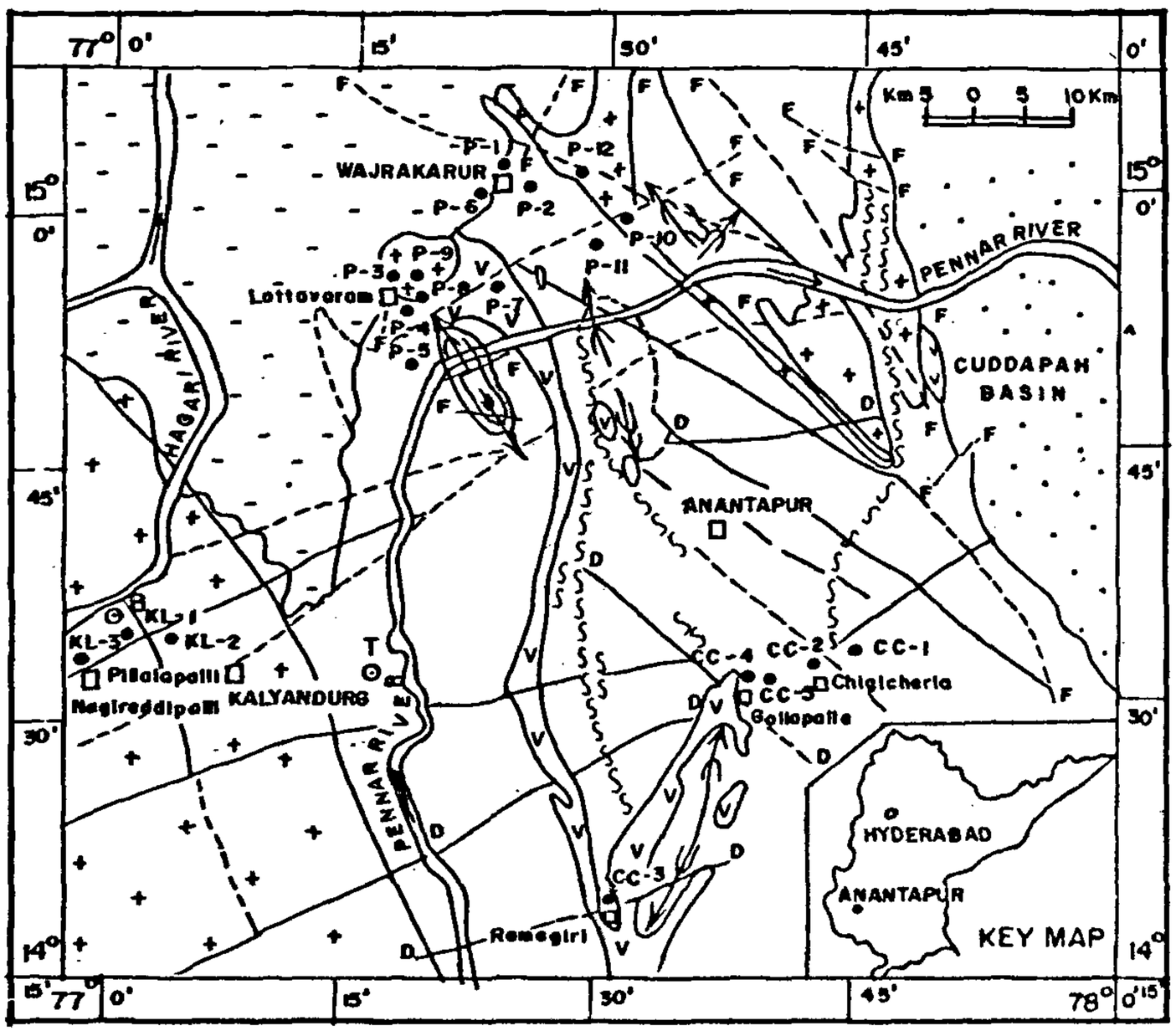
Discovery of diamond-bearing kimberlites in Kalyandurg area, Anantapur district, Andhra Pradesh

Dharwar Craton with two well-known kimberlite fields – the Wajrakarur Kimberlite Field (WKF) in Anantapur district, Andhra Pradesh and the Narayanpet Kimberlite Field (NKF) in the western part of Mahbubnagar district, Andhra Pradesh and the adjoining Gulbarga district, Karnataka, forms a prominent kimberlite province in India. Seventeen known kimberlites of the WKF are distributed mainly in three clusters, viz. (i) The Wajrakarur cluster; (ii) the Lattavaram cluster, and (iii) the Chigicherla cluster and some isolated kimberlite bodies[1]. Ground surveys based on conceptual modelling and characterization of the kimberlite indicator minerals recovered during reconnoitary traverses led to the discovery of a hitherto unknown cluster of diamond-bearing kimberlites around Kalyandurg within the Hagari drainage basin in the southern part of WKF (Figure 1).

The area forms a part of the NNW–SSE trending, 500 km long and 25 km wide zone of post-tectonic granite called Closepet Granite. Two sets of mafic dykes trending NNW–SSE and ENE–WSW intrude the granite. The area is traversed by a number of NNW–SSE faults parallel to the regional trend of the granites and major ENE–WSW trending transverse faults.

Kimberlites, emplaced in the cratonized parts of the earth's crust are essentially controlled by major deep-seated faults/fractures, whose reactivation has a bearing on their emplacement. While these form the regional controls, fault intersections, splay faults around fold closures and resultant fractures form the most ideal local controls for kimberlite emplacement[2,3]. The kimberlites of WKF were emplaced around 1100 m.y. period[4]. Nayak and Burhanuddin[5] related the emplacement of kimberlites, in Eastern Dharwar craton to the reactivation of major crustal fractures around 1100 m.y. period.

A conceptual model, based on the disposition of known kimberlites of WKF in relation to their geological setting and tectonic milieu, supplemented by critical evaluation of the data emerging from study of geological maps, satellite imageries and aerial photographs, was visualized for locating new kimberlites, which envisaged that kimberlite emplacements in this field were controlled by major ENE–WSW faults, passing through the closures of structural domes and reactivated around 1100 m.y period. Intersection of these faults with NNW–SSE faults/fractures formed the favourable loci for kimberlite search. Evidences of reactivation of these faults are recorded in the sediments of the Nallamalai Group of the Cuddapah Basin. Satellite imagery studies indicated that the ENE–WSW faults hosting the kimberlites of WKF extend further west up to the Chitradurga Schist Belt in Karnataka cutting across the Closepet Granite which is believed to have been emplaced along a major NNW–SSE trending fault[6]. The area around Kalyandurg marked by the intersection of these ENE–WSW faults with NNW–SSE trending contact of the Closepet Granite with the gneisses and also faults/fractures parallel to it was considered favourable for kimberlite emplacement.



Base map - After published Geological map (G S I, 1996)

I N D E X

- Black soil
- Kimberlite
- Gabbro/ dolerite dyke
- Closepet Granite and equivalents
- Dharwar suprocrustals
- Peninsular Gneissic complex
- Fault / Fracture
- Shear / Axial Trace of fold
- ⊙ Stream sediment sample locations

B - Bommaganapalli
T - Timmasamudram

Figure 1. Geological map of Wajrakarur Kimberlite Field.

Table 1. Major element chemistry of Kalyandurg kimberlites (KL-1, KL-2, and KL-3) and other kimberlites of Wajrakarur area, Anantapur district, Andhra Pradesh

Oxides	Average kimberlite (Dawson'76)	P-1	P-6	P-7	P-10	KL-1	KL-2	KL-3
SiO_2	35.20	36.59	39.75	26.80	30.34	40.50	10.55	27.61
TiO_2	2.32	1.41	1.49	0.41	0.66	2.95	1.14	4.17
Al_2O_3	4.4	4.44	7.19	4.06	3.74	6.16	1.62	3.07
FeO	9.80(t)	2.42	1.73	4.37	–	–	–	–
Fe_2O_3	–	6.53	4.33	–	6.79	9.45	5.71	13.46
MnO	0.11	0.27	0.55	0.14	0.12	0.15	0.13	0.21
MgO	27.90	22.64	18.10	11.34	20.85	15.69	7.38	24.39
CaO	7.60	9.52	13.72	23.56	16.67	12.46	39.08	12.07
Na_2O	0.32	0.27	0.55	0.05	–	0.30	bld	bld
K_2O	0.98	2.20	1.81	0.04	0.08	1.15	0.03	1.17
P_2O_5	0.70	0.67	0.07	–	1.14	0.21	0.34	0.72
S	–	–	–	–	0.07	bld	bld	0.04
Cr_2O_3	–	–	–	–	0.12	0.07	0.10	0.14
NiO	–	–	–	–	0.07	0.05	0.05	0.09
BaO	–	–	–	–	–	bld	0.05	0.15
LOI	10.70	12.37	10.79	28.67	19.10	10.30	33.21	13.67
Total	95.63	99.33	100.08	99.44	99.75	99.44	99.39	100.96

Analyses: P-1 to P-10 after Rao *et al.*

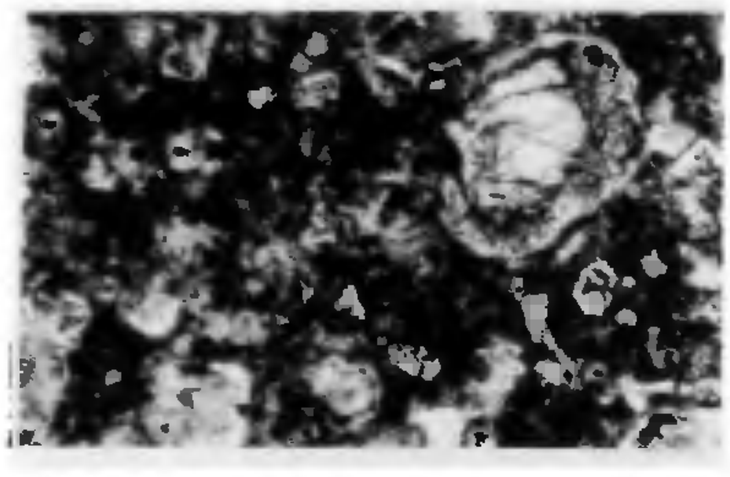


Figure 2. Photomicrograph of pipe KL-3 showing macrocrystal olivine (anhedral) and micro-phenocrystal olivine (euhedral) set in a fine grained groundmass of phlogopite, carbonate opaques and perovskite ppl (120 ×).

Based on this conceptualization, the first author took a few regional geological traverses and collected stream sediment samples in the area around Kalyandurg, mainly in the vicinity of the intersections of the ENE–WSW faults with NNW–SSE faults during 1995–96. Two of the samples collected from confined drainage basins, one near Bommaganapalli and the other near Timmasamudram near Kalyandurg, yielded chrome spinels of kimberlite affinity. Detailed geological traverses in the area south of the indicator mineral location near Bommaganapalli resulted in the discovery of three kimberlite bodies, two near Pillalapalli (KL-1 and KL-2) and one near Nagireddipalli (KL-3) (Figure 1).

Kimberlite KL-1, located about 1 km north of Pillalapalli village, is highly weathered and exposed in a well section and a canal cutting. Rest of the body is covered by about 2 m thick alluvium. Hard greenish-black kimberlite (hardebank) was intersected in a bore well. The weathered part exposed in the well section and canal cutting is yellowish-green and is highly carbonated with clearly discernible macrocrystic texture. Pseudomorphs of large rounded and small euhedral to subhedral phenocrysts of olivine are altered to serpentine or iddingsite. Macrocrysts of ilmenite measuring 1–2 cm are seen. In thin sections it shows typically inequigranular, brecciated texture with large rounded macrocrysts of olivine and ilmenite in a fine grained groundmass consisting of mainly euhedral to subhedral olivine, opaques, calcite, phlogopite, perovskite, diopside and garnet. Opaques are mainly ilmenite, magnetite and chromite. Perovskite is mostly associated with opaques. Panned concentrates of this rock indicated the presence of ilmenite, spinel, chrome diopside and garnet.

Kimberlite KL-2, located about 3 km east of Pillalapalli is capped by calcrete with a distinct tonal difference from the surrounding reddish-brown granitic soil. Calcretized kimberlite fragments consisting of olivine pseudomorphs, ilmenite, chromite and chrome diopside are seen in the calcrete capping. Olivine is completely replaced by carbonate. Macrocrystal ilmenite measuring about 1 cm is common. In thin section, the kimberlite shows an inequigranular texture with pseudomorphs of large rounded olivines in a fine grained groundmass consisting of pseudomorphs of euhedral to subhedral olivine, opaques, clinopyroxene, phlogopite and perovskite. Opaques are ilmenite and chromite. Heavy mineral assemblage includes garnet in shades of lilac, mauve and orange-red, spinel, ilmenite, chrome diopside and corundum.

Kimberlite KL-3, located about 1 km north-west of Nagireddipalli, comprises both weathered kimberlite and hardebank kimberlite. The body is covered by a calcrete capping with the hardebank variety occurring as a few small, detached outcrops. The hardebank variety is melanocratic and inequigranular with large rounded grains of olivine and ilmenite and country rock fragments in a fine-grained groundmass imparting a brecciated texture to the rock. In thin sections, it shows large rounded macrocrystal olivine and ilmenite in a fine-grained groundmass consisting of mainly euhedral to subhedral olivine, clinopyroxene, perovskite, phlogopite and opaques (Figure 2). The opaques are ilmenite, magnetite and chromite. The olivine is altered to serpentine and calcite. Panned concentrates of this

body yielded ilmenite, spinel, chrome diopside and garnets. Some of the ilmenite macrocrysts are seen coexisting with clinopyroxene.

Chemically the three kimberlite bodies are typically undersaturated in SiO_2 and are comparable with pipes 1, 6, 7 and 10 of WKF (Table 1). These kimberlites fall in the classical kimberlite field of Bergman[7] in the ternary plots involving Al_2O_3–FeO–MgO and K_2O–MgO–Al_2O_3.

Preliminary studies indicated the presence of mantle nodules comprising garnet harzburgite, garnet lherzolite, diopside lherzolite and kyanite eclogite which range from a couple of cm to as large as 8 cm in diameter. While the pipe KL-1 yielded garnet lherzolite and garnet harzburgite nodules, pipe KL-2 yielded kyanite eclogite and garnet lherzolite nodules.

Panned concentrates of about 50 kg of kimberlite material from pipe KL-2 yielded one micro diamond – a white broken chip with cleavages – thus establishing the diamondiferous nature of this kimberlite body. These are the first kimberlites recorded in the Hagari drainage basin. It is quite likely that these kimberlite bodies constitute part of a major cluster forming the primary source for the large diamonds being picked up by local villagers around Kalyandurg and also in older gravel patches in the Hagari River basin.

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