

# RIO TINTO

CHG-15

## Rio Tinto Exploration India Limited (Previously Known as ACC Rio Tinto Exploration Ltd.)

A member of the Rio Tinto Group

### Final Relinquishment for the Kalnai Reconnaissance Permit. Chhattisgarh, India

December 2006

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## 1 EXECUTIVE SUMMARY

Exploration was initiated by Rio Tinto Exploration India Limited (Formerly known as ACC RIO Tinto Exploration Limited) after execution of the permit over an area of 1000 km<sup>2</sup> located in the Jashpur, Sarguja and Raigarh districts of Chhattisgarh on December 19<sup>th</sup> 2003. In accordance with the provisions of MMDR Act, 500 km<sup>2</sup> areas are retained by the company at the end of 2<sup>nd</sup> year of RP. Subsequently the balance area was fully relinquished on 28 September 2006, 3 months prior to the 3-year tenure of the RP. Regional reconnaissance indicator mineral sampling from stream gravels (124 samples) completed over the entire RP areas returned few pyrope garnet, chromite, micro ilmenite and chrome diopside but no kimberlite was discovered. SEM analysis of major oxide mineral chemistry was completed on over 2332 of these indicator mineral grains. In addition, analysis of over 124, -80 mesh stream sediment samples collected from each of the first pass reconnaissance indicator mineral sample sites indicated no significant potential for base metals or precious metal mineralization in the area.

Given the low tenor of indicator mineral anomalism, consequent low prospectivity for kimberlite / lamproite occurrences and the lack of evidence for precious or base metal mineralization, airborne geophysical surveys over this permit area are not warranted in this area and have not been undertaken. Relinquishment of the RP Prior to the 3-year tenure was mainly on account of inaccessibility of the area due to Naxalite activities.

## 2 INTRODUCTION

This is the final relinquishment report detailing all exploration completed by Rio Tinto Exploration India (Formerly known as ARTE) within our 1,000 km<sup>2</sup> Kalnai reconnaissance permit in the three years of operation. A summary of exploration activities is given in Table 1. This report compliments previous biannual reports including:

- ACC Rio Tinto Exploration Limited (September 2004); 1st Bi-annual Progress Report for Exploration of the Kalnai Reconnaissance Permits For the period 19/12/2003 to 18/06/2004.
- ACC Rio Tinto Exploration Limited (March 2005); 2nd Bi-annual Progress Report for Exploration of the Kalnai Reconnaissance Permits For the period 19/06/2004 to 18/12/2004.
- ACC Rio Tinto Exploration Limited (September 2005); 3rd Bi-annual Progress Report for Exploration of the Kalnai Reconnaissance Permits For the period 19/12/2004 to 18/06/2005.
- ACC Rio Tinto Exploration Limited (March 2006); 4th Bi-annual Progress Report and Relinquishment Report for Exploration of the Kalnai Reconnaissance Permits For the period 19/06/2005 to 18/12/2005.
- ACC Rio Tinto Exploration Limited (September 2006); 5th Bi-annual Progress Report for Exploration of the Kalnai Reconnaissance Permits For the period 19/12/2005 to 18/06/2006.

All the above reports have been submitted with the relevant government institutions and are further archived with ACC Rio Tinto in Bangalore.

The Kalnai RP area totaling 1,000 km<sup>2</sup> was granted to Rio Tinto Exploration India Ltd. (Formerly known as ACC RIO Tinto Exploration Limited), on the 30<sup>th</sup> June 2003 and subsequently executed on 19<sup>th</sup> December 2003. 50% of the ground was relinquished on 18<sup>th</sup> December 2005 and remaining 50% was relinquished on 28 September 2006. Regional reconnaissance surveys including stream gravel indicator mineral sampling, stream sediment geochemistry sampling, mapping and remote sensed imagery interpretation has been completed over entire permit area. No kimberlite or precious metal or base metal mineralisation is identified anywhere in the RP area. ✓

## Kalnai RP (Jashpur, Sarguja and Raigarh districts):

Granted RP Area km <sup>2</sup>	Date of Execution	First Relinquished RP Area Km <sup>2</sup>	Relinquished Date	Final Relinquished RP Area Km <sup>2</sup>	Final Relinquished Date	Heavy Mineral Samples	Heavy Mineral Chemistry (grains)	Geochemical Samples
1000	19.12.2003	500	18.12.2005	500	28.09.2006	124 gravel	2332	124 stream

Table 1: Summary of exploration completed by RTEI on the Kalnai RP.

### **3 REGIONAL GEOLOGY and PHYSIOGRAPHY**

The regional geology map based on a compilation of published and unpublished GSI geological maps is given in Plan NDbg0651. The geology of the Kalnai RP area is dominated by the Archaean-Proterozoic gneissic complex comprised of quartz-sericite-chlorite schist, phyllite, quartzite, banded quartz tourmaline gneiss, calc-silicate rocks, biotite schist and gneiss, tremolite-actinolite-chlorite-epidote schist, talc-tremolite schist and hornblende schist. The supracrustal and the gneissic rocks are the western continuation of the Proterozoic Chhotanagpur Gneissic Complex. The basement lithologies are overlain by the Permo-Triassic Gondwana sequence in the western part of the RP area. Karharbari Formation and Barakar Formation of Upper Carboniferous to Lower Cretaceous age are the dominant Gondwana stratigraphic units. Paleocene Deccan Traps are present to the northwest of the area. Basaltic traps and Intra Trap sediments can be seen in the Deccan Trap area. The Deccan Basalts are strongly lateritised and bauxitised near Mainpat Plateau in the northwest of the area. The structural trend is easterly in this region.

The permit area exhibits varied topography comprising low hills and ridges with intervening and cross-cutting valleys in the central and eastern parts, high hills and plateau with deep gorges in the northeast and northwest, and low rolling hills in the south-central part.

The area falls at the boundary of the two major river basins including the Mahanadi in the south and the Son in the north. Major rivers in the permit area all drain south into the Mahanadi Basin and include the Mand River, Maini River and Ib River. The drainage pattern is composite in nature with an overall sub-dendritic pattern and local sub-parallel to parallel and trellis pattern indicating structural control.

### **4 RESULTS OF EXPLORATION**

#### **4.1 Geology**

Geological traversing in combination with other exploration activities has found the regional 1:250,000 geological mapping of the GSI to be accurate and sufficient for the interpretation of most of the regional and prospect datasets. Remote sensed geological interpretation and geological traversing integrated with published geological maps from the GSI has been completed over the permit area and presented in plan NDbg0651. Analysis of remote sensed data has not identified any kimberlites or any features that could be attributed to kimberlites intrusion in the RP area.

#### **4.2 Reconnaissance Heavy Mineral Gravel Sampling**

A total of 124 gravel samples were collected from second and third order streams at a nominal spacing of 1 sample per 2.5 to 3 linear km of drainage or one sample per 7 to 9 square kilometers effectively sampling all active drainage areas over entire permit area. This method is considered more effective than airborne geophysical techniques especially in areas of active drainage with minimal laterite development or cover such as mapped in the Kalnai RP.

Each gravel sample comprised approximately 30kg of -1mm sand collected by hand from heavy mineral concentration zones within the active stream sediment bed load. All samples are processed at the company's processing facilities by dense media separation, magnetic and heavy liquid techniques with mineral concentrates manually observed for any potential kimberlitic indicators.

Observation results and major oxide SEM mineral chemistries (table 2 and table 3) identified only minor potentially kimberlitic. The gravel sample details and SEM major oxide results for all heavy mineral indicators are listed in Appendix 1 and Appendix 2 respectively. Gravel sample location details are given in plan NDbg0652

**Table 2:** Summary of indicator minerals from all the samples based on major element oxide SEM data.

	Garnet	Chromite	Ilmenite	Pyroxene
No of grains	268	1079	467	47

**Table 3:** Summary of kimberlitic indicator minerals and positive samples base on major element oxide SEM data.

	Pyrope	Kimberlitic Chromite	Picro Ilmenite	Chrome Diopside
No of grains	2	502	10	0

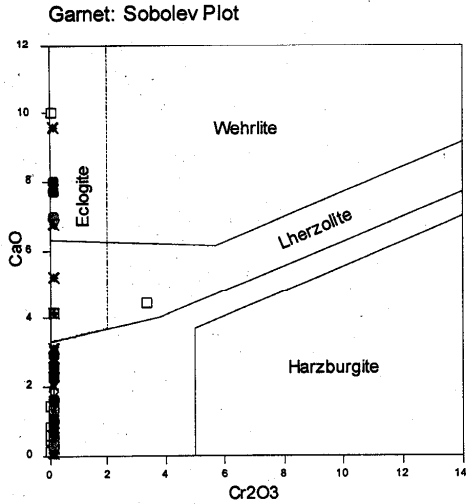
#### 4.2.1 Heavy Mineral Sample Diamond Results

No diamonds were identified during observation of heavy mineral concentrates of samples processed so far.

#### 4.2.2 Heavy Mineral Sample Garnet Results

Only trace garnet grains were identified in the mineral concentrates with all having non-kimberlitic chemistries including grossular, spessartine and almandine garnets (see figure 1).

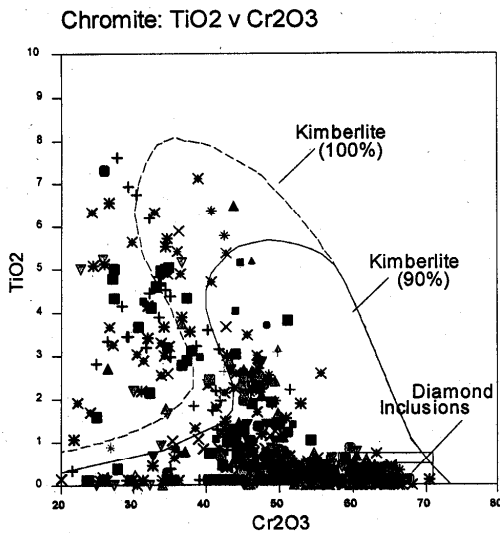
**Figure 1: Garnet Sobolev Plot (Cr<sub>2</sub>O<sub>3</sub> vs CaO) for gravel samples from the Kalnai reconnaissance permit.**



**4.2.3 Heavy Mineral Sample Chromite Results**

Chromite populations are dominated by non kimberlitic sourced species with 40-65% Cr<sub>2</sub>O<sub>3</sub> and 0-20% TiO<sub>2</sub>, almost completely overlapping the mineral chemistry fields of kimberlitic chromite species (see figure 2). An estimated 46% chromite grains are considered to be potentially kimberlite sourced.

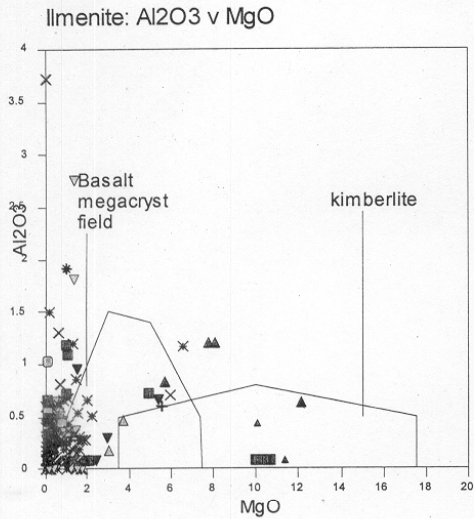
**Figure 2: In this plot (TiO<sub>2</sub> vs. Cr<sub>2</sub>O<sub>3</sub>) of all chromite grains recovered from gravel samples in the Kalnai RP. Note that most of the grains recovered are showing non-kimberlitic trend.**



**4.2.4 Heavy Mineral Sample Ilmenite Results**

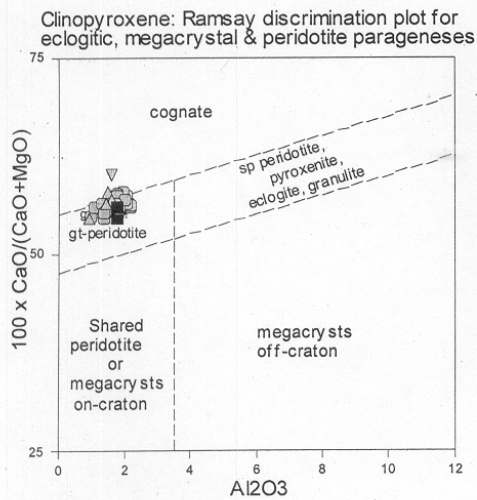
Ilmenite populations are dominated by non kimberlitic sourced species with <8% MgO and typically <1% Cr<sub>2</sub>O<sub>3</sub>. A single grain is possibly kimberlitic with 12% MgO and 1.9% Cr<sub>2</sub>O<sub>3</sub>.

**Figure 3:** In this plot (MgO vs. Al<sub>2</sub>O<sub>3</sub>) of all ilmenite grains recovered from gravel samples in the Kalnai RP. Note that most of the grains recovered are showing basaltic parentage. Few grains are showing kimberlitic signature.



**4.2.5 Heavy Mineral Sample Chrome Diopside Results**

**Figure 4:** No chrome diopside was identified from observation of heavy mineral concentrates.





### 4.3 Geochemical Exploration:

124-stream sediment samples sieved to -80# were collected from 2<sup>nd</sup> and 3<sup>rd</sup> order streams providing complete coverage of all active drainages within the RP area. Each sample consisted of approximately 100gm of -80# (-0.180mm) silt collected at each gravel sample site from the active streambed in the centre or lowest part of the stream. Samples were analyzed by total acid digest and ICP-OES and ICP-MS (\*=ICP-MS) techniques. Elements analyzed and detection limits are as follows: Ag\* (0.1 ppm), Al (10 ppm), As\* (0.5 ppm), Ba (10 ppm), Bi\* (0.1 ppm), Ca (10 ppm), Cd\* (0.1 ppm), Ce (0.5 ppm), Co (2 ppm), Cr (2 ppm), Cs (0.1 ppm), Cu (2 ppm), Fe (100 ppm), Ga (0.1 ppm), K (10 ppm), In (0.05 ppm), La (0.5 ppm), Mg (10 ppm), Mn (5 ppm), Mo\* (0.1 ppm), Na (10 ppm), Nb\* (0.1 ppm), Ni (2 ppm), P (5 ppm), Pb\* (0.5 ppm), Rb (0.1 ppm), Sb\* (0.5 ppm), Se (0.5 ppm), Sr (2 ppm), Te (0.2 ppm), Ta (0.2 ppm), Ti (10 ppm), Tl (0.1 ppm), V (2 ppm), W\* (0.1 ppm), Y (0.05 ppm), Zn (2 ppm), Zr (10 ppm). In addition Au (0.5ppb), Pt (1 ppb) and Pd (1ppb) were assayed by 10gram fire assay with ICP-MS finish.

#### 4.3.1 Stream Sediment Geochemical Results

124-stream sediment samples sieved to -80# were collected from 2<sup>nd</sup> and 3<sup>rd</sup> order streams providing complete coverage of all active drainages within the RP area. Each sample consisted of approximately 100gm of -80# (-0.180mm) silt collected at each gravel sample site from the active streambed in the centre or lowest part of the stream. Stream sediment geochemistry indicates no potential for precious and base metal mineralisation. Stream sediment sample locations with results of Au, Cu, Pb and Zn are given in Plan NDbg0653. Thematic maps for these individual elements can also be seen in NDbg0654 a to d. Summary statistics of stream sediment results are given in table 4. Complete data including sample locations and assay results are listed in Appendix 3.

#### 4.3.2 Soil Geochemical Results

No soil samples collected within the tenement.

	Ag ppm	Al %	As ppm	Au ppb	Ba ppm	B ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm
Mean	0.5	5.6	2.6	25	668	2.1	0.9	0.3	191	21	88	4	24
Median	0.2	5.6	2.5	1	669	1.4	0.8	0.1	114	14	84	4	16
Mode	0.1	5.6	2.0	1	985	0.5	0.4	0.1	117	6	15	4	16
Standard Deviation	0.7	1.4	1.8	130	239	2.3	0.6	0.2	238	20	56	4	23
Minimum	0.1	1.9	0.5	1	217	0.2	0.1	0.1	28	1	10	3	5
Maximum	2.6	9.8	16.5	985	1488	17.1	2.9	0.5	1515	147	262	23	151

	Fe %	Ga ppm	In ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm	Na %	Nb ppm	Ni ppm	P ppm	Pb ppm	Pd ppb
Mean	5	9	0.06	2.8	102	0.38	1730	1.8	1.0	70	17	434	34	1
Median	4	9	0.05	2.6	57	0.32	1250	1.0	0.9	46	15	380	34	1
Mode	2	12	0.05	2.6	67	0.11	1310	1.0	0.9	19	2	600	24	1
Standard Deviation	4	8	0.02	1.1	142	0.28	1508	2.1	0.4	85	14	263	13	1
Minimum	1	5	0.04	0.7	16	0.04	236	0.2	0.1	9	2	58	1	1
Maximum	18	30	0.14	5.8	1113	1.34	11492	14.5	2.3	680	87	1780	80	12

	Pt ppb	Rb ppm	Sb ppm	Se ppm	Sr ppm	Ta ppm	Te ppm	Tl %	Ti ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
Mean	1.0	140	0.4	2.3	111	4	0.2	1.4	0.5	111	1.9	34	65	548
Median	1.0	114	0.5	0.5	102	2	0.2	1.0	0.4	78	1.1	28	60	258
Mode	1.0	73	0.5	0.5	116	1	0.2	0.5	0.7	98	0.8	49	2	101
Standard Deviation	0.3	87	0.2	2.2	47	7	0.0	1.4	0.5	107	3.3	23	39	666
Minimum	1.0	33	0.1	0.5	26	1	0.2	0.1	0.1	12	0.4	6	2	50
Maximum	3.0	542	1.2	5.0	282	47	0.2	11.0	3.1	504	24.8	125	181	3861

**Table 4** Basic statistics of stream sediment geochemistry.

## 5 HEALTH, SAFETY, ENVIRONMENT AND COMMUNITY

Rio Tinto recognises that excellence in managing health, safety, environment and community responsibilities is essential to long-term success. Through effective management practices the Group aims to ensure the health and safety of its employees, to minimise any adverse impacts its activities may have on the environment and to make a positive contribution to local community life.

The policies apply to all Rio Tinto subsidiaries and managed by the concerned company including RTEI and the Kalnai reconnaissance project.

### 5.1 Health and Safety

Rio Tinto Group policies on Health and Safety are designed to minimise the risk of injury or occupation illnesses. A minimum management requirement at all of the company-managed operations is to ensure full compliance with the Rio Tinto Standards. The goal is for zero work related injuries or occupation illnesses.

Minimum prerequisites require that all work activities be based on risk assessments ensuring that effective controls and safe work procedures exist for all hazardous activities. Further the standards require a system for ensuring that employees are trained, equipped and where applicable, certified to carry out their work according to the applicable safe work procedures, and that their competence has been tested. On the Chhattisgarh project the major hazardous activities were assessed to incorporate vehicles and driving, manual handling and electrical work. Risk assessments and selective standard operating procedures have been developed for specific tasks associated with each of these and for many other potentially hazardous activities. Safety training and other initiatives have focused mainly on these higher risk areas including but not restricted to the following:

- Employment of dedicated drivers for all company vehicles.
- Annual first aid, accident management and emergency response training to all senior staff. Professional paramedical instructors sourced from various accredited international companies have undertaken four programs.
- Selected personnel have been trained in managing "work at height", "confined spaces" and in "manual handling" issues by accredited International companies. Knowledge gained from this training has been utilised by the individuals in minimising exposure to

such risks and by coaching other personnel to be able to recognise the risk and where appropriate, designed and implemented safe operating procedures.

- Hire of designated field accommodation and office facilities each upgraded to meet company standards including electrical which required significant rewiring and installation of specialised equipment. Local private electrical contractors were identified and trained to maintain the electrical system to international standards.

The corporate systems have a requirement for all employees, including staff and contractors, to report hazards and incidents and for management to have a system for review and analysis of higher risk incidents and for the implementation of appropriate mitigating measures. The objective of having incident reporting system is to avoid the repetitions of any incident through out-group operations and improve up on the safety culture.

Numerous frontline management and three annual Rio Tinto corporate safety audits have been conducted on the exploration groups operations in India. Audits in all cases have found the Indian operations to be of a high standard and compliant with only minor exceptions that have subsequently been rectified. In 2004 and 2005 the Rio Tinto Exploration –Australasia region, including the Indian operations that contributed significantly, was awarded a Rio Tinto Group Chief Executive Safety award. Over 85 Rio Tinto managed companies from all over the world were reviewed with only three receiving the award in recognition of the excellent safety performance over the proceeding three years. A commendation for the same was received in 2003

#### Environmental

Rio Tinto Environmental Policy aims to prevent or otherwise minimise, mitigate and rehabilitate any harmful effects that the group's operations have on the environment. Although exploration activities including those completed in RTEI Kalnai reconnaissance permits is essentially non-invasive to the environment, the same rigor and level compliance to the standards, systems and procedures is applicable.

For the Kalnai reconnaissance permits an Environmental Management Plan was devised prior to the initiation of field activities and subsequently updated as the program developed. The plan evaluated potential environmental impacts associated with the activities and provided procedures to prevent or minimize impacts. In case where an impact was unavoidable or accidental, appropriate rehabilitation procedures were in place. Relevant exploration personnel including those of contractors were inducted and trained in these procedures. Otherwise a competent person supervised the work to ensure minimal environmental impact. Control systems included incident reporting and annual environmental reporting to first-line management and corporate audits.

Identified areas for potential environmental impact on the Kalnai permits for which procedures were designed and implemented include the following:

- Ground disturbance due to access tracks: No access tracks were constructed for exploration in the permit areas. Access in all cases was achieved by using the existing infrastructure or during the dry season and when no crops were present, by driving cross-country. In the latter case, care was taken to ensure minimal compaction of ground and minimal potential for soil erosion.
- Sampling: Sampling operations had minimal to zero environmental impact. Gravel and stream sediment samples were in all cases taken from the active streambed load and care was taken to avoid any damage to the stream banks. For soil sampling and auger sampling

excess soil was filled back into the excavated hole. In all cases sample sites were accurately located by GPS thus eliminating the need for flagging tape or other tags to mark the sample sites. All sample site photos are incorporated in to the database and a few representative photos are published in annual environmental report.

- No Ground Geophysical Surveys were done in the RP area.
- Regular internal audits are conducted to ensure compliance to internal standards.
- In 2005, RioTinto India achieved the ISO 14001 certification for its environmental practice and commitments.

Most of the forest in the area of operations is dry (arid) deciduous thorny type with dominantly Sal flora. Limited surface sampling was conducted within the forest areas with the permission and cooperation of the relevant forest authorities. No significant environmental incidents were experienced during the period of this survey.

### 5.3 Community Relations

There are more than 50 villages within the RP areas with a total population estimated to be over 75000. Agriculture is the main occupation for over 80% of the population. Industrial activity is mainly agrarian. Agriculture is mostly single crops restricted to the monsoon season with less than 5% under irrigation.

During the term of the exploration specific community relations policy applications included:

- Brief sheet: About 2500 community brief sheets were distributed among the local community to share with them the exploration process and the results so far. The brief sheets were revised once in six months and up dated with latest results of our activities.
- Employment: Employment to a number of local people to work in various roles in the organisation including field supervisors, community relations staff, drivers technical assistants, cooks and housekeeping staff and others. In total up to 30 employees, the majority sourced locally were employed in the field based out of our operational bases at Kalnai, Saraipali, Sitapur and Pathalgaon.
- Established preferred supplier/service relationships with several local businesses for the purchase and supply of most of the required field consumables, notably for food, water and fuel and for service and repair of field equipment.
- Conducted over 500 consultations with stakeholders including village elders, village leader's teachers, individual landowners and others. The main focus of these consultations was to request access and to keep the community informed of our presence and activities.
- Developed internal systems to record, report and monitor community activities and devised strategies to address impacts. All front-end field personnel were oriented and inducted prior to interaction with the community. Two community relation specialists were employed and were available during negotiations and consultations with the local community.
- Briefing sheets in vernacular summarising the exploration activities were distributed to the community in the RP area. The purpose of these sheets was to keep the community informed of the exploration activities and to minimize rumours and misinformation.

During the first two years of work on the RP, the risk of extremist activities was very low and work could continue. However, during the third year, the level of Naxalite activities saw a sharp increase and RTEI had to withdraw in order to minimise staff safety and security risks.

## 6 REFERENCES

Nil

### Keywords

India, Chhattisgarh, Diamond Exploration, Kimberlite, Diamonds, Kimberlitic Indicators, Geochemical-Soil Sampling, Loam Sampling, Geophysics, Magnetic & Drilling

### Locality

Chhattisgarh 64N 1:250 000 sheets

### Descriptor

Final relinquishment report of all exploration work for diamond and other mineral commodities completed in the Sarguja, Jashpur and Raigarh districts of Chhattisgarh by RTEI, during 3 year tenor starting from 19th December 2003 to 28<sup>th</sup> September 2006 of Kalnai RP.

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Photo 1. Discussing exploration...