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OCCURRENCE OF GARNETS WITH ECLOGITIC AND LHERZOLITIC COMPOSITIONS IN GARNET LHERZOLITE XENOLITH FROM THE CANASTRA-01 KIMBERLITE, BRAZIL

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INTRODUCTION

Canastra-01 kimberlite is located in the Canastra Ridge region, Minas Gerais state, southeast Brazil. It is intrusive in the Proterozoic metassedimentary rocks of the Canastra Group, at the southeast border of the São Francisco Craton, a geological entity composed of archean blocks accreted and reworked during Paleoproterozoic and Neoproterozoic orogenies (Alkmim *et al.*, 1993) (Figure 1).
The age calculated for the Canastra Kimberlite is 120±10 (K–Ar in phlogopite) Ma (Pereira & Fuck, 2005) and it is the first Brazilian kimberlite with proved economic diamond reserves (Chaves *et al.*, 2008). It has sampled a large variety of mantle xenoliths, including lherzolites, harzburgites, dunites, pyroxenites and eclogites, and also crustal rocks. Previous studies of mineral chemistry and geothermobarometry carried out in these mantle xenoliths showed P-T arrays that spread between 40 to 60 mW/m^2 geotherms (Costa, 2008). The author proposes that these different geotherms are due to incomplete or even lack of re-equilibration of cratonic mantle portions during the last Proterozoic orogeny.
Most xenoliths are garnet lherzolites with mean modes of 65% of olivine, 5% of garnet, 10% of clinopyroxene and 20% of orthopyroxene. These rocks have mosaic porfiroclastic texture and rounded garnets with quelifitic alteration. Most pyroxene crystals show undulatory extinction and several have undergone recrystallization. In some samples they form trails of recrystallized grains that extend into the olivine neoblast matrix. Secondary minerals comprise phlogopite, which occur in a few samples, and serpentine that is found in all xenoliths.

CAN-106 GRT LHERZOLITE XENOLITH

Among the garnet lherzolite samples, CAN-106 outstood from the others due to the presence of three different colors of garnet: red, purple and orange, which were identified during mineral concentration procedures for Sm-Nd isotopic analysis. The red garnet is the most abundant one (more than 90%). The orange grains make about 7% and the purple variety corresponds to less than 1% of the xenolith's garnet grains.

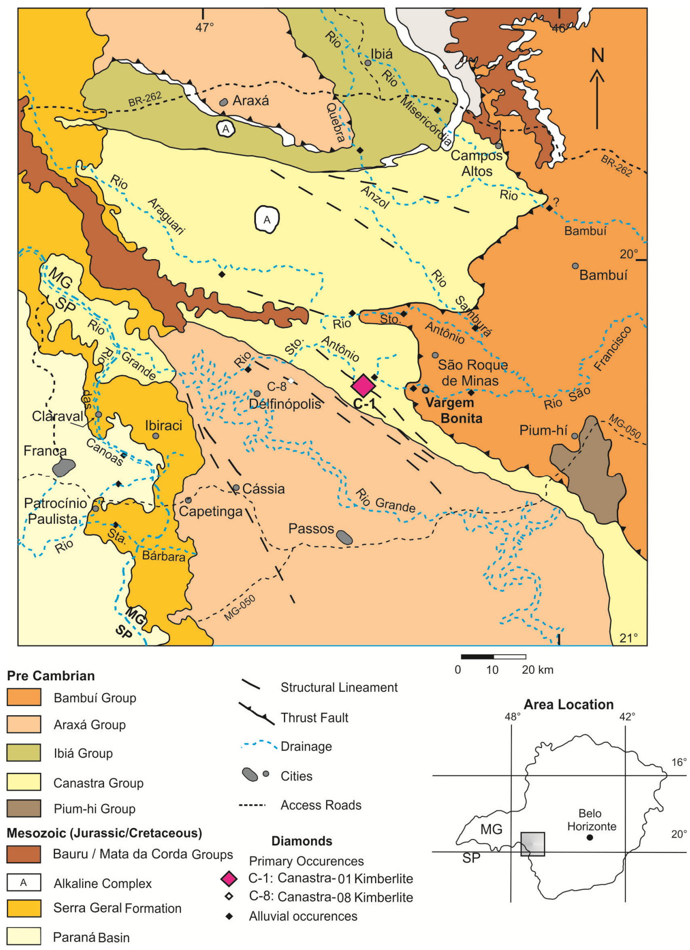

Figure 1 – Simplified geological map of the Canastra Ridge region showing the location of Canastra-01 kimberlite (pink diamond – C-1). Modified from Chaves *et al* (2008).

Microprobe analyses were performed using 15 kv and 10 na in a Jeol superprobe JXA-8230 at the University of Brasilia. The results indicated three main populations based on chemical composition. The first population has high Cr_2O_3 (7.08- 7.57 wt%), medium CaO (5.99 to 6.66 wt%) and TiO_2 (0.06 to 0.14 wt%), and Mg number from 0.83 to 0.85. The second population has medium CaO (4.80 – 5.10 wt%) and Cr_2O_3 (3.00 – 3.65 wt%), high TiO_2 (0.50 – 0.70 wt%), and Mg number from 0.83 to 0.84. The third population has high CaO (9.75 – 10.09 wt%) and TiO_2 (0.42 – 0.54 wt%), low Cr_2O_3 (0.03 – 0.15 wt%), and Mg number ranging between 0.59 – 0.60.

According to Grütter *et al* (2004) garnet classification, the first and second populations have lherzolitic composition (G9), the third one has eclogitic composition (G3) (Figure 2). This group also has high CaO and TiO_2 values that are comparable to those found in garnet related to diamond association paragenesis (Dawson & Stephens, 1975).

Besides these three garnet populations, three grains that were analyzed presented CaO (5.95 wt%) and Cr_2O_3 (0.49 wt%) values compatible with low-Cr pyroxenitic/eclogitic/websteritic composition (G4). These grains also have 0.36 to 0.49 wt% of TiO_2.

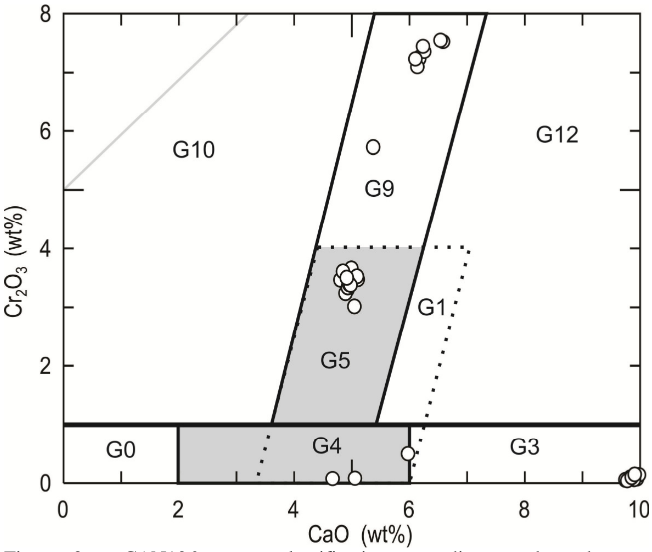

Figure 2 – CAN106 garnet classification according to the scheme presented by Grütter *et al.* (2004). G0: unclassified garnets; G1 (stippled parallelogram): low-Cr megacryst group; G3: eclogitic; G4 and G5: websteritic, pyroxenitic and eclogitic; G9: lherzolitic; G10: harzburgitic; G12: wehrlitic.

CAN106 hand specimen shows a zone with lighter matrix than the surroundings portions, with some garnet grains aligned, but no evidence of different material.

Microprobe analysis where performed in garnets from one thin section of the sample, but showed no compositional heterogeneities and all grains yielded lherzolitic compositions. However, this thin section did not reached the regions with textural variations observed in hand specimen, allowing speculations that the garnets with eclogitic composition might be related to such textural heterogeneities. Futher researches and analysis will be carried out on these different portions of the sample in order to verify this hypothesis.

The occurrence of garnet with eclogitic composition in a lherzolite xenolith is an uncommon feature in the mantle, thus requiring further textural and chemical investigation.

We suggest, however, that metassomatism and/or partial melting followed by crystallization might explain the chemical differences found in these garnet populations. This interpretation seems to be supported by preliminary Sm-Nd isotopic results for the Canastra-01 xenoliths that suggest that this kimberlite may have sampled a quite heterogeneous mantle.

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