

# RIO TINTO

CHG-16

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

A member of the Rio Tinto Group

### Final Relinquishment Report for the Sanna Reconnaissance Permit Chhattisgarh, India.

Report Number: 27714

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Directorate of Geology and Mining, Chhattisgarh, Raipur.  
Indian Bureau of Mines, Nagpur.  
Geological Survey of India, Calcutta.

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## 1 EXECUTIVE SUMMARY

Regional exploration undertaken by Rio Tinto Exploration India Ltd. (Formerly ACC Rio Tinto Exploration Ltd.) after execution of the permits on December 19<sup>th</sup> 2003 over an area of 1000 km<sup>2</sup>. 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 due to security concerns.~~ Regional exploration completed within the Sanna reconnaissance permit in the Jashpur and Sarguja districts of Chhattisgarh has not discovered any kimberlites or other precious or base metal mineralization.

Exploration completed including over 57 heavy mineral gravel samples and 58 -80# stream sediment geochemical samples collected at a nominal spacing of one sample per 7 to 9 square kilometers providing for regional coverage over 360km<sup>2</sup> or 36% of the permit area as seen in plan NDbg0655. A majority of the area in this RP reportedly comes under influence of Naxal movements and therefore could not be sampled for security reasons. Approximately 1107 heavy mineral grains recovered from the gravel samples were subsequently analyzed for major oxide elements by manual and automated scanning electron microprobe. Mineral chemistries of the indicators are largely non kimberlitic with only a portion of the indicators returning indeterminate chemistries overlapping into the kimberlite / lamproite fields. No discrete prospect areas have been defined from these potentially kimberlitic chromites

Given the low tenor of indicator mineral anomalism and 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 and have not been undertaken.

## 2 INTRODUCTION

This is the fifth biannual report detailing all exploration completed by Rio Tinto Exploration India (Formerly ARTE) within our 500 km<sup>2</sup> Sanna reconnaissance permit in the two and half years of operation. A summary of exploration activities are detailed 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 Sanna 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 Sanna 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 Sanna Reconnaissance Permits For the period 19/12/2005 to 18/06/2005.
- ACC Rio Tinto Exploration Limited (March 2006); 4th Bi-annual Progress Report for Exploration of the Sanna Reconnaissance Permits For the period 19/06/2005 to 18/12/2006.
- Rio Tinto Exploration India Limited (Formerly known as ARTE)(March 2006); 5th Bi-annual Progress Report for Exploration of the Sanna 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 Rio Tinto Exploration India in Bangalore.

The Sanna RP area totaling 1,000 km<sup>2</sup> was granted to ACC Rio Tinto Exploration Ltd., on the 30<sup>th</sup> June 2003 and subsequently executed on 19<sup>th</sup> December 2003.

Regional reconnaissance surveys including stream gravel indicator mineral sampling, stream sediment geochemistry sampling, mapping and remote sensed imagery interpretation has been completed 360km<sup>2</sup> of the permit area. No kimberlite or precious metal or base metal mineralization is identified anywhere in the project area.

**Sanna RP: (Sarguja and Jashpur 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	57 gravel	1108	58 stream

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

### **3 REGIONAL GEOLOGY and MORPHOLOGY**

Geology of the RP area is dominated by the Archaean-Proterozoic gneissic complex comprised of mica schist. Quartz-sericite-chlorite forming the western continuation of the Proterozoic Gneissic Complex occurs in the west of the permit. The basement lithologies are overlain by Permo-Triassic Gondwana sequence to the western side of the permit and by the Cretaceous basalt lithologies of the Deccan Traps in the southwest and central north of the permit area. The basalt flows are underlain by Lameta Formation. The Deccan Trap basalts are strongly lateritised and contain numerous bauxite resources including the Mainpat bauxite deposit. Minor pockets of Quaternary laterite and bauxite occur throughout the area. Detailed geological map is shown in plan no NDbg0656.

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 northeastern parts, and a vast flat upland region with low hills in the south-central part.

### **4 RESULTS OF EXPLORATION**

#### **4.1 Geology**

Remote sensed geological interpretation and geological traversing integrated with published geological maps including the 1:250,000 geological mapping of the GSI has been completed over the permit area and presented in plan Ndbg0656. 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 57 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 360km<sup>2</sup> of the 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 Sanna 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 specialist 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 NDbg0657.

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

	Garnet	Chromite	Ilmenite	Pyroxene
No of grains	100	677	257	0

**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	8	200	1	0

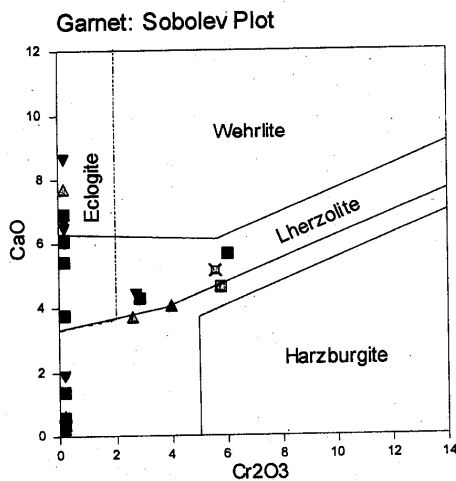
**4.2.1 Heavy Mineral Sample Diamond Results**

No diamonds were identified from observation of heavy mineral concentrates.

**4.2.2 Heavy Mineral Sample Garnet Results**

Over 100 garnet grains from 13 samples were tested by probing returning 8 kimberlitic pyropes. Kimberlitic pyropes are dominantly G9 Iherzolitic with minor G3, eclogitic and G9 megacryst pyrope (figure 1). The location of positive pyrope samples appears random over the entire sampled area without any distinct clustering. The remaining garnets are dominated by grossular and almandine garnet.

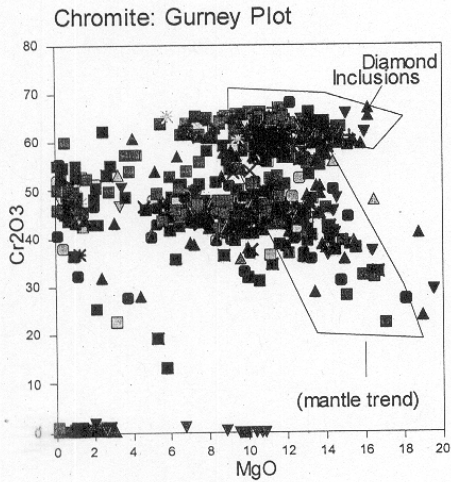
**Figure 1:** Garnet Sobolev Plot (Cr2O3 vs CaO) for gravel samples from the Sanna reconnaissance permit.



**4.2.3 Heavy Mineral Sample Chromite Results**

Mineral chemistries of 677 probed chromite grains are predominantly consistent with a shallow magmatic paragenesis with two converging fractionated trends centered on approximately 50-60% MgO and 60-67% Cr<sub>2</sub>O<sub>3</sub> respectively.

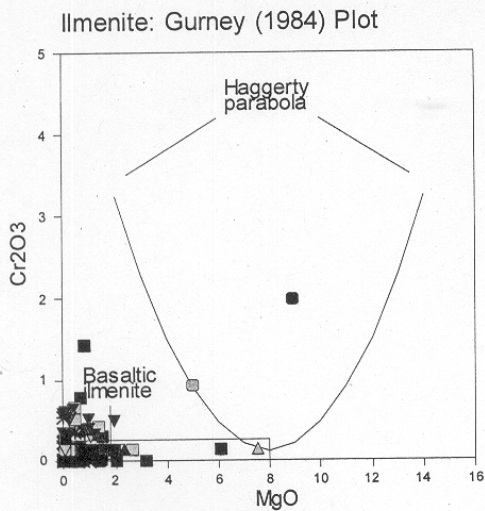
**Figure 2:** In Gurney plot (MgO vs. Cr<sub>2</sub>O<sub>3</sub>) of all chromite grains recovered from gravel samples in the Sanna RP. Note that most of the grains recovered are showing non-kimberlitic trend.



**4.2.4 Heavy Mineral Sample Ilmenite Results**

Probing of 257 ilmenite grains in 24 samples identified only 1 kimberlitic picroilmenites.

**Figure 3:** In Gurney plot (Cr<sub>2</sub>O<sub>3</sub> vs. MgO) of all Ilmenite grains recovered from gravel samples in the Sanna RP. Note from all the samples only one can be identified as kimberlitic Picro Ilmenite.



#### 4.2.5 Heavy Mineral Sample Chrome Diopside Results

No chrome diopside was identified from observation of heavy mineral concentrates.

#### 4.3 Geochemical Exploration:

58-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

58-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 mineralization. Stream sediment sample locations with results of Au, Cu, Pb and Zn are given in Plan NDbg0659. Thematic maps for these individual elements can also be seen in NDbg0658 a – d. Summary statistics of stream sediment results are given in table 3. Complete data including sample locations and assay results are listed in Appendix 3.

	Ag ppm	Al %	As ppm	Au ppb	Ba ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm
Mean	0.6583	5.5771	3.0712	1.6207	989.5345	1.1321	1.0741	0.1207	172.7866	29.0345
Median	0.59	5.545	3.105	1	803	0.73	0.98	0.1	105.425	27.5
Mode	0.1	5.61	0.5	1	683	0.43	0.94	0.1	#N/A	44
Standard Deviation	0.4974	0.8881	1.8105	2.167	497.9093	1.2509	0.6017	0.0894	231.1458	15.8552
Minimum	0	3.43	0.5	1	369	0.19	0.23	0.1	22.62	4
Maximum	2.34	7.61	8.76	13	3228	8.09	3.03	0.5	1336.88	64

	Cr ppm	Cs ppm	Cu ppm	Fe %	Ga ppm	In ppm	K %	La ppm	Mg %	Mn ppm
Mean	111.3621	4.031	25.1552	5.7248	14.9947	0.0491	2.889	86.891	0.451	1264.6724
Median	113.5	3.875	18.5	5.645	15.58	0.05	2.825	50.965	0.33	1095.5
Mode	68	0	12	9.11	0	0.05	3.5	#N/A	0.28	934
Standard Deviation	36.6968	2.0579	17.4132	2.7674	5.7087	0.0043	1.0752	120.5415	0.3217	760.4691
Minimum	25	0	7	1.1	0	0.02	1.15	13.7	0.08	348
Maximum	190	12.91	69	13.26	25.8	0.05	5.54	690	1.26	4025



	Mo ppm	Na %	Nb ppm	Ni ppm	P ppm	Pb ppm	Pd ppb	Pt ppb	Rb ppm	Sb ppm
Mean	1.5602	1.0728	50.2914	23.1897	390.9828	28.5307	1.0172	1.0345	97.6876	0.4897
Median	1.04	1.03	34.745	20.5	325	28.07	1	1	84.715	0.5
Mode	1	0.84	#N/A	16	386	#N/A	1	1	#N/A	0.5
Standard Deviation	1.2956	0.3168	47.0628	11.1	294.457	14.3561	0.1313	0.1841	56.1462	0.0552
Minimum	0.43	0.56	12.17	6	88	6.1	1	1	25.52	0.2
Maximum	7.36	2	241.79	48	1546	75.23	2	2	315	0.5

	Se ppm	Sr ppm	Ta ppm	Te ppm	Ti %	Tl ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
Mean	0.5	172.7069	3.1676	0.2	1.4021	0.32	134.8621	1.5312	32.6526	49.7069	437.1897
Median	0.5	152.5	2.52	0.2	1.105	0.26	122	0.93	26.75	47.5	297
Mode	0.5	115	0	0.2	0.58	0.24	93	0	#N/A	65	200
Standard Deviation	0	98.1605	2.561	0	1.1022	0.3252	88.236	1.6767	22.7551	25.344	387.4672
Minimum	0.5	56	0	0.2	0.16	0.1	11	0	12.04	2	116
Maximum	0.5	497	14.35	0.2	4.87	2.3	361	8.42	138.69	112	1860

Table 4: Basic statistics of stream sediment geochemistry.

### 4.3.2 Soil Geochemical Results

No soil samples collected within the RP.

## 5 HEALTH, SAFETY, ENVIRONMENT AND COMMUNITY

Rio Tinto recognizes 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 minimize 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 ARTE and the Sanna reconnaissance project. A summary of Rio Tinto's HSEC and other policies are summarized

### 5.1 Health and Safety

Rio Tinto Group policies on Health and Safety are designed to minimize 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.
- Training of a staff supervisor as an accredited defensive and 4 – wheel driver instructor.
- 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. 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.

## **5.2 Environment**

Rio Tinto Environmental Policy aims to prevent or otherwise minimize, mitigate and rehabilitate any harmful effects that the group's operations have on the environment. Although exploration activities including those completed in RTEI Sanna 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 Sanna 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 Sanna 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. All sample site photos are incorporated in to the database and a few representative photos are published in annual environmental report.
- Regular internal audits are conducted to ensure compliance to internal standards.
- No Ground Geophysical Surveys were done in the RP area.
- 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 sheet 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 geologists, 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 Sanna, 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 leaders, 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.

## 7 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 contains all exploration data generated for diamond and other mineral commodities. Survey completed in the Sarguja and Jashpur districts of Chhattisgarh by RTEI, during nearly 3 year term of Sanna RP; from 19<sup>th</sup> December 2003 to 28<sup>th</sup> September 2006.