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THE KIMBERLITE JUINA-5, BRAZIL: TEXTURAL FEATURES AND XENOCRYST CHEMISTRY

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INTRODUCTION

Diamonds from Juina are well known in the literature due to the abundant occurrence of diamond inclusions formed over a large depth range, from the upper to the lower mantle. Likewise, Juina-5 kimberlite also carries diamonds formed at depths corresponding to the lower mantle, transition zone and upper mantle (Araujo et al. this volume). Kimberlites from Juina, however, have been poorly studied regarding their textural characteristics and xenocryst chemistry. Here we report preliminary results on macroscopic features of the Juina-5 kimberlite and the chemical compositions of garnets, chromite, Cr-diopside and ilmenite with the aim of investigating the kimberlite and the mantle related to this important occurrence.

GEOLOGICAL SETTINGS

The Juina-5 kimberlite is located in the Cretaceous Juina Kimberlite Field (92-95 Ma; Heman et al. 1998, Kaminsky et al. 2009a, Araujo et al. in prep.), at the SW border of the Amazon Craton (Fig. 1). Kimberlites are partly intruded in Mesoproterozoic terrains of the Rio Negro-Juruena province (Tassinari et al. 2000) and in Pre-Cambrian sediments of the Casa Branca Formation (Silva et al. 1980). The Juina-5 Kimberlite is located 30 km to the south of Collier-4 pipe (Fig. 2).

METHODS

Samples were collected at each 5 meters from three drill cores: DJ5-53 (15.40 m to 111 m), DJ5-62 (25 m to 80.35 m) and DJ5-63 (87 m to 145 m). They were macroscopically examined for textures and presence of xenoliths and heavy mineral concentrates were produced for selected samples. Although samples are considerably weathered the main textural features are preserved.

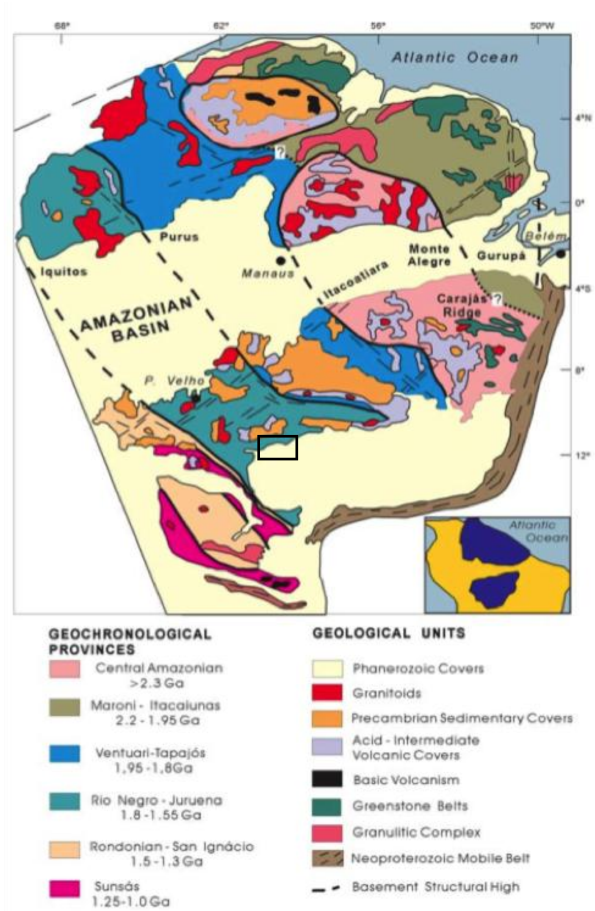

Fig. 1 – Amazon Craton Provinces (Tassinari et al. 2000) and location of Juina Kimberlite Field (rectangle).

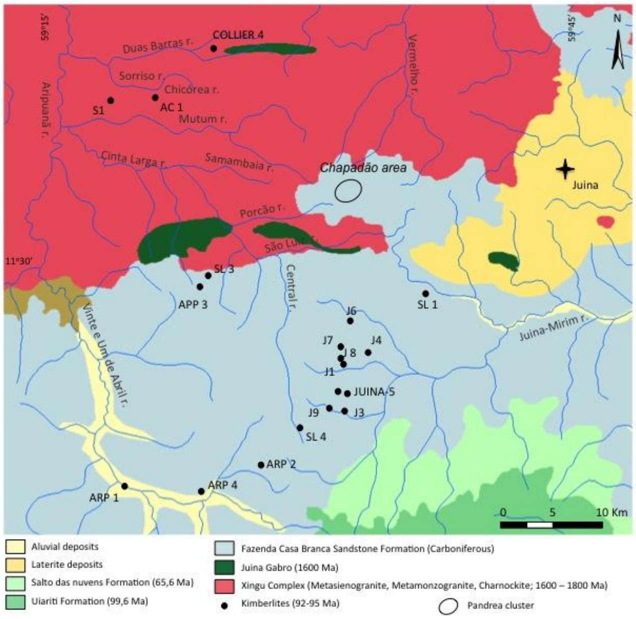

Fig. 2 - Location of kimberlites in the Juina Kimberlite Field. J5 – Juina-5 (Kimberlite locations from Haralyi 1991; geological map (Rizzotto et al 2004); location of Pandrea cluster from Kaminsky et al. (2009b).

Heavy mineral concentrates produced from samples DJ5-62-15 (55 to 65 m) and DJ5-63-9 (119 m to 121 m) were hand picked for garnet, diopside, chromite and ilmenite. Microprobe analyses were performed using 15 kv and 10 na in a Jeol superprobe JXA-8230 in the University of Brasilia.

RESULTS

Juina-5 Kimberlite

The three drill cores sampled mainly the crater facies of the kimberlite. Main features of Juina-5 kimberlite are exhibited in Fig. 3. Redish lenses (cm to dm seized) of reworked breccia sandstone and siltstone matrix are intercalated with greenish tuffaceous lapilli and lapilli tuff matrix (Fig. 3a-c). Kimberlitic material apears below 60 meters with recurrence of reworked sediment (Fig. 3e-f). Carbonate micro-veins were only recorded in the drill core DJ5-62. Crustal xenoliths are most lithic and granitic rocks. Mantle xenoliths are rare.

Mineral Chemistry

EMP analyses were carried out for garnet, diopside, ilmenite and chromite grains from drill cores DJ5-62 and DJ5-63. Garnet xenocrysts are pyrope with #mg (Mg/(Mg+Fe_t) from 0.42 to 0.84, CaO from 4.4 to 7.4 wt% and Cr_2O_3 from 0.1 to 6.1 wt%. Most garnets are lherzolitic, classified as G9 (according to Grutter et al. 2004 G-number classification). Only two garnets are eclogitic G3 and one is G3/G4 (Fig. 4). No garnet presented excess of Si, as found in majorite included in diamonds from this pipe (Araujo et al. this volume).

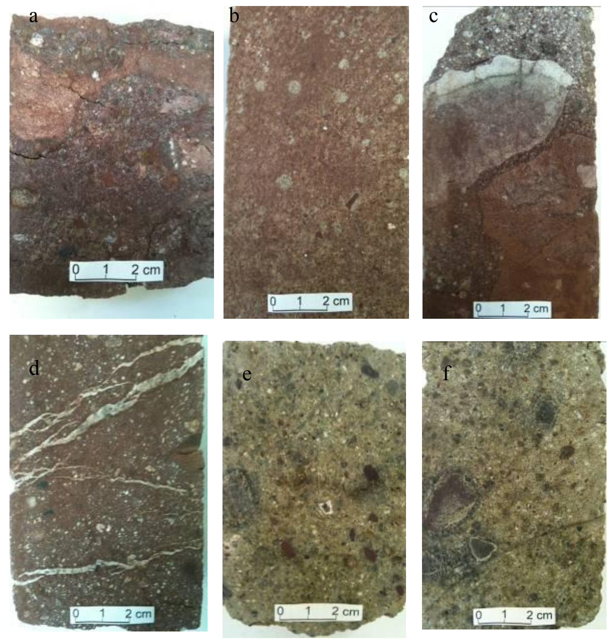

Fig. 3 – Juina-5 kimberlite drill cores. Lapilli tuff kimberlite at crater facies with variable contribution of lithic material, crustal xenoliths, garnet, ilmenite and diopside xenocrysts and carbonate veins. a) DJ5-53-7- 34 m; b) DJ5-53-8a - 38.9 m; c) DJ5-53-9a – 42,8 m; d) DJ5-62-19 - 79,2 m; e) DJ5-53-21b - 104,3 m; e) DJ5-53-23 - 111 m.

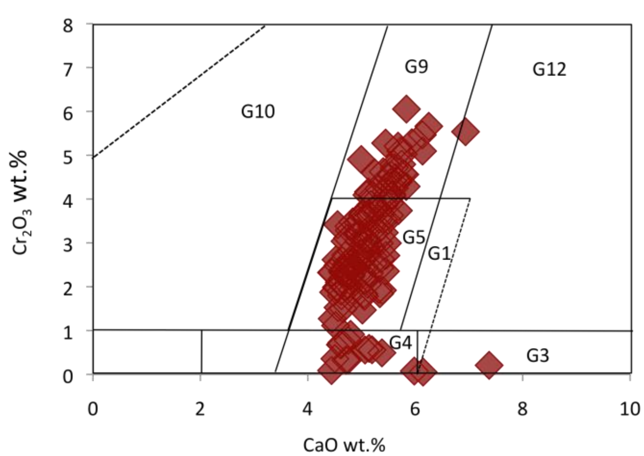

Fig. 4 – Garnets (n=160) from Juina-5 kimberlite. G-number nomenclature for garnets (Grutter et al 2004).

Clinopyroxene grains are Cr-diopside with #mg from 0.89 to 0.93, Cr_2O_3 from 0.7 to 2.3 wt%, CaO from 17.9 to

22.8 wt% and Na_2O from 1.1 to 4 wt%. TiO_2 is less than 0.6 wt% and K_2O less than 0.03 wt%. In a Cr_2O_3 *vs* Al_2O_3 diagram most of them are classified as 'on-Craton' garnet peridotites and subordinately as 'off-craton' garnet- and spinel-peridotites (Fig. 5).

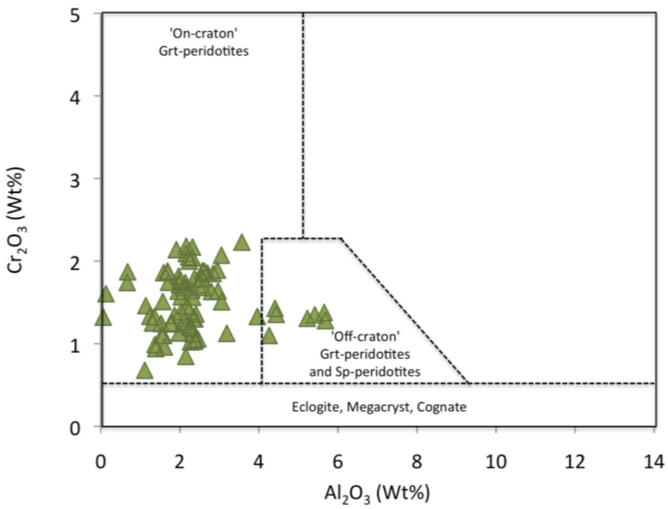

Fig. 5 – Cr-diopside (n=47) from kimberlite Juina-5 (after Ramsay and Tompkins (1994).

Most ilmenite is picro-ilmenite (MgO from 7.6 to 14.3 wt%) and classified as kimberlitic in the TiO_2 *vs.* MgO diagram (Fig. 6). Cr_2O_3 varies from 0.35 to 1.52 wt% and MnO from 0.18 to 0.64 wt %. The Fe_2O_3 content (up to 11.5 wt%) suggests intermediate conditions for diamond preservation (Gurney and Zweistra 1995).

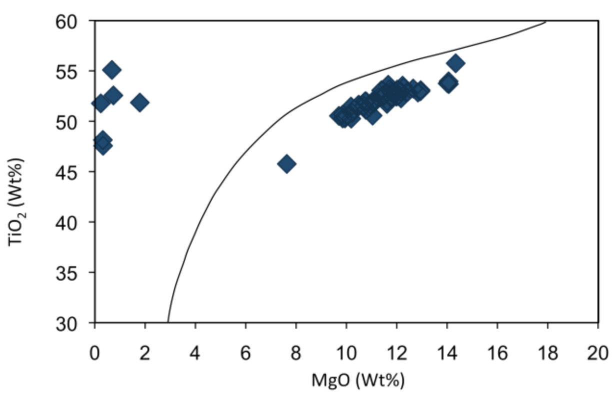

Fig. 6 – Ilmenite (n=60) from Kimberlite Juina-5. Most grains plots on the kimberlite field. The black line represents the bounding reference line of the kimberlitic ilmenite field (Wyatt et al. 2004).

Chromite is not abundant in the mineral concentrate. The results of seven grains are shown in the diagram Cr_2O_3 *vs*. MgO (Fig. 7). Chromite show magmatic trend with decreasing Mg and increasing Cr contents and their composition is not coincident with worldwide field of chromite included in diamond.

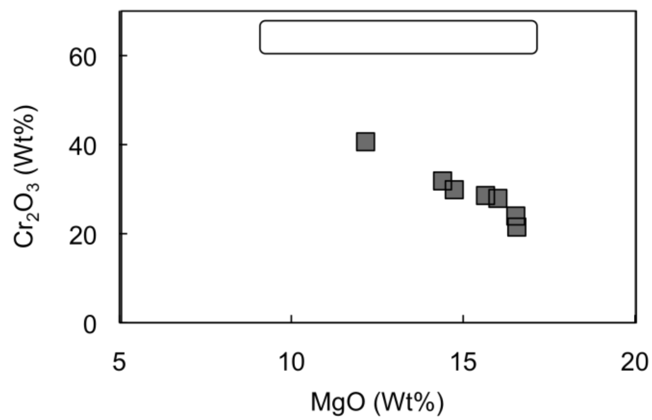

Fig. 7 – Chromite (n=7) from Kimberlite Juina-5. Rectangle limits the worldwide compositional field for chromite included in diamond (Gurney and Zweistra 1995).

DISCUSSIONS AND CONCLUSIONS

The composition of xenocrysts in Juina-5 kimberlite is typical of a peridotitic mantle with low diamond potential. Similar paragenesis was found in a study of xenoliths from the Collier-4 pipe (Costa et al 2003) where most xenoliths are granular predidotite followed by sheared peridotite. Less abundant xenoliths include orthopyroxene-rutile-, sanidine-coesite, and bimineralic (omphacite-garnet) eclogite. The influence of subducted plate in the mantle beneath this region is suggested by the occurrence of sanidine-coesite eclogites (Costa et al. 2003), eclogitic inclusions in diamonds from Collier-4 pipe (Bulanova et al. 2010) and by light carbon isotope composition of diamonds (e.g. Kaminsky et al. 2009b, Bulanova et al. 2010, Araujo et al. this volume).

The occurrence of transition zone and lower mantle diamonds in Juina can outnumber upper mantle diamonds, as reported in studies carried out by Hutchison et al. (1999), Bulanova et al. (2010) and Araujo et al. (this volume). Mantle plume is the most likely mechanism to transport deep diamonds to the base of the lithosphere in the Juina area (e.g. Hutchison et al. 1999, Bulanova et al. 2010) and the Trindade plume is a likely candidate both for the diamond transport (Bulanova et al. 2010) and for the alkaline magmatism along the NW-SE trend in Brazil forming the Alto Paranaiba Province (Gibson et al. 1997). Minerals included in diamonds and fragments of the mantle brought up within the plume are re-equilibrated during ascent and pooled at the base of the rigid lithosphere. Subsequently, material brought by the plume and the surrounding mantle are captured by rapidly ascending kimberlites. Despite the abundance of deep diamonds in Juina, there are no reports yet of xenoliths or xenocryts showing re-equilibration features of deep mineral assemblages at lower pressure. Additional samples and studies of trace element and isotope geochemistry of xenoliths and xenocrysts are being carried out to better understand the mantle in this region and the imprint of a plume impact at the base of the lithosphere.

Acknowledges

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