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Tectonics and the mineral potential of the Amazonas and southwestern Bolívar States, Venezuela

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With 3 figures and 2 tables in the text

ABSTRACT

In 1987 the Corporación Venezolana de Guayana (CVG), through its mining exploration and development subsidiary Técnica Minera C.A. (Técmin) signed a technical cooperation agreement with the U.S. Geological Survey (USGS), with a planned duration of 5 years. This agreement was paid for by CVG and involved technology transfer, training of Técmin personnel, the acquisition and installation of analytical equipment, and an inventory of the mineral resources of the Venezuelan Guayana Shield (see Fig. 1). This cooperative agreement was a model of cooperative scientific effort that involved 4 resident USGS scientists, about 20 visiting USGS geologists, geochemists, and computer specialists, and over 35 Venezuelan geologists, geochemists, computer, soils and forestry specialists. The economic mineral inventory component was a remarkable effort that spanned two languages and two continents. The results are reported in US Geological Survey Bulletin 2062 (including a new geologic map of the southern half of Venezuela) and numerous Técmin and join Técmin-USGS reports and maps. This work is based on the extensive earlier work of Mendoza and others (1977) and Bellizzia and others (1981).

This paper extends and elaborates upon the USGS Bulletin 2062, and for the first time develops a mineral deposit timeline for the Venezuelan Guayana Shield.

RESUMEN

En 1987 la Corporación Venezolana de Guayana (CVG), a través de su filial de exploración minera y desarrollo Técnica Minera C.A. (Técmin) firmó un acuerdo de cooperación técnica con el Servicio Geológico de los Estados Unidos de América (USGS), con 5 años de duración. Este acuerdo fué costeado por la CVG e incluyó el traslado de tecnología, entrenamiento del personal de Técmin, la adquisición e instalación de equipo analítico y computadoras, y un inventario de los recursos minerales del Escudo de Guayana Venezolano (vea Figura 1). Este acuerdo de cooperación es un modelo de esfuerzo científico cooperativo en el que participaron 4 científicos residentes del USGS residente, más de 35 geólogos, geoquímicos, geofísicos, y especialistas de computadora, y de la silvicultura Venezolanas. El componente del inventario mineral económico fué un esfuerzo notable en dos idiomas y entre dos continentes. Los resultados son presentados en parte en el Boletín 2062 del USGS (que incluye un nuevo mapa geológico del sur de Venezuela) y numerosos informes y mapas de Técmin y de Técmin en asociación con el USGS. El trabajo se basa en información original extensiva de la obra de Mendoza y otros, (1977), y de Bellizzia y otros (1981).

Este presentación extende y amplia la obra de USGS Bulletin 2062, más desarolla el primer red de corelación por edad de las unidades geológicas que muestra el contexto temporal de los modelos de depósitos en el Escudo de Guayana Venezolana.

TECTONIC AND AGE CONTROLS ON DEPOSITS

It has long been known (for instance see Derry, 1980) that there is a high degree of correlation between certain types of mineral deposits and particular geologic ages or age-inclusive terranes. For example, a large percentage of gold deposits are Precambrian in age, found in Precambrian shields. More specifically, Superior-type iron deposits all formed in the Archean epoch. Mitchell & Garson (1981) attempted to relate metal deposits to global-scale tectonic events, but found in some cases that the correlation was poor, that there were more complicating factors than just the tectonic setting.

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Table 2. A brief description of the map units in Figs. 2 and 3.

Qa	Alluvial deposits – sand, gravel, and silt
d	Diabase – generally medium-to-fine-grained dikes, sills, and laccoliths
YXac	Alkaline complexes – Riebeckite and aegerine-bearing granites, gabbros
Ylg	Late granite – relatively young intrusives, generally penetrating Roraima sediments
YXra	Auyantepuy Formation – primarily quartzite, cliff-forming unit
YXr	Roraima Group, undivided – metasedimentary sequence of fluvial, deltaic origin
YXci	Carbonatite intrusion at the (incorrectly-named) Cerro Impacto
Yp	Parguaza granite – a Rapakivi-textured granite pluton
Xg	Calk-alkaline granite – massive, coarse-grained biotite granite
Xgr	Post-Supamo granitic rocks – monzogranite, granite, sometimes porphyritic
Xcg	Cuchivero granite – includes the Santa Rosalía granite
Xgu	Intrusive rocks, undivided – underlying the water-flooded jungle in Amazonas State
Xc	Caicara formation – rhyodacite to rhyolite tuff, andesite and dacite lava flows
Xmo	Moriche formation – metaconglomerate, quartzite, and mica schist
Xmp	San Carlos metamorphic-plutonic terrane – granite gneiss, augen gneiss, and pegmatites
Xmu	Greenstone-belt rocks
Xbc	Basement complex – well-foliated granite to granodiorite gneiss

around key prospective features. These rectangles draw upon these models and the papers summarized above, and are all explained in greater detail in USGS Bulletin 2062, to suggest potential investigative target areas in southwestern Bolívar State and all of the State of Amazonas.

One yellow-colored, non-rectangular outline west of the Caura River and southeast of Cerro Impacto (in Fig. 2) marks what may be the most important potential exploration target in southern Venezuela. This is a roughly circular feature with a double magnetic ring surrounding it; additionally, there are concentric uranium and thorium anomalies associated with it. Whatever this may prove to be, it has several characteristics similar to the enormous (and until now unique) Olympic Dam copper-uranium-gold deposit in Australia. Please note that while some of the deposit models in Table 1 are known to exist elsewhere in Venezuela, Brazil, Colombia, or Guyana, they are in most cases not yet known in southwestern Bolívar State and Amazonas State – but are considered possible. These investigative targets in Fig. 2 are suggested by the author on the basis of mapped geology or geologic structures that are supportive of one or more particular deposit models. In a few cases profound intersecting structures are suggested as possible targets worthy of reconnaissance investigation, with the expectation that some of them may lead to discoveries of deposits never before seen.

Figure 3 can be viewed in another way, showing potential deposit models relative to one another ordered by their geologic age. Most of the deposit models described in Table 1 are positioned in Fig. 3 where they would most likely have occurred in time. As the isotopic age database in southern Venezuela continues to grow (age-dating is an essential if poorly realized element of a rational mineral exploration program), geologic units should become better correlated to deposit models from elsewhere in the world. This way, prospective target areas in southwestern Bolívar State and Amazonas State can be further narrowed and refined.

CONCLUSIONS

Venezuela is profoundly blessed with mineral potential. In addition to holding world-class hydrocarbon reserves in Maracaibo and the central plains (Los Llanos) north of the Orinoco River, it hosts some of the richest iron, gold, bauxite, and diamond deposits in the world. There are certainly more resources, however, including new deposit types remaining yet to be discovered. Because of the relative inaccessibility of southern Bolívar State and the deep Amazonas region, most of it remains yet to be discovered. The challenge facing Venezuela will be to find these resources efficiently, and then exploit them without significantly threatening the ethno- or bio-diversity of what may be the most beautiful rain forest left in the world.

The first task of a rational exploration program is to find the mineral resources in the most efficient way possible. This paper has demonstrated that a program utilizing deposit models and permissive terranes – taking care to also consider deposit types not yet seen in Venezuela – is the most cost-effective manner in which to explore for minerals. This way geologists will not pass by and miss clues to something they've never seen before ... and walk away

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SOUTHERN VENEZUELA: MINERAL DEPOSITS VS. AGE

CORRELATION OF MAP UNITS

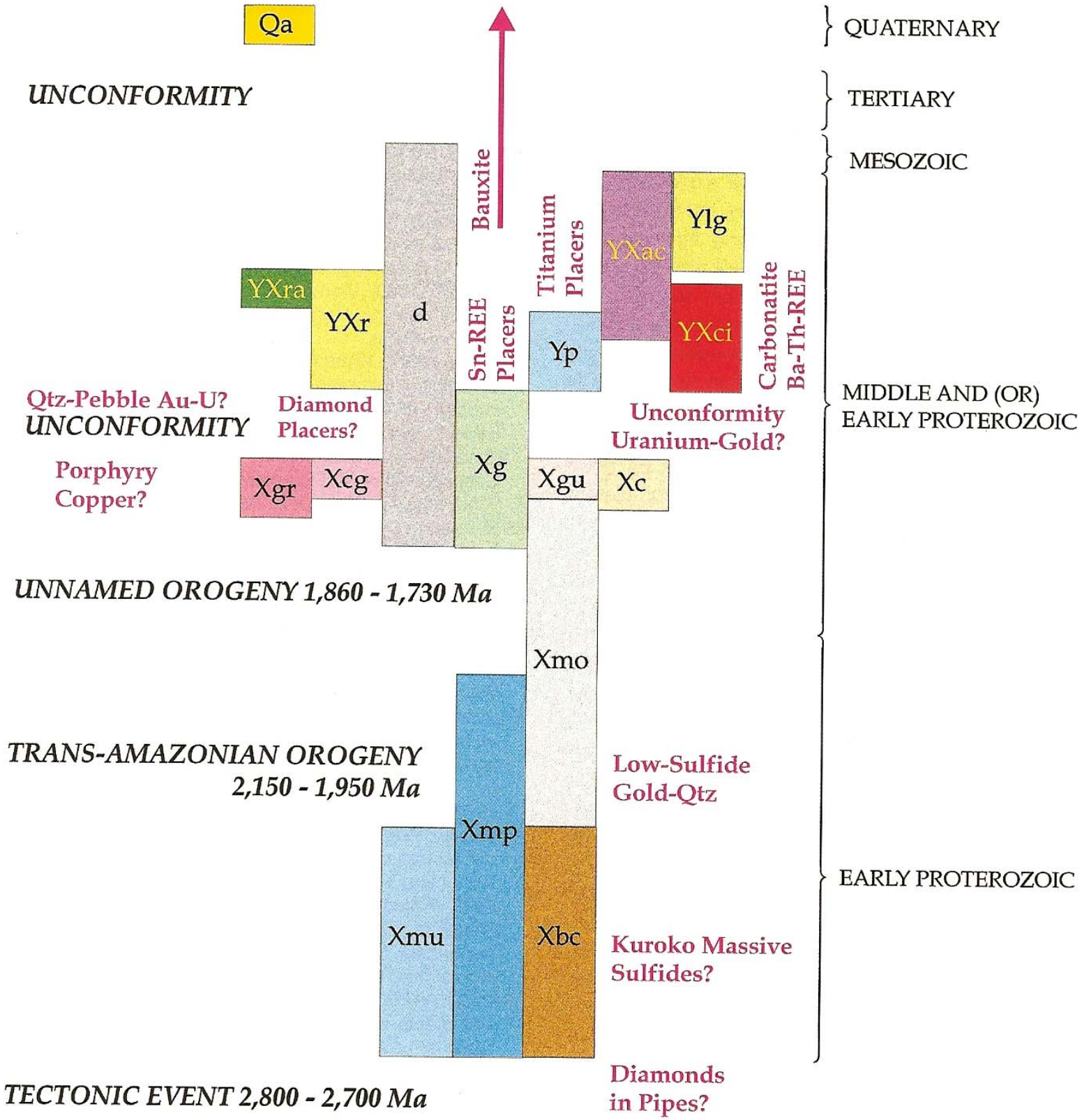

Fig. 3. Geologic correlation chart for the southwestern Venezuelan Guayana Shield, showing possible deposit models by geologic time.

Fig. 3. Un red de corelación por edad de las unidades geológicas del mapa en la figura 2, mostrando el contexto temporal de los modelos de depósitos.