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Geochemistry of Charnockitic Rocks from Northern Rio de Janeiro State: Transition from Amphibolite to Granulite Facies

In the northern Rio de Janeiro and southeastern Minas Gerais States occurs a tectonic juxtaposition between two main terrains. This structure is a large crustal flake piling up a Proterozoic belt over an Archaean terrain related to the São Francisco Craton, by thrust zones toward the west (Figure 1).

The Proterozoic belt corresponds to a thick tectonic pile made up of granulitic infracrustal units, in the northwestern portion of the belt, with mainly volcanosedimentary sequences, metamorphosed to high to middle grade, to the southeast.

The infracrustal units yielded mainly Early Proterozoic ages and were subjected to reworking during the Late Proterozoic under granulite facies conditions, with recrystallization along the regional foliation related to a second phase of deformation. This foliation is also present in the supracrustal units as axial planes of fold nappes.

Several bodies of grey gneissic-migmatitic granitoids occur in the infracrustal terrain, near the amphibolite-granulite facies transition zone. These granitoids can be geochemically characterized as a calcalkaline sequence, probably related to a precollisional environment, and an alkalic-calcic sequence of the Caledonian–Late Orogenic type.

Dark-green charnockitoids showing chemical and structural characteristics similar to the grey gneissic-migmatites occur in the basal position of the tectonic pile.

Field evidence such as charnockitic late-kinematic pegmatoids and large euhedral hypersthene crystals indicate a Late Proterozoic charnockitization, probably related to a CO_2 front. The transition zone is marked by gradational transformation on the grey biotite–hornblende granitoids into hypersthene-bearing dark-green charnockitoids.

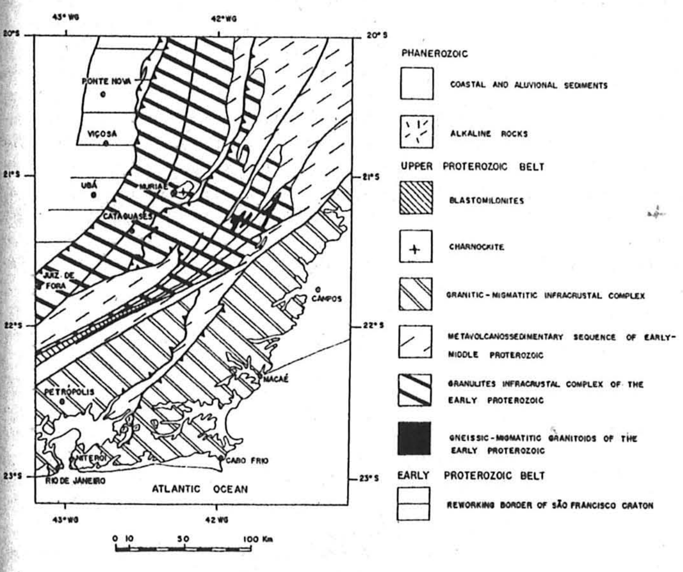

FIG.-1- TECTONIC MAP.

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Relations between Brazil and Germany in Field of Geological Sciences during Nineteenth Century

This paper intends to discuss the relations between Brazil and Germany in the field of geological sciences, during the nineteenth century.

The choice of the subject is justified by the remarkable German presence in the development of geological sciences in Brazil, and the German Wilhelm Ludwig von Eschwege is pointed out by several authors as the "father" of Brazilian geology.

In the investigation of the central problem, we are not interested in elaborating an exhaustive enumeration of German scientists and technicians who worked or stayed in Brazil for some time, nor in listing references to Brazilian geological problems found in German journals and/or books. Our approach will be one of diffusion and institutionalization of scientific disciplines, especially their transfer and implementation in peripheral countries.

The study of the institutionalization of scientific disciplines in the peripheral countries implies the analysis of the specific conditions of its transfer, implementation, and development, as well as the subsequent changes of cultural patterns both in the receiver and in the own implanted science.

In the specific situation of geological sciences in Brazil, we must look to its history, considering the Brazilian colonial condition. The few works that have dealt with the historical aspects of the development of the geological sciences in Brazil all agree to attribute to the activities of mineral extraction—carried on since the early days of the colony—the embryonic role of the geological researches in our country. References to gold and silver are made in the texts by the Jesuits Manoel da Nóbrega and José de Anchieta and also by Gabriel Soares, as well as the interest and the metalist policy of Portugal are clearly shown in the legal texts and in the measures of mining control adopted in the colony.

According to this point of view, we should consider, for instance, up to which point the historical process of introduction and development of geological sciences in Brazil had parts of its determinants originated in the Portuguese metropole and/or in its relation to the other European countries. Or, up to which measure the course of the first Industrial Revolution interfered in this process. Under this approach, the German presence begins to make sense.

By the end of the eighteenth century, the Brazilian mineral production (basically gold and diamonds), decreased very strongly. Faced with this problem, the Portuguese Imperial Government decided to send the Brazilians José Bonifácio de Andrada e Silva (1763–1838) and Manoel Ferreira da Câmara Bittencourt de Aguiar e Sá (1762–1835) to Europe to improve their knowledge of chemistry, mining, and metallurgy, in order to introduce new ideas and methods all over the kingdom. After two years in Paris, Bonifácio and Câmara studied at the Bergakademie Freiberg (1792–1795) with A. G. Werner and had Alexander von Humboldt and Leopold von Buch as colleagues, among others. José Bonifácio stayed in Portugal for several years, working as General Intendant of Mines (supervising the whole kingdom). Câmara came back to Brazil ten years after his departure and became Intendant of Mines of Minas Gerais Province.

In 1803, perhaps influenced by Bonifacio's ideas, the Portuguese government also decided to create "schools for teaching mineralogy and metallurgy," but this decision remained dead-letter until 1810.

Things changed significantly after 1808, when the Royal Portuguese Family was forced by Napoleon's Army to move to Brazil. The transfer of power from the metropole to the colony that happened at this time is unique in history, and the existing studies indicate that the so-called "Joanian period" (1808–1821) involved, indeed, changes in the scientific framework that must be considered as a transition to a new period. As one of the consequences, the Royal Military Academy was created in 1810 and started its work in 1811. The main purpose was to form a ruling scientific elite able enough to administer mines, roads, ports, etc. Mineralogy was one of the important disciplines, and to teach it the government called on the German Wilhelm Ludwig von Eschwege, who also studied at the Bergakademie Freiberg. Eschwege and also Friederich Wilhelm Varnhagen and Martin Stieffel were Germans employed by the Portuguese Government in 1803, in order to improve mining and metallurgy in Portugal. After the displacement of the Royal Family, they were called to Brazil as functionaries and worked here for several years.

Another governmental decision was to open the ports to all nations. This fact stimulated the coming of travelers, with several Germans among them. The German presence was also improved by a clear policy developed by Portugal in order to increase the links with German Royal Houses. By themselves or as part of this policy, Freyreiss (1813), Sellow (1814), Prince Wied-Newied (1815), Olfers (1816), Spix and Martius (1817), Prince Adalbert from Prussia (1842–43), Burmeister (1850–52), etc., arrived in Brazil.

Besides the three kinds of relations listed above—Brazilians who studied in Germany, German functionaries working in Brazil, and German travelers—it should be pointed out the last kind of relation we identify: Brazilian geological samples and/or problems studied by German scientists. The most important example we may cite is the work of Karl Rosenbusch, who analyzed and referred to Brazilian rocks and minerals in his papers.

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Indicators of Collisional Borders in South-Eastern Asia

Analysis of the geological data suggests significant heterogeneity of the Presinian China–Korean plate. This plate includes a series of continental blocks with collisional sutures between them. There are three sutures in the Korean peninsula: Imjigan, Okchon, and Tumangan. The Imjigan suture in the central part of the peninsula extends in the northeastern direction. This suture consists of a set of tectonic slices with vergence to the continent. The allochthon of the suture Imjigan, 12-17 km in width, consists of several tectonic slices. These slices consist of rocks of different facies: limestones, shales, chlorite schists, quartz–chlorite and sericite–chlorite schists, ande-

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