UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOLOGIC PROVINCE MAP OF THE VENEZUELAN GUIANA SHIELD

by

Gary B. Sidder[1]

Open-File Report 90-73

1990

---

[1]U.S. Geological Survey, Denver, Colorado

INTRODUCTION

The U.S. Geological Survey has been assisting the Corporacion Venezolana de Guayana-Compania Tecnica Minera (CVG-TECMIN) since 1987 in its assessment of and exploration for new mineral deposits in the Precambrian Guiana Shield of Venezuela. The following text is a descriptive lithostratigraphic column designed to explain Plate 1, "Geologic Province Map of the Venezuelan Guiana Shield." This map and text have been compiled in order to better evaluate and direct a mineral resource assessment and exploration program. The text is written from the oldest province to the youngest so that the reader may follow more clearly the history of the rocks. Table 1 presents a simplified stratigraphic chart of the rock units and tectonic events of the Guiana Shield of Venezuela. The map has been digitized and plotted with the computer program GS-DRAW 5.0 (Selner and Taylor, 1988).

The Venezuelan Guiana Shield consists of five lithotectonic provinces. These include: 1) the Archean Imataca Complex; 2) the Early Proterozoic greenstone-granite terranes; 3) the Early Proterozoic Cuchivero Group; 4) the Early to Middle Proterozoic Roraima Group; and 5) the Middle Proterozoic Parguazan granite (Gibbs and Barron, 1983; Teixeira and others, 1989).

Description of units:

Wi **IMATACA COMPLEX**: Metasedimentary and meta-igneous rocks of amphibolite to granulite facies form the Imataca Complex. The rocks consist of about 80+ percent quartzo-feldspathic gneiss and granulite, 10 to 15 percent intermediate to mafic gneiss, granulite, and charnockite, 1 percent metamorphosed banded iron formation (BIF), and minor dolomitic marble and anorthosite. Gneisses are migmatitic and non-migmatitic, with quartz-potassium feldspar-plagioclase ± biotite ± hornblende ± orthopyroxene ± clinopyroxene ± garnet ± sillimanite ± cordierite ± muscovite. The protolith of the Imataca Complex consisted of sedimentary rocks, silicic calc-alkaline volcanic rocks of continental affinity, and lesser plutonic rocks. The age of the protolith was about 3700 to 3400 Ma. The entire stratigraphic sequence of the Imataca Complex has been isoclinally folded, and fold axes and foliation trend N50°E to N70°E. The Guri shear zone separates the Archean Imataca Complex from the Early Proterozoic greenstone-gneiss terrane. Numerous iron deposits of enriched Superior-type banded iron formation, some with anomalous values of manganese, are in the Imataca Complex. Individual beds of BIF may extend for 20 km along strike. Oxide facies BIF predominates, with hematite and magnetite

Table 1. Stratigraphic chart (oldest to youngest) of rock units and tectonic events of the Guiana Shield of Venezuela.

Imataca Complex (**Wi** on map)

----PRE-TRANS-AMAZONIAN TECTONOTHERMAL EVENT (about 2800 Ma)

Greenstone belt rocks (**Xg**)
- Pastora Supergroup
  - Carichapo Group
    - El Callao Fm.
    - Cicapra Fm.
  - Yuruari Fm.
- Botanamo Group
  - Caballape Fm.
  - Los Caribes Fm.

Supamo Complex (**Xs**)

Proterozoic Undivided (**Pu**)

----TRANS-AMAZONIAN OROGENY (about 2100 to 1760 Ma)

Cuchivero Group (**Xc**)
- Caicara Fm.
- San Pedro Granite and Santa Rosalia Granite (including the Las Trincheras Granite)
- Guaniamito Granite

Roraima Group (**XYr**)
- Uairén Fm.
- Kukenán Fm.
- Uaimapué Fm.
- Matauí Fm.

Avanavero Suite (**Ya**)

Parguazan Granite (**Yp**)

----NICKERIE TECTONOTHERMAL EVENT (about 1300 to 900 (?) Ma)

Diabase dikes (**Mzd**)

Alluvium (**Qal**)

---

as the dominant iron minerals. Enriched BIF ore generally occupies the limbs and centers of synclines. Minor enriched beds of manganese protore in the Imataca Complex may be represented by the sedimentary-nonvolcanogenic manganese deposit model. Rocks correlative in age to the Imataca Complex elsewhere in the Guiana Shield are not known, although granulites in the Cupixi area, Amapa Territory, Brazil, may be Late Archean in age. (Drovenik and others, 1967; Ascanio, 1975; Dougan, 1977; Montgomery and Hurley, 1978; Montgomery, 1979; Gibbs and Wirth, 1986; Teixeira and others, 1989).

----**PRE-TRANS-AMAZONIAN TECTONOTHERMAL EVENT:** Folding, intrusion by granite and charnockite, and metamorphism to the granulite facies with migmatitization about 2800 Ma characterize this pre-Trans-Amazonian orogenic event. It is also known as the Gurian Orogeny. (Mendoza, 1977a; Moreno and others, 1977; Onstott and others, 1989).

Xg GREENSTONE BELT ROCKS: The greenstone belts contain submarine sequences with mafic-ultramafic intrusions, mafic to felsic volcanic rocks, and chemical sedimentary rocks at the base, to basaltic to rhyolitic lava flows and tuffs, to tuffaceous, volcaniclastic, turbiditic, and chemical sedimentary rocks at the top. Both tholeiitic and calc-alkalic chemical trends are present. Mafic-ultramafic intrusions appear throughout the stratigraphic sequence and occur as both strongly metamorphosed and relatively unmetamorphosed bodies. Ultramafic intrusions include cumulate rocks in gabbro complexes and comprise about 1 to 2 percent of the igneous rocks. Komatiite has been identified in at least two isolated areas on the basis of high magnesian content (22 wt % MgO or more) and relic spinifex texture. All rocks are metamorphosed; metamorphic grade ranges from sub-greenschist facies in the interior of belts to amphibolite facies at contacts with intrusions. The rocks have suffered at least one recognizable deformation. Structural trends are dominantly NE-SW to E-W. Ages range from about 2250 Ma to 2100 Ma. Named stratigraphic units of the greenstone belts currently include the older Pastora Supergroup, which includes the Carichapo Group, and the younger Botanamo Group. The greenstone belt rocks contain gold-quartz-tourmaline vein (low-sulfide Au-quartz vein- and possibly Homestake Au-type) deposits in many areas. Volcanogenic massive sulfide deposits have not been

discovered to date, although the tectonic and volcano-sedimentary environment are favorable for kuroko-type massive sulfide deposits. Dunitic nickel-copper, Algoma-type banded iron formation, porphyry copper ± gold ± molybdenum, and Cuban-type (island arc) volcanogenic manganese deposits are also possible. Platinum group elements (PGE) may be associated with gold lode and placer and nickel-copper deposits. The Pastora Supergroup is correlative with the Barama-Mazaruni Supergroup in Guyana, the Marowijne Group in Suriname, the Paramaca Supergroup (Orapu and Bonidoro Groups) in French Guiana, and possibly the Vila Nova Group in Brazil. (Menendez, 1972, 1974; Mendoza, 1977a; Ghosh, 1985; Gruau and others, 1985; Gibbs, 1987; Teixeira and others, 1989; Tosiani and Sifontes, 1989).

PASTORA SUPERGROUP: isoclinal recumbent folds characteristic.

CARICHAPO GROUP:

El Callao Fm.: metamorphosed (greenschist to amphibolite facies) low-K basaltic to andesitic lava flows, locally with pillowed lava, that commonly occur as biotite-chlorite±actinolite schists; amphibolites developed in proximity to granitic intrusions. Minor ferruginous quartzite (metamorphosed banded iron formation?) is also described from several areas. Hills with irregular crests are the common topographic expression of these rocks.

Cicapra Fm.: metamorphosed (greenschist to amphibolite facies) submarine andesitic tuff, turbiditic graywacke, graphitic shale and siltstone, tuff breccia, and agglomerate, which weather to form a flat topography.

Yuruari Fm.: metamorphosed (greenschist facies) epiclastic and turbiditic rocks, with sandstone, siltstone, and shale forming chlorite-sericite schist and manganiferous phyllite, with dacitic to andesitic and basaltic tuff, breccia, and lava flows. These rocks form low hills with a rectangular drainage pattern.

BOTANAMO GROUP: open folds characteristic.

Caballape Fm.: metamorphosed (greenschist facies) epiclastic volcanic rocks and turbiditic graywacke, siltstone, and conglomerate comprise 80 percent of the unit, and metamorphosed andesitic to rhyodacitic pyroclastic tuff and breccia form 20 percent. These rocks

generally form low hills elongated parallel to the trend of beds with a rectangular drainage pattern.

Los Caribes Fm.: metamorphosed (greenschist facies) red phyllite and arenite, polymict conglomerate, and siltstone. This unit is excluded from the greenstone belt sequence by some authors and is referred to as pre-Roraima metasedimentary rocks or pre-Roraima foliated sandstone. It has even been suggested that this formation is time correlative with rocks of the Cuchivero Group (see below).

Xs SUPAMO COMPLEX: The Supamo Complex includes gneiss, schist, migmatite, and granitic rocks such as tonalite, granodiorite, quartz monzonite, and trondhjemite (sodic granite). The plutonic rocks are massive to foliated and generally form domes. The granitic rocks of the Supamo Complex intrude the greenstone belt rocks, and the grade of metamorphism in the metavolcanic and metasedimentary rocks increases from greenschist facies to amphibolite facies in proximity to the intrusions. The marginal facies of the intrusive bodies are generally concordant with the supracrustal rocks that they intrude. The granitic rocks generally occur as isolated hills with a dendritic drainage pattern within the greenstone belt rocks. The age of the Supamo Complex is commonly described as ranging from 2700 to 2100 Ma, with the younger aged rocks said to be "remobilized Supamo". However, recent uranium-lead isotopic data from zircons indicate that the age of the granitic and gneissic rocks is about 2230 Ma. This date is consistent with an age of 2227 Ma for the apparently correlative Bartica Gneiss in Guyana (Menendez, 1972, 1974; Benaim, 1974; Gibbs and Olszewski, 1982).

Pu PROTEROZOIC UNDIVIDED. Proterozoic rocks not well studied or subdivided are present in the Amazon Federal Territory. They consist predominantly of plutonic rocks and medium to high grade gneisses with both igneous and sedimentary protoliths. The intrusive rocks range in composition from granite to tonalite and quartz diorite. They are generally equicrystalline and are commonly foliated. The metamorphic rocks vary from poorly foliated, mildly tectonized to gneisses and migmatites. Peak metamorphism and intrusion occurred between 1860 and 1760 Ma. (Gaudette and Olszewski, 1985).

----TRANS-AMAZONIAN OROGENY: A major orogenic cycle of deformation, upper amphibolite to granulite facies metamorphism, and intrusive activity occurred between about 2100 and 1760 Ma (the wide range in ages is apparently the result of a progressive migration of tectonic activity with time across the shield from the northeast to the southwest).

Metamorphic complexes developed, and mafic and granitic intrusions were emplaced. Kimberlites, at least in the western Guiana Shield of Venezuela, may also have been intruded. (Priem and others, 1971; Moreno and others, 1977; Gibbs and Barron, 1983; Gaudette and Olszewski, 1985; Gibbs and Wirth, 1986; Nixon, 1988; Onstott and others, 1989).

Xc CUCHIVERO GROUP: The Cuchivero Group consists of a thick pile (greater than 3 km in thickness) of felsic to intermediate continental (subaerial) volcanic, subvolcanic, plutonic, and volcanogenic sedimentary rocks. These rocks are generally unmetamorphosed; reports of lower greenschist facies metamorphism apparently refer to local contact metamorphic aureoles in volcanic and volcaniclastic rocks that are present in proximity to intrusions. Ages range from about 1875 to 1700 Ma. Rocks included within the Cuchivero Group are relatively older volcanic rocks of the Caicara Fm., and the younger granites of Guaniamito, San Pedro, and Santa Rosalia. Broad, open folds are characteristic, and structures such as faults and lineaments generally trend NW to NNW. Epithermal quartz veins with silver and gold occur locally, and isolated areas of rhyolite contain traces of disseminated cassiterite. The granite-rhyolite terrane of the Cuchivero Group in southernmost Bolívar State is permissive for Olympic Dam-type Fe-Cu-U-Au-rare earth element (REE) deposits. The carbonatite (of unknown age) at Cerro Impacto (symbol number 1 on map) that is enriched in niobium, thorium, cerium, and barium is within the Cuchivero province. The Cuchivero Group correlates with the Uatuma Group in Brazil, the Kuyuwini and Burro-Burro Groups in Guyana, and the Dalbana Formation in Suriname. (Mendoza and others, 1975; Montalvao, 1975; Berrange, 1977; Aarden and others, 1978; Premoli and Kroonenberg, 1981; Tepedino, 1985; Gibbs, 1987; Sims and others, 1987; Meyer, 1988; Sidder and Martinez, 1989; Sidder, 1990).

Caicara Fm.: includes pyroclastic rocks such as tuff, welded tuff, and breccia, with minor lava flows, intercalated volcaniclastic rocks, domes, and hypabyssal intrusions. The rocks are aphyric to porphyritic, with both crystal- and lithic-rich tuff. Volcanic glass is devitrified completely, and vitroclastic texture is preserved in some rocks. Compositions range primarily from rhyolite to rhyodacite, with lesser amounts of dacite and andesite. The rocks are generally unmetamorphosed. Reported regional metamorphism is actually contact metamorphism in restricted zones in proximity to intrusions with possibly minor effects of burial rather than metamorphism due to dynamic regional events. (Rios, 1972; Mendoza, 1977b).

San Pedro Granite and Santa Rosalia Granite (including the Las Trincheras Granite): equicrystalline to slightly porphyritic, fine (SPG) to coarse (SRG), dominantly leucocratic granite (SPG) and biotite granite (SRG) with quartz monzonite and granodiorite. Massive, locally foliated.

Guaniamito Granite: porphyritic, coarsely crystalline, biotite granite.

XYr RORAIMA GROUP: A sedimentary suite deposited in fluvatile-deltaic and lacustrine environments in which quartz sandstone and quartz-pebble conglomerate predominate, with lesser feldspathic arenite, arkose, siltstone, shale, jasper, and chert. This sequence of rocks is about 2400 m or more in thickness. Metamorphic grade is very low to low due to burial; locally, rocks are metamorphosed and foliated in proximity to intrusions. Deformation appears as broad, open folds (synclines) and block faults. Structural trends are NW-SE and NNE-SSW. The age of sediments in the Roraima Group is about 1600 +200/-100 Ma. Units named in Venezuela include, from lower to upper, the Uairén, Kukenán, Uaimapué, and Matuaí Formations. Gold and diamond paleo-placers are associated with conglomeratic lenses and beds that occur at several different levels within the lower part of the Roraima Group (lower 500 to 600 m of the Uairén Formation). Similar correlative rocks are known as the Roraima Group or Formation throughout the Guiana Shield in Guyana, Suriname, French Guiana, and Brazil (De Loczy, 1973; Reid and Bisque, 1975; Ghosh, 1977, 1985; Mendoza, 1985; John Dohrenwend, 1989, written communication).

Uairén Fm.: conglomerate, gravel, sandstone, with less common siltstone and shale. Sandstone with trough and festoon cross-stratification and graded beds, to 850+ m thick.

Kukenán Fm.: variegated fissile silty shale and mudstone, to 100+ m thick.

Uaimapué Fm.: lower part with conglomerate and sandstone, upper part consists of arkosic sandstone, quartzite, siltstone, shale, chert, and jasper, to 250+ m thick.

Matauí Fm.: cross-bedded, ripple-marked sandstone and quartzite, >1000 m thick.

Ya AVANAVERO SUITE: Continental tholeiitic dikes, sills, inclined sheets, and small irregular intrusive bodies (laccoliths?) that are generally

oriented N-S ± 15° or nearly east-west and have ages between about 1700 and 1500 Ma. These rocks were formerly known as the Roraima Basic Intrusive Suite. The rocks are strongly differentiated and contain plagioclase and pyroxene with minor biotite, iron-titanium oxide and sulfide minerals, quartz-feldspar intergrowths, with accessory to trace amounts of olivine and amphibole. They are lower in total iron, titanium, and vanadium, with higher volatile content than the Phanerozoic diabase suite. Basaltic copper deposits may be associated with the upper parts of thick bodies. Unmetamorphosed Early to Middle Proterozoic mafic intrusive rocks of the Avanavero Suite are present throughout the Guiana Shield. (De Loczy, 1973; Gibbs and Barron, 1983; Onstott and others, 1984; Teggin and others, 1985; Gibbs, 1986).

Yp PARGUAZAN GRANITE: Rocks in the Parguaza Province consist of massive, coarsely crystalline, porphyritic granite and biotite granite, commonly with rapakivi (wiborgite-type) texture. They are unmetamorphosed and apparently anorogenic in origin. Their age is about 1545 ± 20 Ma. Locally, anomalous values of tin in quartz veins and in greisens are present. Also, anomalous values of niobium and tantalum occur in pegmatites. Associated volcanic rocks, if not completely eroded, may be permissive for Olympic Dam-type Fe-Cu-U-Au-REE deposits. The Parguazan granites correlate with those in the Agua Boa and Madeira plutons, which host the world's largest tin mine (Pitinga, see symbol number 2 on map) in Brazil, as well as the Surucucu, Abonari, Maloquinha, Velho Guilherme, Mapuera, and Saracura intrusive suites in Brazil. (Dall'Agnol and others, 1975; Gaudette and others, 1978; Rodriguez and Perez, 1982; Daoud and Antonietto, 1985; Macambira and others, 1987; Thorman and Drew, 1988).

----NICKERIE TECTONOTHERMAL EVENT: Faulting and crustal uplift, minor igneous intrusion, and resetting or closure of some isotopic systems such as Rb-Sr and K-Ar used to date rocks; about 1300 to 900 (?) Ma. Also known as the Orinoquean Orogenesis. (Mendoza, 1977a; Moreno and others, 1977; Gibbs and Barron, 1983).

Mzd DIABASE DIKES: Thin (<200 m), elongated tholeiitic dikes and sills generally oriented ENE, related to the opening of the Atlantic Ocean (about 200 ± 20 m.y. ago). They contain plagioclase and pyroxene with minor olivine, biotite, amphibole, and opaque minerals. Basaltic copper deposits in thick sections may be present. These rocks have not been divided on the map from the Avanavero Suite (unit Ya). Diabase dikes of this age occur throughout the Guiana Shield. (Teggin and others, 1985; Gibbs, 1986).

Qal ALLUVIUM: Alluvial sediments. As shown on the geologic province map, includes those sediments deposited by the Orinoco River. Also includes Recent sediments deposited by other rivers (not shown on map) and paleo- and modern placer deposits of diamond and gold (not shown on map). Tertiary-Quaternary paleo-placer deposits and the lower Roraima Group are the source of diamonds and gold in Holocene alluvium. (Briceño, 1984; Dohrenwend, 1989, written communication).

REFERENCES CITED

Aarden, H.M., Iturralde de Arozena, J.M., Navarro, J., Moticska, P., Pasquali Z., J., and Sifontes, R.S., 1978, Geología del área del Cerro Impacto, in Petzall, C. ed., Memoria; Segundo Congreso Latinoamericano de Geología: Caracas, Venezuela, Nov. 11-16, 1973, Venezuela, Dirección de Geología, Boln. de Geología, Publicación Especial 7, v. 5, p. 3897-3898.

Ascanio T., G., 1975, El Complejo de Imataca en los alrededores de Cerro Bolívar, Estado Bolívar, Venezuela: X Congreso Geologico Inter-Guianas, Belem do Para, Brasil, Memoria, p. 181-197.

Bellizzia G., A., Pimentel de Bellizzia, N., and Rodriguez, S., 1981, Recursos minerales de Venezuela y su relación a la metalogenesis: Caracas, Ministerio de Energia y Minas, Dirección de Geología, Boln. de Geología, Publicación Especial, no. 8, p. 6-77.

Benaim, N., 1974, Geología de la región El Dorado-Anacoco-Botanamo, Estado Bolívar: Venezuela, Dirección de Geologia, Boletin de Geologia, Publicación Especial 6, Memoria de la Novena Conferencia Geologica Inter-Guayanas, p. 198-206.

Berrange, J.P., 1977, The geology of southern Guyana, South America: Institute of Geological Sciences, London, Overseas Division Memoir, v. 4, 112 p.

Briceño M., H.O., 1984, Genesis de yacimientos minerales Venezolanos II: Placeres diamantíferos de San Salvador de Paúl: Acta Cientifica Venezolana, v. 36, p. 154-158.

Dall'Agnol, R., Dreher, A.M., Araujo, J.F.V., and Abreu, A.S., 1975, Granito Surucucu: X Congreso Geologico Inter-Guianas, Belem do Para, Brasil, Memoria, p. 340-388.

Daoud, Walid El Koury, and Antonietto, Aldo, Jr., 1985, Geologia do granito estanífero Agua Boa-Pitinga: Anais do II Simposio de Geologia da Amazonia, Belem, Sociedade Brasileira de Geologia, v. 3, p. 17-33.

De Loczy, L., 1973, Some problems of the tectonic framework of the Guiana Shield with special regard for the Roraima Formation: Geologische Rundschau, v. 62, p. 318-342.

Dougan, T. W., 1977, The Imataca Complex near Cerro Bolivar, Venezuela; a calc-alkaline Archean protolith: Precambrian Research, v. 4, no. 3, p. 237-268.

Drovenik, F., Krulc, Z., Tajder, M., and Talic, S., 1967, Menas manganesíferas de la región de Upata: Venezuela, Dirección de Geologia, Boletin de Geologia, v. 8, no. 17, p. 3-163.

Gaudette, H.E., Mendoza, V., Hurley, P.M., and Fairbairn, H.W., 1978, Geology and age of the Parguaza rapakivi granite, Venezuela: Geologic Society of America Bulletin, v. 89, p. 1335-1340.

Gaudette, H.E., and Olszewski, W.J., Jr., 1985, Geochronology of the basement rocks, Amazonas Territory, Venezuela and the tectonic evolution of the western Guiana Shield: Geologie en Mijnbouw, v. 64, p. 131-143.

Ghosh, S., 1977, Geologia del Grupo Roraima en Territorio Federal Amazonas: V Congreso Geologico Venezolano, Memoria, v. 1, p. 167-193.

___, 1985, Geology of the Roraima Group and its implications: I Simposium Amazonico, Caracas, Publicación Especial no. 10, p. 31-50.

Gibbs, A.K., 1986, Contrasting styles of continental mafic intrusions in the Guiana Shield, in Halls, H.C., and Fahrig, W.F., (eds.), Mafic dyke swarms: Geological Association of Canada Special Paper 34, Proceedings, International Symposium on Mafic Dyke Swarms, June 4-7, 1985, p. 457-465.

___, 1987, Proterozoic volcanic rocks of the northern Guiana Shield, South America, in Pharoah, T.C., Beckinsale, R.D., and Rickard, D., eds., Geochemistry and mineralization of Proterozoic volcanic suites: Geological Society of London Special Publication No. 33, p. 275-288.

Gibbs, A.K., and Barron, C.N., 1983, The Guiana Shield reviewed: Episodes, v. 1983, no. 2, p. 7-14.

Gibbs, A.K., and Olszewski, W.J., Jr., 1982, Zircon U-Pb ages of Guyana greenstone-gneiss terrane: Precambrian Research, v. 17, p. 199-214.

Gibbs, A.K., and Wirth, K.R., 1986, Origin and evolution of the Amazonian Craton, in Ashwal, L.D., ed., Workshop on early crustal genesis; world's oldest rocks: Godthab, Greenland, July 21-30, 1985, LPI Technical Report, v. 86-04, p. 46-50.

Gruau, G., Martin, H., Leveque, B., Capdevila, R., and Marot, A., 1985, Rb-Sr and Sm-Nd geochronology of Lower Proterozoic granite-greenstone terrains in French Guiana, South America: Precambrian Research, v. 30, p. 63-80.

Macambira, M.J.B., Teixeira, J.T., Daoud, W.E.K., and Costi, H.T., 1987, Geochemistry, mineralizations and age of tin-bearing granites from Pitinga, northwestern Brazil: Revista Brasileira de Geociencias, v. 17, no. 4, p. 562-570.

Mendoza S., V., 1977a, Evolución tectónica del Escudo de Guayana: Segundo Congreso Lationoamericano de Geologia, Caracas, Venezuela, Nov. 11-16, 1973, Dirección de Geologia, Boletin Geologica, Publicación Especial no. 7, v. 3, p. 2237-2270.

___, 1977b, Petrogénesis de rocas volcánicas (-piroclásticas) precámbricas del noroeste del Escudo de Guayana, Venezuela, in Espejo C., A., Zozaya, D., Key, C., and Vasquez, E., eds., Tema II, Petrología y Geocronología; Tema III, Geodinámica (Sismología, Tectonia y Geología Estructural): V Congreso Geológico Venezolano, Caracas, Venezuela, Nov. 19-23, 1977, Memoria, v. 2, p. 555-589.

___, 1985, Potencial aurífero de Guayana; trabajo en progreso, in Espejo, A., Rios, J.H., and P. de Bellizzia, N., eds., Tema IV, Geologia del Petroleo, y Tema V, Recursos Minerales y Energeticos: VI Congreso Geológico Venezolano, Caracas, Venezuela, Sept. 29-Oct. 6, 1985, Memoria, v. 6, p. 4038-4068.

Mendoza, V., Rios, J. H., Moreno, L., Benaim, N., and Tepedino, V., 1975, Evolución geoquímica de rocas graníticas de la Guayana Venezolana: X Congreso Geologico Inter-Guianas, Belem do Para, Brasil, Memoria, p. 558-575.

Menendez, A., 1972, Geologia de la región Guasipati, Guayana Venezolana: IV Congreso Geologico Venezolano, Memoria, v. 5, no. 4, p. 2001-2046.

___, 1974, Guia de la excursion geológica Guasipati-El Callao-Canaima: Memoria de la Novena Conferencia Geologica Inter-Guayanas, Publicación Especial 6, p. 49-67.

Meyer, C., 1988, Proterozoic ore-forming habitats - Tectonic and chemical transitions, in Kisvarsanyi, G., and Grant, S.K., eds., North American Conference on Tectonic control of ore deposits and the vertical and horizontal extent of ore systems: Rolla, Missouri, University of Missouri-Rolla, Proceedings Volume, p. 217-235.

Montalvao, R.M.G., 1975, Grupo Uatuma do Craton Guianes: Anais, 10th Conferencia Geologica Interguianas, Departamento Nacional Produção Mineral, Brazil, p. 286-339.

Montgomery, C.W., 1979, Uranium-lead geochronology of the Archean Imataca Series, Venezuelan Guayana Shield: Contributions to Mineralogy and Petrology, v. 69, no. 2, p. 167-176.

Montgomery, C. W., and Hurley, P. M., 1978, Total-rock U-Pb and Rb-Sr systematics in the Imataca Series, Guayana Shield, Venezuela: Earth and Planetary Science Letters, v. 39, no. 2, p. 281-290.

Moreno, L., Lira, P., Mendoza, V., and Rios, J. H., 1977, Análisis de edades radiometricas en la parte oriental de la Guayana Venezolana y eventos tectonicos-termales registrados, in Espejo, C., A., Zozaya, D., Key, C., and Vasquez, E., eds., Tema II; Petrología y Geocronología; Tema III, Geodinámica (Sismología, Tectonia y Geologia Estructural): V Congreso Geologico Venezolano, Memoria, Caracas, Venezuela, Nov. 19-23, 1977, v. 2, p. 509-518.

Nixon, P.H., 1988, Diamond source rocks from Venezuela: Industrial Diamond Quarterly, No. 51, 1988/III, p. 23-29.

Onstott, T.C., Hall, C.M., and York, Derek, 1989, $^{40}Ar/^{39}Ar$ thermochronometry of the Imataca Complex, Venezuela: Precambrian Research, v. 42, p. 255- 291.

Onstott, T.C., York, D., and Hargraves, R.B., 1984, Dating of Precambrian diabase dikes of Venezuela using paleomagnetic and $^{40}Ar/^{39}Ar$ methods: II Symposium Amazonico, Anais, Manaus, Brasil, p. 513-518.

Premoli, C., and Kroonenberg, S.B., 1981, Radioactive mineral potential of carbonatites in western parts of the South American shields, in International Atomic Energy Agency, Vienna, Austria, Geologia y metalogenesis de los depósitos y manifestaciones uraniferos de Sudamerica: Panel Proceedings Series, International Atomic Energy Agency STI/PUB/641, San Luis, Argentina, Sept. 21-23, 1981, p. 245-268.

Priem, H. N. A., Boelrijk, N. A. I. M., Hebeda, E. M., Verschure, R. H., and Verdurmen, E. A., 1971, Isotopic ages of the Trans-Amazonian acidic magmatism and the Nickerie metamorphic episode in the Precambrian basement of Suriname, South America: Geological Society of America Bulletin, v. 82, p. 1667-1680.

Reid, A.R., and Bisque, R.E., 1975, Stratigraphy of the diamond-bearing Roraima Group, Estado Bolivar, Venezuela: Quarterly Bulletin of the Colorado School of Mines, v. 70, no. 1, p. 61-82.

Rios, J., 1972, Geología de la región de Caicara, Estado Bolívar: IV Congreso Geológico Venezolano, Memoria, Publicación Especial no. 5, v. 3, p. 1759-1782.

Rodriguez, S., Moya, E., Baptista G., J., Vasquez, J.C., Martin F., C., Vasquez, E., Marcano, F., and Vogel, S., 1976, Mapa metalogenico de Venezuela: Ministerio de Minas e Hidrocarburos, Dirección de Geologia, Presentado en el II Congreso Latinoamericano de Geologia (1973), scale 1:1,000,000.

Rodriguez, S.E., and Perez, Herman, 1982, Nb, Ta, and Sn mineralization related to granitic magmatism in western Bolivar State, Venezuela: VI Symposium, International Association on the Genesis of Ore Deposits, Tbilisi, U.S.S.R., 10 p.

Selner, G.I., and Taylor, R.B., 1988, GSDRAW and GSMAP version 5.0: Prototype programs, Level 5, for the IBM PC and compatible microcomputers, to assist compilation and publication of geologic maps and illustrations: U.S. Geological Survey Open-File Report 88-295A, 130 p.

Sidder, Gary B., 1990, Mineral occurrences of the Guiana Shield, Venezuela: U.S. Geological Survey Open-File Report 90-16, 28 p.

Sidder, G.B., and Martínez, F., 1989, Geología y evaluación de recursos minerales de la zona del Alto Río Caura, Estado Bolívar: VII Congreso Geológico Venezolana, Barquisimeto, Estado Lara, Venezuela, Nov. 12-18, 1989, Memoria, v. 4, p. 1977-2004.

Sims, P.K., Kisvarsanyi, E.B., and Morey, G.B., 1987, Geology and metallogeny of Archean and Proterozoic basement terranes in the northern midcontinent, U.S.A.-An overview: U.S. Geological Survey Bulletin 1815, 51 p.

Teggin, D.E., Martínez, M., and Palacios, G., 1985, Un estudio preliminar de las diabasas del Estado Bolivar, Venezuela: VI Congreso Geologico Venezolano, Caracas, Memoria, v. 4, p. 2159-2206.

Teixeira, Wilson, Tassinari, C.C.G., Cordani, U.G., and Kawashita, Koji, 1989, A review of the geochronology of the Amazonian craton: Tectonic implications: Precambrian Research, v. 42, p. 213-227.

Tepedino B., V., 1985, Geologia de la región del bajo Caura, Estado Bolivar: I Symposium Amazonico, Publicación Especial no. 10, p. 151-162.

Thorman, C.H., and Drew, L.J., 1988, A report on site visits to some of the largest tin deposits in Brazil, March 11-25, 1988: U.S. Geological Survey Open-File Report 88-0594, 19 p.

Tosiani, T., and Sifontes, R., 1989, Asociación de rocas máficas-ultramáficas en la región del Cerro Piedra del Supamo, sur de El Callao: VII Congreso Geológico Venezolana, Barquisimeto, Estado Lara, Venezuela, Nov. 12-18, 1989, Memoria, v. 1, p. 163-174.