

U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT

Geology of the Venezuelan Guayana Shield at 1:500,000 scale--A Digital
Representation of Maps published by the U.S. Geological Survey

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PURPOSE OF THE REPORT

This purpose of this report is to publish a digital geologic map of the Venezuelan Guayana shield. This report is in Open-File format and will be available over the Internet. Both features speed publication in comparison with a more elaborate Digital Data Series CD-ROM product currently in formal review, (Schruben and others, 1995). This report is in response to several requests from industry and academia for the data in digital form.

HISTORY OF THE MAPS

The maps in this report are part of a mineral resource assessment of the Venezuelan Guayana Shield, conducted by the U.S. Geological Survey and Corporación Venezolana de Guayana, Técnica Minera, between 1987 and 1991 (USGS and others, 1993). The Venezuelan Shield occupies about 415,000 sq km in the south and east part of Venezuela. The study area is bounded on the north by Río Orinoco. It includes all of the Territorio Federal Amazonas, Estado Bolívar, and part of Estado Delta Amacuro. The publication, Bulletin 2062, contains consists of 121 pages of text, 31 figures, 11 tables, and eight full-color maps. The eight maps are listed below:

- Geographic
- Geologic and tectonic
- Bouguer gravity
- Two mineral occurrence maps
- Side-looking radar image
- Two permissive domain maps

The geologic and geographic maps from Bulletin 2062 were revised in 1994 and published as a series of two-color MF and I maps:

Guri	MF-2242	(Cox and others, 1994)
Ciudad Piar	MF-2246	(Stewart and others, 1994)
San Fernando	MF-2247	(Stewart, 1994)
Santa Elena	in review	(Gray and others, 1995)
Río Caura	I-2309f	(Brooks and others, 1995)
Puerto Ayacucho	MF-2245	(Wynn and others, 1994)
La Esmeralda	MF-2244	(Wynn and others, 1994)
Atababo	MF-2240	(Wynn and others, 1994)
Río Mavaca	MF-2241	(Wynn and others, 1994)
Piedra de Cocuy	MF-2243	(Wynn and others, 1994)

The revisions to the above maps are incorporated in this release. Only the geographic and geologic maps are being released with this report. These maps, together with the permissive domain and mineral occurrence maps will be released in ArcView format on a forthcoming Digital Data Series (DDS) CD-ROM, (Schruben and others, 1995).

INTERNET ACCESS

The maps in this report are in ARC/INFO Version 6.1.2 Export format. The files are further processed with the UNIX "tar" and "compress" commands and are available via anonymous ftp., To download type:

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ftp rgborafsa.er.usgs.gov (or 130.11.54.96)
cd pub/vz
bin (this changes to binary mode)
get vzof.tar.Z
bye

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To import into ARC/INFO type:

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uncompress vzof.tar
tar xvf vzof.tar
arc
&r import

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LIST OF FILES

desc.e00	info table rock unit descriptions
equi2geo.prj	equidistant conformal conic to geographic (decimal degrees) projection file
geo2equi.prj	geographic (decimal degrees) to equidistant conformal conic projection file
ger.gra	plot file rotated 90 degrees
import.aml	ARC aml script for importing all coverages
myalcgeol.e00	markerset for cities, bedding, joint symbols
myplotter.e00	shadeset for geology patterns
myplt.e00	lineset for faults, roads, political boundaries
places.e00	geographic place names
ptpat.e00	geology polygon lookup table, plotter patterns
ptpl.e00	point symbol lookup table
ptype.e00	geology polygon lookup table, Versatec colors
scale.e00	scalebar and projection information, 1:500,000 scale
scale1m.e00	scalebar and projection information, 1:1,000,000 scale
vz.aml	program for creating Versatec electrostatic plots
vzbox.e00	outline box for study area
vzcor.e00	correlation of map units
vzctry.e0*	Northeast South America country borders, 0-1
vzft.e0*	faults, annotation, joints, 0-3
vzge.e0*	geology files, 0-9
vzlab.e0*	rock unit annotation and leaders files, 0-2
vzleg.e00	map legend
vzlegpt.e00	map legend points
vzline.e00	lineset for Arc/Edit, Arc/Plot, Versatec plots
vzma.e00	buried magnetic bodies
vzout.e00	outer edge of combined quadrangles in study area
vzpl.e00	Venezuela country and province borders clipped at the map neatline for plotting
vzprov.e00	Venezuela province borders
vzrd.e00	roads
vzst.e0*	single-line tributaries and annotation files, 0-2
vztc.e00	latitude/longitude numbers and tics

DESCRIPTION OF MAP UNITS

SEDIMENTARY ROCKS

- Qal - Alluvial Deposits (Quaternary)--Sand, gravel, and silt.
- QTm, Tm - Mesa Formation (Pleistocene and Pliocene)--Siltstone and sandy siltstone, generally reddish color; massive to laminated. Unconsolidated gravel and sand in upper part.
- YXr - Roraima Group (Middle and (or) Early Proterozoic), undivided--Compilation of regional ages indicates an age of 1,900-1,500 Ma (Sieder and Mendoza, 1991).
- YXra - Auyantepuy Formation--Mainly quartzarenite and minor arkose; forms steep cliffs and flat-topped mesas. Thickness 300-700 m. Equivalent to Matauí Formation of Reid and Bisque (1975).
- YXrg - Guaiquinima Formation--Fine-grained quartzarenite and arkose that are cross stratified; red, green, and greenish-gray jasper composed of devitrified and silicified ash and small crystals of quartz and feldspar. Weathers to form flat or gently sloping topography. Upper part is mostly covered with debris from overlying Auyantepuy Formation. Several hundreds of meters thick. Equivalent to all but the lowermost part of the Uaimapué Formation of Reid and Bisque (1975).
- YXrc - Canaima Formation--Quartzarenite, arkose, conglomeratic arenite, conglomerate, siltstone, and shale. Abundant crossbeds in arenite and arkose units. Weathers to form cliffs on resistant arenite, arkose, and conglomerate units and slopes on relatively nonresistant siltstone, shale, and silty arenite units. About 1,000-2,000 meters thick. Equivalent to Uairén and Kukuenán Formations and lowermost part of Uaimapué Formation of Reid and Bisque (1975)
- Xpr - Pre-Roraima Group sedimentary rocks (Early Proterozoic)--Fine-grained to very fine grained, clay-rich sandstone, locally containing granule-size quartz grains. Interbedded with red shale and sandy shale (Briceño, 1982).
- Xco - Cinaruco Formation (Early Proterozoic)--Quartzite and sericitic quartzite and minor amounts of sericite-quartz schist and phyllite, ferruginous quartzite, and one or more intra-formational quartzite conglomerate (McCandless, 1962)
- Xma - Maracapa Formation (Early Proterozoic)--Weakly metamorphosed red beds and felsic volcanic rocks.
- Xlc - Los Caribes Formation (Early Proterozoic)--Weakly metamorphosed sequence of reddish arkose, polymict conglomerate, and finely laminated phyllite with minor felsic tuff.

EUGEOYNCLINAL TERRANE

- Xs2 - Mica schist and phyllite (Early Proterozoic)-quartz+muscovite±chlorite±chloritoid±ankerite schist and phyllite, and subordinate quartzite or metachert derived from sedimentary and felsic volcanic rocks. Ankeritic rocks weather to ferruginous schist and phyllite.

Xf2 - Felsic metatuff and flows (Early Proterozoic)--Quartz+muscovite± chloritoid semischist with relict phenocrysts or partially resorbed quartz and broken plagioclase replaced by albite. Groundmass mainly devitrified glass. Traces of relict lapilli locally abundant.

Xm2 - Mafic to intermediate metalava and metatuff (Early Proterozoic)-- Chlorite+epidote±actinolite schist and semischist, and greenstone, commonly with relict pyroxene phenocrysts. Relict textures suggest protoliths were amygdaloidal flows and lithic- and crystal-rich tuffs.

MAFIC AND ULTRAMAFIC ROCKS OF THE EUGEOSYNCLINAL TERRANE

Xg2 - Metagabbro (Early Proterozoic)

Xu2 - Ultramafic rocks (Early Proterozoic)--Mainly metaperidotite and metapyroxenite, serpentinite, and talc schist. Cumulus texture locally preserved.

VOLCANIC ROCKS

Xc, Xcv - Caicara Formation of the Cuchivero Group (Early Proterozoic)-- Unmetamorphosed ash-flow tuffs and rhyolitic to dacitic flows and breccias. Correlative volcanic rocks from Icabarú have a U-Pb age of 1,980 Ma (Brooks and others, in press)

INTRUSIVE ROCKS

d - Diabase (Mesozoic to Early Proterozoic)--Dark-gray to greenish-gray, fine- to coarse-grained diabase of tholeiitic composition. Forms dikes and sills. K-Ar ages of diabase in region are 210-200 Ma and 1,700-1,600± 0.8 Ma (Teggin and others, 1985; Sidder and Mendoza, 1991). Determined from SLAR interpretation or from aeromagnetic data.

Yp - Parguaza Granite (Middle Proterozoic)--Massive, coarsely crystalline, porphyritic granite and biotite granite commonly with rapakivi texture (about 1,545 Ma, Gaudette and others, 1978). The Parguaza Granite is reported by Mendoza and others (1977) and Ghosh (1985) to be unconformably overlain by the Roraima Group, although isotopic dates on the Parquaza Granite (about 1,545 Ma) are within the possible age span of the Roraima Group (1,900 to 1,545 Ma)(Ghosh, 1985; Sidder and Mendoza, 1991). These age relations can be explained if the Roraima Group varies significantly in age within the Guayana Shield; that is, the Roraima Group may be relatively young (<1,545 Ma) where it reportedly (Mendoza and others, 1977; Ghosh, 1985) rests on the Parguaza Granite but may be older than this in the eastern parts of the Guayana Shield.

Ylg - Intrusive rocks typically penetrating through and doming Roraima sediments (Middle Proterozoic)--In Caño Yagua (3°25' N., 65°40' W.), one body was mapped as coarsely equigranular granodiorite with pronounced Rapakivi texture. In the southern part of the Río Negro (1°10' N., 66°50' W.), a similar body named the Piedra de Cocuy is described as a granodiorite with 20 percent biotite, 30 percent quartz, 40 percent feldspar, and 10 percent hornblende (Marcano and others, 1991). These

rocks are characterized by small, subrounded, and generally strong magnetic anomalies and are often visible in SLAR imagery.

ic - Carbonatite(?) intrusion of Cerro Impacto (Mesozoic to Early Proterozoic)--Inferred primarily from geochemistry of the laterite (which is enriched in Ta, Nb, Th, Ba, and REE) and barite outcrops and from geophysical interpretation that indicates a magnetite-rich core. Carbonatite underlies north-south ridge that has a thick lateritic cover in a depression composed of fenitized granodiorite and tonalite. Age may be as young as 80 Ma (Mendoza and others, 1977) or as old as 1,800 Ma as inferred from intrusive relationship with the granitic rocks of the Cuchivero Group (1,900-1,800 Ma; Sidder and Mendoza, 1991)

YXac, ac - Alkaline complexes (Early Proterozoic?)--Inferred to be present based on interpretation of aeromagnetic data. Possibly similar to La Churuata (dated at 1,300 Ma), an alkaline complex to the south where aegirine, riebeckite, biotite, zircon, monazite, and bastnaesite were identified (Soares, 1985)

Xg - Calc-alkaline granite and other silicic plutonic rocks (Early Proterozoic)--Martínez (1991) described these rocks as massive, coarse-grained, gray, equigranular biotite granites with Rapakivi texture similar to the Parguaza batholith. These granites are seen west and north of Cerro Duida (4°00' N., 65°30' W.) in the Amazonas Federal Territory. These rocks are weakly to moderately magnetic, often with east-west to west-northwest trends in the magnetic anomalies. Pronounced west-northwest-striking lineaments in the SLAR imagery are characteristic, especially in the Atabapo quadrangle.

XAgr - Granitic rocks intruding the Imataca Complex (Early Proterozoic and (or) Archean)--Mostly quartz monzonite. Age uncertain; may include granitoids as old as Late Archean as well as granitoids of Early Proterozoic age equivalent to the Supamo or Cuchivero Groups.

XAm - Migmatite and gneiss associated with the Imataca Complex (Early Proterozoic and (or) Archean)--Quartz monzonite, migmatite, and lineated gneiss.

Xcg - Granitic rocks of the Cuchivero Group (Early Proterozoic)--Includes granites of Guaniamito, San Pedro, and Santa Rosalía intruded into volcanic rocks of the Caicara Formation. Commonly equigranular to porphyritic, medium to coarse-grained, and locally foliated. Phenocrysts include orthoclase, microcline, plagioclase, quartz, biotite, muscovite, and accessory sphene, apatite, zircon, and hornblende. Rb-Sr isotopic age range of 1,900 to 1,800 Ma (Sidder and Mendoza, 1991)

diorit - Fenitized zone at Cerro Impacto--Caused by the underlying carbonatite(?). Indicated by smooth depression on SLAR

Xgu - Intrusive rocks, undivided (Early Proterozoic)--Underlying water-inundated plains and jungle in the southeastern Amazonas Federal Territory. Where seen south and east of San Fernando de Atabapo (3°45' N., 67°40' W.), they are described as biotite hornblende granites and granite gneisses (Marcano and others, 1991), These rocks are weakly magnetic and have no apparent trend.

Xgr - Granitic rocks (Early Proterozoic)--Mostly quartz monzonite.

Porphyritic, medium- to coarse-grained, some inclusion of granodiorite. May include potassic granitoids as old as the Supamo Complex and (or) granitoids as young or younger than the Cuchivero Group.

Xsp - Supamo Complex (Early Proterozoic)--Sodic granitic rocks, paragneiss, migmatite, granodiorite, and sparse pegmatite. About 2,230 to 2,050 Ma (Sidder and Mendoza, 1991).

GREENSTONE BELT ROCKS OF THE GUASIPATI-EL CALLAO AREAS

Xcb - Caballape Formation (Early Proterozoic)--Mainly felsic metatuff and phyllite derived from laminated volcanoclastic siltstone and graywacke. Metatuff contains plagioclase phenocrysts, resorbed phenocrysts of quartz, wisps of pumice, and minor lithic clasts.

Pastori Supergroup (Early Proterozoic)--Divided into:

Yurari Formation

Xyf - Felsic metatuff--Quartz±muscovite±calcite semischist. Contains relict quartz and feldspar phenocrysts and traces of lapilli and breccia clasts. Minor greenstone.

Xys - Mica schist and phyllite--Finely laminated quartz±scovite±chloritoid±biotite±andalusite±sillimanite schist. Locally contains volcanoclastic metasandstone and felsic metatuff and breccia.

Carichapo Group

Xcc - Cicapra Formation--Mafic to intermediate metatuff. Mainly albite±epidote±biotite amphibolite. Relict textures suggest interlayering of tuff and volcanoclastic sandstone.

Xce - Ek Callao Formation--Greenstone, greenschist and minor talc schist and amphibolite. Relict pillow structure is common. Flows are commonly intercalated with flow breccias. Fine-grained quartz-hematite rocks in uppermost part. Minor chert.

GREENSTONE BELT ROCKS ELSEWHERE IN THE GUAYANA SHIELD

Xsm - Sedimentary and metasedimentary rocks (Early Proterozoic)--Rocks of uncertain affinity along or near Río Oris in southeastern Ciudad Piar quadrangle. Corresponds in part with La Quina Formation of Bellizzia and others (1976). Hematitic quartz arenite; reddish phyllitic siltstone; feldspathic arenite; conglomeratic arenite; quartz-sericite phyllite; red, laminated, fine-grained meta-arenite with graded bedding and erosional channels.

Xma - Maracapra Formation of Bellizzia and others (1976) (Early Proterozoic)--Weakly metamorphosed red beds and felsic volcanic rocks.

Xmu - Greenstone belt rocks, undivided (Early Proterozoic)--Gold-bearing, greenstone belt rocks are reported in the upper Río Orinoco headwaters. Tremendous magnetic gradients that tend to be sinuous and linear can be

seen along the upper Río Orinoco, such as greenstone belt rocks in eastern Bolívar State. This terrane is distinguished by low to moderate relief in the SLAR imagery.

Xa - Amphibolite schist (Early Proterozoic)--Includes local coarse-grained metagabbro.

Xm1 - Mafic to intermediate metalava and metatuff (Early Proterozoic)--Mainly greenstone and schist, but locally includes amphibolite and hornblende hornfels near granitic contacts.

Xf1 - Felsic metatuff and flows (Early Proterozoic)--Quartz+muscovite±chlorite semischist with relict phenocrysts of partially resorbed quartz and broken feldspar.

Xm1 - Mafic to intermediate metalava and metatuff (Early Proterozoic)--Chlorite+albite+epidote±actinolite schist, semischist, and greenstone, locally amygdaloidal. Subordinate albite-epidote amphibolite and minor amphibolite. Minor chert.

Xs1 - Schist, phyllite, metatuff, and metavolcanic rocks (Early Proterozoic)--Quartz-mica schist; quartz-sericite-chlorite schist; sericitic meta-arenite; sericitic-chloritic phyllite; rhyolitic, dacitic, andesitic, and basaltic metatuffs; minor metabasalt and meta-andesite.

Xg1 - Metagabbro (Early Proterozoic)--Saussuritized and, locally, amphibolitized Metagabbro. Cumulus texture locally preserved.

Xu1 - Ultramafic rocks (Early Proterozoic)--Mainly metaperidotite and metapyroxenite, serpentinite, and talc schist.

Xui - Ultramafic intrusive rocks in La Flor-Carapo area (Early Proterozoic)--Medium- to coarse-grained pyroxenite sills; ophitic or subophitic to cumulus textures; saussuritized plagioclase, clinopyroxene altered to green hornblende, and sparse olivine.

ROCKS OF THE IMATACA PROVINCE

XAi - Imataca Complex (Archean)--Amphibolite- to granulite-facies quartzofeldspathic orthogneiss and paragneiss, commonly garnet-bearing, and felsic granulite. Minor amounts of intermediate to mafic orthogneiss, granulite, and charnockite. Metamorphosed iron formations and ferruginous quartzite are shown by dotted lines on map. Older than 2,800 Ma, the protolith is probably as old as 3,400 to 3,700 Ma (Sieder and Mendoza, 1991).

METAMORPHIC ROCKS

Xmo - Moriche Formation (Early Proterozoic)--Characterized at its type locality (Cerro Moriche on the middle Río Ventuari, 4°40' N., 66°25' W.) as metasedimentary conglomerates, possible remnants of an ancestral greenstone belt terrane eroded from the protolith (Ghosh, 1985). These rocks are highly magnetic and frequently follow major structural lows along the middle and upper Río Orinoco and Río Mavaca. They generally form long, linear bodies sometimes folded by regional metamorphic events

and are usually visible in the SLAR imagery.

Xmp - Metamorphic-plutonic terrane of San Carlos (Early Proterozoic)-Granite, granite gneiss, augen gneiss, and relatively abundant pegmatite.

Xbc - Basement complex (Early Proterozoic)-Foliated granite to granodiorite gneiss.

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