

## **ACTIVITIES OF THE DIRECTORATE OF GEOLOGY, ODISHA**

The Directorate of Geology executes different mineral investigation programmes from its *Headquarters* at Bhubaneswar and six Zonal Offices located at Berhampur, Bolangir, Sambalpur, Keonjhar, Koraput and Dhenkanal within the State. Every year the investigation programme is discussed in the State Geological Programming Board participated by different geological organizations of the country operating in the State before commencement of the field season which generally starts from November. The investigations are executed through a chain of processes such as geological mapping, surveying, trial excavation, drilling, sampling and analysis.

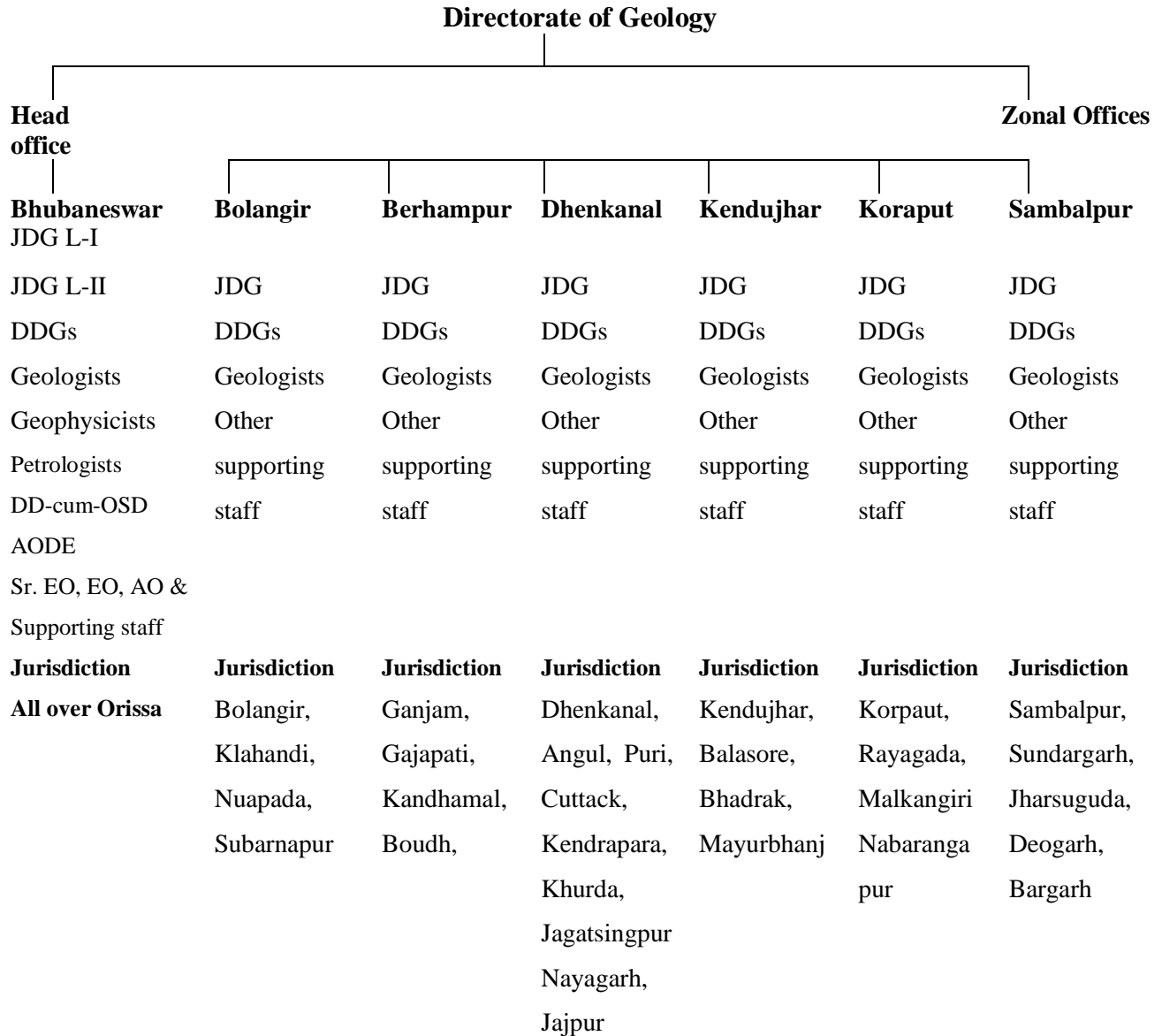
### **Organizational Structure**

The Directorate of Geology has its head office at Bhubaneswar and six zonal offices at Sambalpur, Dhenkanal, Berhampur, Balangir, Koraput and Keonjhar.

The Director of Geology, Joint Director of Geology (Level-I & II), Deputy Director of Geology, Geologist, Petrologist, Asst. ODE, Sr. EO, EO & AO hold their office at headquarters Bhubaneswar. There are other supporting technical and non-technical staffs working under them. The special project scale investigations are taken up from the head office. These include coal, diamond, bauxite, coastal geomorphology and geophysical investigation, aeromagnetic survey etc.

Each zonal office is headed by a Joint Director Geology (Sr. Grade Class-I). He is supported by Deputy Director Geology, Geologists, other technical staff and ministerial staff. The investigations like bauxite, limestone & dolomite, heavy minerals in beach sand, graphite, gemstone etc. are executed from zonal offices.

## Organization structure



This Directorate through its sustained exploration efforts has contributed significantly for assessing minerals/ores like iron ore, chromite, coal, bauxite, limestone, tin, graphite, base metal, heavy minerals in beach sand, gemstone, diamond, gold etc. From last year an integrated exploration for bauxite in parts of Rayagada, Koraput and Kalahandi districts is in progress.

Mineral resource of the state as on 1.4.2013 is as follows:

<b>Sl. No.</b>	<b>Mineral/Ore</b>	<b>RESOURCE AVAILABLE IN MILLION TONNES</b>
1	2	3
1	Basemetal	4.98
2	Bauxite	1811.223
3	China clay	313.931
4	Coal	73710.01 (CMPDI source)
5	Chromite	159.4077
6	Fireclay	175.462
7	Graphite	4.324
8	Iron ore	4958.258
9	Limestone	993.718
10	Dolomite	325.994
11	Manganese	120.114
12	Mineral Sand	221.8458
13	Nickel	174
14	Pyrophyllite	8.308
15	Quartz & Quartzite	70.084
16	Tin ore	0.000347
17	Vanadium	2.5

In the recent past the Directorate has pursued its activities for:-

1. Search for diamond in Nuapada district.
2. Search for gemstone and source of diamond in Bolangir, Subarnapur, Kalahandi, Nuapada, Mayurbhanja districts.
3. Coal exploration in Talcher and Ib valley coal field.
4. Identification and assessment of bauxite resource in Koraput, Rayagada and Kalahandi districts.
5. Heavy mineral resource assessment along coastal tracts of Puri and Jagatsinghpur districts.

6. Iron ore and manganese exploration in Keonjhar, Sundargarh and Nabarangapur districts.
7. Graphite exploration in Bolangir, Rayagada, Koraput and Angul districts.
8. Search for chromite and platinum group element in Sukinda ultramafic complex.
9. Assessment of dimension stone/decorative stone in different districts.
10. Exploration for base metals in Mayurbhanja and Bolangir districts.
11. Geophysical survey for mineral investigations and groundwater.
12. Geo-technical study for Mahanadi-Godavari link project.
13. Environmental impact assessment study in mining belts.
14. Petrochemical study in fluorosis affected areas in Nayagarh district.
15. Geomorphological studies along Odisha coast.
16. Characterisation of gemstones by gem testing laboratory.

#### **FACILITIES:**

The Directorate is equipped with following exploration tools for carrying out the investigations.

##### **1. Remote Sensing:**

The Directorate is having aerial photographs and satellite data over almost entire State and equipped with latest softwares for interpretation of digital satellite data. Geological maps are prepared by interpretation of the data sets for mineral exploration. Besides, GIS based maps of the mining leaseholds in the districts of Keonjhar and Sundargarh districts have been prepared as per requisition from the Directorate of Mines.

##### **2. Geophysics:**

Geophysical equipments like resistivity meter, magnetometer etc. are being used to collect the Geo-physical characteristics of the minerals/ore bodies particularly the sub-surface bodies.

##### **3. Drilling:**

The Directorate has 12 working drilling rigs and two high capacity KME rig for deep drilling, which are being used in the coal, iron, limestone and chromite investigations. Besides, drilling is also done to study the engineering geological characteristics of the rocks.

#### **4. Gemstone Laboratory:**

The Directorate is equipped with a modern & well equipped gemstone laboratory. The laboratory undertakes characterisation of precious and semiprecious samples collected from different fields, seizure by police and samples received from private parties (on payment). It earns annually around Rs. 8 lakhs.

#### **5. Mineral processing:**

The mineral processing laboratory is being utilized mainly for processing of the gravel samples collected from the diamond field from Nuapada district. This facility is unique of the State.

#### **6. Petrological Laboratory:**

The petrological laboratory undertakes identification and characterisation of rocks and minerals collected during exploration activities. Petrographic characterisation of specimens submitted by private parties on payment basis is also done.

Granite cutting and polishing:

Cutting and polishing of the dimension/ decorative stones for their characterisation purposes is being undertaken in the laboratory on promotional and commercial basis.

#### **7. Computer Cell and Data Processing Cell:**

The Directorate is having a Computer Cell and data processing cell with Pentium computers and one Sun work station for geological and geophysical data processing. It also undertakes necessary extraction of the aeromagnetic data collected by World Geo Science Corporation, Australia during the period from 1993-1998. As per the requisition of the indenters aeromagnetic data is extracted and supplied on payment. So far data of Rs. 98, 91898/- lakhs have been sold to various users.

#### **Aeromagnetic Survey over parts of Odisha:**

The World Geoscience Corporation (WGC) of Australia has conducted High Resolution Aeromagnetic Survey over 75,000 sq. kms over northern Odisha. Through this survey magnetic, radiometric elevation data were collected. These data were processed by WGC at Bhubaneswar and WGC had generated various kinds of images and contours using these data from which solid geological maps were generated for locating possible loci of mineral occurrences and ground water sources.

The Atomic Mineral Division (AMD), TISCO, BMP Billiton, Rio Tinto and De Beers, R.W.S.S. Department etc. have purchased the aeromagnetic data worth of more than Rs. 98.91 lakhs from this Directorate for pursuing mineral exploration in Odisha.

### **Significant Achievement of the Directorate**

Since the inception of the Directorate it has contributed immensely to the mineral development sector by way of assessing the mineral resources of the state through scientific exploration. Some of the highlights of the department's achievement are:

- Proving of 500 million tonnes of iron ore resources in Mankarnacha, Baliapahar, Khandadhar deposits of Sundargarh district
- Assessment of 1000 million tonnes of bauxite resources through exploration in Panchpatmali (Koraput), Gandhamardan (Bolangir-Baragarh), Sasubohumali-Bhasangmali (Rayagada), Karlapat (Kalahandi), Baphlimali (Rayagada), Dholkatapahar (Keonjhar) and other small deposits.
- Assessment of 31 million tonnes of heavy minerals (ilmenite, rutile, zircon, silimanite, garnet and monazite) in the beach sands along the Orissa coast
- Assessment of around 18 million tonnes of chromite ore in the Sukinda Valley
- Inventory of nickel resources of the state in the Sukinda area
- Discovery of huge prospects of PGE mineralization in the Sukinda area through regional geochemical study
- Assessment of 4457million tonnes of coal reserves in Talchir coalfield and 2445 million tonnes of coal in the Ib-Valley coalfield. Total proving of 9602 million tonnes of thermal (A to G) grade coal.
- Limestone reserves of 602 million tonnes have been assessed in the Sunki, Khariar, Kotametta, Kiringsera deposits.
- A diamondiferous lamproite rock has been discovered in the Kalmidadar area of Nuapada district through persistent exploration efforts. Potential satellite bodies of kimberlite/ lamproite have been discovered around Pokhanpadar, Supuli, Bharuamunda, Kathiwadi and Arkholi etc. in the same district.
- 28 Gem bearing tracts have been identified through UNDP aided exploration in the Kalahandi, Nuapada, Bolangir, Boudh, Subarnapur, Anugul and Sambalpur districts. Recently another gem quality emerald bearing area has been located and examined in Maurbhanja district.

- 4 million tonnes of vanadiferous magnetite deposit have been established in the Betjharan-Kumardubi belt in Mayurbhanj district.
- 253 tonnes of tin ore were assessed in the single deposit around Mohapadar, Mathili and Temurpalle in the Malkangiri district.
- Remote Sensing study for analysis of coastal geomorphology was carried out over 9439 sq km area along the Orissa coast from AP-Odisha to WB-Odisha border under sponsorship of Ministry of Environment and Forest, Government of India.
- The fireclay deposit of Talabasta area was explored and assessed

**NOTE ON THE EXPLORATION ACTIVITIES UNDERTAKEN BY THE DIRECTORATE OF GEOLOGY (From 2007-08 to 2013-14)**

The objective of this Directorate of Geology is to locate and assess the mineral resource in different parts to augment the resource status of the State. During the last five years the Directorate executed mineral investigations on diamond, coal, bauxite, chromite, heavy minerals, iron and manganese ore, limestone/ dolomite, base metal, gemstone, dimension and decorative stone etc. During the period 9137.061 Km<sup>2</sup> area has been geologically mapped in different scales and 16732.38 m of drilling was completed for various mineral investigations.

**Bauxite:**

Investigation and assessment for bauxite were taken up around Gusuramali, Munda, Murka, Narinigurha, Panchara, Maligan, Dongri, Janigurha, Mundajhola and Kuntesh area in Dasamantpur Block and Ratamali, Bandikar, Tikiragurha, Kamper etc. of Laxmipur block of Koraput district. Ushabali, Tali saru, Hatisala plateau of Khandhamal district, Gunupur, Kaniguma, Gopalpur, Kishanmali & Lingapadar of Kalahandi district and Dholkata pahar in Keonjhar district. A possible resource of 10.74 million tones of metallurgical grade bauxite has been assessed for Ushabali plateaux with average grade 40.5% of Al<sub>2</sub>O<sub>3</sub>. Also a possible resource of 0.125 million tonnes of metallurgical grade bauxite has been estimated in Kusumdihi of Sundargarh district. The bauxite investigation projects identified 49 bauxite bearing plateaux near Lingapadar, Gusuramali, Gopalpur, Dumurigurha, Tala Naranga, Lingapadar etc. in which thickness of bauxite profile varies from 3 to 12 m with variable dimension.

**Coal:**

Exploration for coal was continued in Jagannath, Bhubaneswari and Shubhadra blocks of Talcher coalfield in Angul district and Madhupur block as well as Kudopali block of Ib river coalfield in Jharsuguda district in coordination with CMPDI Ltd for assessment of coal potentiality and physico-mechanical test to study feasibility for development of underground mines by M/s MCL and infrastructural development of OPGC Ltd. Besides mine feasibility study was also taken up in Manoharpur block of Ib valley coalfield on requisition of OPGC. In the mean time drilling in Arakhpal block of Talcher coalfield has been completed for SETSPL. Besides, occurrence of coal has been reported around Rajbahal in Sundargarh district.

**Diamond:**

Exploration for primary source of diamond was taken up in Kalmidadar, Arkholi, Kathiwadi, Supuli, Nangalbod and Darrimunda area of Nuapada district.

Drilling in diamondiferous OL bodies in Kalmidadar of Nuapada district has been completed. The dimension of olivine-lamproite body has been proved to be 320 m x 160 m with thickness varying from 4.60 to 20.10 m. Two lamproite dykes of average 400 m length and 0.5 to 3.5 m width were delineated to the NE of Darrimunda. Diamond potentiality study over the source rocks located in and around Darrimunda area is in progress.

**Chromite:**

Investigation for chromite and high magnesia igneous rocks was conducted in Karadapal area of Dhenkanal district. Further geochemical prospecting around Tangarpara in Dhenkanal district was taken up at the request of M/S IDCOL. Two anomalous zones have been interpreted in Tangarpara area for future exploration. As per requisition of M/S IDCOL, drilling in the Talangi chromite mine Quarry No.2 intercepted chromite lode of thickness ranging from 10.60 to 14 m from the quarry floor. Geophysical studies to the south of Mahagiri hill range interpreted a chromiferous anomalous zone. Besides, 14 chromiferous ultramafic bodies were reported around Karadapal and its potentiality study is in progress.

**Dimension & Decorative stones:**

3, 45, 000 cubic meters of dimension & decorative stone has been estimated around Harabhanga block of Boudh district. Besides, 40, 825 cubic meters of ultramafic rocks suitable for decorative stone specially for sculpture and carvings have been located around Kesna - Jyotipur area in parts of Keonjhar and Mayurbhanj districts.



**Heavy mineral in beach sand:**

Exploration for assessment of heavy mineral in beach sand was taken up over an area of 207.31 sq km along the coastal tract of Puri and Jagatsingpur districts. Detailed exploration has been completed up to Chilka mouth and the samples are under laboratory study. Further five potential placer horizons around Gelinasi, Hunda-Samantaraipur, Mulpari, Mundabar and Chilikabar having THM concentration ranging from 5 to 17.09% have been identified in the southern Ganjam coast for future exploration.

**Iron Ore & Manganese Ore:**

Geological exploration and inventory of iron ore and manganese ore in different parts of Sundargarh and Keonjhar district had indicated possible resource of 15.808 million tonnes of iron ore in Dholtapahar (Dengula) and 17.14 million tonnes around Bhaliadihi, Deojar, Gopisahi, Kadamdihi, Kriyakudar, Patabeda, Malangtoli in Sundargarh district. A possible resource of 2.174 million tonnes of iron ore have been estimated in Kusumdihi of Sundargarh district. Further possible resource of 1.56 million tonnes of iron ore have been estimated around Damaru, Raisuan, Batagaon, Kalta and in parts of Uliburu R. F of Keonjhar district. A possible resources of 0.505 million tonnes of manganese ore have been estimated around Roladihi, Bandhala, Kusumdihi, Deojar, Kenamenta, Mutukudar, Mandajoda, Girhei, Kakarpani area of Sundargarh dist. Detailed assessment of iron ore around Netrabandha Pahar, Balidihi in Sundargarh district, Bakla-Mangarsahi of Mayurbhanj district, Bamniajor of Keonjhar district and manganese ore in Kenamenta in Sundargarh are in progress.

**Limestone/Dolomite:**

Investigation and assessment of cement grade limestone was taken up in Garamura area of Nuapada district. Further investigation for limestone & dolomite around Mundagaon, Jarangloi, Lahandabud, Orangtoli, Udarama, Rangamati, Lephripara, Sargipali, Badulpani, Karamtoli in Sundargarh district and Jharbandh in the western part of Nuapada – Putka belt of Baragarh district for cement grade limestone brought seven dolomite occurrences into lime light. Two dolomite occurrences were located around north of Lephripara and Surgura having dimension of 1300 m x 100 m and 30 m x 25 m respectively.

## **Geological Exploration Activities of the Directorate of Geology during the year 2013-14**

During **2013-14** in total 13 investigations in respect of coal, iron ore, manganese, Chromite, graphite, bauxite and gemstone in Jharsuguda, Sundergarh, Dhenkanal, Angul, Koraput, Rayagada, Kalahandi and Mayurbhanj districts were taken up as per decisions of the 49th State Geological Programming Board meeting held on 18th September 2013. In total 50

501.5 sq. km area was geologically mapped in 1:25,000 scale, 2.16 sq.km area was covered by geophysical survey, 2036.2m drilling & 66.75cum of trial excavation was achieved besides 946 representative samples were collected for analysis. The significant achievements are as follows:

- Coal seam of +1m thickness has been established over strike length of 100m around Rajbahal in Sundergarh district.
- Iron ore occurrence over 250m length has been delineated in Bhaliadihi-Netrabandh pahar area of Sundergarh district.
- Two discontinuous manganese bodies have been reported around Deoghar in Sundergarh district.
- High magnetic intensity zone of TMI ranging from 44263nT to 45444nT in Karadapal area in Dhenkanal district has been inferred through geophysical survey (magnetic survey in 50m X 10m grid) reveals presence of magnetic body (chromite?) at depth.
- A graphite belt over 10 km length has been reported in between Badakantakul and Nuakutu in Angul district.
- Two bauxite bearing plateaus i.e Dabugurha plateau and Maligurha plateau have been delineated in Rayagada district.
- One bauxite bearing plateau has been reported near Chillisankha in Kutinga area of Koraput district.
- In Saraskana Tahasil of Mayurbhanj district a gem belt(emerald) of 8 km X0.18 km has been reported

The above mineral investigations taken up during 2013-14 was reviewed and discussed in the State Geological Programming Board meeting held on 30<sup>th</sup> April 2014.

## Exploration programme for 2014-15

In the 50th State Geological Programming Board meeting held on 30<sup>th</sup> April 2014 in total 15 mineral investigation programme have been finalized in respect of coal, graphite, limestone and dolomite, heavy mineral, gold, bauxite, gemstone, dimension stone and PGE for 2014-15 in the state basing on following aspects.

- Since the private sectors are interested for investment in exploration of major minerals like iron ore , manganese, chromite and bauxite in the state the Directorate of Geology has given emphasis on exploration for coal(in coordination with CMPDI and OPGC), graphite, limestone and dolomite, heavy mineral, gold, gemstone, dimension stone and PGE during 2014-15 for optimum utilization of state funds.
- Proposed collaborative work GSI, State Unit, Odisha with the Directorate of Geology to cover balance area of 80,707 sq. km of the state by Airborne Geophysical Survey for locating various mineral occurrences for augmentation of resources.
- Exploration of gemstones in Mayurbhanj district, Odisha shall be carried out in collaboration with GSI during 2015-16.
- Proposed participation of the Directorate of Geology in offshore exploration in Odisha coast to be conducted by GSI during 2014-15.
- Proposed exploration of Bauxite in collaboration with GSI in the notified areas to be carried out by the Directorate of Geology during 2014-15.
- Proposed geochemical mapping by the Directorate of Geology, in collaboration with GSI, State Unit, Odisha .
- Initiation of the Directorate of Geology for acquiring state-of-the art laboratory facilities and software in respect of analysis of field samples and borehole data. The target envisaged for the year 2014-15 is given below.

Sl No	Item of work	Target envisaged
1	Geological mapping(1:25,000)	1015 sq km.
2	Trial excavation	450 cu.m
3	Drilling	11,000 m
4	Sampling	26,00 nos 950m (Coal)

### **Other important activities**

- The **gem testing laboratory** of the Directorate characterized and certified 3774 coloured, precious, semiprecious and organic stones on payment basis and generated Rs 8,20,461/- as revenue. Further, the laboratory also certified 925 g of gemstones seized by the State police from different parts of the state. Rough gemstone weighing 1442.047 kg has been auctioned by the Directorate and Rs 4, 54,525/- has been collected as revenue towards it. Gemstone stock of 1442.0471 kg has been auctioned for Rs 4,54,525.00 through MSTC.
- The **petrological laboratory** completed petrographical studies of 207 samples which include 174 rock specimens collected from different investigations and 33 samples on commercial basis. Besides, grain counting of 30 heavy mineral composite samples was also undertaken in the period.
- The **diamond laboratory** scanned 153 concentrate samples to examine incidence of diamond in them.
- 10 investigation reports of earlier explorations have been finalized.
- Besides, the final technical report on Remote Sensing studies for analysis of coastal geomorphic features along Odisha Coast has been submitted to the Ministry of Environment and Forest, Govt. of India.
- The **remote sensing Cell** has been upgraded.

<b>Year</b>	<b>Exploration Components</b>	<b>Achievement</b>
<b>2007-08</b>	1. Geological mapping (a) 1:50,000 (b) 1:25,000 (c) 1:4,000 (d) 1:2,000 2. Excavation 3. Drilling 4. Sampling	330 sq km 2145 sq km 2.5 sq km 5.095 sq km 564.4 cum 7618.25 m 4860 Nos./ 15.5 tonnes
<b>2008-09</b>	1. Geological mapping (a) 1:50,000 (b) 1:25,000 (c) 1:2,000 2. Drilling 3. Excavation 4. Sampling	387 sq km 152 sq km 7.49 sq km 11010.8 m 85.25 cum 6214 Nos.
<b>2009-10</b>	1. Geological mapping (a) 1:50,000 (b) 1:25,000 (c) 1:2,000 2. Drilling 3. Excavation 4. Sampling	675sq km 135sq km 15.55 sq km 15197.25 m 191.45 cum 11,532 nos./120 tonnes
<b>2010-11</b>	1. Geological mapping (a) 1:50,000 (b) 1:25,000 (c) 1:2,000 2. Drilling 3. Excavation 4. Sampling	359 sq km 3248 sq km 5.345sq km 10031.50 m 351.265 cum 4695 nos./29.5 tonnes
<b>2011-12</b>	1. Geological mapping (a) 1:50,000 (b) 1:25,000 (c) 1:2,000 2. Excavation 3. Drilling 4. Sampling	28 sq km 507 sq km 3.495 sq km 197.285 m <sup>3</sup> 7242.60 m 3202 nos. 321.22 m of coal samples

<b>2012-13</b>	1. Geological mapping (b) 1:25,000 (c) 1:2,000 2. Excavation 3. Drilling 4. Sampling	623 sq km 4.412 sq km 473.4375 Cu m 4478.98m 1330 Nos.
<b>2013-14</b>	1. Geological mapping (a) 1:25,000 (b) 1:2,000 (c) 1:5,000 2. Excavation 3. Drilling 4. Sampling	501.5 sq km 2.674 sq km 1 sq km 67.76 Cu m 1153 m 946 Nos.