QUADRILÁTERO FERRÍFERO, MG, BRAZIL: REGIONAL CHARACTERISTICS JUSTIFY APPLICATION FOR GLOBAL GEOPARKS NETWORK

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ABSTRACT
Geopark, a concept created in 2000, is neither strictly geological nor a park in the usual sense. Geopark is a holistic concept, aimed at promoting sustainable economic development based on unique geological features (represented by “geosites”, outcrops with special value, under some point of view), but also having a social objective. The Global Geoparks Network (GGN), working in synergy with UNESCO, has 64 members in 19 countries. This paper presents a brief history and some characteristics of a few European Geoparks, followed by some aspects of the Quadrilátero Ferrífero. As shall be seen, this area is rich in geosites, and in historical, social and cultural attractions. On the other hand, foreseeing a decline in mineral exploitation in mid-century, it urgently seeks a good plan for regional development. As a conclusion, it will be seen that its characteristics fit the Geopark concept, and justify the support of the geoscientific community, and that of society in general, to its application, recently submitted to UNESCO, for admission to the GGN.

Keywords: Quadrilátero Ferrífero, Geopark, Global Geoparks Network, Geological heritage, Minas Gerais.

INTRODUCTION
In 2000, four institutions dedicated to the preservation of natural areas with important abiotic features created the European Geoparks Network. A Geopark is a nationally protected natural area with unique characteristics, based on geological occurrences of particular interest,
rarity or beauty - called “geosites” -, that aims at the promotion of sustainable regional development, as well as the protection of geological heritage. In 2004, UNESCO embraced the idea, and it now grants its seal of approval to 64 Geoparks, which form the Global Geoparks Network (GGN), spread in 19 Member States around the world. Within the GGN, regional networks congregate smaller groups: European, Asia-Pacific, soon-to-be-created Latin American. A Geopark may vary in area from a few hundred to a few thousand square kilometers. (See http://www.globalgeopark.org/)

Geopark is a comprehensive concept of locally-supported sustainable social and economic development. So, it has a focus of geological interest, represented by the geosites, but goes beyond that. The “Geo” in the name comes not from geology, but from the original Greek word “gaia”, meaning Earth, in a broad sense. Similarly, “park” is not used with the restrictive meaning it has in most countries. In fact, activities of all sectors of the economy continue to operate normally when a Geopark is established in a certain area.

Always within the basic guidelines and rules, each Geopark has its own characteristics, not only because it’s rooted in the local territory, but also because the cultural aspects vary between different geoparks - in fact, they often vary even within the same one.

We’ll start by taking a look at some characteristics of a few Geoparks, which we’ll later use for comparison. As we’ll discuss a Brazilian candidate, we limited our research to European Geoparks, mostly because our cultural background is essentially European.

CHARACTERISTICS OF SOME EUROPEAN GEOPARKS

Europe hosts 35 Geoparks, listed (with links to their websites and emails) at http://www.europeangeoparks.org/isite/page/3,1,0.asp?mu=1&cmu=6&thID=0. All rely, necessarily, on their geosites as their main assets, but here are examples of other attractions: Bohemian Paradise, Czech Republic - handicraft, souvenir market; Copper Coast, Ireland - 19th-century mine; English Riviera, UK - environmentally-oriented events for all ages; Hateg, Romania - medieval church with mural paintings; Haute Provence, France - expositions of modern art; Lesvos, Greece - revival of old local gastronomic specialties; Maestrazgo, Spain - classical music concerts inside limestone caves; Naturtejo, Portugal - events related to local culture, from music to medieval dinner in a Templar castle; Papuk, Croatia - bird-watching, old vineyards; Psiloritis, Greece - Mediterranean beaches, archaeological remains; Sobrarbe, Spain - folklore festival, mountain bike tour; Vulkaneifel, Germany - gastronomy, art events.

THE QUADRILÁTERO FERRÍFERO

Brazil was discovered in 1500, but its central region was not initially reached by the Portuguese. This region is so rich in minerals that it was named “Minas Gerais”, “general
mines”. Gold was found there in the late 1600’s, and throughout the 1700’s, says Gomes (2009), a total of three thousand metric tons of gold were sent to Portugal; a good part of it went to England and helped to leverage the Industrial Revolution. Mining technology improved after the School of Mines was created in Ouro Preto (1875). Gold is still mined, and since early the 1900’s, iron ore is heavily mined. A high percentage of Brazil’s mineral production comes from an area called the Iron Quadrangle (Quadrilátero Ferrífero, QF).

Barbosa and Rodrigues (1967) define the QF as a block of Precambrian structures, elevated in its four sides by differential erosion. Located in the central-southeastern part of the State of Minas Gerais, this area of about 7,000km$^2$ is surrounded by crests with altitudes of 1,300-1,600m, belonging to four mountain ranges (FIG. 1).

Rock formations in QF date from the Archean to the Paleo-proterozoic (3.3-1.7Ga), and represent meaningful processes in the Earth’s evolution. Briefly, its geodiversity includes some intrusives and three extensive complexes: 1) Archean metamorphics; 2) Archean greenstone belt-type rocks, some gold-bearing; 3) Paleo- and meso-proterozoic metasedimentary sequences, with bodies of banded-iron formation (BIF, alternating layers of hematite and silicates); this world-known itabirite is the main local iron ore, and, along with the quartzites, forms the mountain ranges that surround and characterize the QF.

Younger geological units - Tertiary basins, “canga” (tough surficial/subsurficial reddish-brown rock made up of well-cemented chunks of itabirite) and Quaternary alluvial deposits - occur, but, by consensus, are usually not represented in geological maps.
QF’S GEOSITES AND RELATED SITES OF INTEREST

QF has a series of unique geosites, some of which are quite educational in helping to understand and explain the geoecological history of the Earth; they are related to:

- Basement: gneisses of the tonalite-trondhjemite-granodiorite (TTG) suites, characteristic components of Archean cratons. The first continental crusts and protocratonic nuclei that started to take shape 4Ga ago were made up of this kind of gneisses.

- Rio das Velhas Supergroup: a greenstone belt-type sequence, characterized by volcano-sedimentary cycles, including Archean komatiites, an important source of information about the geodynamic and physico-chemical conditions of magma generation for that eon.

- Minas Supergroup: metasedimentary rocks form the Serra da Moeda, a famous scenic area. The Cauê Formation includes the itabirite BIF’s, that help to understand the atmosphere, oceans and phenomena that led to the Precambrian evolution of life.

- Rola Moça Mountain Range: meaningful canga outcrops, with up to 95% of limonite.

With QF’s mining history, many touristic and cultural sites are related to this activity:

- Ruins of the “illegal mint” in the city of Moeda (“Coin”, literally!!): in the 1700’s, a 20% tax was levied when raw gold was taken to the official mints, so some people started minting their own coins. This site is important both for the history of mining and for economic history, as a unique testimonial of the alternative ways of our Colonial economy.

- Fábrica Patriótica: opened in 1812, first industrial iron smelting facility in Brazil.

- Passagem Mine: a good example of good use of old mines for geotourism. Visitors learn about the mine’s history, see some pieces of mining equipment, go down the inclined tunnel in a cable trolley to an underground lake, and can even try some panning for gold.

- Cata Branca Gold Mine: opened in the early 1800’s, now inactive, it exhibits many original features, such as shafts, tunnels, galleries, plus equipment, documents, etc..

- Morro Velho Mine: started in 1725, and since the early 1800’s a perfect example of the British presence. World-renowned landmark and model of the evolution of gold mining technology, once the world’s deepest mine (2.700m), and the most productive in Brazil.

- Pegmatites holding various gems of economic, social and cultural importance, some very rare, like the imperial topaz and the alexandrite. Some of their mines can be visited.

QF’S HISTORICAL/CULTURAL ATTRACTIONS AND CONSERVATION UNITS

During the heyday of gold mining, a number of rich villages were created, in which the economy thrived, gilded churches housed important artwork (Fig. 2), composers and musicians, and social life was intense. Beautiful homes were built, as well as imposing buildings that, besides housing administrative offices, had also the purpose of affirming the
presence of the Portuguese Crown. Stonemasonry flourished. Being an isolated region, art, local cuisine, handicraft, social habits, even language, took unique characteristics. Due to the same isolation, many of these aspects of life have survived until the present time.

Shipping the gold to Portugal was no easy task. Initially Paraty, later Rio de Janeiro, were the ports used, so the gold (and the diamonds discovered further North) had to be safely transported to the coast. The extensive set of roads/trails developed for that purpose, the Royal Road (Estrada Real), became the main transport artery in Brazil, and many other roads were built connecting important areas to it. The main axis of this trail reached over 1,000km. Nowadays a tourist route, with markers, highly prized by Brazilian and foreign tourists, it crosses the very heart of the QF, in a N-S direction, for about 180km (including branch-outs), and is integrated to the QF Geopark project as a very important asset.

**QF'S ATTRACTIONS COMPARED TO SOME EUROPEAN GEOPARKS**

Respected, of course, historical and geographic limitations (Minas Gerais had no European civilization in the Middle Ages, and has no beaches …), every single one of the non-geological attractions listed above for the EGN Geoparks, from archaeological remains to modern art, from Baroque music to gastronomy and handicraft, can be found in the area of the QF. In fact, historical tourism has been a common practice in QF for a long time; modern nature-related sports are quite well developed, and the touristic industry is well equipped, both in infrastructure and in personnel.
INTERFACE BETWEEN GEOCONSERVATION, GEOTURISM AND MINING

In this context, it is vital to discuss the relationship of the mining industry with the idea of promoting development while protecting the environment. Given the local economy, trying to establish a simple dichotomy between “mining vs. no-mining” is not a good option; what should be discussed is the possible use of the concept of sustainability. This new social concept may be used to try to find a solution to a hitherto overlooked, but now strongly felt, internal contradiction in modern society. Fortunately, dialog between the mining industry and the environmentally-minded groups tends to replace the old-style confrontation.

CONCLUSION

The QF is already a touristic area. By making good use of its rich geodiversity, and caring for its geoconservation, it can become a world-class Geopark. According to Mantesso-Neto et al. (2009), 55 sites have been listed (27 geocological, 8 archaeological, 2 localities, 3 museums, 1 paleontological, 1 road, 11 mining history, 2 religious-cultural). The Geopark’s project recently submitted to UNESCO includes, in this first phase, 25 geosites and other sites of historical, cultural, etc., interest, and various conservation units.

The geopark will be operated by a Forum including the State Government, State Research Supporting Foundation (FAPEMIG), Polo Mineral-SECTES (mineral technology), universities (PUC/MG, UFOP, UFMG), CPRM-Brazilian Geological Service, IEF/SEMAD (environmental agency), IEPHA (cultural heritage), and SETUR (tourism). It has its site, with maps, list of geosites, pictures, etc., at http://geoparkqf.org/.

The authors believe that this project deserves the respect and support of geoscientists, environmentalists, preservation-minded people, historians, politicians, public administrators and society in general, as it is fully capable of enriching Brazil’s and humanity’s heritage, while at the same time promoting the region’s sustainable development.

REFERENCES & BIBLIOGRAPHY