

GEOLOGY AND GEOPHYSICS OF THE REDONDÃO KIMBERLITE DIATREME, NORTHEASTERN BRAZIL.

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INTRODUCTION

Over the past three decades several kimberlite bodies have been recognized in Brazil, mostly in the south-eastern part of the country. They occur mainly in the state of Minas Gerais, generally as small, rounded or elliptical, weathered diatremes. However, other occurrences in the Mato Grosso, Goiás, Rondônia, Santa Catarina and Piauí states are less well documented.

Investigations of the Brazilian kimberlites were first made by mining and prospecting companies. Svisero et al. (1984) made a synthesis of the geology of some bodies known at that time. Castelo Branco (1986a) documented several diatremes in the Parnaíba basin, northeastern Brazil.

THE REDONDÃO DIATREME: GENERAL GEOLOGY

The Redondão diatreme was the first kimberlite body discovered in Brazil during a regional geological survey carried out by PETROBRAS (Brazilian Oil Company) in 1962, but unpublished. Figure 1 shows the localization of the studied area and figure 1b shows the geology of Redondão and adjacent area.

The Redondão diatreme consists of a semi-square structure, with a diameter lengthened around 1100 meters in the NNW direction. Depths may reach up to 60 meters in the center of the structure relative to the Guaribas plateau, which has an average altitude of 600 meters above sea level. The well-shaped structure occurs in the Carboniferous and Permian rocks of the Parnaíba basin (Piauí and Pedra de Fogo sedimentary formations). These rocks are represented mainly by sandstones, siltstones and shales of various colors and grain size. In addition, there are thin, localized deposits of recent sediments such as sands and clays scattered over the Guaribas plateau. In this region, the total thickness of the Paleozoic sediments (Serra Grande, Pimenteiras, Cabeças, Longá, Poti, Piauí, Pedra de Fogo formations) can reach 2000 meters over the Precambrian crystalline rocks (Lodoño 1958, Mesner & Wooldridge 1964).

Photogeologic interpretation with processed remote sensing and associated field geology studies provides detailed information on the geology inside the diatreme, as well as on the regional interpretation of lineaments (Castelo Branco 1986b).

Inside the Redondão structure, the outcrops are formed by weathered kimberlitic breccia surrounded, in most cases, by soil formations. Yellow ground is, therefore, frequent and forms slight depressions; this material forms 60% of the structure. On the other hand, near several elevations, there are floating reefs of sandstone (Piauí Formation) and others of recent lateritic formations as well as small alluvial and colluvial deposits (40% of the structure).

The typical kimberlite outcrops comprise soft, yellowish rocks enclosing numerous fragments (0,5 - 20 mm) of various shapes. The whole assemblage forms a volcanic breccia. There are fragments of an "accidental" and "cognate" nature as well. In thin section, the Redondão kimberlite breccia consists essentially of 40% argillaceous minerals, 10% carbonates, 12% chlorites, 10% talc, 10% quartz, 10% serpentines, 5% phlogopites, and 3% opaques.

The Redondão diatreme also contains xenoliths of mantle origin which Svisero et al. (1977) has been reported as a garnet-serpentine xenoliths composed of pyrope garnet, serpentine, clinopyroxene, phlogopite, chromite and spinel.

The garnets of Redondão breccia were analysed using a electron microprobe with a TRACOR system. They occur as a red rounded isolated crystals (<2.5mm) within the breccia matrix. The microprobe analysis showed then to be pyrope with CaO 4.49-5.67 weight per cent and Cr_2O_3 1.77-4.54 weight per cent. The Cr-pyrope of Redondão diatreme have an average composition (mol. per cent end-members) of pyrope 66.51-67.41, almandine 17.76-19.08, grossular 10.23-10.86, uvarovite 1.83-4.67. Figure 2 displays a diagram with the composition of Redondão garnets compared with those of worldwide kimberlite localities and those of garnets from others brazilian occurrences.

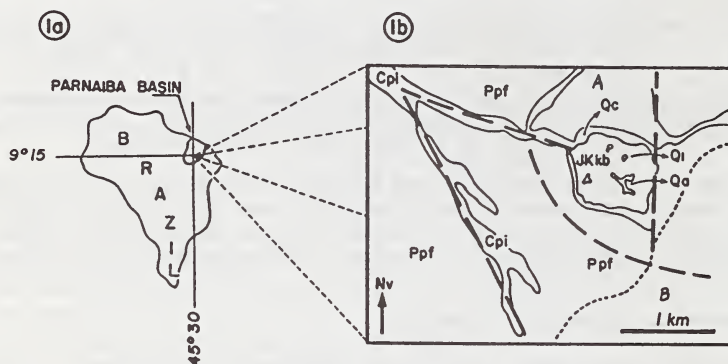


Figure 1a shows the geographic localization of the Redondão area in the Brazilian shield. Figure 1b displays the geology of Redondão diatreme and adjacent areas: Q (Quaternary a-alluvium, c-colluvium, l-laterites), P (Permian pf-Pedra de Fogo), C (Carboniferous pi-Piauí), JK (Juro/Cretaceous kb-kimberlite breccias), Ppf and Cpi essentially sandstone and siltstone. Heavy lines-lineaments, fine lines-geological contacts, trace lines-road, A-B geophysical profile orientation.

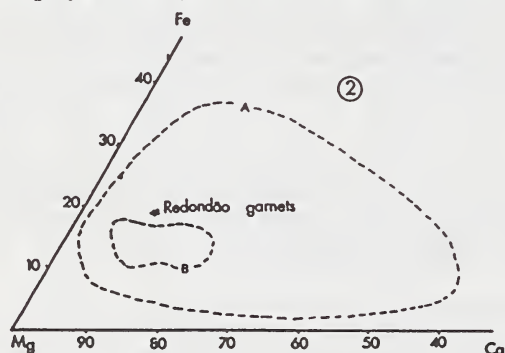


Figure 2 Diagram (mol. per cent end-members) of Redondão garnets. A-Kimberlite garnets worldwide occurrences, B-Kimberlites garnets from Brazilian occurrences.

GEOPHYSICAL SURVEYING AND ITS INTERPRETATION

Magnetometric profiles, electrical resistivity soundings, as well as gamma ray spectrometry exploration, were used in conjunction with geological mapping crossing the diatreme in the NS direction. The best adjustment obtained to compare the field curve with a theoretical one is presented in figure 3 as a result of 2-D computing treatment of the geophysical and dimensional parameters as well as the geological evidence and models of kimberlite diatreme generation. The geophysical parameters used are also visible in the caption. The draft roughly presents the model adopted here.

The diatreme has a funnel shape which extends downwards vertically to 2 Km under the actual surface (1,1 to 1,3 Km in diameter). At depth, there is 2-5 Km thick feeder dike, of kimberlitic nature, oriented in NE direction and dipping 70 - 80° SE. This dike, responsible for 80% of the magnetic anomaly, is set in the cataclastic zone of the

"Transbrasiliiano" lineament and can reach 20 Km in length, as shown by aeromagnetic anomaly. Other, well-defined profiles

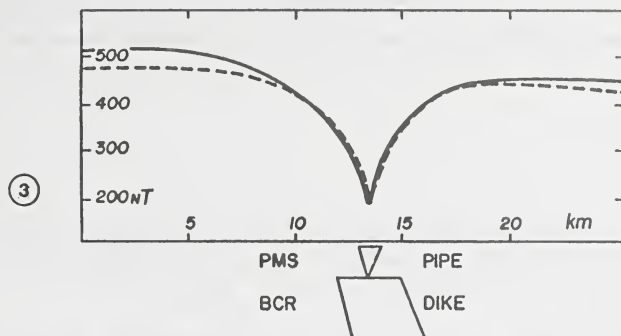


Figure 3 presents the results of the best adjustment between the field and theoretical curves. Geophysical parameters were MSC for dike 0.0055emu, for the pipe MSC 0.0022emu, anomaly due to induced magnetisation, MI 7°, MD -19°, MTF 25700nT, Transverse azimuth of the profile 133°, Total field. PMS-Paleomesozoic sediments, BCR-basement crystalline rocks. Heavy line-field curve, trace line-theoretical. Dimensional parameters-see text.

extending out of the diatreme confirm the presence of this dike. The diatreme was formed by explosive activity at an intersection of a NNW lineament (Serra do Boqueirão). This indicates that the formation of kimberlite diatremes is a localized geological process.

Vertical electrical profiles of apparent resistivity versus Schlumberger array electrode spacing have been applied over the Redondão diatreme. They indicate 4 altered layers with an increasing apparent resistivity at depth around 200 meters. The bottom layer showed resistivities greater than 300 ohm.m, corresponding to a less weathered layer of breccias.

The gamma ray spectrometric results supplied limited geological information over the diatreme surface and were useful for determining the contacts between the kimberlite rocks as a whole and the sedimentary adjacent rocks.

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