

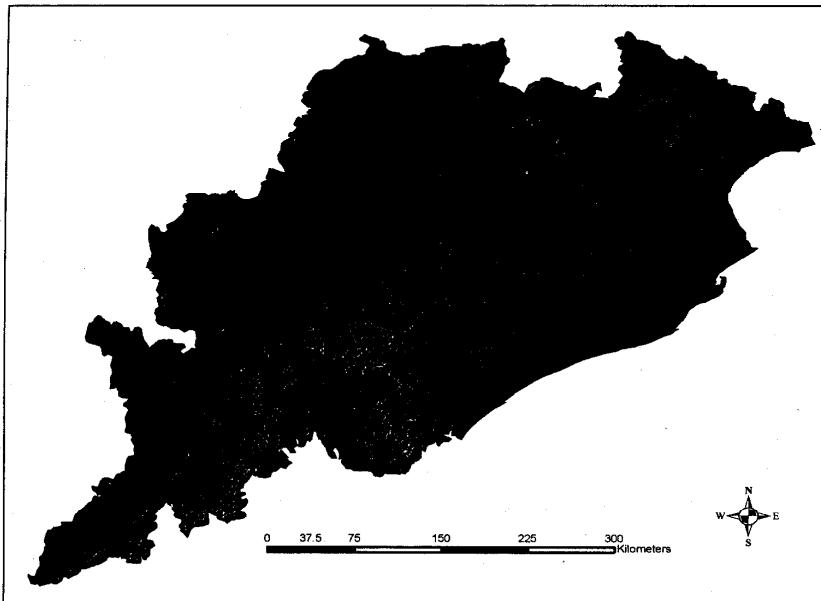
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A DIAMOND IS FOREVER

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**Closing Report on Reconnaissance Permit  
7495/IV (GD) SM 4/2000 Orissa**

Report for the period  
16/02/05 to 15/08/07



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**DE BEERS INDIA PRIVATE LIMITED**

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**1. Reconnaissance Permit (RP) Status**

The RP is 2000 km<sup>2</sup> in extent and was executed at Bhubaneswar on 15<sup>th</sup> February 2005. As per rule 7(i) (a) of MCR 1960, it is scheduled to be reduced by 50% on or before 14<sup>th</sup> February 2007. Already 452 sq km area falling in reserved forest area was relinquished on 7<sup>th</sup> Nov 2005 to retain 1548 sq km. A total of 1258 sq km was relinquished on 20<sup>th</sup> July 2006. Subsequent to this the entire area was relinquished on 15<sup>th</sup> August 2007 (Map 1). This report summarizes the exploration work carried out in the total area of 2000 sq km till date. ✓

**2. Geology and Geomorphology of the RP area**

The Bhandara Craton is rectangular in shape and bounded by the Mahanadi Rift in NE, the Godavari Rift in SW, Narmada Rift to the NW, and the NE-SW trending Eastern Ghat Mobile Belt on the SE.

The Eastern Ghat Mobile Belt is juxtaposed with the Archean craton along a ductile thrust with a northwesterly thrust movement. This shear zone is characterized by south-easterly dipping mylonitic foliation and a down-dip stretching lineation (the L-S fabric of mylonites).

Geologically the RP area consists of the eastern margin of the Bhandara Craton with a complex lithological association of basic intrusive rocks, granitoids, supracrustal rocks and unmetamorphosed Late Proterozoic sediments in the west and the Eastern Ghat Mobile Belt in the eastern side with high grade metamorphic rocks (Map 2).

Uncertainty and unavailability of precise age data of the rocks have resulted in varied interpretations and correlations attempted by different workers. A simplified stratigraphic succession of the Bhandara Craton is presented below. The Sukma and Bengpal metamorphic rocks are possibly the oldest Mesoarchaeon sequences of this region. The relationship of the precursors of the trondhjemitic gneisses (3.56 Ga) with the Sukma and Bengpal sequence is debatable from being a probable intrusive to being basement.

The Sukma supracrustal rocks consists of high grade metamorphosed orthoquartzites, carbonates and pelites in association with prominent iron formations and subordinate mafic ultramafic rocks. The Bengpal Group overlies the Sukma metamorphics with an unconformity and consists of amygdular metabasalts and andalusite-chlorite schist which are overlain by conglomerate and quartzites.

However, Ramakrishnan (1990) assigns Palaeoproterozoic ages (2.5Ga and 2.3Ga) for the Sukma metamorphics and Bengpal Group.



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The Bailadila Group overlies the Bengal Group with an unconformity and is composed of feldspathic quartzites, chloritic phyllite and banded iron formations.

The Eastern Ghat Mobile Belt is recognised as an accreted terrain with high-grade metamorphic rocks. The major mappable units are mafic schists, quartz-feldspar-hypersthene granulites (chamockites), sillimanite-garnet-cordierite-sapphirine-schist and gneisses (metasediments locally known as khondalites) also the Calc-silicates, mafic granulites, leptynites (leucocratic quartz-feldspar-garnet gneiss), intrusions of anorthosite, gabbro, norite, dunite and serpentinite with chromite, and alkaline rocks. Most of these rock suites have been subjected to three or four deformational events and with a large number of shear zones cutting across them, and together comprise the Khariar-Angul Metapelite Complex of the Sukma Group.

Late Proterozoic detached basins containing unmetamorphosed sediments overlie the Archaean rocks of the Bhandara Craton. There are two major and six minor basins in the Craton. Two smaller basins, the Neogarh-Khariar (Nawapara-Kharihar) and the Ampani Basins are located within the RP area.

The Khariar Basin is composed of an alternating sequence of sandstones and shale and is equivalent to the Chandrapur Group of the Chhattisgarh Basin.

The Ampani Basin forms an outlier south of the Khariar Basin and is composed principally of conglomerates, sandstones, siltstones, purple shales and calcareous intercalations. The rock association resembles the Chandrapur Group of the Chhattisgarh Basin and the Tirahgarh Formation of the Indravati Basin.

**Simplified stratigraphic succession of the Bhandara Craton**

Chhattisgarh Supergroup	Un-metamorphosed Sediments	Upper Proterozoic
~~~~~	Unconformity	~~~~~
Basic Dykes	Dolerites, Amphibolites	
~~~~~	Unconformity	~~~~~
Bailadila Group	Banded Iron Formation, Phyllites with chert and local conglomerates	ca. 2.9-2.5 (Bandhopadhyay et al 1995). ca. 2.1 Ga (Ramkrishnan 1990)
~~~~~	Unconformity	~~~~~
Bengal Group	Amygdular metabasalt, andalusite schist and quartzite	ca. 2.9-3.5 (Bandhopadhyay et al 1995). 2.3 Ga (Ramkrishnan 1990)
~~~~~	Unconformity	~~~~~
Sukma (Group ?) metamorphic suite	Sillimanite quartzite, cordierite anthophyllite rocks, Banded Iron Formation	ca. 2.9-3.5 (Bandhopadhyay et al 1995). ca. 2.5 Ga (Ramkrishnan 1990)
~~~~~	Unconformity	~~~~~
	Basement Gneiss (TTG)?	3.56 (?): Zircons of tonalites by U-Pb method.



The RP area is within the drainage basins of the Lant, Chilant and Sundar Nadi which joins with Tel River ( a tributary of the River Mahanadi) out side the RP area (Map 3). The western part of the RP comprises elevated plateaus rising to over 700m. Below is a gently sloping plain falling from approximately 330m in the northwest, to 220m in the southeast. Isolated hills in the north and central area rise to over 750m above the plain.

The western plateau comprises sandstones of the Khariar Basin, whilst the plains are underlain by metapelites of the Sukama Group.

### **3. Activity during the period (16/02/05 to 15/08/07)**

#### **3.1 Reconnaissance Sampling**

A total of 129 reconnaissance stream/loam samples were collected from the RP.

Stream samples comprised 75 litres of unscreened material, collected from natural heavy mineral trapsites and field screened to -2.0mm.

Loam samples comprise 30 litres of material collected from surface in interfluves.

Reconnaissance sample localities and information are shown in Map 4 and Table 1.

The samples were processed at De Beers heavy mineral treatment plant in Bangalore, and the concentrates were consigned to the Bangalore Mineralogical Lab, India for further processing and sorting.

#### **3.2 Reconnaissance Sampling Results**

Results for all the samples were received and 49 samples were reported positive with respect to kimberlitic indicator minerals (Map 5 and Table 2). A total of 1 Ilmenite and 1090 spinels were reported.

#### **3.3 Rock Samples**

A total of 28 rock samples were collected for heavy mineral extraction and whole rock geochemistry and the results are not encouraging. The whole rock geochemistry of the rock samples suggests that they are of ultramafic affinity. (Map 6 and Table 3).

#### **3.4 Airborne Hyper spectral Scanner Survey**

An airborne survey utilizing De Beers's proprietary Hyper Spectral Scanner technology was completed during March 2005 (Map 7). The system works by measuring reflectance of narrow wavelength bands of sunlight reflected from the Earth's surface. Different minerals (as well as other materials) absorb different wavelengths of light to varying degrees. The



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Airborne Hyper spectral scanner Survey system is sensitive enough to actually distinguish some specific types of minerals by the absorption of certain wavelengths of light detected. In the search for kimberlites, the system is configured to look for the presence of magnesium-rich clay minerals, derived from the weathering of ultramafic rocks. There were 19 anomalies selected for field follow-up (Map 8)

Follow up of the survey involved field visits of anomalies and identification of the causative lithological units to conclude whether the source of the anomaly is kimberlitic or not. A total of 18 anomalies were visited (Table 4 and Map 9). Samples were collected from surface material for PIMA (Portable Infra-Red Mineral Analyses) to confirm the causative material.

Detailed sheets of Airborne Hyper spectral scanner survey anomalies followed up are attached as Appendix 1.

### **3.5 Airborne Geophysical Survey**

The Airborne Magnetic survey data were acquired from DMG Orissa for the RP area. The results were processed and interpreted.

Based on the response, a few Aeromagnetic anomalies were identified (Map 10) and followed up with ground geophysical surveys.

### **3.6 Ground Geophysical Survey**

#### **3.6.1 Ground Electro Magnetic Survey**

Two anomalies were followed up with ground electro magnetic survey using a GEM-2 EM Meter (Table 5 and Map 11).

Detailed sheets of anomalies followed up with Electro Magnetic ground survey are attached as Appendix 2.

#### **3.6.2 Ground Magnetic Survey**

Fifteen anomalies were followed up with ground magnetic survey using a Proton precision magnetometer (Table 6 and Map 11).

Detailed sheets of Magnetic anomalies followed up with ground survey are attached as Appendix 3.

#### **3.6.3 Ground Gravity Survey**

Two anomalies were followed up with ground gravity survey using CG-5 gravimeter (Table 7 and Map 11).

Detailed sheets of anomalies followed up with ground gravity survey are attached as Appendix 4.



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### 3.7 Drilling

A total of 4555 meters in 111 holes were drilled to test the geophysical anomalies and Air-borne Hyper spectral anomalies (Table 8 and Map 12).

Detailed sheets of borehole logs are attached as Appendix 5

### 4. Occurrence

Eight of the AHS anomalies are proved to be lamproites and detailed drilling and sampling of the lamproites were carried out. However these occurrences proved to be of relatively small size and of low interest mineral chemistry (Map 13 and Table 9).

### 5. Interpretation

Based on the results received for various techniques used in exploration of this RP, the western portion has been identified as having the most potential for the discovery of a diamond bearing body. This area was retained in order to carry out further exploration. However further studies carried out in this area could not establish the existence of a mine able ore body of significant size and diamond content. Hence the entire RP was relinquished (Fig 1 – 10 and Map 1).

### 6. Personnel

Name	Designation	Education
K.V.Suryanarayana Rao	Project Manager	M.Sc. Tech-Applied Geology
Krishna Pande	Staff Geologist	M.Sc. – Applied Geology
Chandan kumar	Staff Geologist	M.Sc. – Applied Geology
K.V.Praveen Kumar	Staff Geologist	M.Tech-Remote Sensing
Prashant Laharia	Geologist(on contract)	M.Sc Tech Geology
Sukhbinder Sharma	Geologist(on contract)	M.Sc Geology
Sudipta Sarkar	Geologist(on contract)	M.Sc. Tech-Geology
Rekha K.R.	KimberliticMineralAnalyst	M.Sc Geology
Shobha N.	KimberliticMineralAnalyst	M.Sc. Geology
Sanjay Deogiri	IT Manager	B.Sc. Electronics, MCSE
Rina David	SHE Officer	Graduate
Girish Menon	Security Adviser	Grade 12
Gajanana Naik	Treatment Plant Supervisor	Graduate
R.Shrinivasalu	Field Assistant	Grade 10
Venu Kumar	Field Driver	Grade 12
A.Channaiah	Field Driver	Grade 10
Rajanna	Field Driver(on contract)	Grade 10



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Labours

Labourers were employed on a daily basis from local towns and villages to help with the field work

**7. Training**

De Beers maintains high operating standards including safety and environmental awareness. To this end, training is an integral part of career development with the organization. The following is a short summary of training completed during reporting period.

All Earth scientists, field assistants and field drivers attended a training program on Crisis Management to deal emergency situation related to safety and security in the field.

An HIV/AIDS awareness programme was conducted for the entire field based staff.

The drivers attended a training course on Defensive Driving and Road Safety conducted by the Automobile Association of Southern India.

All field drivers attended training on vehicle maintenance conducted by Mahindra & Mahindra.

Earth Scientists attended training on new mineral classification scheme.

All field geologists attended a training program on First Aid conducted by International SOS.

Earth scientists attended a programme on Arc SDE and Arc GIS to hone their skills in Database management.

Earth Scientists also attended a programme on Datamine solutions which will enable them to effectively organize data from drilling programmes.

A brief introductory lecture on basic geology was given to field drivers and field assistants.

Earth Scientists attended a programme on XSIMS database management.

Earth Scientist completed a sort time assignment for drilling and petrology training in Canada and South Africa.

**8. Expenditure**

Total expenditure of Rs. 24,423,651 has been incurred for the Reconnaissance Permit to date. The expenditure was incurred as follows:

Capital expenditure: Rs. 2,156,845

Revenue expenditure: Rs. 22,266,806



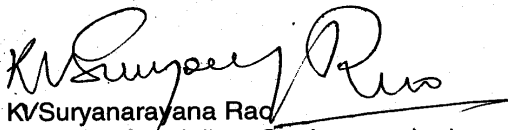
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**9. References**

Bandyopadhyay, B. K. Roy A. Jain A. K. 1995: Structure and Tectonics of a part of the Central Indian Shield: In Continental crust of north-western and central India. Sinha Roy S, Gupta K. R. (Eds) Geol Soc India, Mem 31, 433-468.

Ramakrishnan M 1990, Crustal development in southern Bastar, Central Indian Craton. In Precambrian of central India Geol, Surv, India Spl Publ. No 28 44-66



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