Petrography, geochemistry and mineral chemistry of the Aroeira Kimberlite, Salvador-Curaçá orogen, NE São Francisco craton

José Paulo Donatti Filho[1], Christian Neves Schobbenhaus[2], Elson Paiva de Oliveira[1], Kenneth Johnson[2], José Ricardo Thibes Pisani[3]

[1]Department of Geology and Natural Resources, University of Campinas, Brazil (donatti@ige.unicamp.br)

[2]Lipari Mineração Ltda., Brazil

[3]Georadar S/A, Brazil

ABSTRACT: Regional diamond exploration using kimberlite indicator mineral sampling, especially garnets, in the early 1990s resulted in the discovery of the Aroeira kimberlite. It is situated in the northeast part of São Francisco Craton, Bahia State, Brazil, and forms part of the extensive kimberlitic magmatism in the northern Brazilian Shield. The Aroeira kimberlite is diamondiferous and is represented by a N10W-trending sub-vertical dyke intruded into a Neoarchaean enderbite from the Caraíba Complex, northern part of the Itabuna-Salvador orogen. Aroeira kimberlite shows no fragmented or explosive structures (e.g. pelletal lapilli), and exhibits evident igneous texture formed by a hot, volatile-rich kimberlitic magma. Hypabyssal facies is dominant and field relationships indicate deep root zone as the remaining kimberlite pipe structure. The kimberlite exhibits macrocrystic texture dominantly inequigranular porphyritic. Modal analysis of the mineral phases including macrocrysts and microcrysts comprises: phlogopite (32.4%), spinel (5.2%), perovskite (9.4%), olivine phenocryst (16.4%), olivine macrocryst (19.2%), anatase (1.4%), calcite and serpentine (16%), apatite (<1%), ilmenite (<1%) and garnet macrocryst (<1%). Mineral chemical analyses show that garnet macrocrysts are dominantly calcium saturated chromium pyrope exhibiting a linear trend to the lherzolitic field showing moderate contents of Cr_2O_3 (0.12 – 7.8 wt%), CaO (4 – 6.6 wt%) as well high and low titanium garnet (TiO_2 = 0.9 – 1.54 wt%).

Low chromium eclogitic garnets (G3) and high chromium (G10 and G12) garnets are minimal. The data also indicate garnet megacryst stable at pressure conditions higher than 35 kilobars. Spinels have all high MgO contents (6.6 – 14.6 wt%) and can be classified as kimberlitic chromites with Cr_2O_3 contents in the range of 26 to 64 wt %. Ilmenite can be divided into two groups: (i) kimberlitic source: High TiO_2 and MgO contents (TiO_2 = 40-55 wt% and MgO = 6-18 wt%); and (ii) non kimberlitic source: high TiO_2 and low MgO contents (TiO_2 = 42-57 wt% and MgO = 0.1-8 wt%). The high chromium contents in ilmenite suggest that it may be metassomatic in origin. Clinopyroxenes are “kimberlitic” chromium diopside derived from a garnet peridotite mantle within the diamond stability field. The Aroeira kimberlite is iron-rich (Fe_2O_3 = 13.11 wt%) with Mg# = 74.30 and has geochemical signature transitional between kimberlite (La/Sm = 8.3; Gd/Yb = 14.4) and orangeite (Nb/La = 0.76; Th/Nb = 0.3; Ni = 1438 ppm; Cr = 2389 ppm). High trace element abundance and moderate steep REE patterns suggest low degree of partial melt and/or a moderate enriched source. Melting models, assuming ~2% melting, indicate derivation of the primary magma from a source enriched in light rare earth elements by ~10times chondrite and heavy rare earth elements by 2-9times chondrite, the latter is relatively high compared with kimberlitic rocks and probably depend on the proportion of residual garnet in the source. The low to moderate Al_2O_3 (3.66 wt%), high Mg# and high Ni and Cr contents indicate strongly depleted refractory peridotitic mantle sources. These characteristics are interpreted as melting product of the sub-continental lithospheric mantle previously enriched by metasomatic fluids.

KEYWORDS: SÃO FRANCISCO CRATON; KIMBERLITE; PETROLOGY.