

# The Basal Conglomerate of the Capacete Formation (Mata da Corda Group) and its Relation to Diamond Distributions in Coromandel, Minas Gerais State, Brazil

## *O conglomerado basal da Formação Capacete (Grupo Mata da Corda) e sua relação com as distribuições de diamantes em Coromandel, Minas Gerais, Brasil*

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**ABSTRACT:** The diamond bearing district of Coromandel is located in the northwestern part of Minas Gerais, within the Alto Paranaíba Arch, famous for the discovery of most of Brazil's large diamonds above 100 ct. Detailed mapping, aimed at characterizing the Mata da Corda Group of Upper Cretaceous age of Coromandel, has been carried out. This Group was divided into the Patos Formation, composed of kimberlitic and kamafugitic rocks, and the Capacete Formation, presented by conglomerates, pyroclastic rocks, arenite and tuffs. Exposures of the latter Formation have been studied in detail at the small abandoned mine called Canastrel, as well as in the headwater of Santo Antônio do Bonito River. The results have been compared to studies of the kimberlite bodies in the nearby Douradinho River. Kimberlite indicator minerals from these localities show the same compositional trend. Moreover, in the basal conglomerate of the Garimpo Canastrel two diamonds have been recovered and described. The Garimpo Wilson, situated in the headwater of the river Santo Antônio do Bonito in paleo-alluvium, is composed of material exclusively derived from the erosion of the Capacete Formation and Precambrian (sterile) Canastra quartzites and schists. These detailed investigations suggest that the basal conglomerates of the Capacete Formation represent the main source rock of the alluvial diamond deposits in the Coromandel region.

**KEYWORDS:** Upper Cretaceous; conglomerate; diamond; alluvium.

**RESUMO:** Conhecida como "Terra do Diamante", o município de Coromandel está localizado no nordeste de Minas Gerais, no Arco do Alto Paranaíba, famoso pela descoberta da maioria dos diamantes brasileiros acima de 100 ct. Foi feito um mapeamento detalhado da região, visando caracterizar o Grupo Mata da Corda (Cretáceo Superior) de Coromandel. Este Grupo foi dividido entre a Formação Patos, composta de rochas kamafugíticas e kimberlíticas, e a Formação Capacete, que apresenta rochas piroclásticas, arenito e tufo. Desta última, foram detalhadamente estudadas exposições encontradas na pequena mina abandonada de Canastrel, assim como na nascente do rio Santo Antônio do Bonito. Os resultados foram comparados a estudos de outros corpos kimberlíticos do entorno do rio Douradinho. Minerais indicadores de kimberlita dessas regiões mostram a mesma tendência composicional. Além disso, no conglomerado basal do Garimpo Canastrel, foram recuperados e descritos três diamantes. O Garimpo Wilson, situado no paleoalúvio da nascente do rio Santo Antônio do Bonito, é composto de material derivado exclusivamente da erosão da Formação Capacete e de quartzitos do Grupo Canastra e xistos Pré-cambrianos (estéreis). Estas investigações detalhadas sugerem que os conglomerados basais da Formação Capacete representam a principal rocha de origem dos depósitos de diamantes aluviais na região de Coromandel.

**PALAVRAS-CHAVE:** Cretáceo Superior; conglomerado; diamante; alúvio.

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## INTRODUCTION

Since the beginning of the “diamond rush” to the Coromandel region in the second half of the 18th century (Barbosa 1991), this region stood out in the Brazilian geological scene as the only periodic producer of large diamonds (> 100 ct) in the country, mainly in the 20th century (*e.g.* Reis 1959; Barbosa 1991; Liccardo & Svisero 2005; Hoover & Karfunkel 2009). The diamonds are explored from gravel horizons of Pleistocene to Holocene age by garimpeiros in the Santo Antônio do Bonito, Santo Inácio, Douradinho, Dourados and Santo Antônio das Minas Vermelhas rivers.

Despite broad prospecting programs run by major diamond companies over many decades and the discovery of hundreds of sterile or non-economic kimberlites and similar intrusions, to date there is no consensus about the source and distribution of these gems. During the last years many authors discussed two hypotheses to explain such an enigma.

The first hypothesis, which was introduced by Tompkins & Gonzaga (1989) and Gonzaga *et al.* (1994), suggests an allochthonous diamond source. Primary Precambrian diamond sources, such as kimberlites, intruded in the São Francisco Craton, and were transported by glaciers during a Proterozoic continental glaciation (Karfunkel & Hoppe 1988), and deposited in diamictites of the Ibiá Group and Samburá Formation. They then have been reworked and concentrated locally in river gravels.

The other hypothesis suggests an autochthonous diamond source, linked probably to the various kimberlite bodies present in the region (*e.g.* Svisero *et al.* 1984, 1986; Barbosa 1991; Svisero 1992; Leonardos *et al.* 1996; Chaves *et al.* 2005; Svisero & Basei 2005). Their main arguments are the similar indicator mineral chemistry, as well as the diamond mineralogy and crystallography suggesting little transport.

Geological mapping on a scale of 1:50,000 has been carried out by Fernandes (2013), aimed at characterizing the Upper Cretaceous units in the Coromandel region, especially those of the Mata da Corda Group, and to link some of their minerals, such as the indicator minerals, to those found in many alluvial diamond garimpos of the region. As case studies an alluvial garimpo situated at the headwaters of the Santo Antônio do Bonito River, and another situated in the Mata da Corda conglomerates were chosen. The latter was of great value, because it revealed, in the geologic section, rocks of different nature, as well as facies transitions. In the lower conglomerate three diamonds were recovered and characterized. Moreover, the indicators mineral compositions have been compared to those of two small kimberlites in the nearby Douradinho River. Although the present study is a first step towards a different hypothesis concerning the

source of diamonds in Coromandel, it hopes to show the relationship between alluvial diamond occurrences in the region and the Mata da Corda rocks in the study area.

## GEOLOGICAL SETTING

The Coromandel diamond district in western Minas Gerais belongs geographically to the Triângulo Mineiro (Fig. 1). Geologically, it is located within the Brasília Fold Belt (Almeida 1967, 1977) and is built up by crustal sequences, converged against the São Francisco Craton, towards the East, during the Brasiliano geotectonic cycle.

The stratigraphic units that form the Brasília Belt are represented by Meso-Neoproterozoic rocks of the Vazante, Canastra, Ibiá-, and Araxá groups. Dardenne (2000) divides the Vazante Group into seven formations, composed by carbonate and pelitic rock successions and subordinately rudaceous rocks. The Canastra Group (Barbosa *et al.*, 1970) is composed essentially of quartzites, phyllites and schists. Pereira *et al.* (1994) divided the Ibiá Group into the Cubatão Formation (diamictites of glacial origin) and the Rio Verde Formation (phyllites). Rodrigues (2008) dated detrital zircon grains, and determined maxima sedimentary ages of 1.2 – 0.9 Ga, 1.0 – 0.9 Ga and 990 – 640 Ma for the Vazante, Canastra and Ibiá groups, respectively. The Araxá Group (Barbosa *et al.* 1970) is composed mainly by metamafic rocks, with subordinate metasedimentary rocks such as schists and quartzites (Seer & Dardenne 2000; Seer *et al.* 2001). They are intruded by syn-collisional granites dated at  $637 \pm 2$  Ma (Valeriano *et al.* 2004).

The Coromandel region is part of the Alto Paranaíba Arch (Ladeira *et al.* 1971), which divides the Sanfranciscana and Paraná basins (Fig. 1). The uplift of this crustal segment, followed by intrusions of alkaline rocks (*e.g.* Serra Negra, Catalão, and Araxá), kimberlites and kamafugites, during the Late Cretaceous was within a NW-SE-oriented narrow strip in the Proterozoic Brasília belt. The magmatism, clearly seen on magnetometric maps (Hasui & Haralyi 1991), has been related to the Trindade mantle plume (Gibson *et al.* 1995).

A consequence of this mafic magmatism was the formation of the Mata da Corda Group rocks, which occur above Precambrian sequences, separated by an angular unconformity. These rocks are widely distributed in the study area. Campos & Dardenne (1997) and Sgarbi *et al.* (2001) divided the Mata da Corda Group into the Patos and Capacete formations.

The Patos Formation consists of volcanic and sub-volcanic rocks with kamafugite, kimberlite and lamproite affinities as well as subordinate volcanoclastic

rocks (Leonardos *et al.* 1991; Sgarbi 1991). The Capacete Formation is composed principally of volcanoclastic rocks, conglomerates and epiclastic arenites derived from the erosion of the Patos Formation. Its thickness can reach 130 m (Sgarbi *et al.* 2001), reflecting the magnitude of this Late Cretaceous volcanism. The Capacete Formation in the Sanfranciscana basin is time-correlated to the Uberaba Formation of the Paraná Basin (Sgarbi *et al.* 2001). The age of the Mata da Corda Group lies between 80 and 90 Ma (Hasui & Cordani 1968; Gibson *et al.* 1995; Sgarbi *et al.* 2000, 2004; Svisero & Basei 2005).

### CHARACTERIZATION OF THE MATA DA CORDA GROUP NEAR COROMANDEL

The rocks of the Upper Cretaceous Mata da Corda Group unconformably overlay the Meso-Neoproterozoic lithologies of Vazante, Canastra, Ibiá and Araxá groups. The Mata da Corda Group has been divided (Sgarbi *et al.* 2001) into the Patos and Capacete formations, as illustrated in the stratigraphic column (Fig. 2). The Patos Formation is composed of kimberlitic, kamaufitic, and similar ultramafic rocks, occasionally including

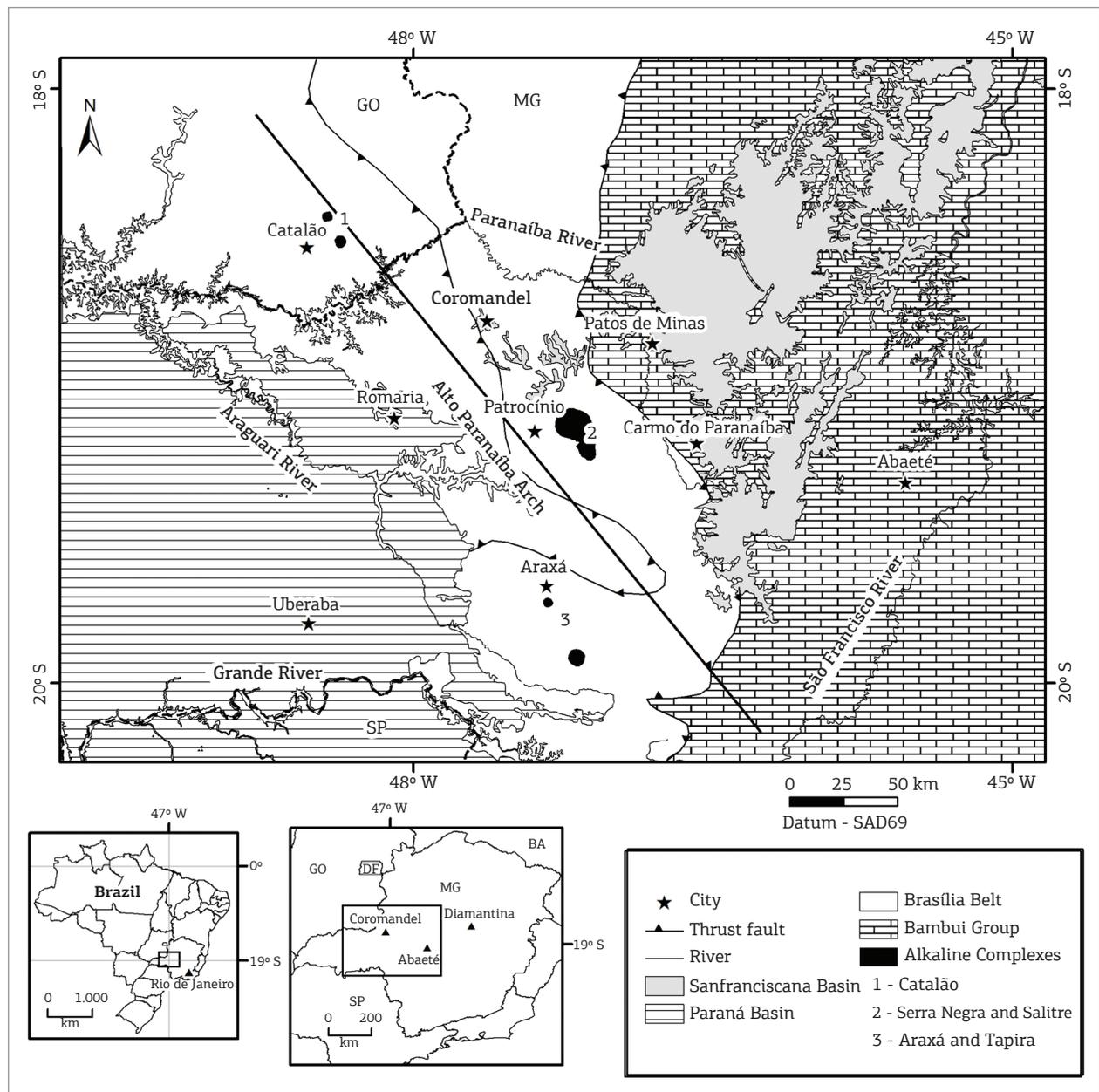


Figure 1. Geologic map of the Coromandel area, showing the Alto Paranaíba Arch, the Sanfranciscana and Paraná basins, and the major alkaline complexes (modified from Heineck *et al.* 2004).

pyroclastic and sedimentary rocks as well. The Capacete Formation is composed of epiclastic and volcanoclastic rock successions that reach a thickness up to 65 m. Laterite and lateritic soil cover the full extent of the Capacete Formation. These rocks stand out in the morphology by forming flat-topped mesas as in the Serra das Mesas between Coromandel and Patrocínio (the term Capacete means helmet), typical for

the Alto Paranaíba Arch region (Mata da Corda Upland), which lies between 950 and 1,000 m and represents the Late Tertiary Sul-Americana peneplain surface as named by King (1956).

### Patos Formation

The unit is represented by volcanic and subvolcanic rocks. These occur in outcrops usually as volcanic breccia

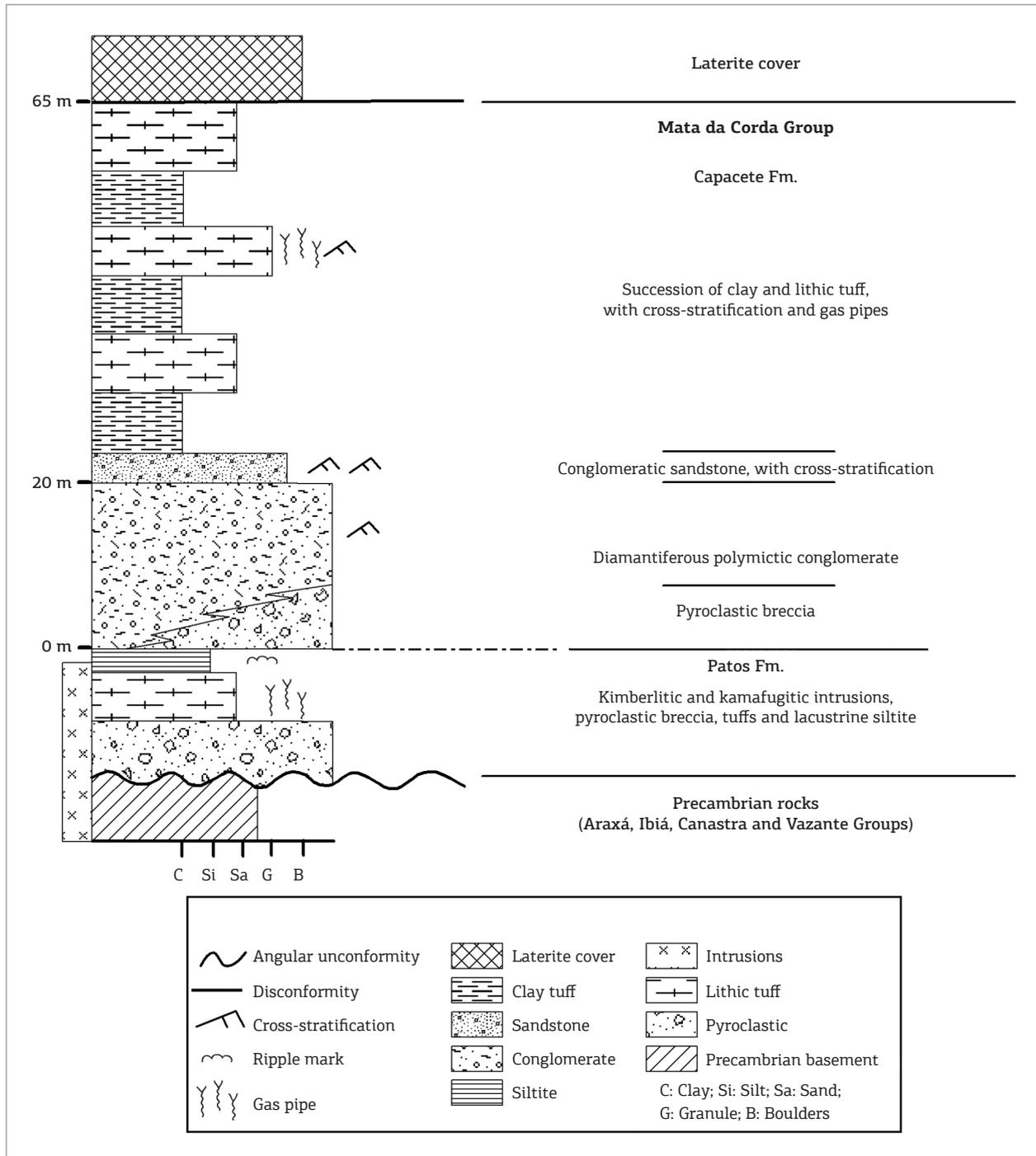


Figure 2. Stratigraphic column of Mata da Corda Group for the Coromandel region (Fernandes 2013), showing details of the Patos and Capacete formations.

with multiple rock fragments such as quartzite, schists, phyllites, pelites, dolomites, quartz, and volcanic fragments in a clayish matrix of green, grey, yellow, beige and brown colors, depending on its weathering stage. Mantel derived macrocrystals of garnet, ilmenite, chromite, Cr-diopside and olivine occur too. The presence of pyroclastic rocks (Fig. 3A) points towards the explosive nature of some eruptions. Lacustrine siltstone rarely occurs on top of some intrusive bodies, representing Maar sediments.

## Capacete Formation

The Capacete Formation is composed of volcanoclastic and rudaceous epiclastic rocks containing abundant contributions of volcanic rock fragments, derived from the Patos Formation. At the base of the Capacete Formation a polymictic conglomerate occurs, subordinately alternating with pyroclastic rocks. The conglomerate shows lateral facies transitions to lithic sandstones with cross-bedding; layers of tuffs follow on top of the sequence.

The conglomerate is matrix supported (Fig. 3B) with a maximum thickness of 15 – 20 m, comprised of quartzite, ferruginous quartzite, metapelite, schist, volcanic rocks, sandstone, pelite, limestone, chert quartz and granitoid clasts. The majority of the clasts are sub-rounded; however some are well rounded or angular and their sizes vary from granule to cobbles, but pebble sizes predominate. The matrix is sandy and poorly sorted, formed mainly of quartz grains and subordinate clay and altered feldspars as kaolin. Locally, the conglomerate has a green, pelitic matrix (smectite), with some clay and rock fragments, but the total absence of quartz and the amount of volcanic rock clasts are outstanding.

Our petrographic studies show that the quartz in the quartz-rich conglomerate matrix is composed of well-rounded grains and cemented by microcrystalline silica, interpreted as diagenetic chalcedony. Plagioclase, microcline, phlogopite, pyroxene, titanite and opaque minerals (magnetite, ilmenite and perovskite) in minor quantities have also been observed. Some quartz grains show “rounded entrances” (Fig. 3C), interpreted as a consequence of corrosion processes in the magmatic milieu, which together with the other described aspects such as components of different genesis in many conglomerates leaves no doubt about the mixed character of these conglomerates and allows one to designate them as epiclastic sediments.

On top of the conglomerate a 5 m thick layer, composed of sandstone and some rock fragments, occurs. Sandy laminations (white, beige and grey) intercalated in this layer define a planar stratification, as well as cross-bedding with sets reaching up 0.5 m. Isolated pebble and conglomerate levels in the middle of the cross-bedding can be observed, as shown in Fig. 3D.

A thick tuff package succeeds within the Capacete Formation sequence towards the top, reaching up 40 m in thickness. The high quality of the clay in this layer is exploited by the ceramic industry. The best outcrops are found in clay mine situated about 15 km SE of Coromandel. The tuff is often silicified with geodes of microcrystalline quartz, which, under the microscope, can be classified as chalcedony. Smectite and phlogopite were also detected in petrographic studies (Fernandes 2013). Alternations between exclusively metric clay layers and clay-silt layers are observed. In the latter, cross-bedded sandy intercalations containing dispersed rock fragments also occur. Of genetic importance are opaque oxide grain levels, composed of magnetite and ilmenite, as well as vertically oriented structures filled with quartz and kaolin, interpreted as gas pipes (Fig. 3E). They represent original cavities of trapped gas formed during the rapid deposition of the sediment (Cas & Wright 1987). All the above observations corroborate a pyroclastic origin of these rocks according to the Schmid (1981) classification.

## CASE STUDIES

The first case study has been carried out at the Garimpo Canastrel, which is located within rocks of the Capacete Formation, whereas the second site is situated at an old garimpo, named Wilson, within alluvials, located at the headwaters of the Santo Antônio do Bonito river.

### Garimpo Canastrel (UTM Projection, Datum SAD 69, E279584/N7950829)

This garimpo is located 25 km SE of Coromandel, on the NE slope of a narrow mesa, formed by Capacete Formation rocks, and overlain by a laterite crust. The range runs NNW–SSE and forms the watershed between the Rivers Santo Antônio do Bonito and Santo Inácio (Fig. 4). The garimpo, deactivated for over a decade, consists of a rectangular pit, approximately 30 m long by 15 m wide, from which around 1,000 m<sup>3</sup> of material has been worked for diamonds.

The washed material corresponds to the basal conglomerate of the Capacete Formation, which can reach over 5 m in thickness. The basal contact is with the Vazante metapelites, whereas the top represents a lateritic crust of 15 m thickness, which hides almost all outcrops beneath the plateau. The conglomerate (Fig. 5A) is composed of rock fragments in sandy beige to brown matrix, containing secondary feldspar grains (kaolin) and microcrystalline silica. The clasts are mainly quartz, quartzites and sandstone, subordinately ferruginous quartzite, schist, phyllite, pelite, limestone, granitoid and volcanic rocks.

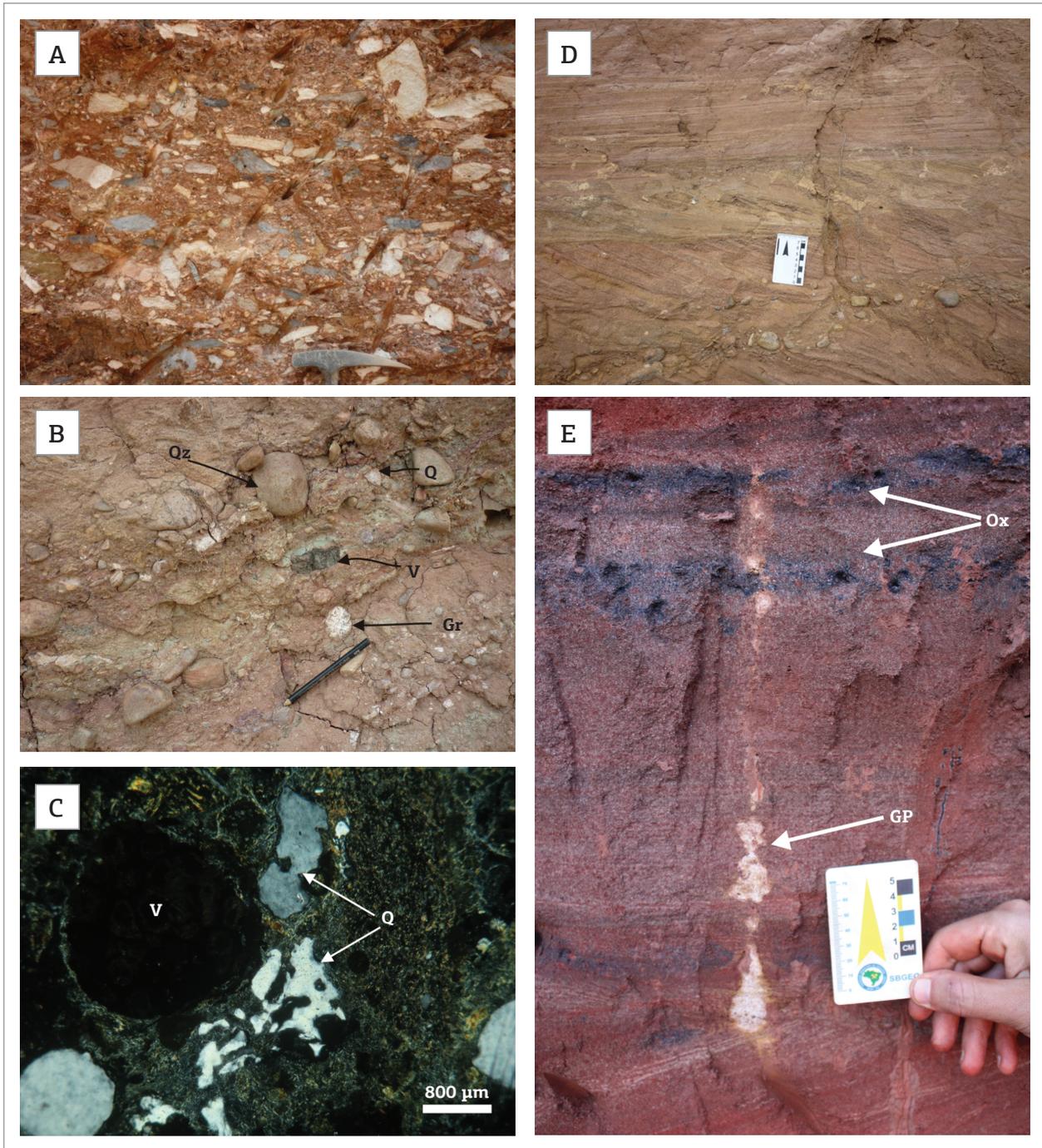


Figure 3. (A) Pyroclastic rock, interpreted as conduit breccia within the Patos Formation (UTM Sad 69, E276563/N7948936); (B) Basal polymictic conglomerate of the Capacete Formation containing clasts of quartz (Q), quartzite (Qz), granitoid (Gr) and volcanic rocks (V), dispersed in a sandy matrix. Outcrop location: Serra da Mesa (UTM Sad 69, E273118/N7948766); (C) Photomicrography of a polymictic conglomerate from the Capacete Formation, showing quartz grains (Q) with rounded “corrosion entrances” and clasts (V) of volcanic rocks; (D) Cross-bedded sandstone and conglomeratic levels from the Capacete Formation (UTM Sad 69, E273138/N7948796); (E) Top layer of the Capacete Formation in a clay mine 15 km SE of Coromandel showing cross-bedded tuff with a white gas pipe (GP) filled with quartz and kaolin, as well as levels of oxides (Ox), identified as magnetite and ilmenite (UTM Sad 69, E276563/N7948936).

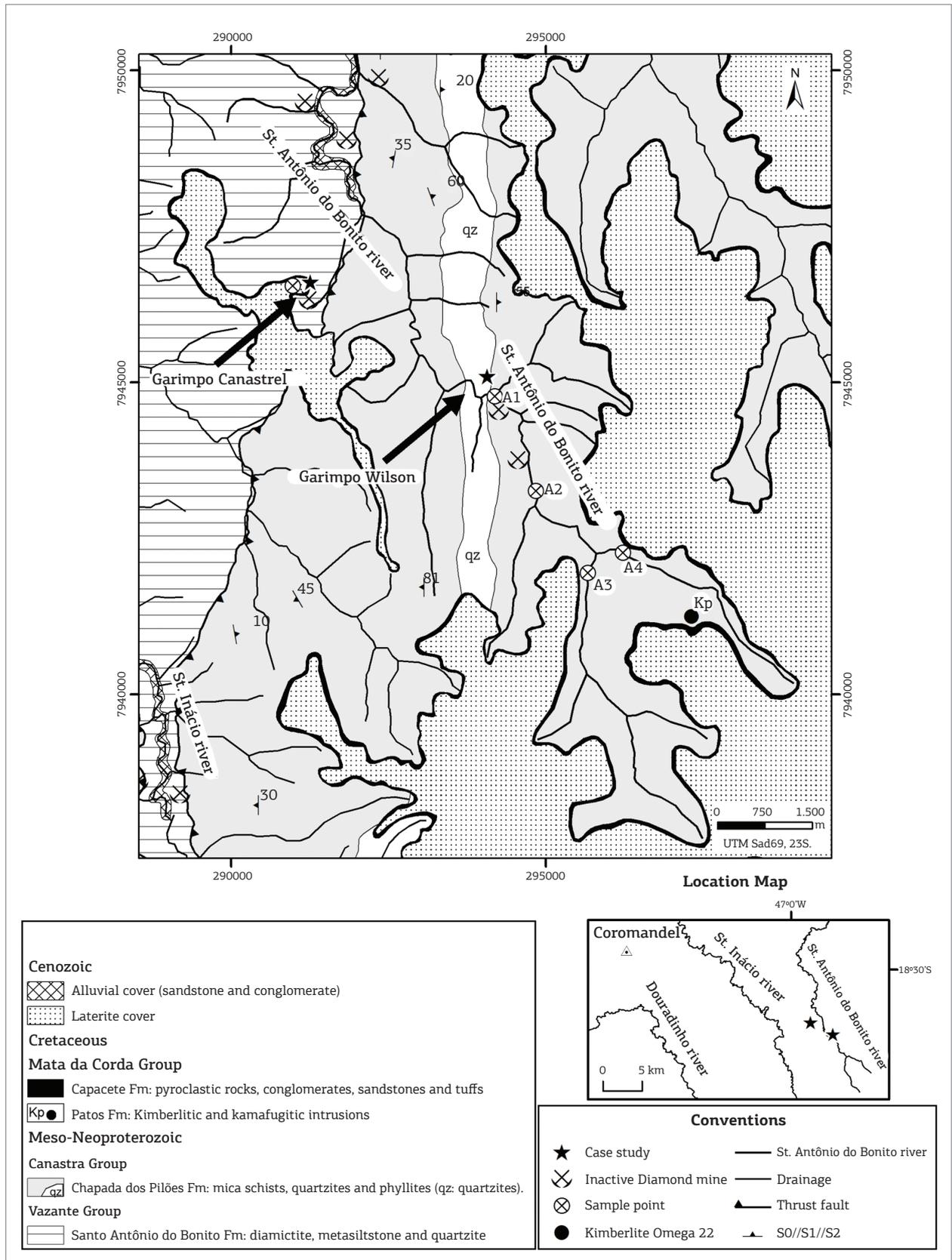


Figure 4. Detailed geological map, with the Garimpos Canastrel and Wilson, as well as the sampling points in the Santo Antônio do Bonito River.

The authors washed 120 liters of the conglomerate and found garnet and ilmenite grains, which have been classified as indicator minerals of kimberlites (chapter on Chemistry). The garnets are red, rounded and about 3 mm in diameter. Scanning electron microscope (SEM) shows that the garnets exhibit a kelyphitic rim (Fig. 5B) formed during ascension within the volcanic conduit. They also show a striated surface resulted from dissolution caused by reaction with magma and, no breakages. These characteristics suggest a proximal source with a short transport for the garnet. The ilmenites are tarnished grey due to an alteration shell (leucocene), caused during the same magmatic ascension process. Conchoidal fractures reveal a black metallic luster in the inner parts of the ilmenites.

According to the last owner of the Garimpo, Mr. Ingo Wender, three diamonds had been recovered from this garimpo during the 1990s. Two of these diamonds (Fig. 5D) are described and analyzed in detail by Karfunkel *et al.* (2014), who describe the larger one (0.75 ct) as yellow and with small inclusions and the smaller one (0.497 ct) as white. Both diamonds exhibit surface features that indicate a short transport and comparison with diamonds from the

Diamantina region (Karfunkel *et al.* 2001) show a different transport history.

### Garimpo Wilson (UTM Projection, Datum SAD 69, E291126/N7946476)

The Garimpo Wilson is situated on the right bank of the headwaters of the Santo Antônio do Bonito River, approximately 7 km downstream from its two sources (Fig. 4). It lies about 27 km SE of Coromandel and only 3 km ESE of the Garimpo Canastrel. The garimpo occupies an area of 60 m along the stream, and 20 m in E-W direction. Other small pits have been observed near the stream and upwards from the main garimpo. The authors estimated that a volume of approximately 8,000 m<sup>3</sup> of material has been washed. The extracted rock corresponds to an alluvium, consisting of a gravel layer, essentially composed of quartz and micaceous quartzite clasts (probably inherited from Canastra Gr. rocks), which vary from granule to cobble, with most of them pebble size, normally rounded, but some angular examples occur as well. In minor quantity schist, phyllite, laterite, and grains of hematite, magnetite and ilmenite occur. The matrix is reddish brown to beige, with a clay to sandy composition.

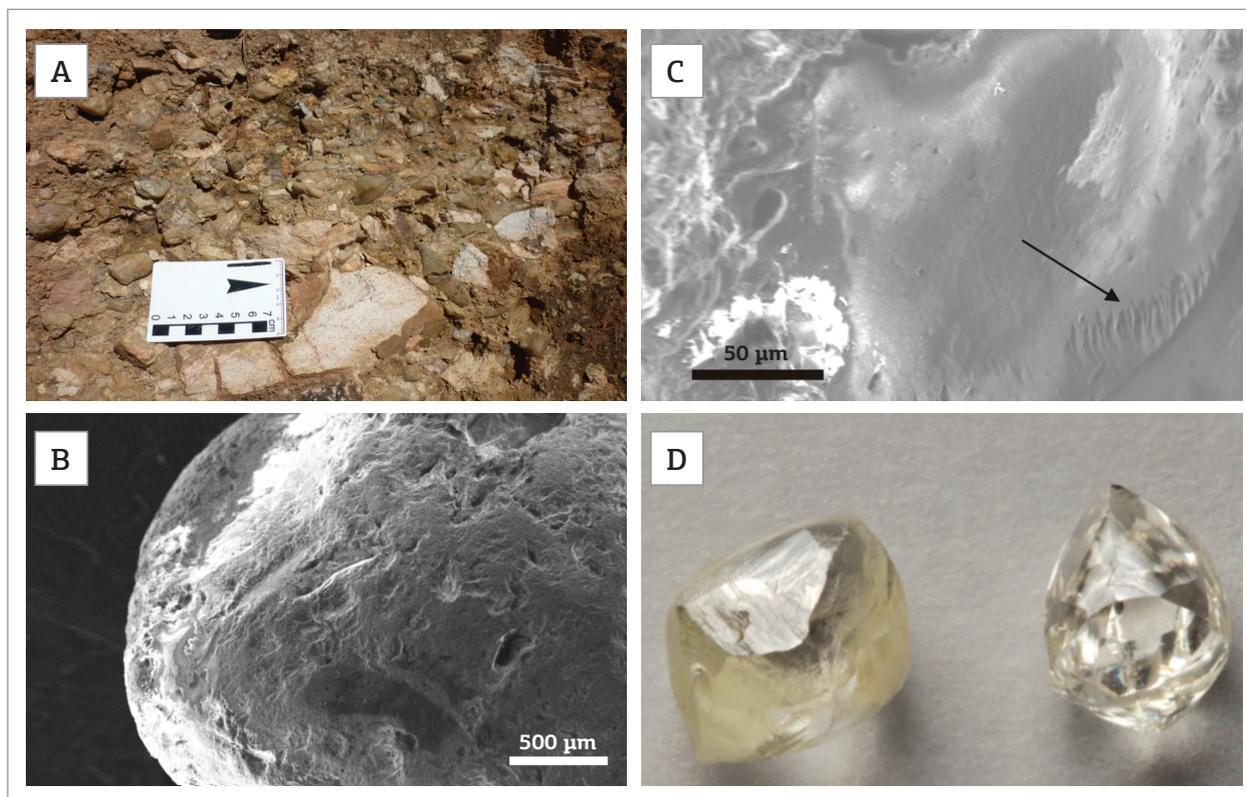


Figure 5. (A) Diamondiferous polymictic conglomerate of the Garimpo Canastrel worked within the Capacete Formation (UTM Sad 69, E279584/N7950829); (B) Photomicrography showing the kelyphite rim of garnets from the Garimpo Canastrel; (C) Detail (SEM) of a garnet showing striated surface resulting from dissolution, caused by the magma reaction; (D) Two diamonds, 0.75 ct and 0.497 ct, from the Garimpo Canastrel, described and analysed by Karfunkel *et al.* (2014).

This gravel layer is on average 0.5 m thick, but can reach a maximum of 1 m, and is covered by colluvium up to 8 m in thickness, but usually not passing 4 m in thickness.

The authors performed a follow-up campaign with four sampling sites of approximately 100 liters per site (A1 to A4 in Fig. 4) along the riverbed. At sampling sites A4 and A3 no possible kimberlitic indicator minerals have been found; only hematite, magnetite and limonitic pyrite were found. At sampling sites A2 and A1 ilmenite grains have been recovered in abundance (compare chemical composition in the next section).

## CHEMICAL ANALYSES OF INDICATOR MINERALS

Analyses to compare the chemical composition of indicator minerals (garnet and ilmenite), from three different kinds of source materials, have been carried out. These materials were conglomerate from Garimpo Canastrel, alluvium from Garimpo Wilson and two kimberlites (Douradinho 10 and França 1) located in the nearby Douradinho river basin (UTM, Sad 69, E266888/N7948592 and E287109/N7932456 respectively). Pyrope garnets and magnesian ilmenites are considered as excellent indicator minerals of kimberlites and, consequently, used in diamond prospection, as shown by pioneer studies of Mitchell (1973) and Gurney (1984).

Five pyrope garnet grains, as well as five ilmenites, were analyzed (Tabs. 1 and 2), with 10 point analyses in each

section of a grain. All analyses were performed at the Micro Analyses Laboratory of the Instituto de Ciências Exatas, at the Universidade Federal de Minas Gerais, by using an electron microprobe (EMP) (model JCXA-8900R; JEOL), with an energy-dispersive detector NORAN. Related composition analyses (EDS) as well as quantitative analyses (WDS) were carried out.

The analyzed grains were two garnets and one ilmenite from Garimpo Canastrel, two ilmenites from Garimpo Wilson, and three garnets, as well as two ilmenites from the above mentioned kimberlites. The garnets were classified using the  $\text{CaOxCr}_2\text{O}_3$  diagram proposed by Grütter *et al.* (2004). They have CaO values of 3.84 to 4.83% and  $\text{Cr}_2\text{O}_3$  values of 0.47 to 3.19%, and thus can be classified as pyroxenitic garnets of the type G4 and G5 (Fig. 6A). These garnets are associated with diamond bearing peridotites and eclogites. The values for the ilmenite grains show high magnesium content between 7.58 and 12.09%, indicating that they are magnesian ilmenites. According to the  $\text{MgOxTiO}_2$  diagram proposed by Wyatt *et al.* (2004), all ilmenite grains are of kimberlitic origin (Fig. 6B).

## DISCUSSION

The basal polymictic conglomerate of the Capacete Formation shows abundant contributions of volcanic and volcanoclastic rocks in its composition, as already indicated by several authors (*e.g.* Sgarbi *et al.* 2001). This evidence combined with many other features such as rounding and

Table 1. Composition of the garnets from the sampling sites in the Garimpo Canastrel, as well as from the kimberlites Douradinho 10 and França 1 (EMP analyses)

n°	Sample	SiO <sub>2</sub>	FeO	MgO	CaO	Cr <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Na <sub>2</sub> O	TiO <sub>2</sub>	MnO	Total
GC-1	Conglomerate (Canastrel)	40.63	8.98	20.24	4.09	2.14	21.98	0.06	0.33	0.43	98.88
GC-2	Conglomerate (Canastrel)	39.94	9.09	20.90	3.84	0.47	23.55	0.03	0.12	0.30	98.24
GK-1	Kimberlite Douradinho 10	41.15	8.75	19.82	4.63	2.4	22.32	0.05	0.08	0.44	99.64
GK-2	Kimberlite Douradinho 10	41.14	8.63	19.56	4.83	3.19	21.76	0.04	0.05	0.45	99.65
GK-3	Kimberlite França 1	40.53	9.32	20.35	3.84	1.68	22.45	0.07	0.31	0.41	98.96

Table 2. Composition of the ilmenites from the sampling sites in the Garimpo Canastrel, Garimpo Wilson, as well as from the kimberlites Douradinho 10 and França 1 (EMP analyses)

n°	Sample	TiO <sub>2</sub>	FeO	MgO	MnO	Al <sub>2</sub> O <sub>3</sub>	ZnO	Cr <sub>2</sub> O <sub>3</sub>	Total
IC-1	Conglomerate (Canastrel)	48.78	40.56	8.84	0.47	0.07	0.05	0.20	98.97
IW-1	Gravel (Wilson)	50.18	37.69	9.04	0.28	0.42	0.08	0.93	98.62
IW-2	Gravel (Wilson)	47.39	41.52	7.58	0.30	0.02	0.98	0.05	97.84
IK-1	Kimberlite Douradinho 10	52.08	32.85	12.09	0.24	0.18	0.05	1.46	98.95
IK-2	Kimberlite França 1	50.18	39.74	7.44	0.47	0.04	0.22	0.05	98.14

imbrication of the clasts and cross-bedded sandstones indicate a high energy debris flow. The lateral variation within the conglomerates observed is probably the result of a detachment from its source area. From these features, the authors interpret the depositional environment as alluvial fans and braided channels, a consequence of the uplift of the Alto Paranaíba Arch during Upper Cretaceous time.

That the conglomerates from the Capacete Formation contain kimberlitic indicator minerals in the Coromandel region has been mentioned by many authors (*e.g.* Barbosa *et al.* 1970; Barbosa 1991; Sgarbi *et al.* 1998, 2001; Svisero & Basei 2005). However, diamond occurrence in these rocks was not recognized in the geological literature until recently. The first mention of the Capacete Formation as a diamond source rock in the Coromandel area has been made by Fernandes (2013) and described and analyzed by Karfunkel *et al.* (2014) and in this article. The diamonds and garnets from the conglomerate (Capacete Formation) of Garimpo Canastrel indicate a short transport, and therefore, a proximal source for the diamonds.

The results of the field work conducted near Garimpo Wilson and at the headwaters of the Santo Antônio do Bonito River provide no evidence for the occurrence of other kimberlites in the headwater region of the Santo Antônio do Bonito basin, except the known, very small Omega 22 kimberlite, which was abandoned by De Beers (Fig. 4). Magnetic maps support this observation by the lack of clear dipolar anomalies. The authors infer that only the Mata da Corda rocks and Precambrian (sterile) Canastra quartzites and schists are responsible for the deposition of sediments in the alluvium

of this river. Therefore, the Capacete Formation rocks, specifically the basal conglomerate, would be the probable source rock of diamonds at the Garimpo Wilson.

The studies of Svisero *et al.* (2005), Pereira and Fuck (2005), and Andrade (2012) clearly indicate that the Coromandel region garnets vary in composition and belong to the G4 and G5 fields, of eclogitic and pyroxenitic rocks, but some also belong to the lherzolitic G9 field. The classification diagram of garnets (Fig. 6A) exhibits that the garnets from Garimpo Canastrel are of kimberlitic origin and are inserted in the same trend shown by the above authors mentioned. In this study, the ilmenites from the three study areas have been classified as kimberlitic and the data are compared with those from Andrade (2012). They show similar grades of MgO and FeO, as shown in the diagram of Fig. 6B. These preliminary results compared with literature data characterize the Capacete conglomerate and alluvial gravels as having kimberlitic indicator minerals with similar chemical signatures, indicating that the minerals are derived from mantle xenoliths as a result of the Upper Cretaceous magmatism, as already described by Svisero and Basei (2005).

The detailed mapping and the stratigraphy of the Capacete Formation established by Fernandes (2013) have been essential for determining the stratigraphic positioning of the conglomerates at the Garimpo Canastrel, in which the three diamonds have been recovered. According to geological map, the plateaus composed of Capacete Formation rocks played an important role as watersheds of the Santo Antônio do Bonito, Santo Inácio and Douradinho rivers. Therefore, these rocks represent the main source rocks that provided

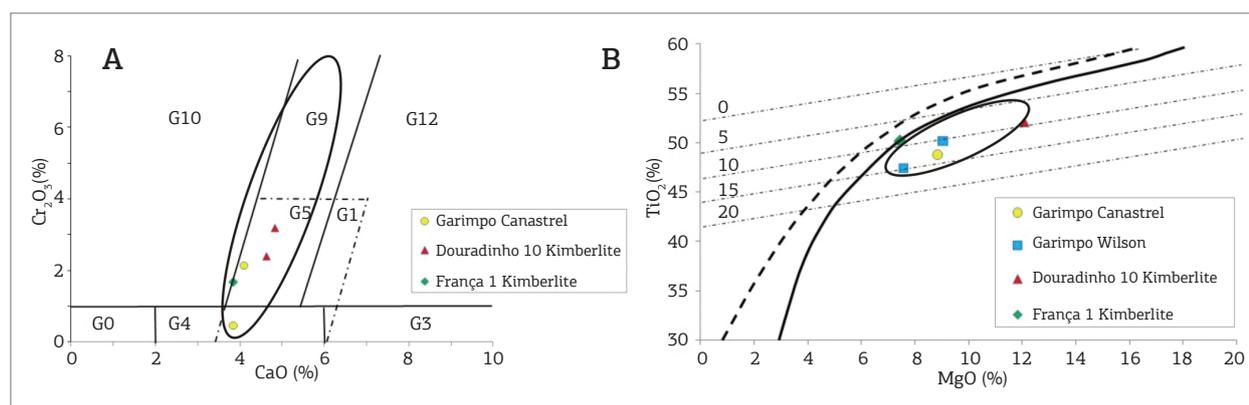


Figure 6. (A) Diagram of  $\text{CaOxCr}_2\text{O}_3$  for garnet classification (after Grütter *et al.* 2004) showing the garnets analysed in this study. The garnets belong to the G4 and G5 groups, associated with diamonds from eclogitic and peridotitic sources. The ellipsoid represents the trend found by Pereira & Fuck (2005), Svisero *et al.* (2005) and Andrade (2012); (B) Diagram of  $\text{MgOxTiO}_2$  for ilmenite classification (after Wyatt *et al.* 2004). The solid curve corresponds to the bounding line of kimberlitic ilmenites whereas the dashed curve corresponds to the bounding line of non-kimberlitic ilmenites. The straight, slightly tilted, weaker dashed line represents percentage of  $\text{Fe}_2\text{O}_3$ . The ellipsoid corresponds to the trend found by Andrade (2012) from ilmenites of the Douradinho River region.

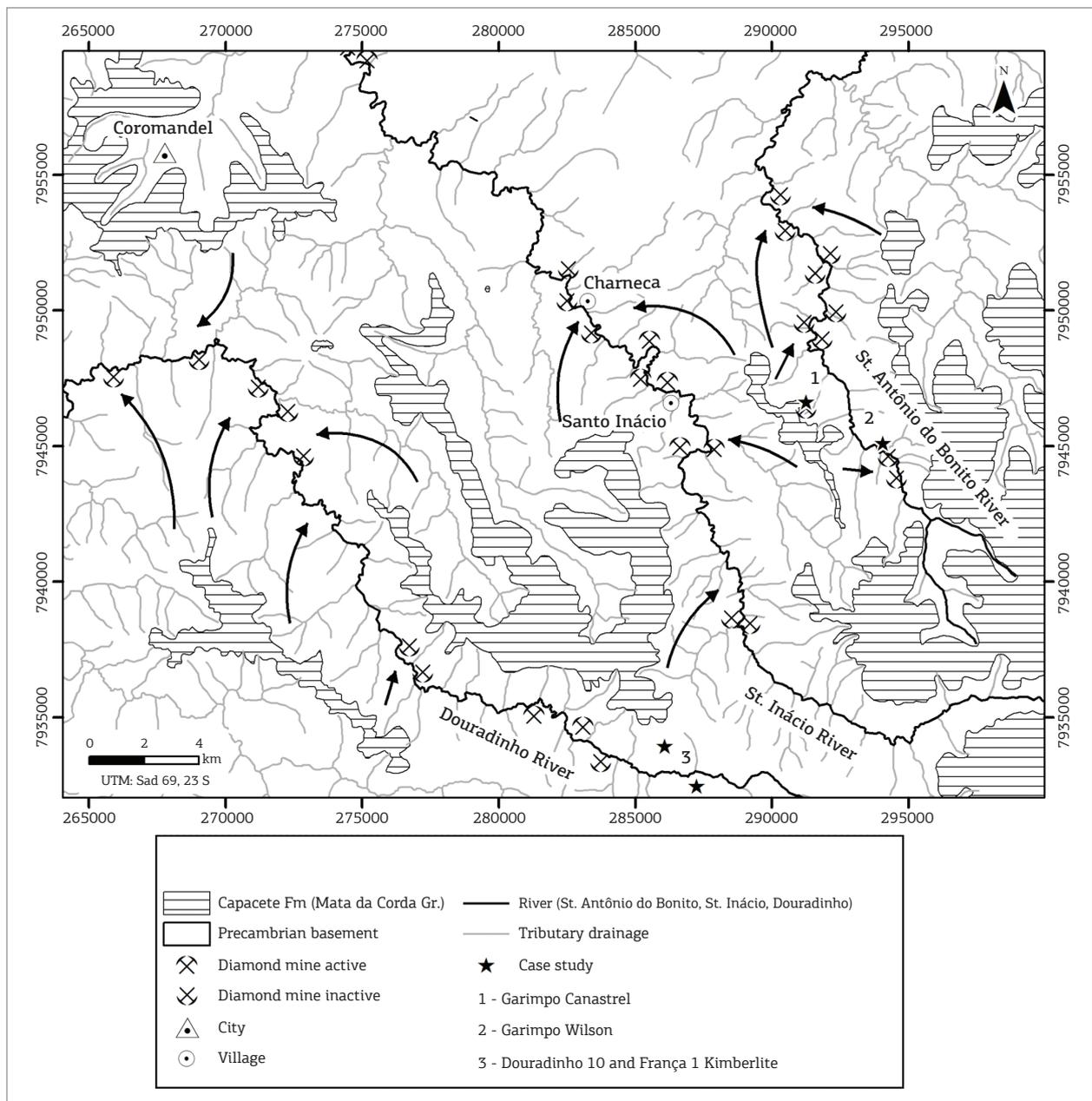


Figure 7. Lithological map of the Capacete Formation and its relation with the distribution of sediments and diamonds in the Santo Antônio do Bonito, Santo Inácio and Douradinho rivers.

the sedimentary detritus, as well as the diamonds to the paleo-alluviums and actual alluviums of these rivers (Fig. 7).

## CONCLUSION

The basal polymictic conglomerates of the Capacete Formation have been shown to be diamondiferous in the Coromandel region. These results also suggest that the

conglomerates are probably the main diamond source rock in the Santo Antônio do Bonito, Santo Inácio and Douradinho river alluviums. The authors do not exclude the possibility that neoproterozoic diamictites from Ibiá Group, as well as Cretaceous kimberlites, may have contributed, in other localities, to part of the diamond distribution in the Coromandel region. But in places such as Garimpo Wilson, this contribution can be excluded, since diamictites and kimberlites do not occur upstream from the Garimpo. However, as

diamonds in the Capacete Formation are scattered over a huge area, the grade appears low and distribution is unknown, therefore they are economically not significant at this time. Future lithostratigraphic and sedimentological studies, especially lateral continuities of the basal Capacete conglomerate, the determination of the conglomerate thickness and diamond content in the Capacete Formation, could result in new investments in diamond extraction from these rocks.

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