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Chapter 9

The Mata da Corda Volcanic Rocks

By

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HISTORICAL BACKGROUND

The history of the knowledge of the Mata da Corda volcanics dates back to 1880 when F.P. Oliveira discovered porphyritic picrites between Areado and Abaeté in the foothills of the Mata da Corda plateau, seven years before Lewis (1887) used the term Kimberlite for the diamond bearing porphyritic biotite-picrites of Kimberley. A few years later Hussak (1891,1894) and Campos (1891) suggested a possible kimberlitic pipe source for the pyrope and the perovskite found as satellite minerals in the Água Suja (today Romaria) diamond deposit. After studying the rocks collected by Oliveira, Hussak (1906) called attention to the close resemblance of the Mata da Corda rocks with those of Kimberley. But while Hussak still left the diamond origin an open problem, Rimann (1915, 1917, 1931) actually described the Mata da Corda rocks as kimberlites, strongly advocating them as the source of the region's diamond. The proposal met fierce opposition from Guimarães (1927,1930, 1931, 1933) and Barbosa (1934) who following Derby (1911) defended an acid "source" for the Minas Gerais diamonds, further criticizing Rimann for failing to recognize the alkaline nature of the Mata da Corda rocks. Yet the theory of a kimberlite/Mata da Corda source for the Alto do Paranaíba diamonds kept returning time after time (Ferraz, 1928; DuToit, 1937; Williams, 1938; Leonardos, 1956 and Rocha Ferreira, 1968). Guimarães (1955), presented the first chemical data and a more detailed account of the petrographic aspects of the Mata da Corda rocks, characterizing their alkaline-ultrabasic affiliation, and Ladeira and Brito (1968) and Barbosa (1970) published the first comprehensive regional studies on the Mata da Corda geology and stratigraphy. Ladeira and Brito (op. cit.) emphasized the alkaline character of the tuffs and lavas, describing among them intercalations of volcanic agglomerates with fragments of picritic lava and alkaline rocks such as jacupirangites and nepheline syenites. Following Guimarães (1955) they considered the Mata da Corda rocks as representing the final stages of magmatic differentiation processes that yielded the carbonatite complexes of the region.

The characterization of the kimberlite pipes only started in the late sixties through systematic exploration programmes by SOPEMI (the Brazilian subsidiary of De Beers Consolidated) and by PROSPEC. Barbosa et. al. (1970) refer to small pipes of kimberlitic character in the Fazenda Cascata, Patos de Minas (within the domains of the Mata da Corda fm.) also suggesting that the region's diamond could come from pipes of this type. Since the mid seventies, Barbosa et. al. (1976) and Svisero et. al. (1977, 1979, 1980, 1982 and 1984) recognized numerous kimberlite pipes (e.g. Limeira, Vargem, Santa Clara, Japecanga, Pantano, Poço Verde, Lagoa Seca, Morangá, Indaiá, Santa Rosa, Tamborete, Quartel) presenting the first mineral chemistry data for them. Recently Tompkins and Gonzaga (1989), Gonzaga and Tompkins (1991), and Barbosa (1991) reviewed the diamond geology of Brazil adding important informations of several dozens of (new) kimberlites and kimberlitoid occurrences. They described the presence of diamonds in kimberlites (e.g. Três Ranchos, Cana Verde, Boa Esperança and Fundão) but while Gonzaga and Tompkins take the view that the major potential sources for the region's diamonds are the basal Proterozoic tillites of the Bambui group, Barbosa keeps Rimann's concept of a kimberlite source.

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Field Guide Book.

THE MATA DA CORDA FORMATION

Until the mid seventies the Cretaceous of Minas Gerais was the subject of much conflicting stratigraphy concepts and nomenclature. The proposal set forth by Ladeira et al. (1973) presented solution for most of the conflicts and was, thus, generally followed by recent authors. The concept of the Paranaíba arch, after Costa and Sad (1968) was used to divide the sediments of the Bauru formation in the Paraná basin from those of the Areado and Mata da Corda formations, in the Sanfranciscana basin. The Bauru formation was subdivided into the Uberaba and Ponte Alta facies, the former consisting of tuffs, volcanic derived conglomerates and epiclastic sediments with a greenish "volcanic" matrix, and the later of carbonatic sediments (with fossils of dinosaurs and other reptiles) and conglomeratic limestones. The entirely volcanic Mata da Corda formation had its various members regrouped into the Patos and Capacete facies, the Patos facies being formed by ultramafic/alkaline tuffs and lavas and the Capacete facies by their psammitic and psephitic derivatives. The Mata da Corda formation overlies the lower Cretaceous Areado formation. The Areado formation is subdivided into lacustrine (Quirico), fluvial (Três Barras) and alluvial fan (Abaeté) facies; ventifacts are common within the Abaeté facies and attest the prevailing desertic climatic conditions. Life was sustained by periodic flooding and consisted of a conifer flora and fauna dominated by small fishes and ostracods (Ladeira and Brito, 1968). Widespread phreatomagmatic explosive structures in the Areado formation similar to those described by Lorenz (1987), are consistent with a well-charged water table, despite the desertic climate.

The Mata da Corda volcanic rocks cover an area of 4,500 sq km, from Presidente Olegário, in the north to São Gotardo in the south. They form the top of the Mata da Corda ridge, a 1,100 m high dissected plateau which divides the diamondiferous drainages of the São Francisco river basin from those of the Paranaíba basin, and the butte remnants that stand over the Canastra and Bambui badlands as far east as Coromandel. Preserved crater facies rocks in the Japecanga caldera, close to the axis of the Alto Paranaíba arch, indicate that the Mata da Corda and the Bauru volcanics merge into one another. As a rule, the Mata da Corda/Bauru volcanics are strongly weathered into a characteristic "green ground" that supports intense agriculture. The soil profiles may reach depths of several dozen meters, being often capped and protected from erosion by a hard lateritic crust. Fresh-rocks outcrops are seldom present save along few road-cuts in the Presidente Olegário region and on the steep slopes that border the Mata da Corda tablelands, in the Carmo do Paranaíba region. The Mata da Corda volcanics are closely related to necks, dykes and other small to medium-sized intrusions scattered through out this segment of the Brasilia belt. (see Chapter 1, Part 2).

THE PRESIDENTE OLEGÁRIO REGION

Geology

This region occupies the northern tip of the Mata da Corda plateau, being the site of numerous volcanic centers from which thick sequences of lava and tuffs radiated. These sequences are conformably underlain by white to pink fluvial cross-bedded sandstones of the Areado formation, or by the strongly folded red slates and green siltstones (verdetes) of the Bambui Group. While the Areado sandstone form vertical slopes, the Bambui rocks are the typical lithologies of the dissected valleys. Only two of the volcanic centers have been studied. Barbosa et al. (1970) described a neck of "perovskite-olivine basalt" in association with tuffs of "melteigitic" composition at the Fazenda Cascata in Patos de Minas and Leonardos and Ulbrich (1987), refer to a sequence of intrusive and extrusive ultrabasic potassic rocks along the MG-410 (Patos-Presidente Olegário) road with some characteristics common to madupitic lamproites but with petrographic and chemical convergence towards the kamafugitic-kimberlitic clan (Ulbrich and Leonardos, 1991).

These difficult-to-classify ultrabasic potassic rocks form the borders of a strato-volcano, whose lower strata gently dip towards the central volcanic feeders as in the champagne-glass geometry of lamproitic maars. The volcanic pile reaches a thickness of many tens of meters and consists of a succession of lava flows and pyroclastic rocks varying from ash to lapilli and blocks. The sequence is cut by numerous centimetric to metric dykes of rocks of similar composition and apophyses and dykes of breccia made up by a mixture of well rounded to angular fragments of volcanic and sedimentary material with a salt-and-pepper texture which indicates phreatomagmatic processes.

The lava flows and tuff strata succession of the Presidente Olegário rocks are schematized in the cross-section of fig.1, the intrusive feeder rocks lying on the left side of the figure. Adjacent to it, the regional flat-lying sandstones are strongly disrupted, being vertical or chaotically folded as consequence of their fluidization during the explosive phreatomagmatism that according to Lorenz (1985) accompanies the formation of maars of this nature. A more detailed cross-section of the lava and tuff succession is given in figure 2. Here, the volcanic sequence is marked by three distinct horizons of block-size ejecta up to 1 meter in diameter that overlie graded bedded lapilli tuffs. The block-size rock fragments are formed by two distinct populations: (a) volcanic porphyritic rocks and (b) plutonic rocks with compositions varying from melasyenites to pyroxenites. The above mentioned coarse-pyroclasts horizons are covered by amigdaloidal lavas with vesicles filled by

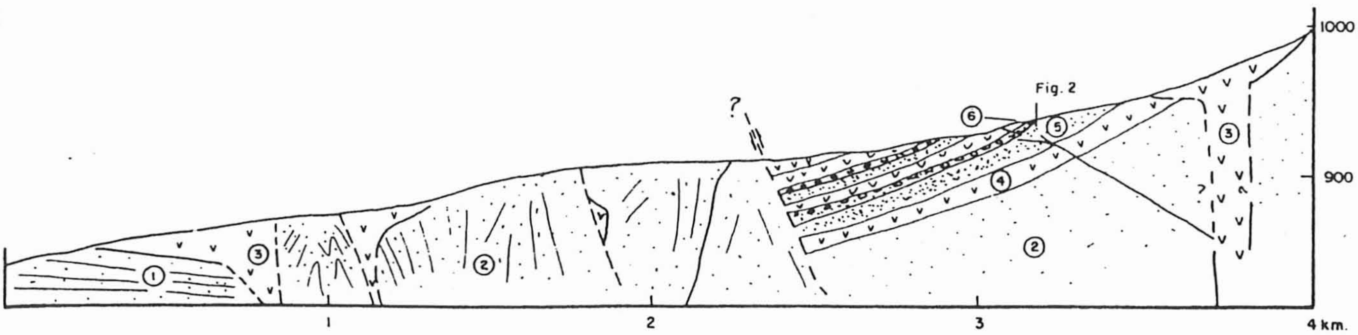

Figure 1 – Schematic cross-section of the Presidente Olegário potassic ultramafic rocks along the road to Patos. (1) flat lying sandstones of Areado Formation; (2) disrupted, fluidized and vertical sandstones adjacent to intrusion; (3) intrusive facies; (4) massive lavas; (5) ash- and lapilli tuffs; (6) horizon of block-sized ejecta; d- dyke.

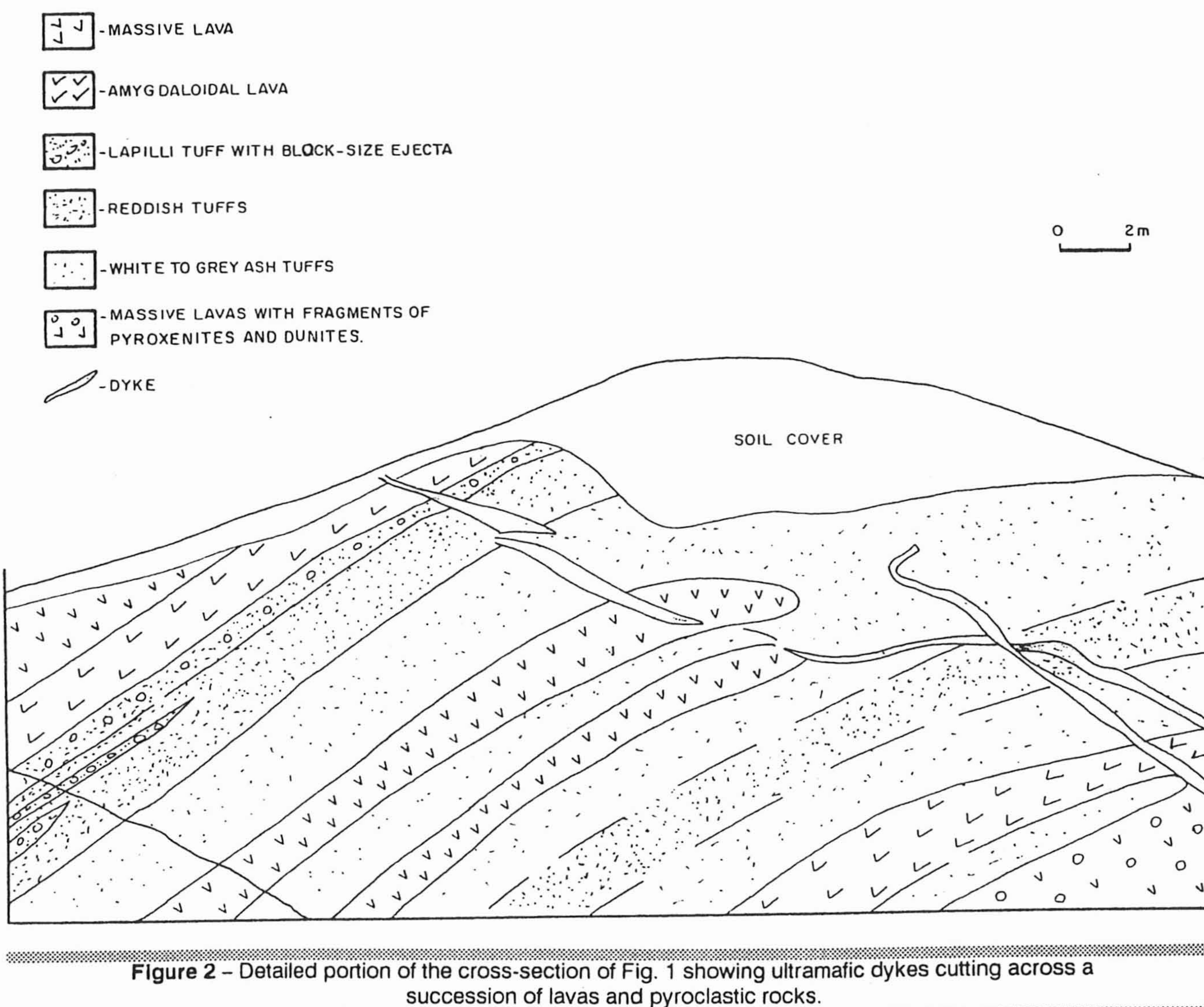

Figure 2 – Detailed portion of the cross-section of Fig. 1 showing ultramafic dykes cutting across a succession of lavas and pyroclastic rocks.

Ba-rich zeolites and calcedony which underlie black to dark green massive lavas with abundant olivine macrocrysts and minor magnetite-perovskite-ilmenite xenocrysts. Below the pyroclastic horizons there is a succession of weathered lavas marked by the presence of abundant xenoliths that resemble the block-sized fragments in the pyroclastic horizons. These lavas can be better observed on the hill slope adjacent to the road cut were fresh outcrops of both massive lavas and fragments of perovskite and magnetite rich "dunites" are available.

MINERALOGY, PETROGRAPHY AND MINERAL CHEMISTRY

The Presidente Olegário rocks are all ultramafic, both lavas and tuffs carrying large round to euhedral olivine phenocrysts immersed in a fine-grained aphanitic matrix. The tuffs are always strongly weathered but original textures are often preserved. Volcanic breccias, ash and lapilli tuffs and crystal tuffs are of widespread occurrence, commonly transformed into green, white and brown nontronitic clay material which after washing yields a heavy concentrate of magnetite, ilmenite, anatase, apatite, minor barite and rare-earth phosphates and sporadic lava fragments.

LAVAS

All lavas have a similar porphyritic texture and essentially the same mineral composition: olivine macrocrysts, minor phlogopite phenocrysts and scattered magnetite-perovskite-ilmenite xenocrysts embedded in a matrix of diopside, phlogopite, richterite, perovskite, magnetite and glass. The matrix shows an intersertal to hyalopilitic textural arrangement of very small pyroxene prisms, often oriented along the magma flux, small euhedral olivine and perovskite grains, poikilitic Ti-phlogopite and ilmenite and aggregates of pink K-Ti-richterite; small spherulites (analcime?, devitrification nuclei?) are locally present. Mg-ilmenite replaces both perovskite and magnetite in the opaque xenocrysts; ilmenite occurs along the fracturing and on the borders of perovskite grains and as broad lamellae within the borders of magnetites. Sporadic very small crystals of a platinum-copper-nickel sulphide were found within magnetite grains. A special internal feature of the lavas is the presence of lighter irregular patches with diffuse contacts that enclose the darker matrix. The border of the olivine crystals show reaction rims of richterite or richterite plus phlogopite, mainly restricted to the lighter patches. Such a feature seems to indicate a potassium and titanium enrichment related to a late-stage magma pulse. The modal composition of the lavas is variable: olivine (20 to 50%); perovskite (10-15%), phlogopite (2-15%), diopside (10-25), richterite (0-10%), magnetite (5-15%), ilmenite (0-15%), apatite (0.5-2%), glass (5-30%), Ba-zeolites/calcedony (0-30%). The chemical composition of olivine, pyroxene, mica and ilmenite and perovskite are given in Tables 1 to 5. The groundmass and phenocrystal micas of the lavas are titanian (5 to 7.5% TiO_2), and Al_2O_3-poor phlogopites (Table 3a) which fall within the field of lamproitic phlogopite, matching particularly well the compositions of the phlogopites from Smoky Butte studied by Mitchell (1985). The amphibole is a titanian

Table 1 – Olivine composition

	(MVOL 3G)	
	A	B
SiO_2	40.7	40.9
FeO	8.84	10.6
MgO	49.01	47.3
CaO	0.36	0.51
NiO	0.33	0.14
Total	99.23	99.45

Table 2 – Pyroxene composition of lavas and nodules

	MVOL	MVOL4				
	3E	(a)	(b)	OL-9	OL-1	OLEG 1C
	(1)	(2)	(3)	(4)	(5)	(6)
SiO_2	52.4	50.9	53.6	51.5	53.4	54.41
TiO_2	2.24	2.50	1.05	1.88	1.13	0.55
Al_2O_3	0.39	2.30	1.63	0.75	0.30	0.18
FeO_T	6.50	6.41	7.59	5.33	3.65	4.21
MnO	0.12	nd	nd	nd	0.08	nd
MgO	14.50	13.3	13.1	15.8	16.9	15.34
CaO	23.2	23.4	22.0	23.6	23.1	24.31
Na_2O	0.96	0.60	1.02	nd	0.52	0.39
K_2O	0.07	0.03	0.06	0.21	0.08	0.92
Total	100.38	99.44	100.05	99.07	99.16	99.39

Table 3.a. – Phlogopites from the lavas

	M3G1	M3G2	M3G3	M3G4C	M3G5	OL81	OL82	OL84
SiO_2	39.54	41.98	41.65	42.37	42.15	40.75	39.71	39.48
TiO_2	7.36	5.17	6.42	5.65	6.51	6.73	7.82	6.52
Al_2O_3	9.15	8.82	9.45	7.67	8.43	9.04	9.30	10.44
Cr_2O_3	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
FeO	7.52	6.76	6.29	7.24	7.75	7.95	9.10	7.39
MnO	0.04	0.08	0.02	0.04	0.00	0. 00	0.08	0.09
MgO	20.41	22.01	20.71	22.54	21.85	19.69	18.78	20.64
BaO	1.39	1.11	1.26	0.25	0.40	1.41	1.79	2.26
CaO	0.02	0.02	0.12	0.00	0.00	0.00	0.03	0.18
Na_2O	0.36	0.66	0.53	0.73	0.55	0.52	0.32	0.32
K_2O	9.30	9.83	10.12	9.35	9.47	9.91	9.68	9.76
Total	95.08	96.44	96.57	95.83	97.12	96.00	96.61	97.08

	OL85C	OL85R	MU3E	OL1	OL9P	OL9M	OL8B	MU3GB
SiO_2	41.58	40.92	41.80	40.60	39.50	40.20	40.80	40.60
TiO_2	6.88	7.03	4.64	5.96	6.61	7.50	5.43	6.05
Al_2O_3	8.72	8.85	7.24	8.19	10.30	9.46	7.44	8.75
Cr_2O_3	Nd	Nd	0.01	0.03	Nd	Nd	Nd	Nd
FeO	7.97	8.33	7.35	7.22	8.48	8.96	9.18	7.75
MnO	0.04	0.12	0.05	0.05	Nd	Nd	Nd	Nd
MgO	19.86	19.54	21.50	20.90	21.10	20.50	20.90	22.10
CaO	0.04	0.00	0.15	0.22	Nd	Nd	Nd	Nd
Na_2O	0.63	0.70	0.79	0.66	0.24	0.25	0.25	0.24
K_2O	9.96	9.91	10.01	9.73	8.74	9.35	9.45	9.32
Total	96.47	96.40	94.37	95.29	94.97	96.22	93.45	94.81

Table 3b – Biotites from the nodules

	O101	O102C	O102R	O103	O104	O105C	O105R
SiO_2	39.17	38.35	39.13	40.05	40.58	40.61	41.02
TiO_2	1.88	1.76	1.54	0.60	0.21	0.13	0.17
Al_2O_3	6.46	7.09	7.07	5.80	5.51	5.86	5.35
FeO	21.72	21.39	20.29	19.75	18.35	19.58	18.82
MnO	0.62	0.48	0.48	0.60	0.62	0.55	0.59
MgO	16.77	16.90	17.19	19.02	19.62	19.08	20.39
BaO	0.00	0.16	0.13	0.09	0.07	0.04	0.00
CaO	0.03	0.00	0.11	0.08	0.10	0.08	0.00
Na_2O	0.08	0.03	0.07	0.08	0.03	0.10	0.00
K_2O	9.60	9.84	9.54	9.24	9.85	9.61	9.31
Total	96.32	95.99	95.55	95.30	94.93	95.64	95.65

	O106C	O106R	O1A1C	O1A2C	O1A2R	O1A3C	O1A3R
SiO_2	39.52	41.18	39.27	41.70	42.30	39.68	40.05
TiO_2	0.21	0.12	0.35	0.21	0.13	0.75	0.58
Al_2O_3	5.32	6.21	6.80	7.49	6.75	6.96	6.80
FeO	20.32	18.09	19.00	14.54	14.31	21.13	20.67
MnO	0.63	0.51	0.67	0.70	0.73	0.76	0.65
MgO	19.11	19.75	18.31	21.00	21.49	18.04	17.59
BaO	0.26	0.09	0.04	0.14	0.00	0.11	0.00
CaO	0.90	0.11	0.01	0.21	0.01	0.01	0.16
Na_2O	0.07	0.10	0.12	0.49	0.10	0.05	0.04
K_2O	8.97	9.08	9.73	9.57	10.33	9.69	9.83
Total	95.33	95.25	94.30	96.05	96.15	97.19	96.37

potassian richterite (partial analysis: MgO-20.31; Al_2O_3-1.36; K_2O-5.06; Na_2O-6.73; TiO_2-3.39; FeO_T-4.14) with a composition characteristic of madupitic lamproites (Mitchell, 1985). At the same time, the ilmenites associated with the amphibole have high MgO values typical of kimberlitic ilmenites.

PYROCLASTIC COARSE LAPILLI AND BLOCKS

The fine-grained volcanic porphyritic rocks within the coarse lapilli block-sized pyroclastic horizons are mineralogically different from the above described lavas. Besides olivine macrocrysts they exhibit euhedral tabular phenocrysts of weathered melilite (?) (up to 10-30%) and nodules of fine-grained pyroxenites.

On the other hand the coarse-grained plutonic fragments within the same horizons are less abundant tham the above ones. They can be subdivided into mela-syenites and pyroxenites (bebedourites) according to the amount of pyroxene they carry. Both rocks have the same mineralogy: pyroxene (20 to 60%), garnet (5 to 50%), biotite (5 to 20%), Ba-orthoclase (10 to 25%), apatite (2 to 15%), perovskite (5 to 20%) and magnetite (2 to 20%). The highly variable mineral proportions reflect the strong magmatic layering and individual mineral concentrations which can be observed in both thin-sections and hand-specimen. The pyroxene is a colorless (An.6, Table 2) Fe-poor member of the diopside-hedenbergite series with a slight Fe-enrichment on the green outer rim of the crystals. The garnet is a brown variety of andradite with melanitic centers (CaO-33.34; MgO-0.32; Al_2O_3-0.50; Fe_2O_{3T}-27.66; TiO_2-2.37) and schorlomitic borders (CaO-33.25; MgO-0.84; Al_2O_3-0.23; Fe_2O_{3T}-24.02; TiO_2-13.25). Contrary to the lavas, the nodules carry Ti-poor, Fe-rich biotites (Table 3b), entirely different from the titanian phlogopites (Table 3a). Ba-rich K-feldspar with up to 7% BaO is the only felsic mineral. Apatite, perovskite and magnetite are scattered throughout the rocks but can be strongly concentrated in the darker feldspar-free layers. Wadeite is present in accessory amounts.

The perovskite dunite fragments consist of cumulitic olivine (serpentine) with interstitial perovskite, magnetite and minor pyroxene. Both perovskite and magnetite can be locally in excess of 30% of the total rock.

Table 4 – Perovskite composition

	MVOL 4b	OL-9b*	OLEG-1C
SiO_2	0.42	0.75	0.25
Al_2O_3	0.93	0.40	0.00
CaO	38.98	39.82	40.24
TiO_2	54.94	49.53	56.27
Fe_2O_{3T}	1.86	1.59	0.95
MgO	0.01	0.35	0.01
K_2O	0.08	nd	0.01
Na_2O	0.02	nd	0.50
Total	97.47	92.45	98.23

* partial analysis, REE detected but not analyzed.

Table 5 – Ilmenite composition

	MUOL 4a	MUOL 4b
SiO_2	-	0.65
TiO_2	50.33	51.00
Al_2O_3	-	-
Cr_2O_3	-	-
Fe_2O_3	8.44	5.86
FeO	34.30	37.47
MnO	nd	nd
MgO	6.06	5.13
CaO	0.12	0.02
Total	104.40	100.13
#Si	-	0.02
#Ti	0.92	0.93
#Al	-	-
#Cr	-	-
$\#Fe^{+3}$	0.15	0.11
$\#Fe^{+2}$	0.70	0.76
#Mn	-	-
#Mg	0.22	0.19
#Ca	0.00	0.00
Cations	2.00	2.00
#O	3.00	3.00

BULK CHEMISTRY

Selected bulk chemical analysis of the Presidente Olegário lavas are reproduced in Table 6. They are Ti-rich ultrabasic potassic rocks with high amounts of incompatible elements, particularly barium. Major element chemistry is generally consistent with that of kamafugites according to the classification proposed by Foley et al. (1987), but in the CaO vs Al_2O_3 and CaO vs SiO_2 diagrams these rocks fall in a transition field between group 1 (lamproites) and group 2 (kamafugites). REE distribution curves for the Presidente Olegário lavas support the idea that they might be the volcanic equivalents of the kimberlite-like intrusions in the Alto Paranaíba province (see Chapter1, Part 2).

OTHER OCCURRENCES IN NEARBY REGIONS

Recent studies of the volcanic rocks of the Mata da Corda formation have also been carried out in the region of Lagoa Formosa and Carmo do Paranaíba, in

Table 6 – Selected chemical analysis of Presidente Olegário massive lavas (after Ulbrich and Leonardos, in press).

Sample	3G	3G1	87–04		3G	3G1	87–04
	wt%				ppm		
SiO_2	39.1	37.2	38.9	Ba	10748	11644	11656
TiO_2	6.0	6.6	6.5	Rb	150	150	160
Al_2O_3	5.6	5.3	5.0	Cs	n.a.	< 10	< 10
Fe_2O_3	8.6	5.9	6.1	Sr	1250	1310	1650
FeO	4.67	6.8	7.0	Zr	710	790	800
MnO	0.19	0.18	0.17	Nb	200	192	33
MgO	17.1	18.4	15.0	Y	30	38	62
CaO	10.1	10.6	11.6	V	200	n.a.	n.a.
Na_2O	0.75	0.81	0.56	Cr	752	570	650
K_2O	2.3	2.2	1.7	Co	n.a.	80	66
P_2O_5	0.47	0.5	0.49	Ni	338	440	270
H_2O^+	3.05	3.73	4.67	Cl	< 20	110	93
CO_2	0.6	0.3	0.45				
S	0.07	0.08	0.05	La	173	153	183
F	0.24	0.21	0.19	Ce	348	294	340
rest	1.73	1.83	1.86	Nd	154	147	168
				Sm	23.4	19.2	28.86
less O = F,S	0.14	0.13	0.10	Eu	5.5	4.24	5.15
				Gd	13.4	10.98	13.46
sum	100.43	100.21	100.14	Dy	6.2	4.8	6.05
				Ho	1.0	0.7	1.01
#mg*	0.74	0.76	0.72	Er	2.0	1.52	2.40
(Na + K)/Al	0.66	0.70	0.55	Yb	1.0	0.91	1.09
K_2O/Na_2O**	2.0	1.80	2.0	Lu	0.13	0.10	0.18

* #mg = $Mg/(Mg + Fe^{2+})$ calculated with Fe_2O_3/FeO ratio of 0.2; ** molar ratio; n.a. = not analyzed;
Analyst: C. Dutra, GEOLAB, Belo Horizonte, Minas Gerais, Brazil.

the south portion of the Mata da Corda plateau. Moraes et al. (1986) described pyroclastic breccias, tuffs and lava flows of olivine and phlogopite mela-leucitites and kimberlite dykes and pipes. Bulk chemical analyses were provided by Moraes et al. (1987), who concluded that these rocks have some intrinsic characteristics of their own, despite the suggested affinity with kamafugitic rocks. Seer et al. (1988), after presenting additional petrographic data, state that further geochemical studies are needed in order to characterize these rocks. Seer et al. (1989) presented a detailed field guide for the region, with the precise location of relevant outcrops of both intrusive and extrusive alkaline rocks of the Mata da Corda formation and described dykes and pipes of kimberlitic rocks. Sgarbi and Valença (this conference) report, from a region near Carmo do Paranaíba, ultrabasic lavas varying from ultramafitites to kalsilitites consisting of olivine, diopside, perovskite, Ti-magnetite, melilite, apatite and phlogopite embedded in a groundmass with abundant kalsilite and leucite. Those rocks vary from potassic, Mg-richer and moderately alkaline terms to ultrapotassic, Mg-poor and strongly alkaline terms and they have an unquestionable kamafugitic affinity.

The Mata da Corda volcanics are also found west of the Mata da Corda plateau in butte remnants elsewhere in the Alto Paranaíba region, such as near Pantano, Coromandel and Japecanga. These volcanic remnants link the Mata da Corda formation with the Bauru volcanics of similar composition that outcrop in Romaria, Uberaba and Sacramento. The strongly weathered nature of these rocks have so far prevented further investigations.

ECONOMIC POTENTIAL OF THE MATA DA CORDA VOLCANICS

Diamond

Recent alluvial diamonds occur on both sides of the Mata da Corda plateau, a dividing ridge between the Paranaíba and São Francisco river basin. The Indaiá, Borrachudo, Areado, Tiros and Abaeté rivers in the eastern side and the Paranaíba, Santo Antônio, Santo Inácio, Dourados, Bagagem and Quebra-Anzol rivers in the western side, are all diamondiferous. Many millions carats of diamond have been recovered since the early eighteenth century. For nearly two centuries this region was the world's leading producer of larged diamonds, and even nowadays sporadic large stones are being found. Diamonds occur along these drainage systems up to the top of the Mata da Corda plateau such as in the headwaters of the Corrego Gigante (Leonardos, 1956) and Córrego São Bento (Seer et al. 1989). While some of the alluvial diamonds have been traced to the volcanic conglomerates of the Mata da Corda (Bauru) formation, which host the Água Suja mine, the primary source has not been found. Some geologists (e.g. Tompkins and Gonzaga, 1988; Gonzaga and Dardenne, this volume) claim that the main diamond source is the Proterozoic tillite at the base of the Bambui Group, but fail to explain how glacial transport can produce the economic concentrations such as those in Romaria. Following Rimann (1915), we believe that the Mata da Corda volcanics and their intrusive "kimberlitic" counterparts may be an important source for the Alto Paranaíba diamonds.

PLATINUM

The only sulphide mineral found so far in the Mata da Corda volcanics were the small crystals of a platinum-copper-nickel sulphide dispersed in magnetite crystals reported in this study. These sulphides may have given origin to the platinum nuggets that have been occasionally reported in the heavy mineral concentrates of diamond workings which are thought to be formed within the soil profile of the Mata da Corda volcanics.

Despite the early exciting work on the Mata da Corda platinum by Hussak (1906) and of the exploration campaign by the Brazilian Geological Survey sixty years ago (they described platinum average grades of 2 g/ton in the tuffs of Patos, Coromandel and Carmo do Paranaíba), little has been done since then.

TITANIUM AND RARE-EARTHS

The Mata da Corda volcanics are abnormally enriched in titanium and incompatible elements such as the light rare earths, barium and thorium, further enriched in the weathering process forming their residual lateritic products. TiO_2 in excess of ten percent and expected rare-earth values of the order of a few percent indicate ore deposit potential for the Mata da Corda Laterites.

ROCK FERTILIZERS

The potassic to ultrapotassic and magnesium-rich nature of the Mata da Corda volcanics and their high (0.5 to 5%) phosphate values in association with most nutrient minor elements make these volcanic rocks excellent rock fertilizers (Ilchenko, 1955; Leonardos et al. 1976, 1987), eventually to be used in the local agriculture as cheap non-pollutant alternatives to the soluble conventional fertilizers.

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