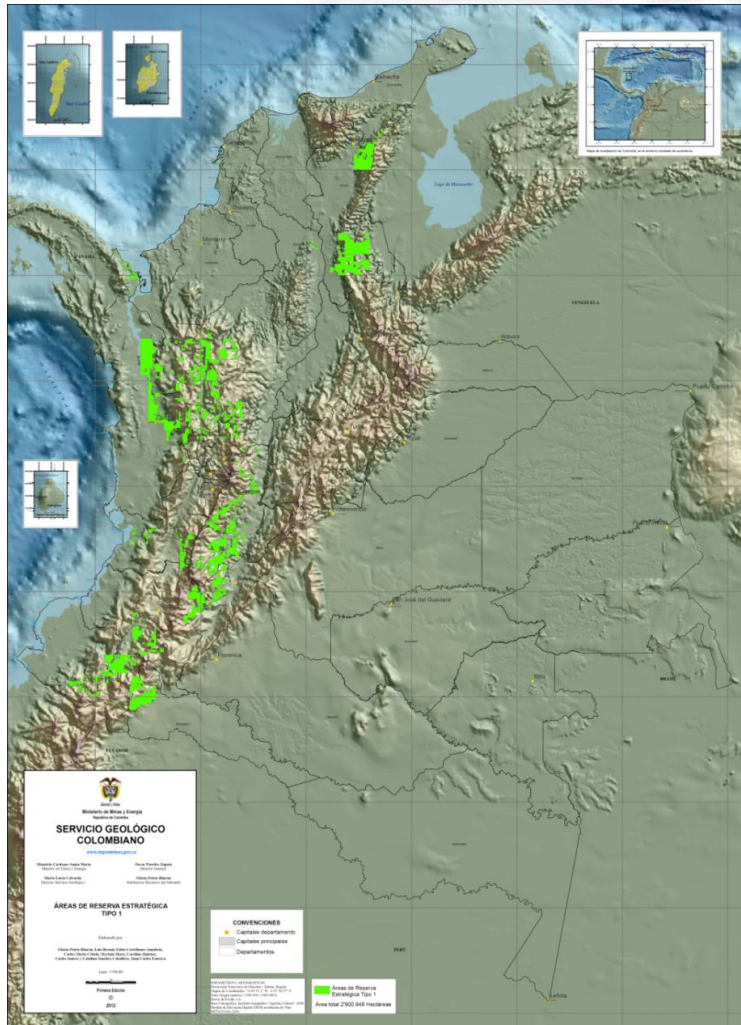
TIPO I	ÁREA	
	Km ²	ha
	53.401	5.340.126

Subtracted areas

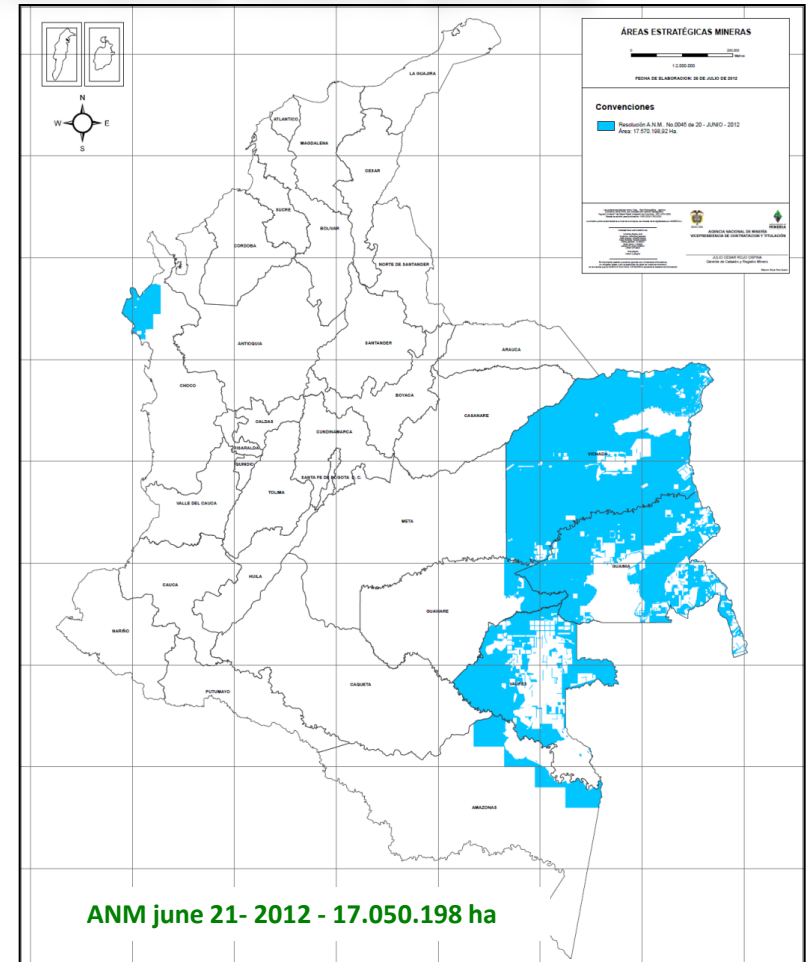
- National natural parks
- Regional natural parks
- Forestry reserves
- Páramo zones (highlands)
- Mangrove zones (RAMSAR)
- State investment areas (Law 685/2001)
- Special mining zones
- Agriculture and livestock zones
- Mining titles
- National mining cadastre request
- Indigenous mining zones
- Afro communities mining zones

SMA - 2.900.000 ha

STATEMENT OF STRATEGIC MINING AREAS (SMA)



MME February 24 – 2012 - 2.900.000 ha



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5%

AEROGEOPHYSICS

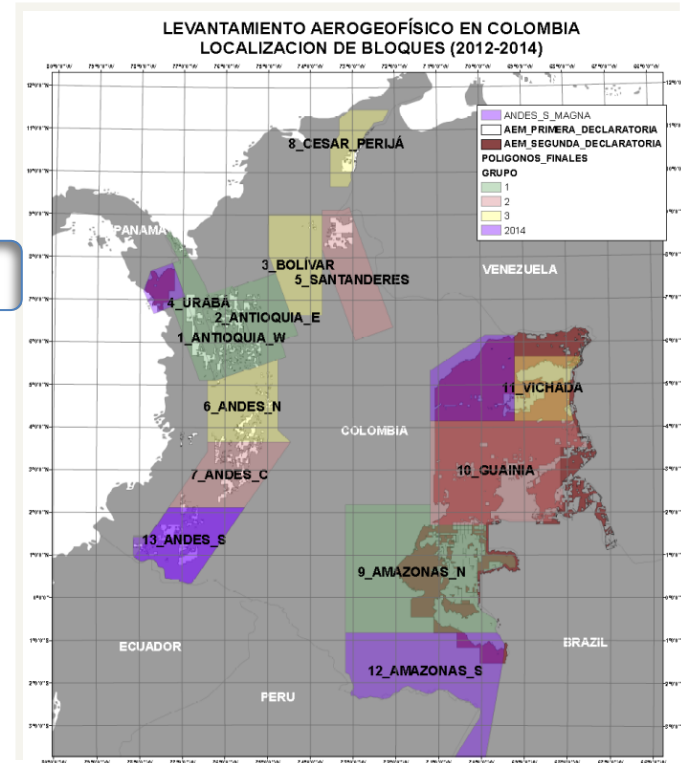
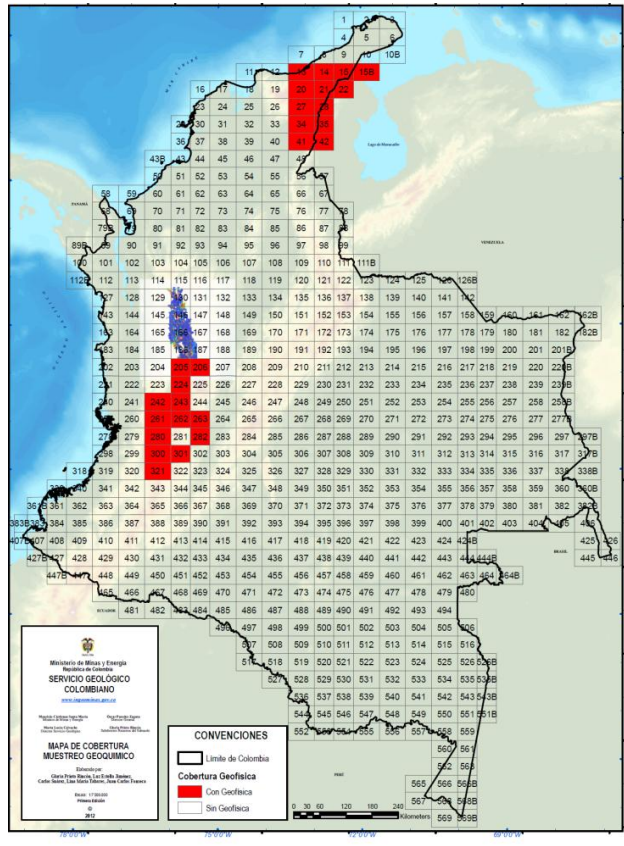
44%

MAGNETOMETRY

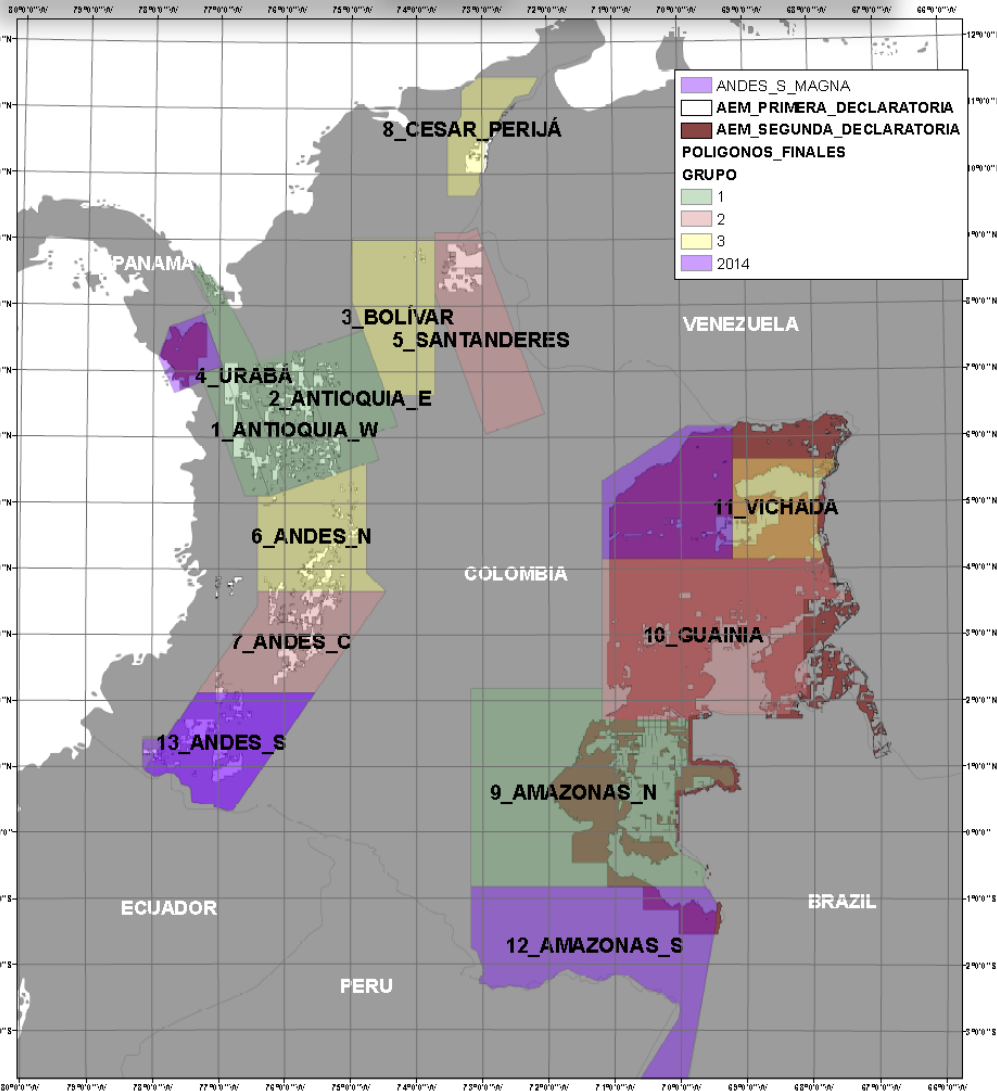
GAMMA - SPECTROMETRY

International tender
US\$40,000,000

CGS and international assistance



Areas



MAGNETOMETRY

GAMMA-SPECTROMETRY

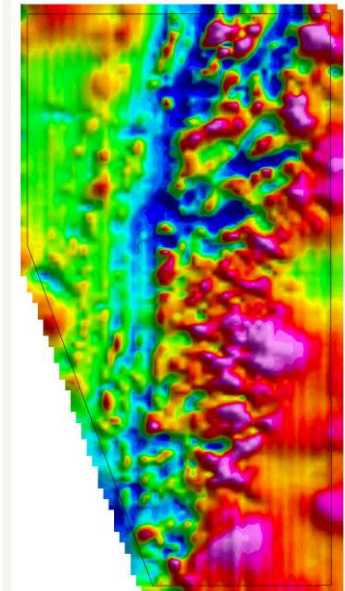
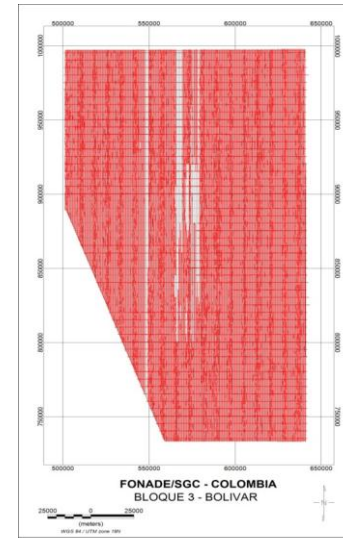
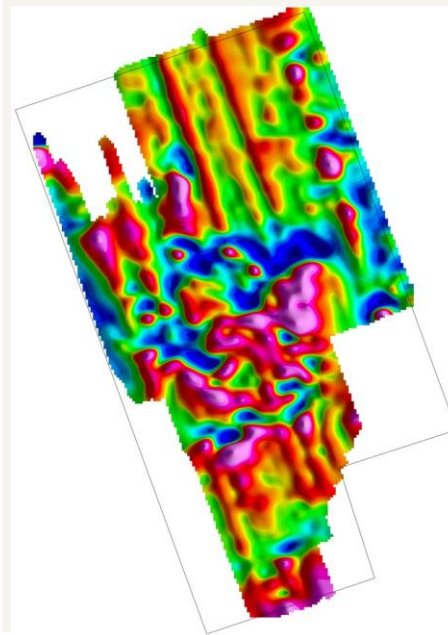


Magnetic and Radiometric System – PR-PEC

Lines 500m / 5km (N20W)
Lines 1000m / 10km (N-S)

G1	G2	G3
AMAZONAS_N	GUAINIA	BOLIVAR
ANTIOQUIA W	SANTANDERES	VICHADA
ANTIOQUIA E	ANDES C	CESAR PERIJA
URABA		ANDES N
256.926	252.625	233.526

Development



	Antioquia W	Antioquia E	Urabá	Amazonas N
GROUP 1	9993 km	31974 km	0 km	0 km
	Santanderes	Guainía	Andes C	
GROUP 2	Magnetic base installation	Magnetic base installation	Magnetic base installation	
	Bolívar	Andes N	Cesar Perijá	Vichada
GROUP 3	<u>69981 km</u>	19140 km	12861 Km	22470 Km

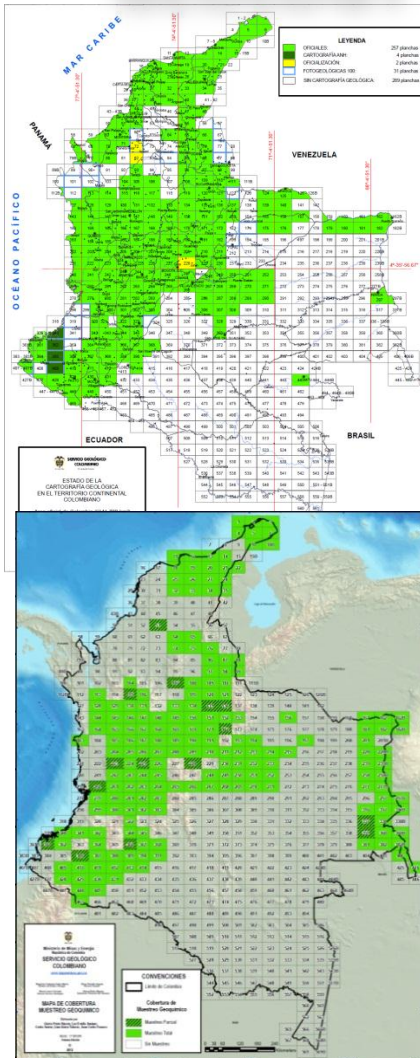
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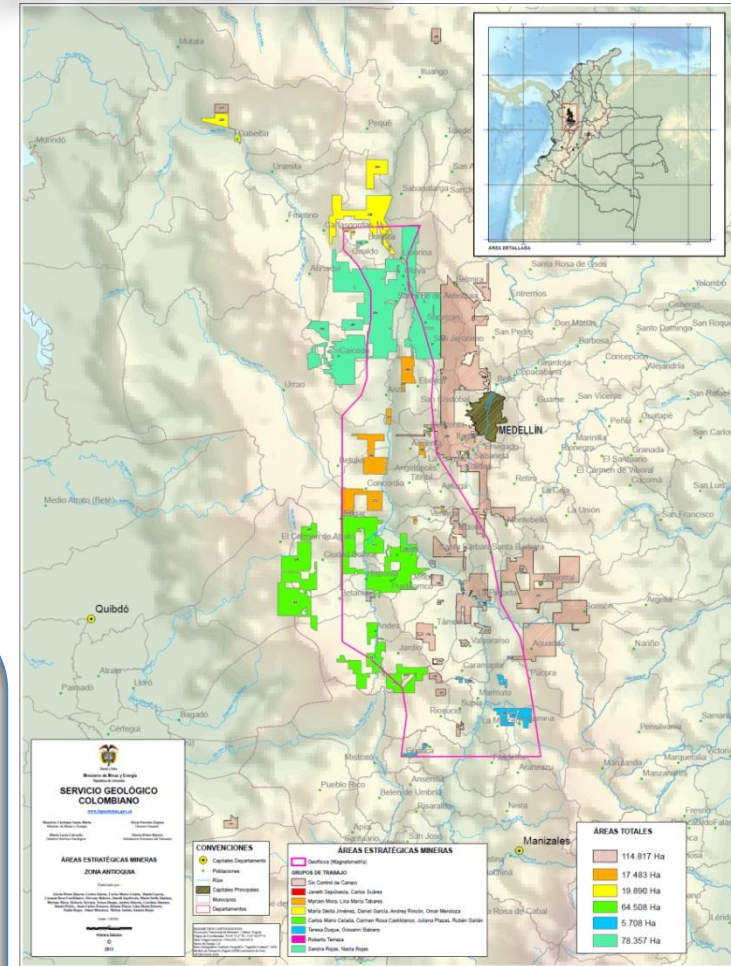


GEOLOGY AND GEOCHEMICAL EXPLORATION



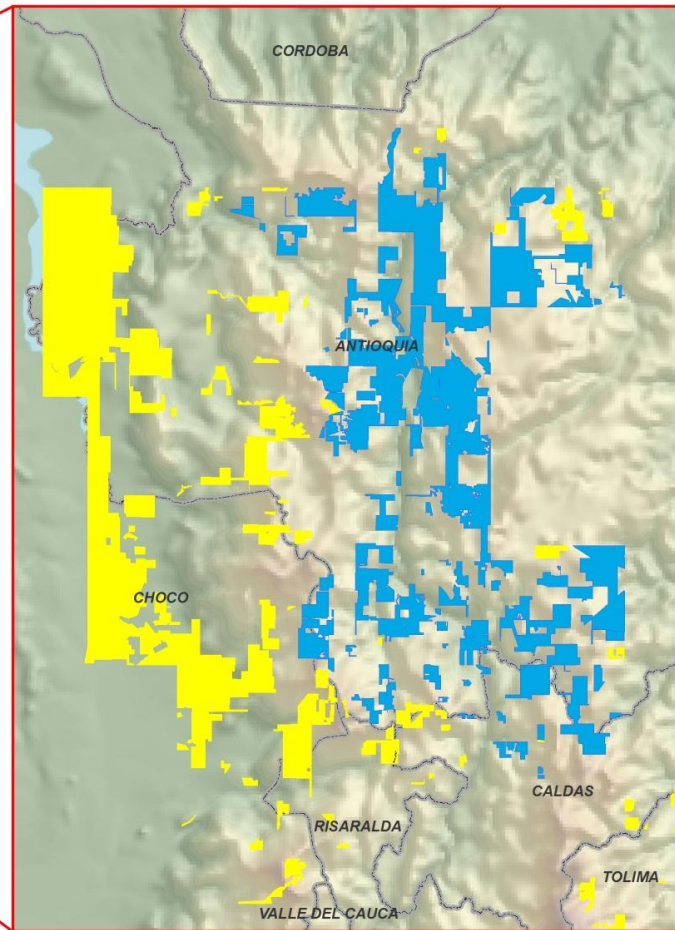
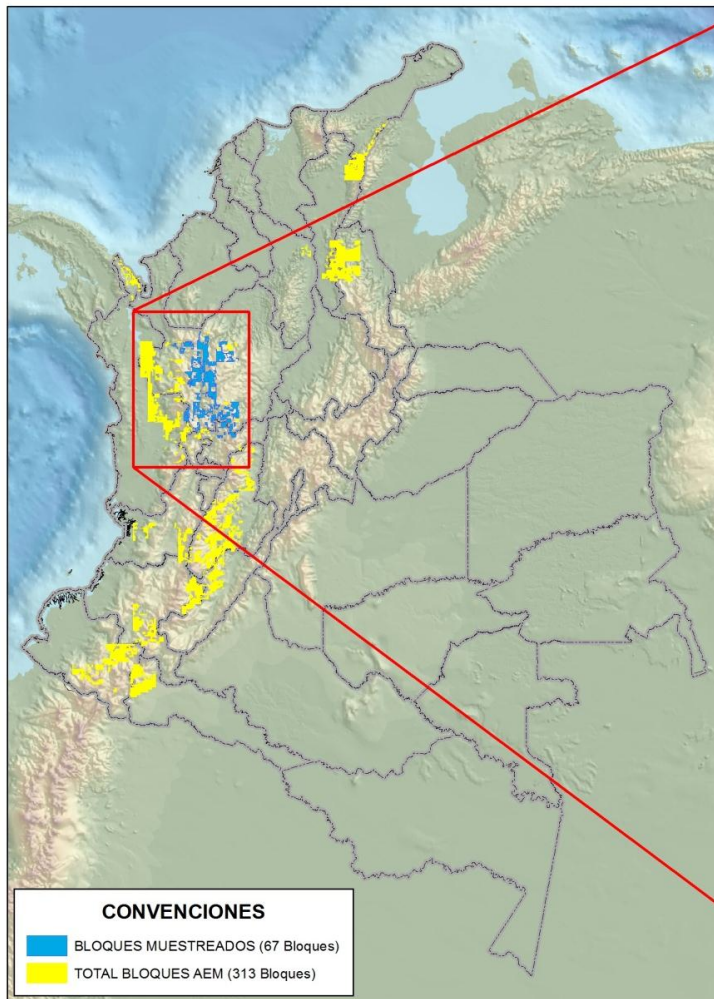
PROYECTO "ÁREAS ESTRATÉGICAS DE MINERALES"		FORMULARIO DE TITULO DE DATOS EN CAMPO PARA LOS BLOQUES O ÁREAS ESTRATÉGICAS DE MINERALES		HOJA 1 DE 2	
I. INFORMACIÓN GENERAL					
COLOMBIA	DEPARTAMENTO	MUNICIPIO	COMUNIDAD ORGANIZADA	LOCALIDAD	SECCION
NO. DE BLOQUE	NO. DE TITULO	NO. DE PLANILLA	NO. DE PLANILLA	NO. DE PLANILLA	NO. DE PLANILLA
II. INFORMACIÓN GEOLOGICA					
III. INFORMACIÓN ADMINISTRATIVA					
IV. INFORMACIÓN DE INVESTIGACIONES					
V. INFORMACIÓN DE LABORATORIOS					
VI. INFORMACIÓN DE OBRAS DE INTERÉS					
VII. INFORMACIÓN DE OBRAS DE INTERÉS					
VIII. INFORMACIÓN DE OBRAS DE INTERÉS					
IX. INFORMACIÓN DE OBRAS DE INTERÉS					
X. INFORMACIÓN DE OBRAS DE INTERÉS					
XI. INFORMACIÓN DE OBRAS DE INTERÉS					
XII. INFORMACIÓN DE OBRAS DE INTERÉS					
XIII. INFORMACIÓN DE OBRAS DE INTERÉS					
XIV. INFORMACIÓN DE OBRAS DE INTERÉS					
XV. INFORMACIÓN DE OBRAS DE INTERÉS					
XVI. INFORMACIÓN DE OBRAS DE INTERÉS					
XVII. INFORMACIÓN DE OBRAS DE INTERÉS					
XVIII. INFORMACIÓN DE OBRAS DE INTERÉS					
XIX. INFORMACIÓN DE OBRAS DE INTERÉS					
XX. INFORMACIÓN DE OBRAS DE INTERÉS					
XXI. INFORMACIÓN DE OBRAS DE INTERÉS					
XXII. INFORMACIÓN DE OBRAS DE INTERÉS					
XXIII. INFORMACIÓN DE OBRAS DE INTERÉS					
XXIV. INFORMACIÓN DE OBRAS DE INTERÉS					
XXV. INFORMACIÓN DE OBRAS DE INTERÉS					
XXVI. INFORMACIÓN DE OBRAS DE INTERÉS					
XXVII. INFORMACIÓN DE OBRAS DE INTERÉS					
XXVIII. INFORMACIÓN DE OBRAS DE INTERÉS					
XXIX. INFORMACIÓN DE OBRAS DE INTERÉS					
XXX. INFORMACIÓN DE OBRAS DE INTERÉS					

- Diagnosis of information
- Standardization
- Field work
- Laboratory Analysis
- Data processing
- Selection of prospective zones



Sampling 2013

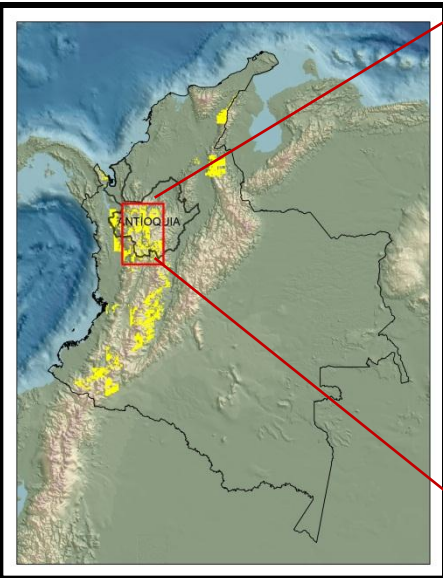
10 field work campaign (CGS)



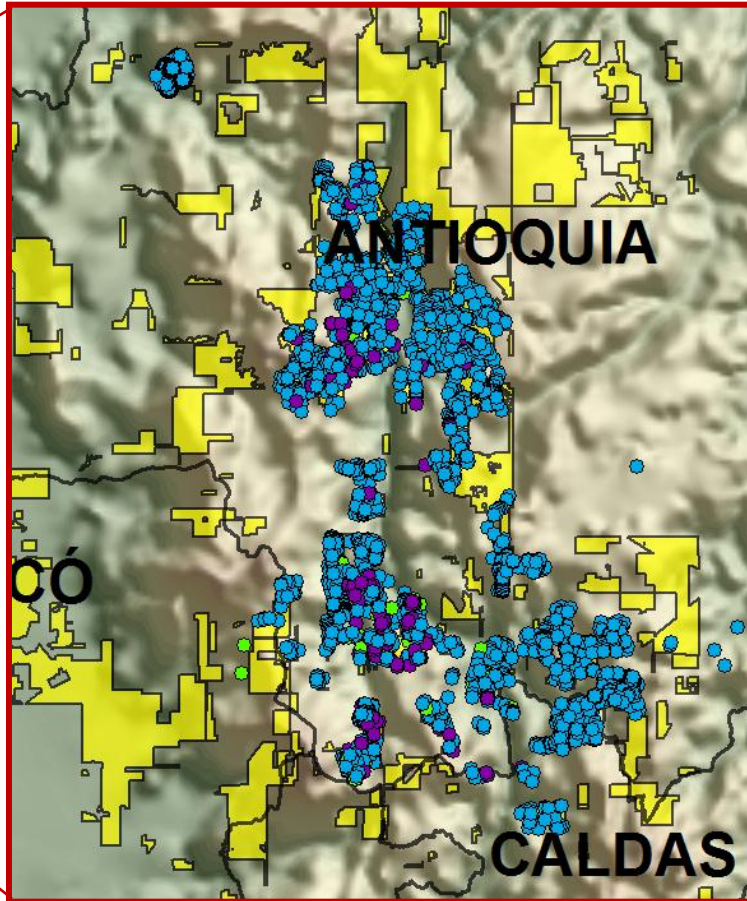
- ✓ Stream sediments
- ✓ Rocks
- ✓ Panning concentrates

532.641 ha
5326,41 km²

Samples collected



3592
samples



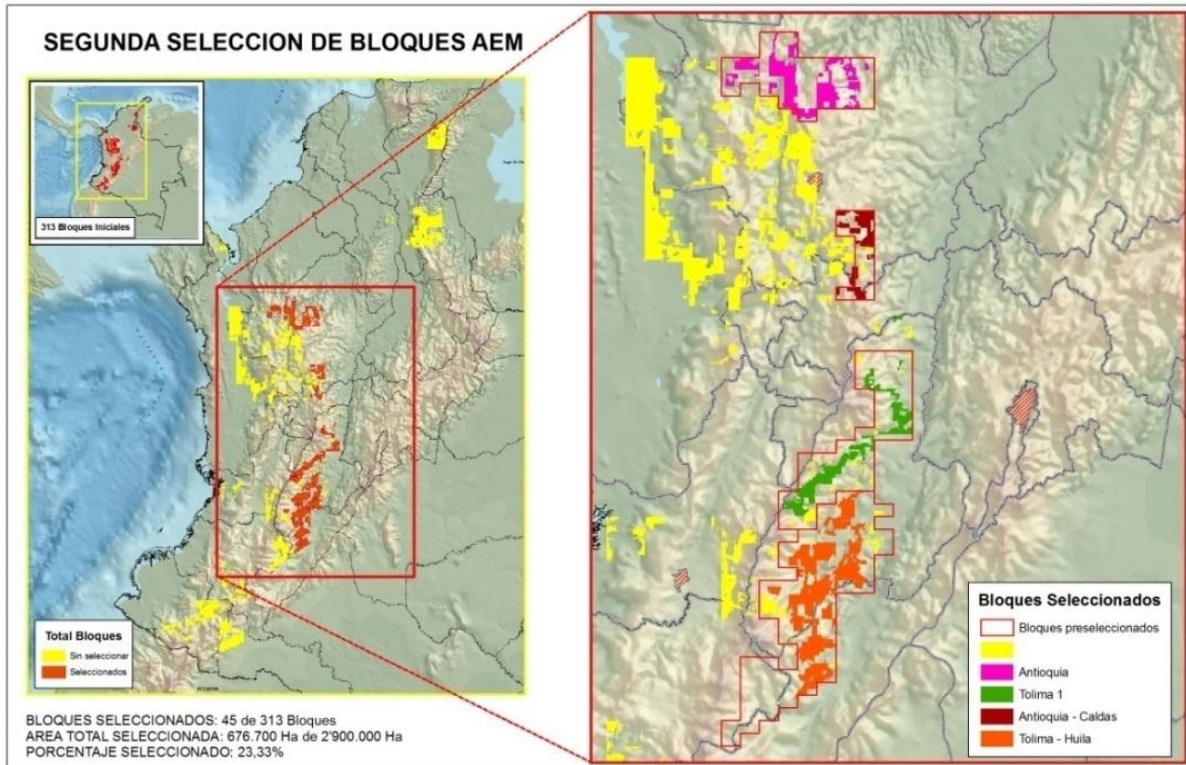
- CB: Concentrado de Batea
- R: Roca
- RO: Rodado
- SA: Sedimento Activo Fino
- SL: Sedimento Seco

TYPE	No.
STREAM SEDIMENTS	2821
PANNING CONCENTRATES	167
ROCKS	604

Sampling 2014

In process

- Area - 6765 km²
- Samples – 3531 stream sediments



Group	Zone	Location	Area (km ²)	Samples
I	1	Antioquia	1676	875
	2	Antioquia y Caldas	603	319
	3	Tolima	1061	639
II	4	Tolima, Huila	3425	1698
		Total	6765	3531

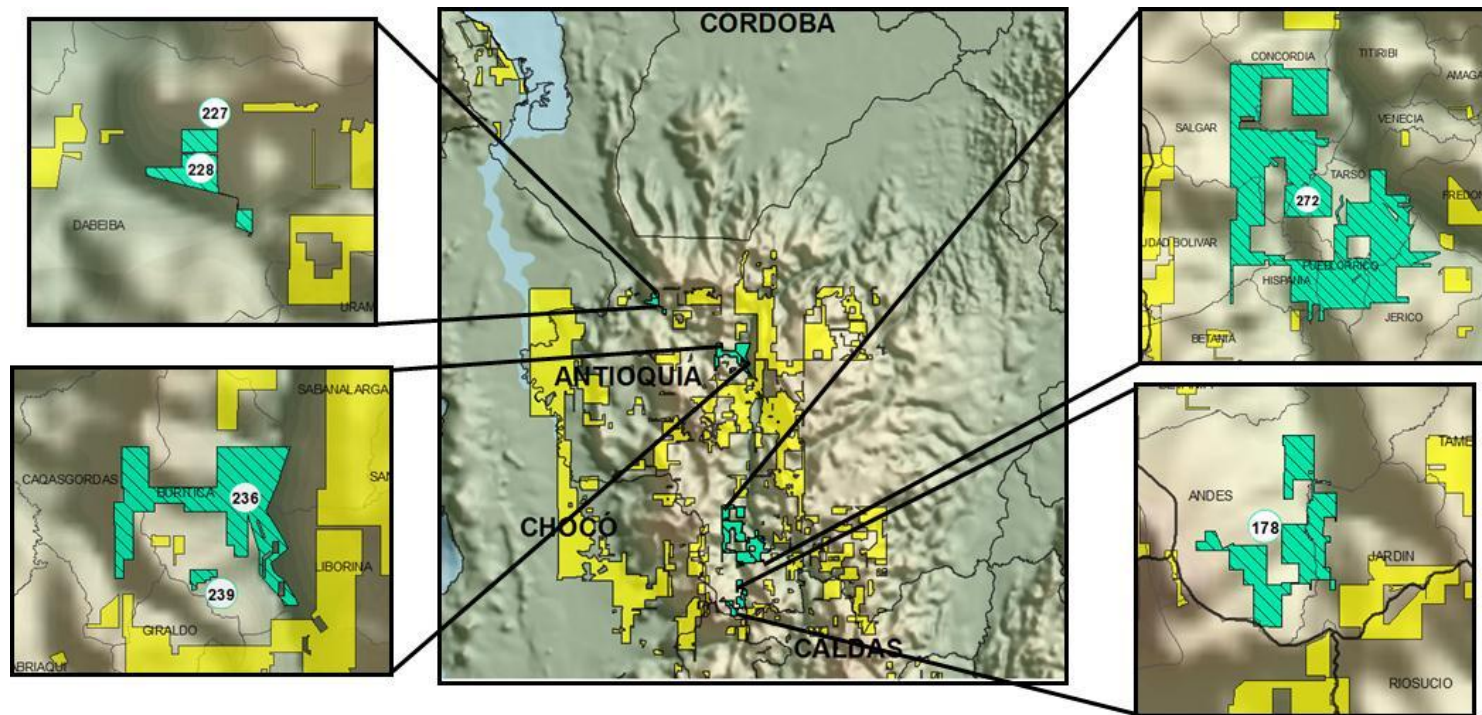
Geochemical Analysis

60 elements by sample

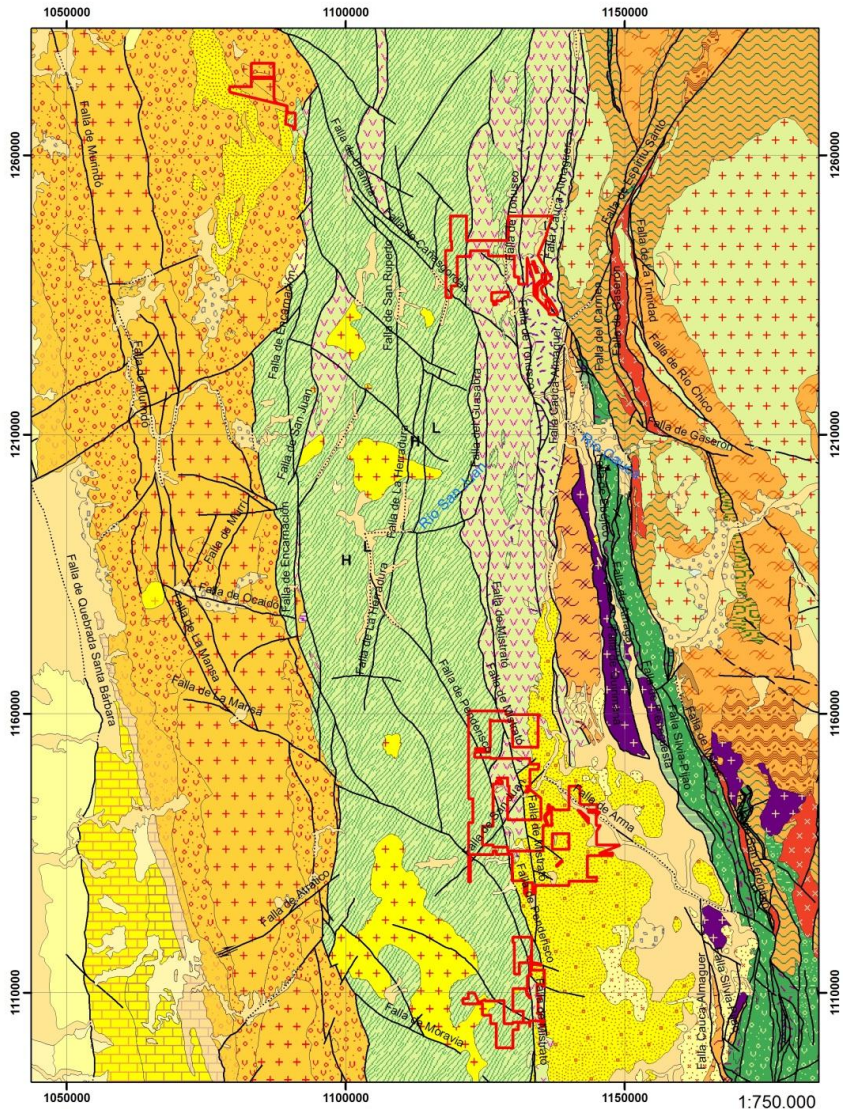
Analytical Techniques																	
H Hidrogeno																	He Helio
Li Litio	Be Berilio											B Boro	C Carbono	N Nitrogeno	O Oxigeno	F Flúor	Ne Neón
0,5	0,1											Al Aluminio	Si Silicio	P Fósforo	S Azufre	Cl Cloro	Ar Argón
Na Sodio	Mg Magnesio											0,18%	0,36%	0,02%	0,01%		
0,11%	0,10%																
K Potasio	Ca Calcio	Sc Escandio	Ti Titanio	V Vanadio	Cr Cromo	Mn Manganeso	Fe Hierro	Co Cobalto	Ni Níquel	Cu Cobre	Zn Cinc	Ga Galio	Ge Germanio	As Arsenico	Se Selenio	Br Bromo	Kr Criptón
0,08%	0,10%	0,05	0,04%	0,2	0,5	0,8	0,10%	0,8	0,5	1	4	0,2	2	1	0,6*		
				9		100	0,13%										
Rb Rubidio	Sr Estroncio	Y Itrio	Zr Circonio	Nb Niobio	Mo Molibdeno	Tc Tecnecio	Ru Rutenio	Rh Rodio	Pd Paladio	Ag Plata	Cd Cadmio	In Indio	Sn Estaño	Sb Antimonio	Te Teluro	I Yodo	Xe Xenón
0,2	1	0,05	2	2	2					10	0,08	0,005	8	12			
										1							
Cs Cesio	Ba Bario	Lantánidos	Hf Hafnio	Ta Tántalo	W Wolframio	Re Renio	Os Osmio	Ir Iridio	Pt Platino	Au oro	Hg Mercurio	Tl Talio	Pb Plomo	Bi Bismuto	Po Polonio	At Astató	Rn Radón
0,05	1		8	7	8					1	7	0,01	2	0,05			
Fr Francio	Ra Radio	Actínidos															
		Lantánidos	La Lantano	Ce Cerio	Pr Praseodimio	Nd Neodimio	Pm Prometio	Sm Samario	Eu Europio	Gd Gadolinio	Tb Terbio	Dy Disprobio	Ho Holmio	Er Erbio	Tm Tulio	Yb Iterbio	Lu Lutecio
			0,1	0,1	0,1		0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	0,005	
		Actínidos	Th Torio	Pa Protactinio	U Uranio	e l e m e n t o s											
			0,1		0,005	u r a n i c o s											

ZONES SELECTION

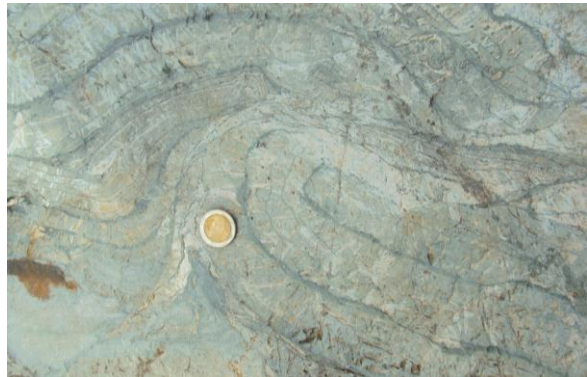
Identification of **6 zones** according to its mineral potential (11 blocks – 128.243 ha): Buriticá , Cauca Medio, Dabeiba, Yarumal, Fresno, Tolima



Metallogenesis research – Cooperation agreement

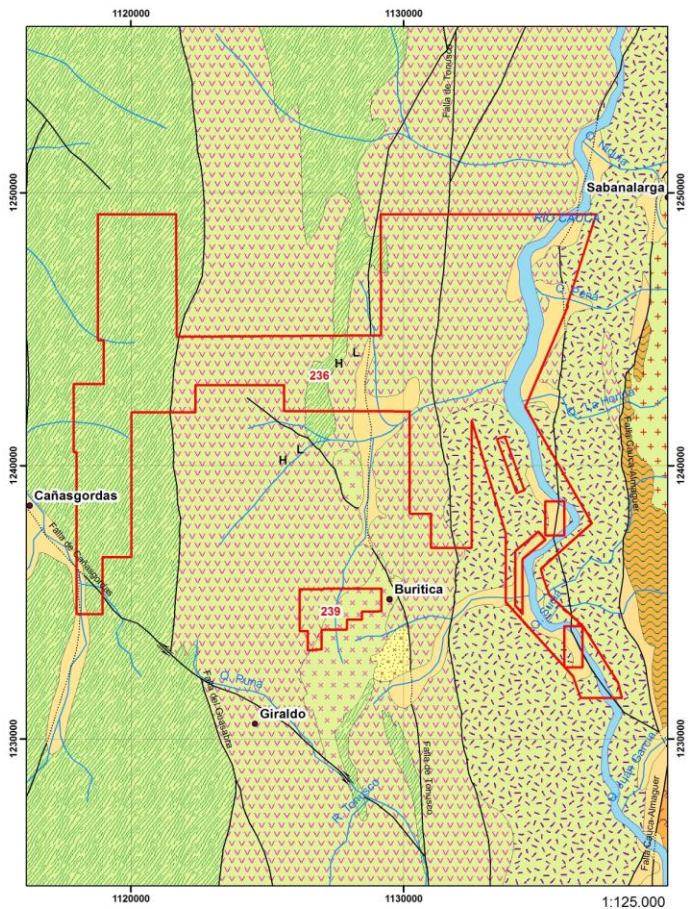


Zones Selection

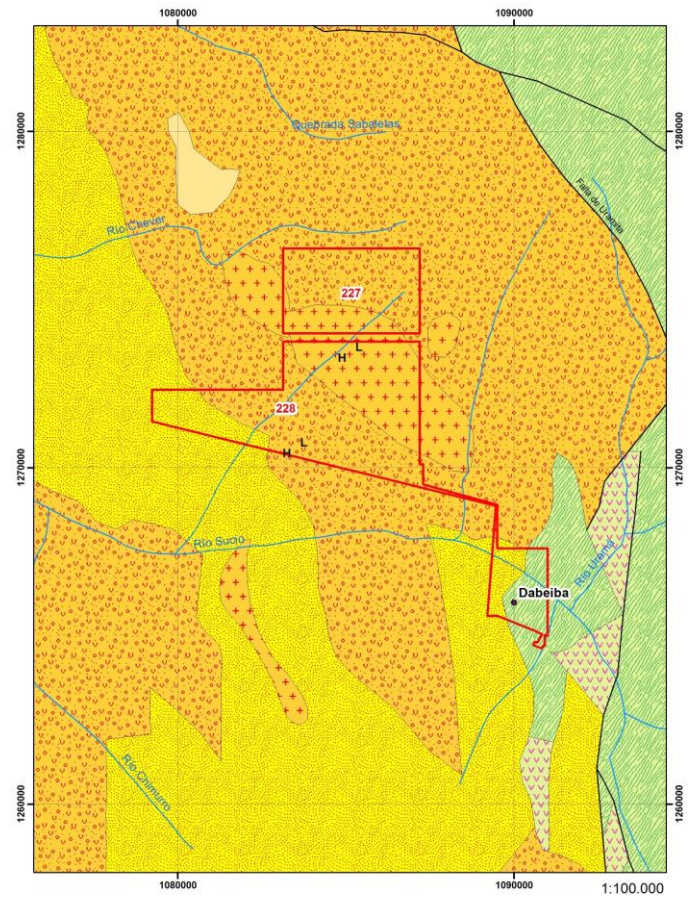


3 Priority Zones

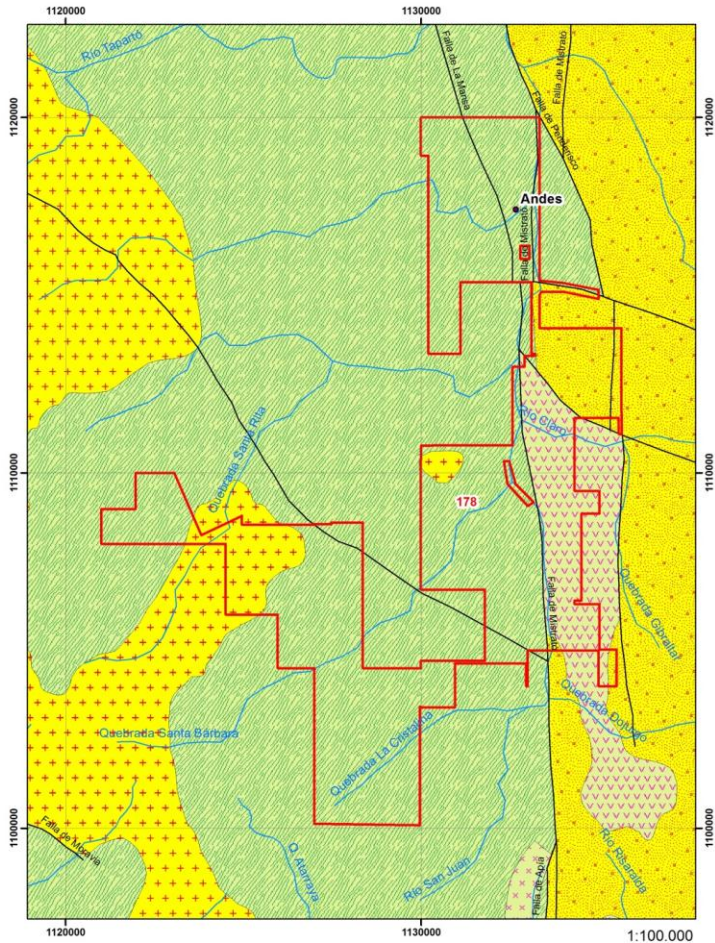
Buriticá , Cauca Medio, Dabeiba



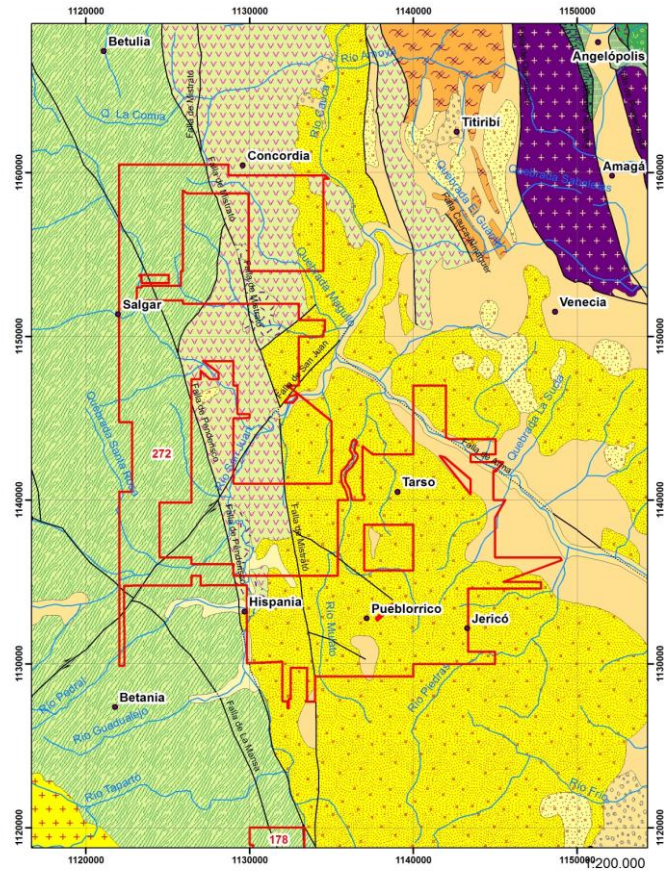
Buritica



Dabeiba



Cauca Medio North

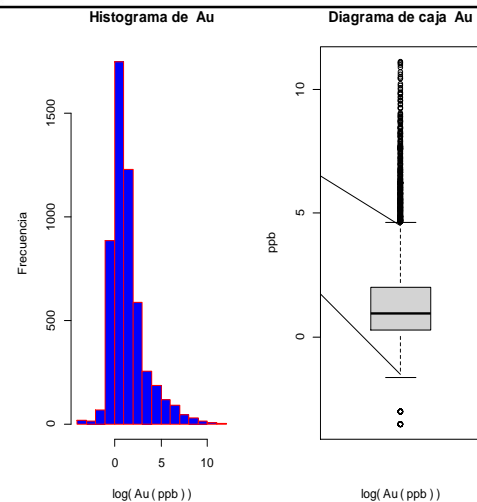
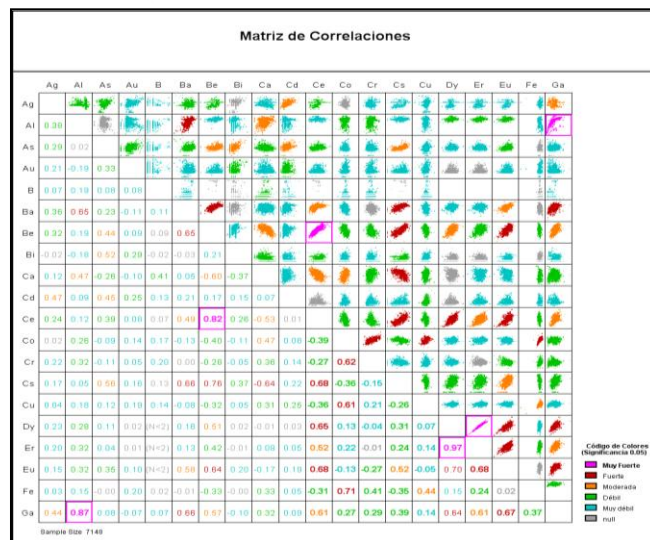


Cauca Medio South

Geochemical Data Processing

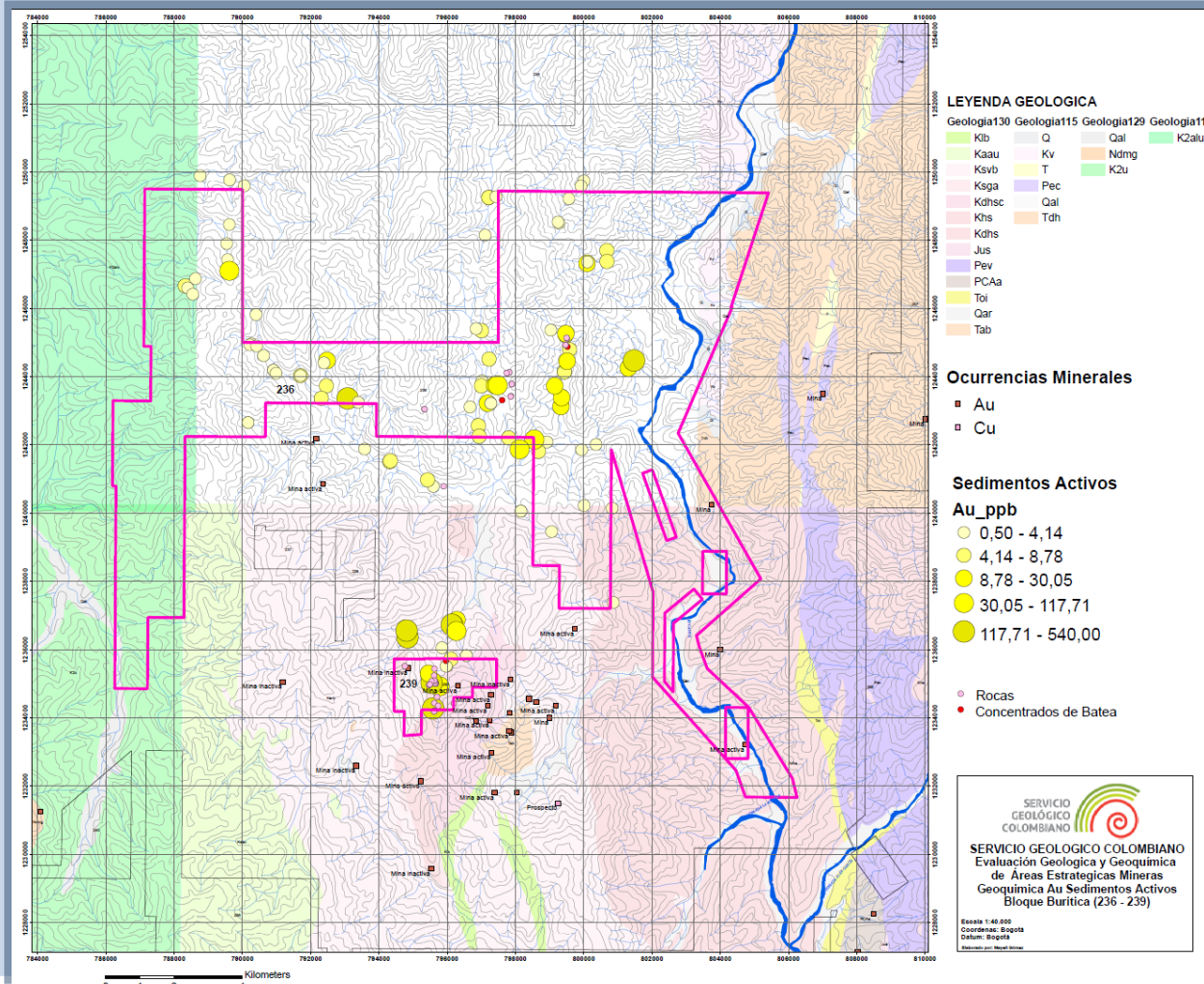
Dabeiba	Buritica	Cauca Medio
Ag – Mo (0.67)	Ag – Mo (0.98)	Ag – Mo (0.30)
Ag – Sb (0.73)	Ag – Sb (0.95)	Ag – Sb (0.36)
Ag - As (0.63)	Ag - Sn (0.99)	Ag - As (0.22)
Au – Bi (0.69)	Au – Bi (0.22)	Au – Bi (0.13)
Au – Cu (0.74)	Au – Cu (0.52)	Au – Cu (0.23)
Au – Pb (0.61)	Au – Pb (0.24)	Au – Pb (0.11)
Hg – As (0.82)	Hg – As (0.53)	Hg – As (0.30)

Statistics	Au (ppb)
NumValid	2604
Dummies	0
Min	0,5
Max	14100
Range	14099,5
Mean	41,1335
StdDev	394,556
Var	155675
GeoMean	2,78067
Median	2,09
StdErr	7,73194
Skewness	24,0689
Kurtosis	720,954



Geochemical Results

Buritica

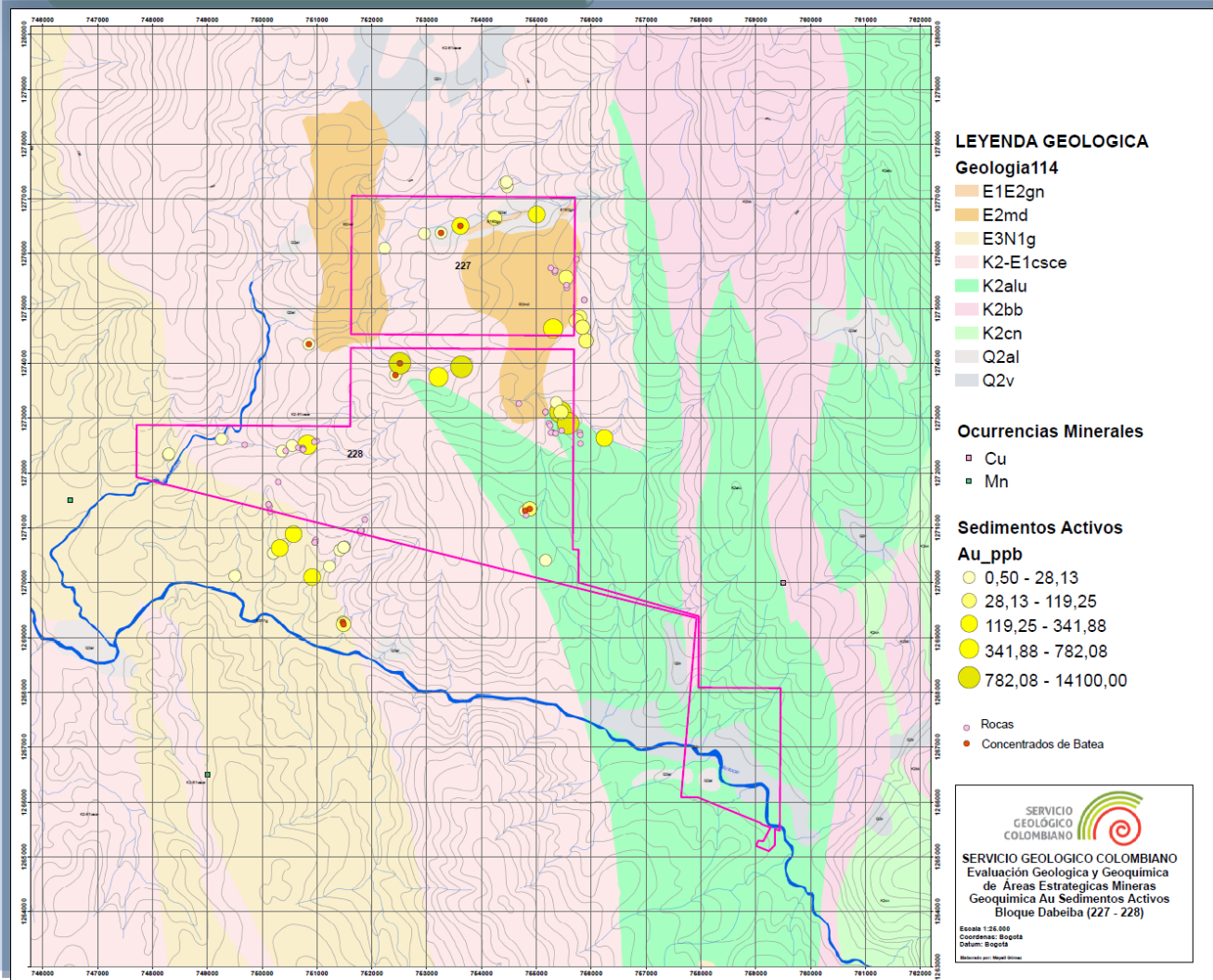


Sedimentos Activos

Au_ppb

- 0,50 - 4,14
- 4,14 - 8,78
- 8,78 - 30,05
- 30,05 - 117,71
- 117,71 - 540,00

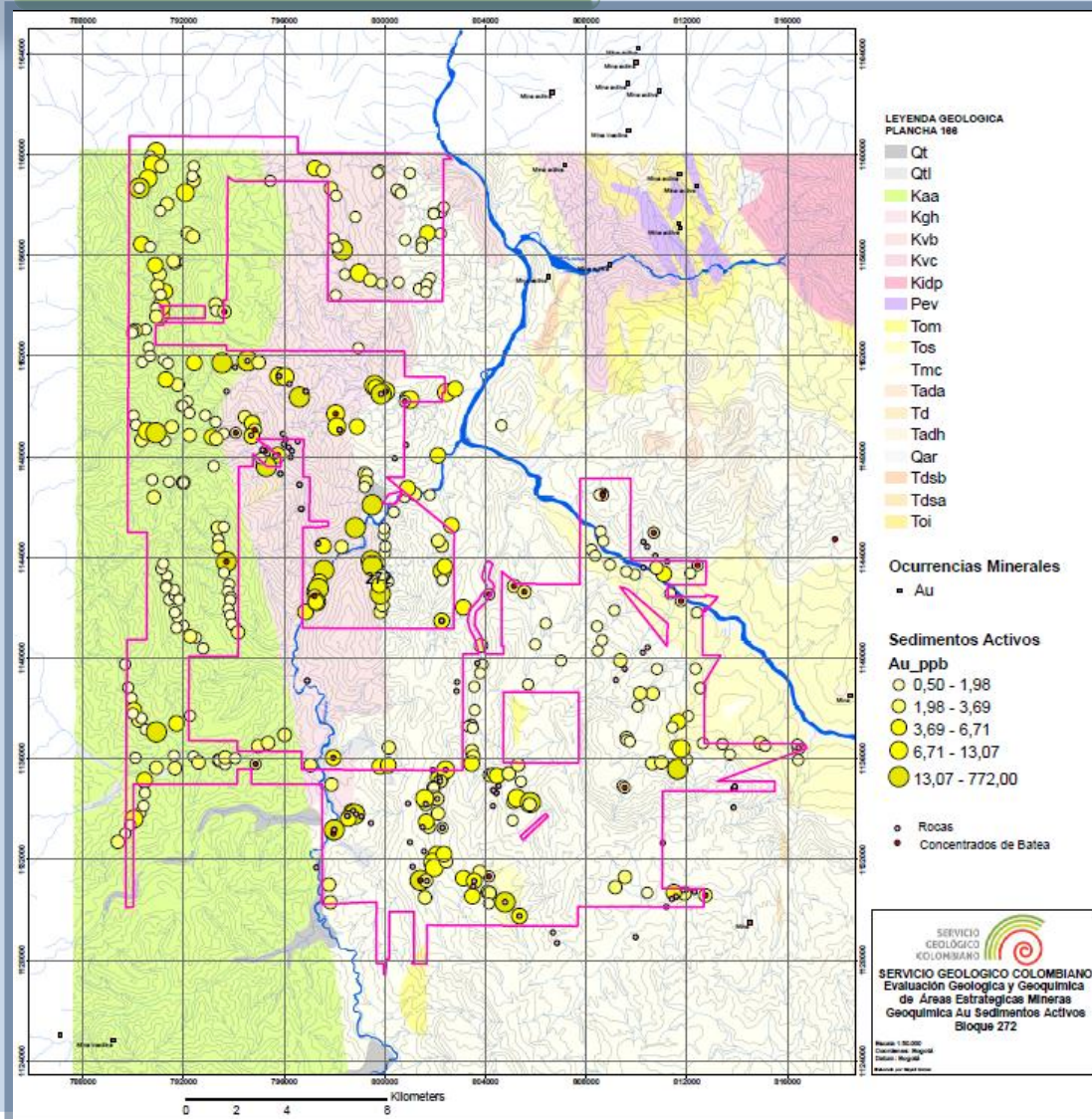
Geochemical Results



Dabeiba

Sedimentos Activos
Au_ppb
 0,50 - 28,13
 28,13 - 119,25
 119,25 - 341,88
 341,88 - 782,08
 782,08 - 14100,00

Geochemical Results



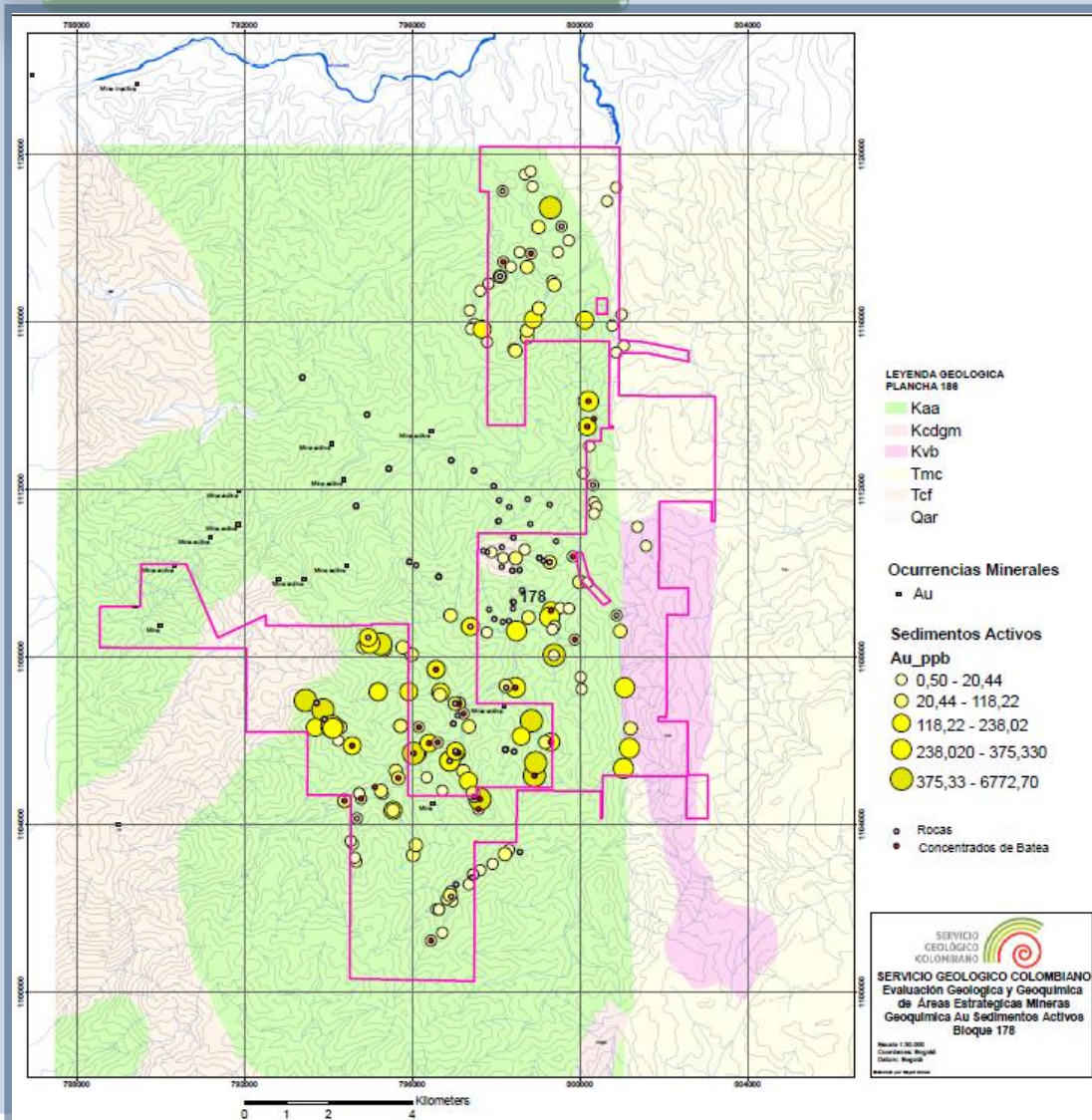
Cauca Medio North

Sedimentos Activos

Au_ppb

- 0,50 - 1,98
- 1,98 - 3,69
- 3,69 - 6,71
- 6,71 - 13,07
- 13,07 - 772,00

Geochemical Results



Cauca Medio South

Sedimentos Activos

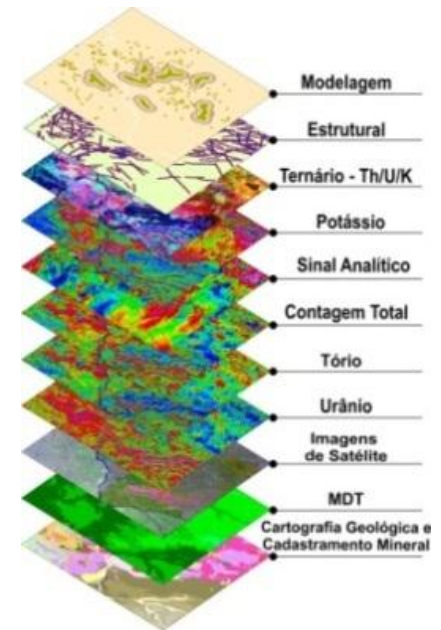
Au_ppb

- 0,50 - 20,44
- 20,44 - 118,22
- 118,22 - 238,02
- 238,020 - 375,330
- 375,33 - 6772,70

INFORMATION

1. Standardization
2. Safe storage

Distribution



AGENDA

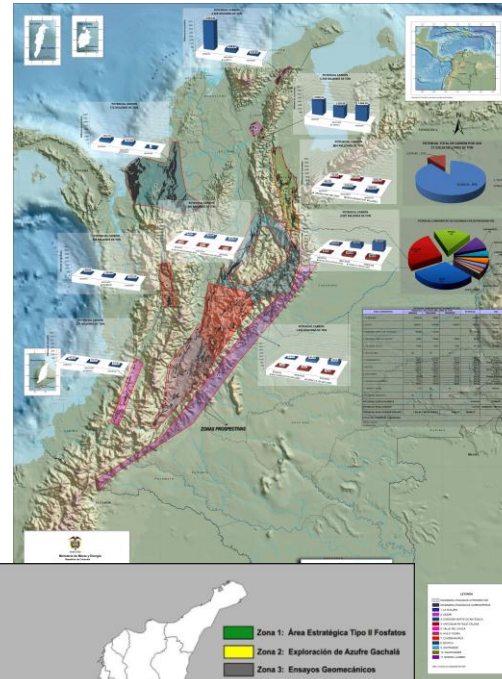
GEOLOGICAL SURVEY OF COLOMBIA MINERAL EXPLORATION

1. GENERAL OVERVIEW
2. EXPLORATION IN STRATEGIC MINING AREAS 2012 - 2014
 - ANTECEDENTS
 - AEROGEOPHYSICS
 - GEOLOGY AND GEOCHEMICAL EXPLORATION
3. EXPLORATION IN OTHER AREAS
4. SPECIAL TOPICS OF RESEARCH



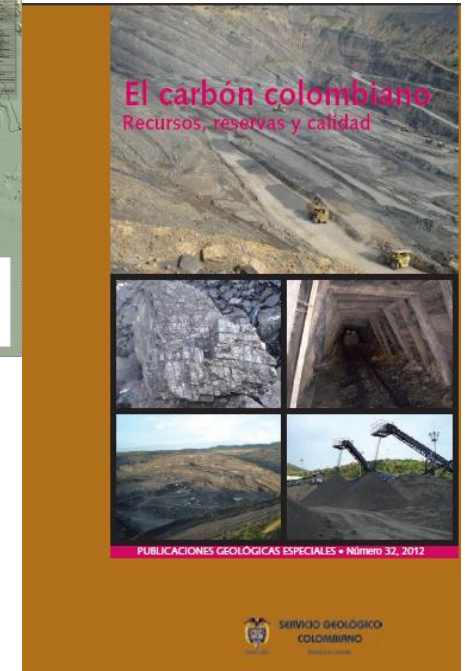
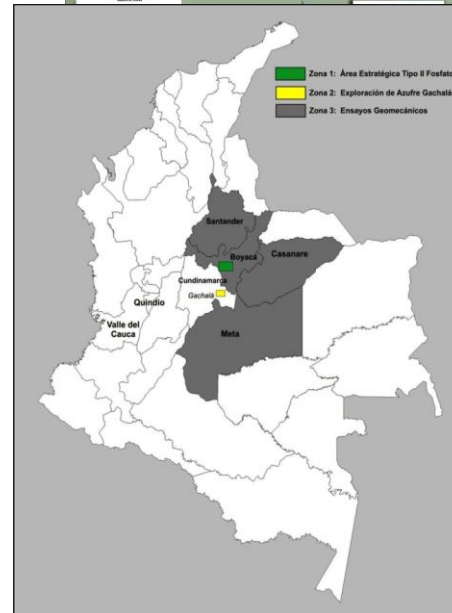
COAL and CBG

- Exploration in Central Colombia
- Publication of second edition of “El Carbón Colombiano: Recursos, Reservas y Calidad”



PHOSPHATES, SULPHUR

- PHOSPHATES: Central Colombia
- SULPHUR: Central Colombia



AGENDA

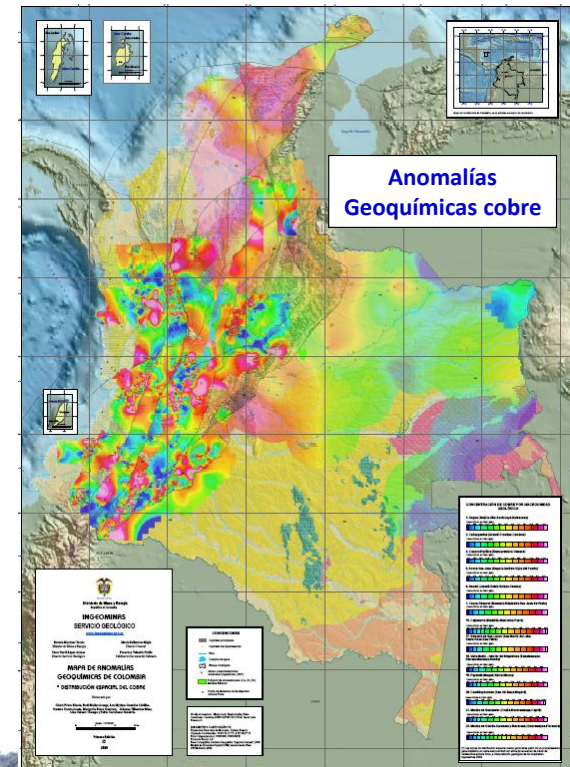
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SPECIAL TOPICS OF RESEARCH

- Geochemical Atlas of Colombia
- Metallogenetic Map of Colombia
- Research in mineral deposits and the environment





Gracias

<http://www.sgc.gov.co>