

EXPLORATION & DEVELOPMENT



Indian Minerals Yearbook 2013

(Part- I: GENERAL REVIEWS)

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EXPLORATION & DEVELOPMENT

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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GOVERNMENT'S POLICY

The National Mineral Policy, 2008 for non-fuel and non-coal minerals, introduced by the Government in replacement of the National Mineral Policy 1993 lay enormous thrust on the various aspects of mineral industry, such as regulation of minerals, role of State in mineral development, survey and exploration, database of mineral resources and tenements, strategy of mineral development, etc. Among other things, strong emphasis is laid on the following:

- * To judiciously exploit and utilise the country's mineral potentialities, systematic regional and detailed exploration will be carried out using state-of-the-art techniques in a time bound manner. Zero-waste mining will be the national goal and mining technology will be upgraded to ensure exploration and utilisation of entire run-of-the-mine.
- * To make regulatory environment conducive to private investment, procedures for grant of mineral concessions, such as Reconnaissance Permits, Prospecting Licences and Mining Leases shall be transparent and seamless with security of tenure guaranteed. Prospecting and mining shall be recognised as independent activities with transferability of concessions playing a key role in mineral development.
- * To attract large investments and high technology, a new concession, namely, Large Area Prospecting Licence (LAPL) will be introduced. Duration of all concessions will be rationalised and areas of operations enlarged suitably within each State.
- * IBM will maintain a digitised database comprising a Resource Inventory and a Tenement Registry. The Tenement Registry will give information of leasehold and freehold areas in terms of greenfield, brownfield and relinquished areas, etc. Data filing will be rigorously applied and

concession holders will be monitored. Lock-in arrangement will be assured and the data will be released to prospectors after integration.

- * Prospecting being a high-risk venture, access to risk funds from capital markets will be facilitated.

This policy initiative is expected to encourage greater involvement of private sector in survey and exploration of minerals.

The High-Level Committee constituted by the Government of India which brought out the National Mineral Policy, 2008 has recommended amendments to the MMDR Act, 1957 with the purpose of providing necessary initiatives to attract investment and participation of private and public sectors in areas of exploration and exploitation of minerals. In a latest development, MMDR Bill, 2011 has been introduced in Lok Sabha on 12.12.2011, which has been referred to Standing Committee on Coal & Steel. The Committee submitted its 36th Report on the MMDR Bill on 07.05.2013.

ORGANISATIONS INVOLVED

GSI, DGMs of various states, public sector companies like NMDC, MECL, MOIL, etc. continued their efforts in respect of surveying, mapping and exploration of new deposits and re-assessment of old deposits/mines during 2012-13.

In oil sector, ONGC, OIL and a few joint venture and private companies were engaged in exploration of onshore and offshore areas.

IBM

IBM, as a facilitator to the Mineral Industry, (a) provides technical consultancy services for conducting feasibility studies, environment impact assessments, environment management plans, etc; (b) carries out mining research project on need-based aspects of mining; (c) conducts mineral beneficiation studies, including mineralogical testing and chemical analysis and (d) prepares mineral maps.

During 2012-13, IBM prepared 100 multi-mineral leasehold maps with forest overlays on 1:50,000 scale in respect of Karnataka and Odisha. Forest overlays are prepared in collaboration with Forest Survey of India.

During 2012-13, IBM conducted 59 ore dressing investigations, chemical analysis in respect of 42,771 radicals, 2,509 mineralogical studies and 09 in-plant study.

Indian Bureau of Mines undertakes preparation of National Inventory of mineral resources on a quinquennial basis. Under this programme, implementation of UNFC system was adopted in 2002 replacing the earlier resource classification based on Indian system. Subsequently, NMI as on 1.4.2005 was updated. Updation of the NMI of mineral resources in respect of 70 minerals based on UNFC system as on 1.4.2010 has also been completed in March, 2012.

GSI

GSI pursued its systematic geological mapping in 2012-13 and had completed 4,917 sq km large-scale mapping, 45.43 sq km detailed mapping and 70,007 m drilling as against preceding year's achievement of 1,880 sq km large-scale mapping, 45.105 sq km detailed mapping and 63,097m drilling. Out of the total mappable areas of 3.146 million sq km of the country, 3.096 million sq km has been covered so far by systematic mapping bringing the total coverage to 98.42%.

Reserves Established

Reserves/resources established in the course of mineral exploration during 2012-13 are furnished below:

i) About 3,172 million tonnes resources of coal in various coalfields of Andhra Pradesh, Chhattisgarh, Madhya Pradesh, Maharashtra, Odisha and West Bengal were estimated.

ii) A total resources of 484 million tonnes of lignite were estimated in Rajasthan, Tamil Nadu and West Bengal.

iii) In Umphriuh block, Jaintia Hills district, Meghalaya, an inferred resource (333) of limestone were estimated at 389.68 million tonnes.

Survey

Marine Survey

GSI continued its offshore geoscientific studies both in Exclusive Economic Zone (EEZ) and Territorial Waters (TW) along the East and West Coasts of India. Survey in the near-shore zones (0 m - 10 m isobaths) were carried out using hired small mechanical boats.

During 2012-13, a total of twenty two cruises were undertaken using three vessels.

The following marine geoscientific surveys were carried out during 2012-13 Field Season:

1. Six cruises aboard R.V. Samudra Manthan within EEZ conducted the following:

a) Multibeam bathymetric survey of the continental slope off Visakhapatnam, Andhra Pradesh coast (SM-224).

b) Studies of geomorphological configuration of the "Swatch-of-No-Ground" in Upper Bengal Fan (SM-225).

c) Study of the seabed morphology and magnetic anomaly pattern across the arc-trench gap off West of Tarasa Dwip, Nicobar Group of Islands (SM-226).

d) Multibeam bathymetric survey to the south of Central Andaman Trough on the Sewell Rise. (SM-227).

e) Multibeam bathymetric survey in the continental slope off Marmagao, Goa (SM-228).

f) Multibeam bathymetric survey in the continental slope off Veraval, Gujarat (SM-229).

2. Nine cruises aboard R.V. Samudra Kaustubh within the Territorial Waters (TW) off the East coast conducted:

a) Parametric (magnetic & seismic) survey within TW off Pentakota, Andhra Pradesh coast (ST-221).

b) Placer mineral resource evaluation in the TW off North of Bhimunipatnam, Andhra Pradesh (ST-222).

c) Study of the seabed morphology in the inner to mid-continental shelf off Rushikulya river mouth, Odisha (ST-223).

- d) Parametric surveys in shelf between Devi river mouth and Mahanadi river mouth, Odisha (ST-223A).
- e) Geotechnical appraisal off Chilka lake, Odisha (ST-224).
- f) Parametric surveys between Kushabhadra and Prachi river mouths off Odisha coast (ST-225).
- g) Placer mineral resource appraisal in TW off Puri, Odisha (ST-226).
- h) Geotechnical appraisal off Palar river mouth, Tamil Nadu Coast (ST-227).
- i) Mapping of sea bed within TW, North East of Point Calimere, Tamil Nadu (ST-228).

3. Seven cruises aboard R.V. Samudra Shaudhikama within the TW off the West Coast conducted:

- a) Seismic survey in the area off Bharathapuzha to identify and delineate the paleo channels (SD-241).
- b) Mapping of the seabed off Okha, Gujarat (SD-242).
- c) Swath bathymetry off Okha, Gujarat (SD-243).
- d) Multibeam bathymetric survey of part of Gulf of Kachchh off Nova Tapu (SD-244).
- e) Swath bathymetric survey of part of Gulf of Cambay off Valsad, Gujarat (SD-245).
- f) Parametric surveys (magnetic & seismic) with TW off Devagarh-Dhabol-Jaigarh, Maharashtra, Arabian Sea (SD-246).
- g) Geotechnical appraisal off Nileswaram, Kasargod, Kerala (SD-247).

Airborne Survey

GSI pursued airborne geophysical survey for generating database by employing magnetic and gamma ray spectrometric techniques. The survey was followed by data processing, preparation of aerogeophysical maps and interpretations that help in ground evaluation and add information to geological maps and would aid prospecting and exploration for minerals. The data from the aerial surveys thus form an important backup for refining the geological understanding of an area, with focus on identification of favourable locales of mineralisation, crystal structure, etc.

Airborne survey operations could not be taken up over western offshore of India (Vengurla-Jamnagar) during 2012-13 as there was delay in getting the DGCA certification. The GSI aircraft has underwent upgradation in Avionics configuration and the aircraft could not be placed for survey operation before March, 2013, as such multi-sensor data could not be acquired during 2012-13.

Since the acquisition and induction of TOASS, a total of 495,062 line km over an area of 294,045 sq km was covered by multi-sensor survey involving magnetic, spectrometric, radiometric and electromagnetic methods till the field season 2010-12, in the following areas: Mamandur (Tamil Nadu), Aladahalli, Gadag, Wajrakarur-Vedavathi basin (Karnataka and Andhra Pradesh), Agartala-Silchar (for ONGC in Tripura and Assam), Ratnagiri (Maharashtra), Siliguri-Guwahati (for ONGC in West Bengal and Assam), Tosham-Singhana (Haryana and Rajasthan), Sukinda-Baripada (Odisha), Bundi-Bharatpur (Rajasthan), Agucha-Malpura-Chaksu (Rajasthan), Moradabad -Bareilly (for OIL in Uttar Pradesh), Gorakhpur-Muzaffarpur (for OIL in Uttar Pradesh and Bihar), Satyamangalam (Tamil Nadu), Hindoli (Rajasthan), Bhilwara (Rajasthan), Gangapur-Nasirabad (Rajasthan), Chhattisgarh basin (Chhattisgarh and Odisha), Betul-Chhindwara (Madhya Pradesh), Narayanpet-Raichur (Andhra Pradesh and Karnataka), Hungund-Mudhol (Karnataka), Lalitpur (Uttar Pradesh), Mahoba-Panna (Uttar Pradesh and Madhya Pradesh), Nalgonda-Mahbubnagar (Andhra Pradesh), Bangalore-Penukonda (Karnataka and Andhra Pradesh), Mulbagal-Tambalpalle (Karnataka and Andhra Pradesh), Nagpur-Wardha valley area (Maharashtra), Baihar-Katru area (Madhya Pradesh and Chhattisgarh), Kanker area (Chhattisgarh), Mauranipur-Sarila area (Madhya Pradesh and Uttar Pradesh), Hosadurg-Vengurla area over Western offshore and Chandrapur-Brahmapuri (Maharashtra).

Ground evaluation of aerogeophysical data is carried out with the help of aerial photos and imageries, mostly by detailed mapping, sampling, pitting and trenching, and wherever necessary, by drilling.

MECL

The highlights of exploration carried out by MECL during 2012-13 are given below:

- i) The company has registered 296,853 m of drilling for various minerals and for atomic minerals on behalf of Atomic Mineral Directorate for Exploration & Research (AMDER), Hyderabad.
- ii) A total of 138,448 m of geophysical logging was carried out.
- iii) A total of 110 sq km of geological mapping was done for different minerals in various parts of the country.
- iv) In laboratories, a total of 39,562 samples were analysed and 94,366 radicals were determined along with petrological and ore microscopic studies of 141 Nos. samples.
- v) A total of 26 detailed geological reports for mineral exploration & geophysical survey, environmental & remote sensing studies were submitted.
- vi) A total of 2,761 million tonnes of reserves were added to NMI. Mineral-wise details of reserves established by MECL during 2012-13 are:
 - Coal - A total of 1,132.80 million tonnes of non-coking coal and coking coal in Mand-Raigarh Coalfield, Chhattisgarh; North Karanpura Coalfield, Jharkhand and Wardha Valley Coalfield, Maharashtra were established.
 - Lignite - 768.51 million tonnes of lignite reserves were established in Rajasthan.
 - Limestone - 274.04 million tonnes of limestone reserves were established in Tongnub, Meghalaya.
 - Lead-Zinc- 9.42 million tonnes of lead-zinc ore reserves were established in Tikhi and Gurla blocks, Rajasthan.
 - Dolomite - 561.26 million tonnes of dolomite reserves were established in Rupa, Arunachal Pradesh, and
 - High MgO rock - 15.36 million tonnes of High MgO flux grade rock in Rajabasha block, Odisha were also established.

**MINERAL-WISE EXPLORATION ACTIVITIES
PETROLEUM AND NATURAL GAS**

The Government of India has formulated a New Exploration Licensing Policy (NELP) to accelerate and expand exploration of oil and gas

in the country. A total of 235 blocks have been awarded so far in eight rounds of NELP during 2000-2010. Exploration under NELP has shown positive results, in both inland and offshore areas. With a view to accelerate further the pace of exploration, in the ninth round of NELP, 34 exploration blocks were offered and bids were received for 33 blocks.

ONGC

Business Development and Joint Ventures Group of ONGC (BD & JV), in line with the ONGC's pursuit for Business Growth Plans has initiated several measures for achieving enhanced value chain integration in hydrocarbon business in the field of Petrochemicals, Power & Fertilizer.

ONGC continued its operations for exploration of oil and gas. Out of 26 identified sedimentary basins in onshore and offshore areas of the country, exploration was continued in Cambay Basin, Gujarat; Jaisalmer in Rajasthan; Upper Assam, Tripura, Mizoram in Assam-Arakan; Himalayan foothills, Himachal Pradesh; Vindhyan/Gondwana (Madhya Pradesh); Krishna-Godavari (Andhra Pradesh); Cauvery (Tamil Nadu); West Bengal and in East Coast and West Coast offshore areas.

During 2012-13, ONGC made 22 new hydrocarbon discoveries which include 12 new Prospects (4-Offshore and 8-Onshore) and 10 new Pools (5-Offshore and 5-Onshore). As a result of these exploratory efforts, ONGC accreted the highest ultimate reserves of 84.84 Million Tonnes of Oil Equivalent (MTOE) from domestic discoveries.

OIL

OIL owns a vast array of advanced computing systems to process and interpret geo-scientific data through integrated exploration applications such as Remote Sensing, Structural & Stratigraphic Interpretation, Seismic Attribute Analysis, Source Rock Evaluation, Biostratigraphy, Sequence Stratigraphy, Petrophysics, Basin Analysis, Techno-Economic Evaluation, etc.

During 2012-13, OIL carried out 128,905 m drilling in 37 wells in Onshore areas of Assam (35, wells - 126,408 m drilling) and Rajasthan (2 wells - 2,497 m drilling).

Significant discoveries of oil/gas struck by OIL at various districts in Assam during 2012-13 are as below:

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i) The exploratory Well NHK 600 (Loc. HUI) falls in the unexplored eastern part Zaloni structure of Hugrijan ML. The aerial extent of the structure at Upper Tipam level is 1.18 sq km. This well was drilled as a deviated well to probe the hydrocarbon prospects within Upper Tipam and Barail Third Sand. The well was spudded on 03.03.2012 and reached the final depth of 3,311 m within the Barail Arenaceous Formation on 13.04.12. The well has encountered a number of prospective sand ranges within Tipam and Girujan formations. Due to the absence of any prospect in Barail Sand based on the available evidence, higher-up Tipam Sand was tested. On testing 2,253 m Upper Tipam (TS-40) Sand through perforations in the range of 2,262 -2,268 m, the well produced gas at the rate of around 50,000 SCMD through 4 mm bean with FTHP: 165 kg/cm². Initial gas sample analysis showed C₁:97.98%, C₂:1.54%, C₃:0.10%, N₂:0.33%, O₂:0.05%, Gas gravity: 0.5,638, Gross calorific value: 8,915.8 Kcal/SCM, Net calorific value: 8,031.6 Kcal/SCM. The well was rigged down on 08.05.2012. The discovery of gas within the Tipam Sand in this well has opened up new area for exploration and exploitation of gas in Zaloni structure to the North West of Madhuting-Tipling area.

ii) The exploratory Well Moran 116(Loc. MFC) is located in the unexplored Dimowkinar structure within Moran ML. The areal extent of the structure is 3.4 sq km and 2.02 sq km at Lakadong+Therria and Barail level, respectively. This well was drilled as a deviated well to probe the hydrocarbon prospects within Barails and Lakadong+Therria formations. The well was spudded on 17.02.2012 and reached the final depth of 4,280 m within Basement on 25.05.2012. The well has encountered a few prospective sand ranges within Lakadong+Therria Formation and the prospects within Barails are not encouraging. On testing of 4,180 m LK+TH Sand through perforation in the range of 4,181 - 4,186 m, the well produced water with floating oil sluggishly. The flow behaviour of the well did not change even after extension of the perforation in the range of 4,179.5-4,183.5 m. Sample analysis showed mainly formation water (Salinity: 3,700 ppm and Bicarbonate: 305 ppm) with floating oil. The sand was plugged back by setting BP at 4,178 m. On testing 4,140 m Lakadong+Therria Sand through perforation in the range of 4,143 - 4,149 m, the well produced @84 KLPD through 5 mm bean with FTHP: 120 kg/cm². Sample analysis shown oil: 91% (API: 30.34°,

pp: 30 °C) water: 9%. The well was rigged down on 26.07.2012. The discovery of oil in this well has opened up a new area for further exploration and exploitation in Dimowkinar structure of Moran area.

iii) The exploratory Well Balimara 2 (Loc.BF) lies in the Balimara structure and is located in between Umatara and Jaipur structure within Borhat PEL. This well was drilled as a deviated well to probe the hydrocarbon prospects within Tipam and Barail formations. The well was spudded on 14.03.2012 and reached the final depth of 4,050 m within Barail Formation on 25.05.2012. The well has encountered a number of prospective sand ranges within Tipam and Barail formations. The 4,314 m Barail Sand was tested through perforations/re-perforations in the range 4,314 - 4,320 and 4317 - 4320 m. The well produced @72 KLPD through 6.5 mm bean with FTHP : 134 kg/cm². Sample analysis showed oil: 25% (API: 34.6°, pp: 30 °C) and water: 75%. The well was rigged down on 06.07.2012. The discovery of oil in this well has opened up a new prospect for future exploration and exploitation in Balimara area.

(iv) The exploratory Well East Khagarijan 1 (Loc.TAI) lies in the unexplored East Khagarijan structure within Tinsukia ML. This well was drilled as a vertical well to probe the hydrocarbon prospects within Lower Eocene-Palaeocene formations. The well was spudded in on 21.06.2012 and reached the final depth of 3,716 m within Basement on 06.08.2012. The well has encountered a number of prospective sand ranges within Langpar and Lakadong+Therria reservoir. Owing to very poor cementation against the prospective Langpar Sand as well as some of the Lakadong+Therria Sands, the 3,597 m Lakadong Therria Sand was tested through perforations in the range of 3,597- 3,600.5 m and the well initially produced @ 66 KLPD through 5 mm bean with FTHP: 49 kg/cm². Samples analysis is showed oil: 43% (API :23.6°, pp: 24°C) and water: 57% (Salinity: 3,700 ppm, Bicarbonate: 732 ppm). The well was rigged down on 21.09.2012. The discovery of oil in this well has opened up a new area for future exploration and exploitation in East Khagarijan structure.

(v) The Well NHK 531 (Loc.HNR) lies in Deohal area within Hugrijan ML. In a workover operation during 05.08.2012 to 27.08.2012, after setting bridge plug at 2,446 m within 9.5/8" casing,

2,440 m Barail Sand was tested through perforations in the range of 2,439 m - 2,445 m. Subsequently, the well produced gas @ 75,000 SCMD through 7 mm bean with FTHP of around 176 kg/cm². The discovery of gas in this well has opened up a new reservoir/prospect for exploration and exploitation of gas in Deohal area.

(vi) The exploratory Well Barekuri 12 (Loc.DGJ) lies in the eastern fault block of the West Barekuri structure. This structure is located in the unexplored North-West part of Barekuri structure within Dumduma ML. This well was drilled as a deviated well to probe the hydrocarbon prospects within Langpar and Lakadong + Therria formations as primary target and Narpuh Formation as secondary target. The well was spudded on 14.09.2012 and reached the final depth of 4,027 m within Basement on 23.11.2012. The well has encountered prospective sand ranges within Narpuh and Lakadong + Therria formations. On testing 3,947 m Lakadong+ Therria Sand through perforations in the range of 3,947-3,953 m, the well initially produced @ 100 KLPD through 5.0 mm bean with FTHP: 116 kg/cm². Sample analysis showed oil: 98.2% (API: 27.9°, pp: 33 °C) and water: 1.8%. The discovery of oil in this well has opened up a new area for exploration and exploitation in North-West part of Barekuri area.

(vii) The Well NHK 581 (Loc.HTF) lies in Duliajan area within Hugrijan ML. In a workover carried out during 28.08.2012 to 05.11.2012, the 2,322 m Tipam Sand was plugged back by setting bridge plug at 2,322 m. Subsequently, the higher up 2,295 m Upper Tipam Sand was tested through perforations in the range 2,305 m - 2,308 m. The well produced gas @ 35,000 SCMD through 5 mm bean with FTHP of around 173 kg/cm². The well has opened up a new reservoir for exploration and exploitation of gas in and around Duliajan area.

(viii) The exploratory Well Singhibil - 1 (Loc.HVT) lies in Singhibil structure which is an independent footwall closure bounded by NE-SW trending major fault towards East and E-W trending major fault towards North. This structure is located in the unexplored northern part of Ghuguloni structure within Hugrijan ML. This well was drilled as a vertical well to probe the hydrocarbon prospects within Langpar, Lakadong + Therria formations and Barail prospects as primary target and Tipam Sands as secondary

target. The well was spudded on 19.08.2012 and reached the final depth of 4,102 m within Basement on 15.12.2012. The well has encountered few prospective sand ranges within Lakadong + Therria and Barail formations. Initially on testing 3,983 m Lakadong + Therria Sand through perforations in the range of 3,983 m - 3987 m, an immediate pressure build up of 42 kg/cm² was recorded. The well ceased to flow after displacing 55 bbls of well fluid with heavy/high pour point oil. Sample analysis showed oil : 74% (API:12.5°, pp: 51°C) water : 26%. In view of presence of heavy oil, the sand was plugged back by putting a bridge plug. Subsequently, 3,970 m and 3,958 m Lakadong + Therria sand were tested through perforations in the ranges 3,970 m - 3,972 m and 3,959 m - 3965 m, respectively and the same were also plugged back due to inflow of heavy oil. Further, testing 3,936 m Lakadong + Therria Sand through perforations in the range 3,936 m - 3,939 m, an immediate pressure build up of 35 kg/cm² was recorded after the perforation. After displacing a cumulative of 55 bbls of well fluid, the tubing pressure rose to 218 kg/cm² and gas surfaced with freezing of the flow line, gas potential yet to be ascertained. The well was rigged down on 26.02.2013 and kept shut-in to install infrastructure for gas production. Installation of gas production infrastructure for regular production is in progress. The discovery of gas in this well has opened up a new area for exploration and exploitation in Singibil.

(ix) The Well NHK 141 (Loc.NDO) lies in Naharkatiya area within Naharkatiya extension ML. In the work-over operation carried out during 24.01.2013 to 27.03.2013, the 2,177 m Tipam Sand was plugged back by setting bridge plug at 2,098 m. Subsequently, the higher up 1,894 m Upper Tipam Sand was tested through perforations in the range 1,899 m - 1,908 m. The well produced @ 3,000 SCMD through 8 mm bean with FTHP of around 28 kg/cm². The discovery of gas in this well was not appraised earlier. The well has discovered a new reservoir for exploration and exploitation of gas in and around Naharkatiya area.

The physical achievements of exploration activities pursued for petroleum and natural gas during 2012-13 are given in Tables - 1 & 2.

Reliance Industries Ltd (RIL)

RIL's portfolio includes 13 Production Sharing Contracts (PSC) blocks in India of which 9 are in the active exploration/appraisal phase. There are 4 blocks which are under development and production including KG-D6 in Krishna Godavari offshore basin, Panna-Mukta and Tapti in Mumbai offshore basin and NEC-25 in the Mahanadi basin. During the year, as part of the appraisal programme for CY-D6 block reviewed, new 3D seismic was acquired and also one appraisal well was drilled. The exploration work by RIL in the forthcoming years is likely to target Krishna Godavari and Cauvery basins.

Table – 1 : Exploratory and Development Drilling for Petroleum & Natural Gas during 2012-13*

Area	Drilling	
	Wells (No)	Meterage ('000 m)
Total	570	1408
(a) Exploratory: Total	197	599
Onshore	137	368
Offshore	60	231
(b) Development: Total	373	809
Onshore	290	569
Offshore	83	240

*Provisional.

Source: Oil & Natural Gas Corpn. Ltd, Oil India Ltd and Directorate General of Hydrocarbons.

Table – 2 : Number of Wells and Meterage drilled for Petroleum & Natural Gas during 2012-13*

Area	Drilling	
	Wells (No)	Meterage ('000 m)
Total	570	1408
(a) Onshore: Total	427	937
Assam	73	244
Gujarat	238	405
Others	116	287
(b) Offshore: Total	143	471
Bombay High	143	471

*Provisional.

Source: Oil & Natural Gas Corpn. Ltd, Oil India Ltd and Directorate General of Hydrocarbons.

COAL

The agencies engaged in exploration for coal during 2012-13 were mainly GSI, CMPDI, MECL and State Directorates of Geology & Mining.

GSI

The GSI continued its operations for search and assessment of coal resources in the country through regional exploration in coalfields of Andhra Pradesh, Assam, Chhattisgarh, Madhya Pradesh, Maharashtra and Odisha. An additional resources of 3171.62 million tonnes of coal have been assessed from the data generated from regional exploration during 2012-13.

In Andhra Pradesh, Reconnaissance stage (G-4) exploration by scout drilling was continued during 2012-13 in Vutasamudram-Venkatapuram area, Southern sub-basin of Godavari Valley Coalfield, Khammam and West Godavari districts to explore and evaluate coal potentiality of Barakar and Lower Kamthi formations, already established in northern adjoining Narayanpuram-Pattayagudem and Sitanagaram areas and to decipher the structural and stratigraphic set up of the area. A total of 67.70 m was drilled in one borehole and 390 m Geophysical (GP) logging was completed. The borehole intersected Lower Kamthi Formation. Regional exploration for coal was continued in Bugga-Khammamtoogu sector, Southern part of main basin, Godavari Valley Coalfield, Khammam district in 2012-13 to explore and evaluate coal resource potentiality of Barakar coal seams already established in the adjoining Manuguru Mining block lying to the North-East. During the period a total of 625.05 m was drilled in three boreholes. An area of 1.50 sq km was mapped on 1:10,000 scale and 578 m Geophysical logging was completed. Three Barakar coal/carbonaceous shale bands varying in thickness from 0.50 m - 1.90 m were intersected between 537.85 m and 556.20 m depth in borehole BH-2, whereas nine coal/carbonaceous shale bands and six Barakar coal/carbonaceous shale bands varying in thickness from 0.50 m-2 m were intersected between 57.36 m and 371.60 m depths in borehole BH-4. Regional exploration for coal in Pagaderu (West) sector, Southern part of main basin, Godavari Valley Coalfield, Khammam district was carried out to explore and evaluate coal potentiality of Lower Kamthi and Barakar coal seams in the down dip side of adjoining Manuguru

Mining block and north-east of Bugga-Khamamtogu sector. During the period a total of 1,387.60 m was drilled in four boreholes. A total of 224 m Geophysical logging was completed. Thirteen Lower Kamthi coal/carbonaceous shale bands and four Barakar coal/carbonaceous shale bands varying in thickness from 0.30 m - 2.10 m were intersected between 15.90 m and 236.87 m depths in borehole (BH-1). Fifteen coal/carbonaceous shale bands varying in thickness from 0.55 m - 1.96 m were intersected between 196.95 m and 443.59 m depths in BH-2, whereas eight coal/carbonaceous shale bands of Lower Kamthi Formation varying in thickness from 0.50 m - 1.35 m were intersected within shallow depth ranging from 33.90 m to 86 m in borehole (BH-3). Thirty coal/carbonaceous shale bands varying in thickness from 0.50 m - 1.45 m were intersected between 30.86 m and 373.18 m depths in borehole (BH-4).

In Assam, Prospecting stage (G-3) exploration was taken up during 2010-12 in Sukchar-Singrimari area, Singrimari Coalfield in Dhubri district at the border of Assam and Meghalaya to explore the behaviour and the extension of the Gondwana coal bands and to establish the coal resource potentiality of the area. During the period a total of 1,387.60 m was drilled in three boreholes. An area of 2 sq km was mapped on 1:10,000 scale. Three Karharbari coal seams varying in thickness from 0.50 m-1.25 m were intersected between 161.90 m and 181.75 m depths in borehole (BH-3).

In Chhattisgarh, Regional exploration under G-2 stage was continued in Teram block, Raigarh district, Mand - Raigarh Coalfield to establish the continuity of the regional Barakar coal seams intersected in already explored adjacent Kurumkela block and to evaluate additional coal resource. A total 2,528.95 m was drilled in seven boreholes. An area of 4 sq km was mapped on 1:10,000 scale and 999.36 m of Geophysical logging was completed. Nine regional coal seams /zones and few local coal seams ranging in thickness from less than a metre to 13 m (cumulative) were intersected within depth range from 162.23 m to 585.35 m. Coal Seam/Zone V (1.77 m to 11.32 m), VI (8.44 m to 13 m) & XI (3.41 m to 5.19 m) are important considering their thickness and regional persistence. The regional continuity for coal seams was established for five km along strike and 2.5 km along dip direction. Exploration was

completed in December, 2012 with a total of 5,871.75 m of drilling in eleven boreholes. Regional exploration under G-2 stage in Samarsingha block, Raigarh district, Mand - Raigarh Coalfield was continued in order to establish the continuity of the regional Barakar coal seams which has already been established in the Nawagaon Block in the North and Sithra-Kurekela area in the West. The prime objective of this investigation was to assess coal resource potentiality and to carry out appraisal of CBM content. A total of 2,788.75 m was drilled in six boreholes. An area of 4 sq km was mapped on 1:10,000 scale and 1,768.25 m of Geophysical logging was completed. Twelve regional Barakar coal seams/zones and few local coal seams ranging in thickness from less than a metre to 11.10 m (cumulative) were intersected within depth range from 16.30 m to 738.06 m. Coal Seam /Zone- I (4.70 m to 6.26 m), IV (3.26 m to 11.10 m) & VI (1.01 m to 4.16 m) are important for their thickness and regional persistence. During the period, about 5 km strike extension and 2 km dip extension have been proved. Regional exploration for coal was carried out in Amlidhonda block, Raigarh district, Mand-Raigarh Coalfield to establish the continuity of the regional Barakar coal seams intersected in adjacent explored Kesarchuan-Lamdand block towards East and Gare area towards North. The prime objective of this investigation was to evaluate additional coal resource and to carry out appraisal of CBM content. A total 2,673.30 m was drilled in seven boreholes in the area. An area of 4 sq km was mapped on 1:10,000 scale and 1,902.01 m of Geophysical logging was completed. Seven regional coal seams / zones and few local coal seams varying in thickness from less than a metre to 18.87 m (cumulative thickness) were intersected between 118 m and 473.40 m depths. Coal seam/ zone X (cumulative thickness 3.21 m to 5.25 m), IX (cumulative thickness 1.85 m to 5.65 m) and combined coal seam zone VI and VII (cumulative thickness 10.63 m-18.87 m) are important for their thickness and regional persistence. During the period, about 2 km strike extension and 2.5 km dip extension have been proved. Regional exploration for coal was continued under G-2 stage in Vijaynagar-Giddhi block, Tatapani - Ramkola Coalfield, Surguja district in order, (a) to establish the structural disposition of the Lower Gondwana sequences, (b) to establish the continuity of Barakar coal seams beneath the cover of Barren

Measures and Raniganj Formation, (c) to appraise the resource potentiality of Barakar coal seams and (d) to generate CBM baseline data. During the period, a total of 3,151.80 m was drilled in seven boreholes in the area. An area of 3 sq km was mapped on 1:10,000 scale and 990.65 m of Geophysical logging was completed. The boreholes intersected Barren Measures and Barakar Formation. Thirteen regional Barakar coal seams/ zones ranging in thickness from less than a metre to 18.94 m were intersected in the depth range from 102.05 m to 555.32 m. Seam nos./zones III (cumulative thickness 5 m to 18.94 m), IV (maximum cumulative thickness 9.04 m) are important for their thickness and regional persistence. Besides few local coal seams were also intersected in Barakar Formation, with thickness varying from less than a metre to 3.81 m, between depths 19.35 m and 508.65 m. The coal contents in Barakar Formation increase from Eastern to Western part of this block. The continuity of coal seams in Barakar Formation has been established over a strike length of about 6 km and 1.5 km along down dip direction. Quality-wise, seams are mostly of power grade with minor superior grade coal.

In Madhya Pradesh, Regional exploration for coal was carried out in Sarai (West) area, Singrauli Coalfield, Singrauli district for : (a) development pattern and resource potentiality of coal horizons in Raniganj and Barakar formations with determination of coking propensity, (b) extension of coal seams of Hatta-Dudhmaniya and Sarai (East) area and to identify high rank coal at shallow/intermediate depth range,(c) stratigraphic set up and structural frame work of the area and (d) generation of CBM baseline data. A total of 2,259.30 m was drilled in five boreholes. An area of 5 sq km was mapped on 1:10,000 scale and 1,527.79 m of Geophysical logging was completed. Three regional (R-I to R-III) and three Raniganj local seams (RL 1 to RL 3) with thickness varying from 0.54 m - 3.43 m, were intersected at very shallow depth (25.60 m - 146.11 m). Seven regional and few local Barakar coal seams were intersected between depths of 288.12 m and 531.67 m. Thickness of individual coal section varies from 0.51 m-2.40 m. Reconnaissance stage (G-4) exploration by scout drilling was continued during 2012- 13 (Spill Over Work) in Sarai (East) area, Singrauli Coalfield, Singrauli district as spill over

item to assess the coal development pattern and resource potentiality, establishing stratigraphic set up of the area and to generate CBM baseline data. During the period a total 167 m was drilled in two boreholes viz. BH-4 and 6 in the area. A total of 1,082.87 m Geophysical logging was completed. Regional exploration under G -2 stage was continued in Pachri block, Sohagpur Coalfield in Shahdol district to establish developmental pattern of superior grade Barakar coal seams at shallow depth, to decipher major structural set-up of the area and to evaluate additional coal resources. During the period a total of 917.65 m was drilled in four boreholes in the area. An area of 10 sq km was mapped on 1:10,000 scale and 947.96 m Geophysical logging was completed. Four regional Barakar coal seams ranging in thickness from 0.55 m to 6.15 m were intersected within the depth range from 79.80 m to 257 m. Regional exploration under G - 2 stage was continued in Maiki (North) block, Sohagpur Coalfield, Shahdol district with the following objectives a) establish the developmental pattern of superior grade Barakar coal seams at shallow depth b) decipher major structural set-up of the area and c) evaluate additional coal resources. A total of 2,911.95 m was drilled in seven boreholes. An area of 10 sq km was mapped on 1:10,000 scale and 3,015.89 m of Geophysical logging was completed. Four regional Barakar coal seams were intersected within the depth range from 404 m to 579.50 m. Thickness of individual coal section varies from 0.30 m - 6.35 m. Regional exploration under G- 2 stage was carried out in Bihar block, Sohagpur Coalfield, Shahdol district in order to : a) establish developmental pattern of superior grade Barakar coal seams at shallow depth b) decipher major structural set-up of the area and c) evaluate additional coal resources. A total of 487.15 m was drilled in two boreholes. The block area is mostly covered by Lameta Formation. Four regional Barakar coal seams were intersected between depths of 141.80 m and 291.50 m. Thickness of individual coal section varies from 0.70 m - 3.50 m. Regional exploration under G-2 stage for coal was carried out in Malka block, Sohagpur Coalfield, Shahdol district in order to a) establish developmental pattern of Barakar coal seams at moderate depth and few Raniganj coal seams at shallower depth b) decipher major structural set-up of the area c) evaluate additional coal resources. A total of 89 m was drilled in one

borehole. Three Raniganj coal seams varying in thickness from 0.50 m - 1.62 m were intersected at shallow depth range from 12.95 m - 41.32 m. Regional exploration under G -2 stage was carried out in Bhurkumdhana sector, Pench Valley Coalfield, Chhindwara district to establish the dip continuity of Barakar coal seams already recorded in Payalidhana sector to the South, below the Deccan trap under favourable structural set up and to assess coal resource potentiality of the area. A total of 1,029.35 m was drilled in three boreholes. An area of 8 sq km was mapped on 1:25,000 scale and 373.88 m of Geophysical logging was completed. Borehole BH-2 was closed in Barakar Formation after intersecting four regional seams within 420.95 m and 460.85 m depths. Individual coal sections in these seams vary in thickness from 0.50 m - 2.50 m. Regional exploration under G3 stage was continued as spill over item in Payalidhana sector, Pench Valley Coalfield in Chhindwara district to establish the strike extension of Barakar coal seams below the Deccan traps under favourable structural setup, already recorded in Bagbardiya sector to the South West and Dhankasa area in the South East, and to assess the coal resource potentiality of the area. A total 106.45 m was drilled in one borehole. A total of 341.16 m of Geophysical logging was completed. Three regional Barakar coal seams varying in thickness from 1.50 m - 3.50 m were intersected between 289.76 m and 312.15 m depths.

In Maharashtra, Regional exploration under G-2 stage was carried out for coal in Jhamkola area, Wardha Valley Coalfield, Yavatmal district to establish Barakar coal seams below Deccan trap, South West of Parsoda-Ghonsa coal belt and to assess coal resource potentiality of the area. A total of 896 m was drilled in three boreholes. A total of 10 sq km was mapped on 1:25,000 scale. The borehole BH-1 intersected Deccan traps, Motur Formation and Barakar Formation whereas the boreholes BH-2 and BH-3 intersected Deccan traps and Motur Formation. Regional exploration for coal in Dewala-Mangli block, Yavatmal district was completed. Prospecting stage (G-3) exploration initiated during 2008-09 has been continuing in Dewala- Mangali block of Wardha Valley Coalfield in Yavatmal district to establish the strike continuity of Barakar coal seams, already recorded in Asthona- Kothurla- Mangli area in the North West below the Deccan traps under favourable structural set up and to assess the coal

resource potentiality of the area. During this period, two boreholes were drilled and one coal seam of 0.60 m in thickness was intersected at 459.40 m depth in Barakar Formation.

In Odisha, exploration for coal under G-3 stage was continued in Nuagaon North area, Talcher Coalfield in Angul district to explore the down dip continuity of regional coal seams of Barakar and Karharbari formations which has already been explored in adjacent Nuagaon-Telisahi and Kudanali North East blocks. During the period, a total 1,713.85 m was drilled in five boreholes viz. BH-7 to 11 and 1,796 m GP logging was completed. Five Barakar and one Karharbari seam zones with cumulative thickness varying from 3.07 m (Seam - I, BH - 8) to 37.67 m (Seam - III, BH -11) were intersected within the depth range of 350.25 m (BH -10) and 761.14 m (BH - 8). Continuation of coal seams was established for 6 km along strike and 1.5 km along dip direction. Exploration for coal was initiated on 31.01.2013 by scout drilling in Chadchadi block, Deogarh and Sambalpur districts. During the period under consideration, a total 327.50 m of drilling was accomplished in one borehole (BH-1). In addition to these, an area of 4 sq km was covered by Large scale mapping in this block. Coal bearing Barakar Formation with thin coal and carbonaceous shale bands were intersected in this borehole. Regional exploration under G -2 stage was continued in Khariaparha block of Ib River Coalfield in Jharsuguda district to explore the possible continuity of regional coal seam/seam zones of Raniganj and Barakar formations towards North East of already explored Kuraloi (A) North Block. The objective of this investigation is to assess the coal resource potentiality and to have preliminary appraisal of CBM potentiality of the area. During the period, a total 814.20 m of drilling was done in two boreholes along with 971 m of Geophysical logging. Two coal seam zones of Raniganj (R - I & R - II) and five regional coal seam zones of Barakar formations ranging in thickness from 2.38 m - 61.19 m were intersected between 23.48 m and 616.20 m depths. The Lajkura seam zone which is the thickest with cumulative coal thickness of 61.19 m has been intersected at roof depth of 381.20 m. R II, R-I, Belpahar, Parkhani and Rampur seam zones show maximum cumulative thickness of 3.98 m, 5.86 m, 24.79 m, 20.84 m and 45.98 m. The seam zone consists of two to nine splits ranging in thickness from

0.50 m - 27.25 m. Ib seam is impersistent in nature and has cumulative thickness of 2.38 m with 2 splits sections. Extension of regional Barakar coal seam zones has been established for about 2.5 km in strike and 2 km along down dip direction. Coal seams are of power (E to G mainly) grade with superior grade coal (Grade A to E) occur only in Ib seam. Regional exploration under G - 2 stage in Grindola block, Ib River Coalfield, Jharsuguda district was continued with an objective to explore the possible continuity of regional coal seam/ seam zones of Raniganj and Barakar formations encountered in already explored neighbouring Kuraloi (A) North block, to assess the coal resources potentiality of the area. During the period, a total 1,896.90 m was drilled in three boreholes in the area. An area of 7 sq km was mapped on 1:10,000 scale and 457 m GP logging was completed. Four Raniganj coal seam zones and four regional Barakar coal seam zones ranging in thickness from 2.15 m - 57.67 m were intersected between 27.62 m and 655.54 m depths. Seam zones R - I (17.20 m to 22.48 m), Belpahar (16.31 m to 21.50 m), Parkhani (22.88 m to 31.81 m), Lajkura (18.94 m to 57.67 m) and Rampar (35.38 m) are important for their thickness and regional extension. The Raniganj seam zones are intersected at a very shallow depth range. Regional exploration under G - 2 stage commenced in 2012-13 in Bandbahal block, Ib River Coalfield, Jharsuguda district, with an objective (a) to explore the possible continuity of the regional coal seam zones of Raniganj and Barakar formations of on going Khariaparha block (b) to establish structural set up and stratigraphy of the area and (c) to assess the coal resource potentiality of the area. During the period, a total 771.20 m was drilled in one borehole. An area of 3 sq km was mapped on 1:10,000 scale. Four regional Raniganj coal seam zones and two regional coal seam zones of Barakar with thickness varying between 1.75 m and 18.78 m were intersected between 66.92 m and 406 m depths. Seam zone R-I (cumulative coal thickness of 18.53 m - 18.78 m) are most important Raniganj seam for thickness and lateral persistence. The seam zone Belpahar (cumulative thickness 11.64 m - 12.27 m) is also important for thickness. CBM desorption study revealed the presence of 0.01cc/gm of desorbed gas in regional seam zone R-I intersected in borehole BH-1.

Additional resources estimated by GSI in various coalfields during 2012-13 are given in Table-3.

Table – 3 : Additional Resources Estimated by GSI in Various Coalfields, 2012-13

(In million tonnes)

State/Coalfield/Block	Additional resources
Andhra Pradesh	
(A) Godavari Valley Coalfield	
(i) Vutasamundram-Venkatapuram area	14.25
Chhattisgarh	
(A) Mand-Raigarh Coalfield	
(i) Nawagaon Block	515.47
(B) Hasdo Arand Coalfield	
(i) Korja Block	131.35
Madhya Pradesh	
(A) Sohagpur Coalfield	
(i) Amiliah Block	54.49
(ii) Devanitola Block	262.14
(B) Pench Valley Coalfield	
(i) Payalidhana Sector	138.87
(C) Singrauli Coalfield	
(i) Sarai (East) Area	193.04
Maharashtra	
(A) Wardha Valley Coalfield	
(i) Dewala-Mangli Block	10.70
Odisha	
(A) Talcher Coalfield	
(i) Simlisahi-Kunjbiharipur Block	1542.98
West Bengal	
(A) Birbhum Coalfield	
(i) Dhobbanpur Sector	74.19
(ii) Gazipur Area	180.78
(B) Raniganj Coalfield	
(i) East of Bhabaniganj Area	53.36
Total	3171.62

CMPDI

CMPDI continued its coal exploration activities in 2012-13, mainly in CIL and Non-CIL/Captive Mining Blocks. Exploration in CIL blocks was taken up to cater to the project planning/production support needs of subsidiaries of CIL, whereas exploration in Non-CIL/Captive Mining Blocks was undertaken to facilitate allotment of coal blocks to prospective entrepreneurs for captive mining. A total of 115 to 140 drills were deployed in 2012-13, out of which 53 were departmental drills.

CMPDI deployed its departmental resources for exploration of CIL/Non-CIL/Promotional blocks, whereas State Governments of Madhya Pradesh and Odisha deployed resources in CIL, blocks only. Besides, five other contractual agencies have also deployed resources for detailed drilling/exploration in CIL/Non-CIL blocks.

In 2012-13, CMPDI and its contractual agencies took up exploratory drilling in 102

blocks/mines spread over 22 coalfields in six states. These coalfields with no. of blocks/mines are: Raniganj (10), Brahmani (1), Jharia (4), West Bokaro (2), East Bokaro (1), Ramgarh (2), South Karanpura (6), North Karanpura (4), Kamptee (7), Nand-Bander (3), Wardha Valley (5), Katol Basin (1), Singrauli (7), Sohagpur (7), Mand Raigarh (12), Tatapani-Ramkola (3), Johilla (1), Korba (3), Bistrampur (4), Talcher (12), Ib Valley (6) and Sonhat (1). Out of 102 blocks/mines, 35 were Non-CIL/Captive blocks and 67 CIL blocks/mines. Departmental drills of CMPDI took up exploratory drilling in 63 blocks/mines, whereas contractual agencies drilled in 39 blocks/mines.

A total of 5.63 lakh m of exploratory drilling was carried out by CMPDI in 2012-13 through departmental resources (2.76 lakh m) and outsourcing (2.87 lakh m) to State Governments/MECL/Tendering (CIL/Non-CIL blocks). Details of exploratory drilling carried out by CMPDI in 2012-13 are given in Table - 4.

Table - 4 : Exploratory Drilling by CMPDI (Departmental and Outsourcing) in 2012-13

Sl. No.	Agency	Target (m)	Exploratory drilling achieved (m)	Achieved (%)
1.	Departmental	257,000	276,199	107
2.	Outsourcing			
	i) State Govts.	8,000	7,397	92
	ii) MECL (MoU)	89,000	138,761	156
	iii) Tendering (CIL Blocks)	147,000	90,779	62
	iv) Tendering (Non-CIL Blocks)	81,000	49,772	61
	Total	582,000	562,908	97

Singareni Collieries Company Ltd (SCCL)

During 2012-13, SCCL carried out detailed exploration in Godavari Valley Coalfield, Andhra Pradesh. A total of 120,105 m drilling was achieved against a target of 150,000 m and coal reserves of the order of 45.63 million tonnes were proved in 2012-13. The total proved geological reserves of Godavari Valley Coalfield are placed at 9,923.31 million tonnes as on 1.4.2013.

State Directorates

The details of exploration for coal carried out by the State Directorates of Geology & Mining during 2012-13 are given in Table-5.

LIGNITE

GSI, MECL, DMG, Rajasthan and GMDC conducted investigation for lignite during 2012-13.

EXPLORATION & DEVELOPMENT

GSI

GSI continued exploration for lignite in the East Coast lignite fields of Tamil Nadu and at the Tertiary sequence in Palana and Nagaur basins, Rajasthan to identify and assess lignite potentiality.

The search for lignite resources has been accorded priority in the states of Tamil Nadu and Rajasthan which are devoid of any coal deposit.

In Tamil Nadu, Prospecting stage (G-3) exploration was carried out for lignite in Uttarakosamangai sector, Ramnad sub-basin, Ramanathapuram district. Regional exploration

was continued to (a) delineate lignite-bearing areas and (b) assess the resource potentiality of the area. During the period, a total of 5,182.65 m of drilling carried out in thirteen boreholes and a total of 3,954 m of GP logging was completed. The boreholes intersected Quaternary sediments, Cuddalore/Tittacheri Formation and Neyveli Formation. Three regionally persistent lignite seams have been recorded within Neyveli Formation between 315 m to 385 m depths. Maximum thickness (21 m) of lignite seams was intersected in borehole BH-12. The exploration has so far established a strike continuity of lignite seams for about 9 km and dip continuity of 5.5 km.

Table – 5 : Exploration for Coal by State Directorates of Geology & Mining, 2012-13

State/ District	Location	Geological mapping		Drilling		Remarks
		Area (sq km)	Scale	Boreholes	Meterage	
Chhattisgarh						
Korba	Saila block, Saila Pali area	-	1:50,000	04	832.45	Geological resources remain at 51.15 million tonnes as previous year.
		-	1:4,000			
Surguja	Gotan-Birjupali area	340 1.76	1:50,000 1:4,000	-	-	Survey work with collection of 58 nos. of samples have been done. Work under progress.
-do-	Saidu area	105 2.10	1:50,000 1:4,000	01	862.25	Total 53.04 m coal core and 15 nos. rock samples have been collected. About 12.6 million tonnes of coal resources have been estimated.
Maharashtra						
Nagpur	Dawa-Phukeshwar	-	-	-	281.65	About 1.23 million tonnes resources of coal were estimated (9.84 million tonnes so far).
-do-	Nand-Panjrepar	-	-	-	4082.95	About 2.18 million tonnes resources of coal were estimated (29.40 million tonnes so far).
Yavatmal	Adkoli-Khadakdon	-	-	-	1231.50	About 0.36 million tonnes resources of coal were estimated (3.2 million tonnes so far).
-do-	Ashtona Kothurna	-	-	-	673.00	About 0.85 million tonnes resources of coal were estimated so far.
Chandrapur	Nandori	-	-	-	1581.00	About 9.15 million tonnes resources of coal were estimated (188.70 million tonnes so far).
-do-	Wilson block	-	-	-	1096.00	About 11.14 million tonnes resources of coal were estimated (52.62 million tonnes so far).
-do-	Chalbardi	-	-	-	1422.00	About 1.28 million tonnes resources of coal were estimated.

EXPLORATION & DEVELOPMENT

In Rajasthan, Reconnaissance stage (G-4) exploration for lignite by scout drilling was taken up during 2012-13 in Kharicharnan South area in the Palana basin of Bikaner district to locate lignite bearing blocks and to establish the stratigraphic set up in the North Central part of Palana basin. A total of 1,534 m was drilled in twelve boreholes and a 937 m of GP logging was completed during the period. The boreholes intersected quaternary sediments, Marh formation and Nagaur formation. No lignite seam intersected during the period.

GMDC

GMDC carried out exploration for lignite in its Tagadi, Panandhro, Mata - No- Madh and Tadkeshwar lignite mines. Particulars of exploration carried out by GMDC are given in Table-6.

NON-FERROUS METALS

BASE METALS

GSI, MECL and HZL conducted investigations for copper, lead and zinc ores in different parts of the country during 2012-13.

GSI

The details of exploration activities carried out by GSI during 2012-13 are given in Table-7.

MECL

During 2012-13, MECL carried out exploration for lead-zinc in Tikhi Extension South Block, Sawar Metasedimentary Belt, Ajmer district, Rajasthan by mapping in 0.50 sq km area on the 1: 1,000 scale; 100 cu m trenching; 1911 m of borehole geophysical logging; chemical analysis of 775 nos. primary samples, 51 nos. check samples and 26 nos. composite samples, and 3414 m core drilling in 15 boreholes. Total 2.32 million tonnes of lead - zinc resources with a grade of 5.98% Pb, 0.86% Zn & 0.20% Cu at 3% TMC (Pb, Zn & Cu) cut off have been estimated in the block. As per UNFC, deposit is placed under 332 category. Similarly, in Gurla (North) Block, Bhilwara district, Rajasthan, MECL carried out exploration for Lead-Zinc involving mapping in 1.20 sq km area on 1: 5,000 scale; 200 cu m trenching; chemical analysis (1948 nos. primary + check core samples for Cu, Pb + Zn & Cu; 100 nos. primary samples for Co, Ni & Cd; 100 nos. primary samples for Au & Ag; 27 nos. composite samples each for Pb + Zn & Cu; Au & Ag and Co, Ni & Cd); baseline environmental study for 10 km radius area and 3,941m core drilling in 23 boreholes. A total of 7.10 million tonnes resources with 0.86% Pb, 1.40% Zn and 0.36% Cu, 2% TMC & 0.50% Cu cut off grade were estimated under UNFC - 332 (B - Category).

Table – 6 : Exploration for Lignite by State Undertaking, 2012-13

Agency/State/ District/Location	Mapping		Drilling		Sampling (No.)	Result
	Area (sq km)	Scale	No. of boreholes	Meterage		
GMDC, Gujarat						
Bhavnagar	-	-	-	-	-	Total 114.72 million tonnes of geological reserves (111) of lignite have been estimated in Block-A.
Tagadi						
Kachchh						
Panandhro	-	1:5,000	-	-	-	Balance resources of lignite is approximately 6.85 million tonnes.
Mata - No -Madh	-	-	45	2,647	150	Total 5.19 million tonnes of tentative lignite resources were estimated.
Surat	-	1:5,000	29	2,207	24	Total 24 nos. of lignite samples were analysed. 71 million tonnes total resources were estimated, out of which 40 million tonnes & 31 million tonnes are placed under measured & recoverable categories, respectively.
Tadkeshwar	-	1:3,000				

EXPLORATION & DEVELOPMENT

HZL

The most advanced technologies are being deployed by the HZL for systematic investigations of the exploration properties. A high power (50 KW) IP resistivity survey which can scan up to 700 m depth, was deployed this year, to detect deeper prospective zones. During the year greenfield exploration was carried out over 1,680 sq km in five reconnaissance permits (RPs) in Rajasthan. The drilling at three prospects in the state has yielded

economic to sub-economic intersections of massive sulphide zones over varying widths. Assay results of the holes drilled in one of the RPs in Rajasthan has outlined potential economic resources, where mining lease applications were lodged in 2012. A total of 91, 500 m of core drilling was completed at various exploration sites throughout the mines and tenements. A hole of 1,702 m drilled in Rampura - Agucha is the deepest ever at any of India's base metal sites.

Table - 7 : Exploration for Base Metals by GSI, 2012-13

State/District/	Name of block	Details of exploration	Results
Andhra Pradesh			
COPPER			
Anantapur	Cherlapalle block, Kanganapalle area (Ramagiri - Penakacherla schist belt)	Mapping, trenching, pitting sampling and drilling	Prospecting stage (G-3) exploration for copper was carried out to assess copper reef by mineralisation in quartz reef by detailed mapping on 1:2,000 scale, trenching, pitting and collection of bedrock samples followed by exploratory drilling. The work was taken up based on encouraging results of base metal mineralisation in quartz reef located SW of Cherlapalle in 2008-10. The mineralised quartz reef having strike length of 1.2 km and width 1 m to 12 m has been delineated at the sheared contact between granite, granodiorite and amphibolite. The surface manifestation of base metal mineralisation occurs as Malachite stains, box work and cavities due to leaching of sulphides. Most of the BRS samples indicated copper value less than 0.2%. Trench sections across the quartz reef show composite quartz veins. From the analytical results of the trench samples, it is found that the copper concentration in the mineralised body is 0.11% (wt. Av) over a strike length of 1 km. This is wider in the middle part and pinches out towards both North and South ends. A total of 818.30 m drilling in 7 boreholes was done in Cherlapalle block (6 boreholes to intersect the mineralised zone at 60 m vertical depth and one borehole to intersect at 120 m vertical depth). Four mineralised zones have been identified in borehole: BH-1 i.e. (i) 2.5 m x 0.24% Cu between 40.55 m and 43.05 m depth (ii) 2.5 m x 0.21% Cu between 45.85 m and 48.35 m depth (iii) 1.5 m x 0.2% Cu between 64.65 m and 66.15 m depth (iv) 4.10 m x 0.23% Cu between 67.15 m and 71.25 m depth and one zone in BH-3 i.e. (i) 2.5 m x 0.38% Cu between 47.50 and 50.00 m depth. The copper mineralisation in all the boreholes is in the form of malachite and covellite (up to 30 m to 35 m depth) and fine disseminated fresh chalcopyrite at deeper level. Wall rock alteration also has been seen in the form of chloritisation, silicification and epidotisation.

(Contd.)

EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District/	Name of block	Details of exploration	Results
Arunachal Pradesh BASE METAL East Kameng	Pakro-Ningcho areas	Mapping and sampling	Reconnaissance stage investigation (G-4) was carried out to delineate zones of base metal and associated mineralisation. An area of 48 sq km was covered by large scale mapping (1: 12,500 scale). The mapped area exposes Palaeoproterozoic rocks of Bomdila Group represented by Khetabari Formation and Ziro gneiss. No significant base metal mineralisation has been noticed in the study area. The channel/BRS samples were collected from the gossanised and ferruginised portions for estimation of base metal and precious metal contents from four localities. The mineralisation occurs within the quartzite bands which occur as enclaves within schist of the Khetabari Formation. A zone of highly oxidised and ferruginised BMQ is exposed in a road section near Ningcho village. Eleven (11) nos. of channel samples were collected and analysed for copper content which ranges from 0.22% to 0.66%. Malachite stains were observed in the rolled boulders.
Haryana COPPER Mahendragarh	North of Bakrija	Mapping, sampling and drilling	Prospecting stage investigation (G-3) was carried out to demarcate host rock of copper mineralisation in the unexplored areas. The objective of this investigation was to assess the potential of copper mineralisation both in depth and strike extension in alluvial covered areas. Detailed mapping on 1:2,000 scale of an area of 0.30 sq km was carried out from North of Jagreet- ki-Dhani to South of village Berundola. A total of 440.55 m drilling was completed in four first level boreholes in South-Western part of Jagreet-ki-Dhani over a cumulative strike of 650 m to intersect the mineralised zone at 60 m vertical depth below the surface. The lithounits exposed in and around this area belong to Golwa – Gangutana Formation (Kushalgarh Formation of Rajasthan) of Ajabgarh Group of Delhi Supergroup. It comprises calcareous quartz biotite schist (host rock of copper mineralisation) amphibole marble, mica schist & quartzite. Channel sampling was carried out in the South-West of this area. Analytical results of 15 nos. channel samples indicate Cu <5 ppm, Pb <10 ppm and Zn 11 ppm - 37 ppm. The analytical results of 53 core samples from the boreholes BH-1 to BH-4 indicated Cu <5 to 1704 ppm, Pb <5 to 146 ppm and Zn <5 ppm to 431 ppm.

(Contd.)

EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District/	Name of block	Details of exploration	Results
Jammu & Kashmir LEAD-ZINC Baramulla	Buniyar area	Mapping and sampling	Reconnaissance stage investigation (G-4) was carried out to reassess the nature and extent of Pb-Zn and other associated mineralisation. The investigation was initiated during 2010-12 and was continued in 2012-13. An area of 0.2 sq km has been covered by detailed mapping (1:2,000) along with 10 sq km of large scale mapping (1:25,000) in Banali - Tirkanjan area. The area exposes the rocks belonging to Tirkanjan and Baren formations of Dogra Group of Meso-Proterozoic age. The Tirkanjan Formation is composed of grey sericitic phyllite and chloritic phyllite intruded by basic sills. The Baren Formation is composed of quartz-sericitic phyllites, quartz chloritic phyllites with basaltic flows. Two sets of quartz veins are sparsely distributed, in which one set is parallel to bedding/ foliation and contains sulphide mineralisation and other set which is oblique is devoid of mineralisation. Surface indications of mineralisation are recorded in the form of limonitisation, ferruginisation, poor to well developed gossan and presence of old trenches and pits. The galena commonly occurs in the form of chunks, nodules and dissemination within quartz veins along with other associated sulphide minerals such as pyrite, chalcopyrite, sphalerite and arsenopyrite. The mineralised veins are impersistent without any noticeable lateral or depth persistence and evidences of pinching and swelling is recorded. The mineralisation is of hydrothermal origin.
Kerala BASE METAL Wayanad	Padinjarattara area	Mapping and sampling	Reconnaissance stage (G-4) investigation was carried out to trace the massive sulphide-bearing zone and to delineate potential areas for base metal mineralisation. Large scale mapping on 1:12,500 scale was carried out over 20 sq km area in and around Padinjarattara to delineate sulphide bearing zones. The mapped area comprises predominantly of charnockites. Other associated rock types are mafic granulites, hornblende – biotite gneisses, sulphide-bearing BIF, garnet-bearing quartz-felspathic granulite and minor metapyroxenite and porphyritic granite. The predominant structural fabric in the area is in the NW-SE direction. The sulphide-bearing BIFs occur as two separate bands 1) Northern band 2) Southern band. The Northern band extends for a length of about 570 m and Southern band has been traced for a strike length of about 650 m. The sulphide-bearing BIF bands trends NW-SE to NS and range in thickness from 2 m - 12 m and are discontinuous. A total of seventy (70) bedrock and groove samples were collected. In addition to these, another thirty five (35) soil samples were also collected in grid pattern from the Northern sulphide-bearing BIF band. Analytical results of groove samples indicated copper values varying from 42 ppm to 639 ppm and zinc from 40 ppm to 129 ppm.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District/	Name of block	Details of exploration	Results
Rajasthan BASE METAL Ajmer	Pilwa block	Mapping, sampling and photogeological interpretation	Reconnaissance stage investigation (G-4) was carried out in South Delhi Fold belt to evaluate the AEM and magnetic anomalies and to identify target area for base metal mineralisation. An area of 40 sq km was mapped on 1:10,000 scale in and around Pilwa along with 0.5 sq km detailed mapping in West of Chinwali village. 233 nos. of geochemical (BRS/SS) samples, 20 nos. of petrological, 50 nos. of channel samples, 50 nos. of PTS samples were collected and 100 cu m trenching/pitting were also done. Beside these, 100 sq km area was also studied by way of aerial photos and photogeological interpreted map was prepared. The area is a part of Taragarh Formation of Ajmer Group of Delhi Super Group rock. The rocks exposed are quartzite, porphyritic granite, charnockite, calc silicates and pelitic granulite. The high-grade rocks are the host rock for sulphide mineralisation. At places, charnockite shows fine disseminations of sulphide mineralisation and the granite shows porphyroblastic texture with plagioclase feldspar, quartz, garnet, biotite and opaques. Plagioclase feldspar shows lamellar twinning and sericitisation along the cleavage planes.
COPPER Alwar	Khera block Mundiawas- Khera area	Sampling and drilling	Prospecting stage investigation (G-3) was carried out to evaluate the depth potential of copper and precious metal mineralisation. Malachite stains, presence of old workings and occasional presence of fresh specks of sulphides like bornite, chalcopyrite and pyrite manifest surface indications of mineralisation. Three zones of mineralisation extending for about 300 m with an average width of 10 m - 30 m have been identified. Channel sampling was carried out along three profiles across the mineralised zones. Investigation was supplemented by drilling to test the subsurface copper & associated precious metal mineralisation if any, through the six boreholes. The mineralisation mostly occurs in the form of disseminations, streaks, stringers, veinlets & fracture filling. Chalcopyrite, pyrrhotite, pyrite & rare specks of bornite & covellite were recorded within thin quartz & carbonate veins.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District	Name of block	Details of exploration	Results
COPPER			
Alwar	Khera East block, Mundiyawas Khera area	Mapping and delineation	Reconnaissance stage investigation (G-4) was carried out to evaluate the potential of copper and precious metal mineralisation. The Khera East block exposes rocks belonging to the Thanagazi Formation of the Ajabgarh Group of the Delhi Super Group. The litho units exposed are cherty quartzite, dolomitic marble intercalated with quartzite bands and patchy development of phyllite, meta greywacke and carbon phyllite. The surface indication of mineralisation is present in the form of sporadic malachite stains in dolomitic marble intercalated with quartzite bands and scattered slags in the eastern part of the area. In the Western part of the area, disseminations of sulphides (pyrrhotite and arsenopyrite) occur within a fine grained black coloured rock / cherty quartzite containing carbonates. This band also extends up to the Northern part of the mapped area and the width of the band is about 4 m - 5 m which contains very fine sulphide grains.
BASE METAL			
Bhilwara	Karoi-Rajpura area, (Pur-Banera belt)	Microscopic studies and drilling	Prospecting stage investigation (G-3) was carried out for base metals to assess the basemetal potential. Based on field evidences and ore microscope studies, it is established that the mineralisation is stratabound and evidences of re-mobilisation has been identified. The sulphide mineralisation occurs as fracture filling in the form of stringers and veins. The investigation was supplemented by drilling to test the presence of sub-surface copper mineralisation in this area. Total eight boreholes were drilled and a total of 1,224 m drilling was accomplished. The different units intersected in the boreholes are biotite - bearing banded calc-silicate rock, silicate amphibole-bearing banded calc-rock and garnet-bearing banded calc-silicate rock. The sulphide mineralisation intersected in the boreholes are in the form of disseminations, stringers and veins of chalcopyrite, bornite, covellite, pyrite and pyrrhotite. Analytical results of borehole BH-1 have been received. One mineralised zone is intersected in this borehole between depths of 3 m and 8.70 m with 0.28% Cu.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District	Name of block	Details of exploration	Results
BASE METAL Bhilwara	Between Salampura and Dariba blocks, (Pur-Banera belt)	Mapping and sampling	Reconnaissance stage investigation (G-4) was carried out for base metal mineralisation to assess the base metal potential in the gap area between Pur-Dariba copper prospect and Gurla base metal prospect. The detailed mapping and geochemical sampling was carried out. The garnet- biotite-sericite schist/quartzite are exposed in South-Eastern part of the area and garnet biotite schist, calc-silicate rock/amphibolite marble in the North-Western part, while the Central part is characterised by inter-banded sequence of garnet biotite schist/calc-silicate with minor band of BMQ. There are two major old workings located at South East and North Western part of Dariba village. The mineralisation is mainly hosted in magnetite bearing calcareous schist/amphibolite marble which is intimately associated with Banded Magnetite Quartzite (BMQ) and calc-silicates. Malachite stains are also recorded in interbanded sequence of calc-silicates and garnet-biotite schist and BMQ. An area of 0.5 sq km has been mapped on 1:2,000 scale. The general strike of beds are N30°E- S30°W with steep dips towards SE or NW. Pinch and swell structures are developed in BMQ at places. 100 nos. of soil samples have been collected from the area on 50 m x 200 m grid, which shows presence of anomalous zone in the area.
-do-	Northern part of Salampura block, (Pur-Banera belt)	Delineation of mineralisation	Prospecting stage investigation (G-3) was carried out to assess the base metal potentiality. The host rock of base metal mineralisation is calc-silicate rock. The sulphide mineralisation occurs in the form of disseminations and veins along foliation planes of calc-silicate rock. The identified sulphide minerals are pyrite, pyrrhotite, galena and sphalerite. Details of mineralised zones intersected in Boreholes are furnished as: BH-12-Depth between 16.80 m and 90.6 m, Width - 0.60 m to 1.5 m, Average grade - 0.39% - 3.32% Pb + Zn, BH-13-Depth between 69.50 m and 124.30 m, Width - 1.10 m to 3.95 m, Average grade - VE - 1.0% - 2% Pb + Zn.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District	Name of block	Details of exploration	Results
BASE METAL			
Bhilwara	Ramupriya and Gadariyakhera blocks (Pure-Banera Belt)	Mapping, pitting, trenching, drilling and sampling	Prospecting stage investigation (G-3) was carried out to assess the base metal and associated gold mineralisation. An area of 1 sq km was covered by detailed mapping on 1:2,000 scale along with 100 cu m of pitting and trenching which is supplemented by 873.20 m of drilling in five bore holes. In addition to these, collection of 363 nos. of soil/ BRS samples, 119 nos. channel samples and 66 nos. of PTS were also done. The analytical results indicate Pb values ranging from 25 ppm - 791 ppm and Zn from 60 ppm - 3,636 ppm. Analysis of channel samples shows 1.13% Zn and 0.47 % Pb (weighted average) over a width of 12 m. The borehole-I had intersected sulphide-bearing mineralised zones between depth of 86.40 m and 97.85 m and contains pyrite, pyrrhotite and sphalerite. The ore minerals are present in the form of dissemination and vein filling. The Zn values ranges from 5 ppm - 1.8% and Pb values from < 25 ppm - 0.32%. The borehole BH-3 has intersected mineralisation between depth of 38.05 m and 45.10 m with 7.05 m. x 1.0 - 2 % VE (Pb+Zn).
COPPER			
Jhunjhunu	Ponkh South Extension block (Central Khetri Belt)	Pitting/trenching sampling and drilling	Reconnaissance stage investigation was carried out to evaluate potential of copper and precious metal mineralisation. The litho units exposed in the area belong to Ajabgarh Group of Delhi Super Group. The main rock types exposed in the area are carbon phyllite, dolomitic marble, impure marble and quartzite. Gossan has also been noticed at the top of carbon phyllites. A total of 153 nos. of channel samples have been collected from gossan zones and oxidised carbon phyllite. A quantum of 150 cu m of pitting/trenching has been carried out and 272 nos. of BRS have been collected. Three gossans have been demarcated in the North-East of the Ponkh village, out of which the largest gossan lies in the North Western part of the area and is about 130 m about in length with 30 m of width. The result of the chemical analysis shows very poor copper mineralisation (10 ppm to 224 ppm) in the area. Four borehole profiles have been prepared and 99 m of drilling has been accomplished in one borehole. The mineralisation mostly occurs in the form of disseminations, stringers, veins and specks of pyrite only. Evidences of malachite staining and occurrences of copper sulphides were not observed in the core samples.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District	Name of block	Details of exploration	Results
BASE METAL			
Sikar	Nanagwas area (North Delhi Fold belt)	Delineation of mineralised zones and drilling	Prospecting stage investigation (G-3) was carried out to test the sub-surface continuity of base metal mineralisation and associated precious metals. Two mineralised zones - I & II have been delineated on surface. Four boreholes were drilled to intersect mineralisation at targeted depth Zone - I as detailed below : BH-1 Depth - 64.15 m to 107.85 m Width - 1.00 m to 15.25 m Average grade : 0.30% to 0.37% Cu and 0.21% Pb BH -2 Depth - 60.05 m to 107.50 m Width - 1.0 m to 9.2 m Average grade - 0.13% to 0.39% Cu.
do-	Dariba North block	-do-	Prospecting stage investigation (G-3) was carried out within North Delhi fold belt. The item was oriented to assess zones of base metal mineralisation and associated precious metals through sub-surface probing and to trace the northern continuity of sub-surface sulphide mineralisation, which has already been established by drilling in the southern continuation of this Block. The drilling was planned by keeping 200 m spacing of boreholes along geochemical profiles laid down in Mineralised Zone -I. The mineralisation mostly occurs in the form of foliation parallel fine disseminations, streaks, stringers, veins and specks of bornite, covellite, chalcopyrite and pyrrhotite. A total of 705.75 m of drilling has been accomplished in five boreholes. Zones of highly silicified and brecciated quartzite with semi-pelitic rock and intercalated amphibole marble containing sulphides which is manifested by disseminations of pyrite, chalcopyrite and occasional specks of bornite and covellite. The borehole BH-1 has intersected two mineralised zones with 0.50 m x 0.15% Cu and 2 m x 0.19 % Cu at shallow depth.
-do-	Ghatiwala block (North-Delhi Fold belt)	Mapping & Sampling	Reconnaissance stage investigation (G-4) was carried out to trace the northern continuity of sulphide mineralisation which has been established in the southern continuation of the proposed block. The present block is located to the North of the Dariba North block and South of Nanagwas block. The work includes 1sq km of detailed mapping on 1:2,000 scale along with collection of 168 nos. of BRS, 79 nos. of channel samples, 16 nos. of PTS. A mineralised zone of about 200 m length has been delineated on the western margin of the mapped area. The analytical results of channel samples from channel BH-1 indicate Cu value ranging from 5 ppm - 990 ppm.

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EXPLORATION & DEVELOPMENT

Table - 7 (Contd.)

State/District	Name of block	Details of exploration	Results
BASE METAL			
Sikar	Palaswala-ki-Dhani block (North-Delhi Fold belt)	Mapping and sampling	Reconnaissance stage investigation (G-4) was carried out to delineate zones of base metal mineralisation and associated precious metals. The achievement includes about 0.78 sq km of detailed mapping (1:2,000) along with collection of 77 nos. of channel samples from six channel lines coupled with collection of 105 nos. of BRS. The surface indications of sulphide mineralisation is manifested in the form of bedding parallel pervasive malachite stains and specks of fresh sulphides in tremolite dolomitic marble and siliceous dolomitic marble. Three mineralised zones (I, II & III) have been identified. The I & II lie in western limb of the synform, whereas the III is in core part. The average strike length of I, II and III is about 400 m, 600 m & 250 m, respectively, with widths varying from 7 m to 15 m. The analytical results of channel - I indicates Cu content ranging from 5 ppm - 0.76%.
Sirohi	Bhimana and Kivarli blocks	Mapping, pitting, trenching and sampling	Reconnaissance stage investigation (G-4) was carried out for delineation of target areas for identification of base metal mineralised zones for future follow up investigation. An area of 16 sq km has been mapped by large scale mapping on 1:10,000 scale and 0.5 sq km area has been covered by detailed mapping on 1:2,000 scale. The quantum of the other field achievements include collection of 199 nos. of geochemical samples (SS and BRS) on 100 m x 25 m grid pattern, 15 nos. of petrological samples, 50 cu m pitting and trenching, 20 nos. of grab bedrock samples and 52 nos. of channel samples. Four blocks showing favourable zone for mineralisation has been demarcated. The Danva and Pipela blocks have already been explored and remaining two blocks viz Bhimana and Kivarli blocks have been taken up during 2012-13 for the base metal investigation. Basic volcanics, calc-silicates / impure marble, volcano-sedimentary rocks and intrusives (basic dyke, Erinpura granite and quartz veins) comprise the litho sequence. The regional strike of the bedding and foliation is N45°E-S45°W with moderate to steep dips towards North-West. Evidence of mineralisation has been recorded in the basic volcanics in the form of malachite stains and sulphide specks. Analytical results of eleven(11) grab samples from basic volcanics has indicated the Cu and Zn values ranging from 11 ppm to 785 ppm and 21 ppm to 450 ppm, respectively.

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EXPLORATION & DEVELOPMENT

Table - 7 (Concl.)

State/District	Name of block	Details of exploration	Results
COPPER			
Udaipur	Chari NW block (South Delhi Fold belt)	Mapping, pitting, trenching and sampling	Reconnaissance stage investigation (G-4) was carried out to evaluate the North Western extension of Chari copper deposit and to identify target areas for sulphide mineralisation. An area of 40 km ² was mapped on 1:10,000 scale (LSM), detailed mapping of 0.5 km ² on 1:2,000 scale with the collection of 257 nos. of geochemical (BRS/SS) samples on 100 m x 25 m grid pattern, 50 nos. of PTS samples, 57 nos. of channel samples, 50 m ³ of pitting/ trenching, 29 nos. of petrological samples. Large scale mapping indicates that the area can be divided into two stratigraphic domains, i.e. older Archaean basement lying in the North-Eastern part and over lying Lower Proterozoic Aravalli cover rocks in the South-Western part of the block. The basement rocks are represented by granitic-gneiss, granite and its variants, while the Lower Aravalli cover sequence is made up of basal quartzite, metavolcanics, dolomite/impure marble and meta-argillite. Meta-volcanics is host rock for base metal mineralisation. At places, sulphide minerals such as pyrite, chalcopyrite and arsenopyrite were also reported in meta-volcanics. The banded magnetite/haematite quartzites (BMQ/BHQ) are present mostly within the quartzites or at the contact of meta-volcanics and quartzite. A NW-SE trending gossan/ oxidised zone was identified in the metavolcanics. This gossan/ oxidised band is about 350 m - 400 m in strike length with thickness varying from 10 m to 15 m and is the favourable locales for base metal mineralisation. Detailed mapping and channel sampling has been carried out in this zone. Pyrite, chalcopyrite and malachite stains are observed in hand specimens from this zone. Ore microscopic study reveals presence of pyrite and chalcopyrite mineralisation in meta-argillites/slate.
Sikkim			
BASE METAL			
East	Dickchu basemetal prospect	Mapping and delineation of mineralised zones	Reconnaissance stage investigation (G-4) was carried out to assess the base metal and gold prospect which includes all areas of visible sulphide occurrences. An area of 75 sq km was mapped on 1:12,500 scale in the southern part of the investigated area. The rocks exposed in the area belong to Central Crystalline Gneissic Complex (CCGC), Daling Group, Lingtse Granite Gneiss and basic intrusive. The litho units present are phyllite with interbands of fine grained quartzite, Lingtse streaky granite gneiss, mylonite, chlorite schist/phyllite, quartz-biotite schist, garnetiferous-quartz-biotite schist and banded gneiss. The base metal mineralisation in the South and North of Dickchu river occurs as poor to moderate impersistent pockets, lenses, veins and fracture fillings. Three different mineralised zones have been noticed 1) Bakchechu- Rethechu confluence – Phodong (Cu values range from 3,637ppm to 15,600 ppm), 2) Nampung - 4th mile Pangthang (Cu values ranges from 206 ppm to 5,600 ppm) and 3) Nabey-Luying (Cu ranging from 364 ppm to 16,260 ppm).

Bauxite

State Directorates

During 2012-13, Directorate of Geology & Mining, Chhattisgarh conducted exploration for bauxite in Darai area, Kabirdham district (Mapping on 1:50,000 and 1:4,000 scales in 95 sq km and 2.16 sq km, respectively; 105 cu m pitting; 1,077 m drilling in 102 boreholes; 475 sample collections and estimation of about 2.50 lakh tonnes of bauxite) and in Dandkeshra area, Mainpat plateau, Surguja district (Mapping on 1:50,000 and 1:4,000 scales in 55 sq km and 1.28 sq km areas, respectively; 102 cu m pitting; 1,096 m drilling in 98 boreholes; 1,577 nos. of sample collection and estimation of about 5 lakh tonnes of metal grade bauxite).

During 2012-13, Directorate of Mining & Geology, Kerala carried out exploration for bauxite/aluminium laterite in lateritic plateaus between Vidhyanagar and Manjeshwaram, Kasargod district by field verification and sample collection in 600 sq km area and conversion of interpreted maps in geodata base by plotting the area covered during exploration. A total of 101 nos. samples were subjected to chemical analysis.

GMDC

During 2012-13, GMDC has conducted exploration of bauxite in its various mines by 20,027 m drilling in 1,953 boreholes covering an area of 3,769.75 ha in 100 m x 100 m grid pattern. Total 2,093 samples were sent for analysis.

FERROUS MINERALS

CHROMITE

GSI

In Andhra Pradesh, reconnaissance stage (G-4) exploration for chromite and PGE in the area between Kondapalli and Gangineni area in Krishna and Khammam districts was carried out to delineate mineralised zones of chromite and PGE. The area is represented by high grade granulite and gneisses belonging to the khondalite and charnockite suite belonging to the Eastern Ghat Supergroup. The acid and basic charnockites are the predominant rock types, which are represented by hypersthene-K-feldspar-quartz-garnet-gneiss, pyroxene granulite, meta gabbro, etc. The

ultramafic suite of rocks occur as lensoid bands and thin sheets within acid and basic charnockites. Chromite occurs within the ultramafic rocks particularly serpentinite and pyroxenite as lenses, veins, pockets, bands and as disseminations. These bands vary in dimension from quarry to quarry ranging from few cm to 1.5 m - 2 m. The detailed mapping on 1:2,000 scale was carried out in the old working area of Gangineni quarry block and Nakkerlapadu-Jangambodu quarry block. Gangineni quarry shows several bands of chromite varying in thickness from 30 cm - 3-4 m. Chromite occurs as patches, pods or pockets, lenses, veins, etc. within pyroxenite. Nakkerlapadu quarry is an old pit where lumpy and massive chromite occurs as small vertical and parallel bands and also in the form of disseminated chromite grains within pyroxenite. The mineralised zones within pyroxenite trend in N 20°W direction and are ~ 1m in width. Towards SE side of the main Nakkerlapadu quarry a zone of chromiferous pyroxenite of approximately 2 m has been traced within a trial trench. A zone of weathered pyroxenite of ~2m width has been noticed along with sulphide staining within the Jangambodu quarry. At place, pyroxenite occurs as conformable bands and lenses of variable dimensions from 1 m - 20 m in length and 0.5 m - 5 m in width, with sharp contacts. Systematic sampling has been done during the mapping from significant locations of contact/alteration zones, sulphide enrichment zones, in ultramafic bodies for chromite /PGE mineralisation. Chemical analysis results of 174 nos. of bedrock samples out of 200 show Cr ranging from 1.11% to 36.3% with Ni value ranging from 1,087 ppm - 2,658 ppm showing favourable for PGE mineralisation. Cr % from Gangineni quarry area ranges from 1.11% - 34.68%, Nakkerlapadu quarry area 1.49% - 36.3%, Jangambodu quarry area 1.51% - 33.19% making them suitable for metallurgical purpose. The analytical result of 82 samples for PGE mineralisation was still awaited. The EPMA study of chromite and chromiferous pyroxenite shows that the composition of Cr₂O₃ ranges from 30.05-54.38 wt%, FeO from 6.64-27 wt%, Al₂O₃ from 10-14.48 wt %, MgO from 6.36- 32 wt %. EPMA analyses of chromitites

revealed the presence of significant Al_2O_3 (up to 14.48%) indicating that the major part of chromitite is made up of chrome - spinel showing presence of PGE. At places, notable MgO contents (upto 9.5 %) are analysed indicating the presence of subordinate magnesio - chromite content. The ortho-pyroxenes may be ferro-hypersthene, present as a major silicate. Chromite ore also shows presence of sulphide minerals like pyrrhotite, chalcopyrite, pyrite, molybdenite which indicate the presence of sulphide phase along with oxide phase of chromite. The geophysical survey has been also carried out in the Gangineni quarry block (3.6 Gravity survey / 5.1 Magnetic surveys) for locating potential ultramafic bodies and to ascertain the depth persistence, overall disposition and expected volumetric dimension of host rock of mineralisation.

In Manipur, an item on magnetic survey for chromite-bearing ultramafics bodies was taken up in Moreh area, Chandel district to delineate chromite bodies within ultramafics. An area of 3.70 sq km was covered by Magnetic (TF) survey which is mostly covered by Tertiary sedimentary sequence of Disang Formation and Oceanic Pelagic sediments comprising sandstone, shale, siltstone, quartzite and limestone. The intrusive ultramafics bodies within Tertiary sediments are exposed. The ultramafic rocks are highly deformed, weathered, metamorphosed and show wide spread serpentinisation. The chromites are of massive, granular, nodular, banded and podiform types. Moderate magnetic variations ranging between 50 nT - 150 nT correspond to meta ultramafics, high and sharp magnetic variations with more than 150 nT correspond to chromite occurrences and smooth magnetic variations of less than 50 nT belongs to Tertiary sedimentary formations. However, few magnetic anomalies were noticed on laterite capping over sedimentary sequence. The Northern contact between ultramafics and sedimentaries was clearly indicated by manifestation of break in the trend of the contours. Isolated high magnetic closures (more than 150 nT) spreading along traverses may correspond to chromite bodies located at shallow depth. The disposition of the emplaced ophiolite

belt within Tertiary Formation is clearly demarcated by the magnetic surveys. The geophysical work has indicated the presence of possible chromite bodies in the explored area.

IRON ORE GSI

In Chhattisgarh, prospecting stage (G-3) investigation was carried out for assessment of iron ore in Bhalapuri, Eklama-Chelikama block, Kabirdham (Kawardha) district within Chilpi Group. This is a sponsored project of M/s Chhattisgarh Mineral Development Corporation for two years duration. The quantum of field achievement includes 19.09 sq km of Large scale mapping (1:25,000), 3.2 sq km of Detail mapping (1:2,000) supplemented by pitting/trenching and drilling. The iron ore band occurs discontinuously along NNE - SSW for a strike continuity of approximately 8 km. Iron ore is exposed in the dip slope of the hills in the E to SE direction at different levels. A new iron ore band has been identified in the area, which is exposed over a strike length of 1.2 km to 1.5 km with thickness varying from 2 m - 6 m. The extension of iron ore band at CMDC deposit no. 30 was also traced further in the NNE direction for a strike length of approximately 700 m - 800 m.

In Jharkhand, reconnaissance stage (G-4) investigation was carried out with DMG, Jharkhand in areas between Koygarh and Lokesai in West Singhbhum district to trace the low grade iron ores and associated pockets of manganese ore in the targeted area. The quantum of field achievement includes 75 sq km of Large scale mapping (1:25,000) supplemented by pitting/trenching along with collection of PTS and GCS. The area is occupied by Khaki colour shale belonging to Iron Ore Group (IOG), basic volcanics rock of Jagannathpur lava, dark brown sandstone and conglomerate, purple shale of Kolhan Group intruded by quartz veins. Laterite capping is recorded on top of volcanics and on sandstones and shales of Kolhan Group. It is porous to nodular in appearance. The laterites are recorded in places South of Kunniritha, South of Kuchibara, South-West of Setakiya, North of Pachasai and Didakuar.

In Meghalaya, reconnaissance stage (G-4) investigation was carried out around Rambrai in West Khasi Hills district to delineate the vanadiferous-titaniferous magnetite bodies within Pre-Cambrian gneissic complex. The dominant lithology is medium to coarse grained, crudely foliated granite gneiss. One mappable magnetite body has been delineated East of Lawdingbah, at Mawlangria, which trends NNE-SSW with a width of about 50 m and extending for about 300 m. The outcrop is bouldary in nature and does not have depth continuity. A total of ten out of 16 samples for lateritic bauxite indicate more than 45% Al_2O_3 content with a maximum of 62.29% Al_2O_3 . The Cr value is significant with seven samples having more than 600 ppm with maximum being 1,213 ppm. Four samples of magnetite show Fe_2O_3 content in the range of 42.41% to 50.69%, TiO_2 from 13.1% to 16.25%, V-6,304 ppm to 7,654 ppm, Cr - 6,020 ppm to 6,817 ppm.

In Odisha, prospecting stage (G-3) investigation was carried out in Kalamang West Block, Bonai Kendujhar belt of Sundergarh district for assessment of iron ore potential in the eastern continuity of the area between Ghoraburhani and Kalamang for augmentation of resources. This was a new item taken up to probe the laterite covered area in the eastern part of Ghoraburhani & Sagasahi blocks to locate hidden ore bodies up to 120 m vertical depth. The quantum of field achievement includes detailed mapping of 1 sq km on 1: 2,000 scale coupled with 1,083.90 m of drilling. The area is mostly covered by ferruginous laterite with minor iron ore. Twelve boreholes viz. BH - 1 to BH - 12 have been completed. All the boreholes excepting BH - 7 and BH - 11 have intersected mineralised bodies. Total 108 core samples from SKB-1 to SKB-4 were analysed with average grades from 51.84% to 60.96% Fe. Prospecting stage (G-3) investigation was carried out in Sagasahi East Block, Sundergarh district to assess the potential of iron ore in the northern contiguous area of Ghoraburhani block for augmentation of resources. A total of six boreholes (BH - 8 to BH - 13) had been completed. The borehole BH - 8 & BH - 11 have intersected iron ores bands for 42.1m and 65.3 m, respectively capped by overburden

of 55 m and 48 m. The boreholes BH - 9, 10 & 13 have not intersected iron ore bands below shale and laterite cover. The mineralised zone is not continuing further North, and hence, the northern boundary of Sagasahi block has been delineated with certainty. On the basis of analytical results, the average iron, silica and aluminium content of the iron ores are 63.79%, 1.83% and 3.53%, respectively. Reconnaissance stage (G-4) investigation was carried out around Nayagarh - Suakati area in Kendujhar district to search for new occurrences of detrital iron ore and to work out structural disposition and to correlate them with the iron ore bodies along the southern margin of Horse Shoe basin. Large scale mapping on 1:25,000 scale was carried out in southern, North-Eastern and North-Western part of the area which is occupied by rocks of Older Metamorphic Group, granite, quartzite, metabasalt with tuffaceous shale at various places, gabbro, dolerite dykes and ferruginous shale laterite/latosol and their contact have been delineated. Detrital iron ore deposit (DID) of Kolhan sequence has not been encountered in the area.

In Rajasthan, reconnaissance stage investigation (G-4) for iron ore was carried out in 2012-13 in Hindoli Group of rocks in Karauli-Bundi area in parts of Karauli, Sawai Madhopur, Tonk, Bundi and Bhilwara districts to assess the potentiality of the iron ores and iron rich lithounits occurring in Hindoli Group of rocks. Large-scale mapping was carried out in parts of Bharatpur and Karauli districts. The main lithounits exposed in the mapped area are BIF (BHC & BHJ) and quartzite with small patches of shale, dolomitic marble and basic rock. A number of old workings of variable dimensions have been noticed in the Banded Iron Formations near Karwari, Karbar mina, Ghuseethi, Doghati and Dedrauli areas in Karauli district. Two types of iron ore (Haematite) have been identified - (a) Very soft, friable, dark steel grey to reddish in colour and (b) compact, massive, iron black in colour. XRD analysis of two grab samples of BIF has been done which indicated presence of hematite < 50% and quartz > 50% in one sample collected from Karwari. The other sample collected from Ghuseethi indicated 20% hematite and 68% quartz. Chemical analysis of 40 nos. of grab samples has analysed Fe content

varying from 25% to 45%, whereas two samples from Doghati area assay 56% of Fe with 9% SiO₂. The SiO₂ content generally is high and varies from 35% - 75%. There is no signature of REE, gold and base metal mineralisations from the samples analysed so far.

State Directorates

During 2012-13, Directorate of Geology and Mining, Chhattisgarh carried out exploration for iron ore in Pavaras-Kachora area, Kondagaon district by 39 sq km mapping on 1:50,000 scale, and 4 sample collected. During the year, about 3 lakh tonnes of iron ore resources with 31% - 38% Fe was inferred in the area.

During 2012-13, Directorate of Geology & Mining, Nagaland carried out first phase of detailed exploration of magnetite deposits at Ziphu, Washello / Laluri in Phek district. A magnetite / hematite band has been delineated at Ziphu and Laluri and magnetite floats have been identified North of Washello.

NMDC

During 2012-13, NMDC carried out exploration for iron ore in Bailadila Iron ore Deposit, South Bastar Dantewada district, Chhattisgarh by conducting drilling: Deposit nos. 14 & 11 C - 3338 m drilling in 28 boreholes; Deposits nos. 10/11 A - 502 m drilling in 7 boreholes and Deposit no. 05 m - 2,350 m drilling in 17 boreholes. Similarly, in Donimalai Iron Ore Mines, Bellary district, Karnataka 443.50 m drilling in 3 boreholes, collection of 212 samples with estimation of 1.20 million tonnes of iron ore resources were achieved during 2012-13.

CMDC

In Sahaspur-Lohara Forest Range, Kabirdham district, exploration for iron ore is being carried out by GSI in accordance with the UNFC format as per MoU signed between GSI and CMDC. During 2012-13, exploration includes mapping (1:12,500 & 1: 2,000), channel sampling, chemical analysis and 1,449.80 m drilling in 28 boreholes.

MANGANESE ORE

GSI

In Karnataka, reconnaissance stage (G-4) investigation was carried out in association with

DMG, Karnataka for manganese in Chiknayakanhalli area of Chitradurga schist belt, in Tumkur district to delineate the manganese-bearing zones in four free hold blocks. The manganese ore horizon occurs as an inter-bedded sequence in argillite and meta-chert overlying conglomerate, orthoquartzite, basic volcanics and Banded Iron Formation. These belong to lower horizon of Vanivilas Formation. During large scale mapping on 1:25,000 scale, the contact of dolomite/ limestone with phyllite in connection with the disposition of manganese-bearing zones has been studied in detail. Moreover, shear zones were identified at the contact of gneisses and Proterozoic sediments. The manganese oxide mineralisation is of syngenetic type. The occurrence of sulphides is shear controlled. The samples are submitted for assessment of manganese and sulphides.

In Odisha, prospecting stage (G-3) investigation for manganese was carried out in the identified Bolani NE Block, Bonai - Kendujhar belt, Kendujhar district. The work was taken up on the basis encouraging analytical results of the samples collected in 2008-09 and presence of abandoned quarries in the block. A total of eight boreholes (BH - 1 to BH - 8) have been completed with a total meterage of 500 m. All the boreholes have intersected the mineralised zones at expected depth. A total of 69 core samples and 12 nos. of petrological samples have been taken into account for further studies.

MOIL

During 2012-13, MOIL carried out 5,823 m exploratory drilling involving 29 boreholes in two mines Tirodi and Bharweli situated in Balaghat district, Madhya Pradesh; four mines Dongri Buzurg & Chikla in Bhandara district and Gumgaon, Kandri & Mansar in Nagpur district, all in Maharashtra. The reported resources of manganese ore as on 1.4.2013 were Bharweli (23.98 million tonnes), Tirodi (1.40 million tonnes), Gumgaon (4.11 million tonnes), Sitapatore/Sukli (0.40 million tonnes), Kandri (5.53 million tonnes), Mansar (4.64 million tonnes), Chikla (5.10 million tonnes), Dongri-Buzurg (11.91 million tonnes), Ukwa (8.63 million tonnes) and Beldongri (0.33 million tonnes).

STRATEGIC METALS**MOLYBDENUM****GSI**

In Maharashtra, reconnaissance stage (G-4) investigation was carried out in Sakoli fold belt in Khobna area, Nagpur district to identify zones of molybdenum, associated mineralisation and evaluation of its potentiality. The quantum of work include large scale mapping on 1:12,500 scale over an area of 55 sq km in and around Khobna, detailed mapping of 3.0 sq km area on 1:5,000 scale and scout drilling of 430.40 m in Khobna block. In addition to these, a quantum of 40 nos. of bedrock samples, 40 nos. of soil samples on 50 m x 100 m grid, 35 groove and 5 bulk samples from pits and trenches have been collected. The rock types exposed are granitic gneiss, chlorite mica schist, mica schist, pegmatites, milky white and smoky quartz veins and laterite. The general trend of the foliation is NNE-SSW. The molybdenum mineralisation occurs near the contact of foliated granite, whereas the tungsten mineralisation occurs well within the greisen zone and at its contact with the chlorite mica schist. Specks of molybdenite present in greisens are observed in the dump material excavated from shafts. A total of 40 each of bed rock and soil samples on 50 m x 100 m grid were collected. In addition, 35 groove and five bulk samples from pits and trenches were also collected. The analytical results of bedrock, soil and borehole samples are as follows: Bedrock samples - W <10 ppm to 900 ppm, Mo <10 ppm to 50 ppm, Cu 16 ppm to 0.35%, Ag <2 ppm, Au <50 ppb; Soil samples-W <10 ppm, Mo <10 ppm Cu 26 ppm to 85 ppm, Ag < 2 ppm & Au < 50 ppb and Borehole samples-W < 5 ppm to 0.3%, Mo < 10, ppm to 100 ppm, Cu 16 to 590 ppm, Ag < 2.

In Tamil Nadu, prospecting (G-3) stage investigation was carried out in Velampatti South Block in Harur-Uttangarai molybdenum belt, Dharmapuri district to reassess the molybdenite resources. The NNE-SSW trending Alkaline-Carbonatite Province (ACP) is a well known lithotectonic belt in the North-Western Tamil Nadu. A number of sub-parallel NNE-SSW shear zones, some of which carrying sulphide mineralisation, particularly molybdenite and galena are well established within the Alkaline Carbonatite Province. The Harur- Uttangarai Belt (HUB) is one such shear zone. The HUB is divided into a

Southern Harur sector and a Northern Uttangarai sector on either side of the easterly flowing river Ponnaiyar. Three sub-parallel mineralised shear zones are established in the HUB. The main shear zone extends from Velampatti in the South to Nochchipatti in the North. The other two sub-parallel shear zones occur West of the main shear zone. The sub-surface probing by drilling in 6 boreholes (each up to 150 m depth) indicated a number of both high and low grade-mineralised zones. In view of absence of lodes towards deeper levels the investigation was closed.

TUNGSTEN**GSI**

During 2012-13, reconnaissance stage investigation (G-4) was carried out in Bundelkhand Granitoid Complex, Jhansi and Mahoba districts to assess tungsten and associated mineralisation. Disseminations of fine specks of chalcopyrite and pyrite occur discontinuously in quartz reef in Habupura area over an extent of 200 m with a width of 10 cm -50 cm. Night surveys with UV lamp indicated bluish white fluorescence of scheelite in quartz reef from Bhasne area. The analytical results indicate very low tungsten values ranging from 0.5 ppm to 1,001.24 ppm. The values of rare earth elements are also recorded to be low.

RARE METALS & RARE EARTHS (RM/REE) ELEMENTS**GSI**

Reconnaissance stage (G-4) investigation for REE in the area between Vutukuru and Kalichedu in Nellore district in Andhra Pradesh was initiated in 2012-13 as two year item to delineate REE zones within pegmatite by large scale mapping (1:12,500 scale) pitting, trenching and sampling. Heavy mineral concentrates comprising ilmenite, hornblende, tourmaline, staurolite, hematite, garnet, magnetite and corundum were recovered during the course of stream sediment sampling in the Kalichedu block. The stream sediment samples collected in and around Ammavaripalem area shows anomalous REE values. The source for the anomalous value may be granite. Ilmenite mineralisation in the form of thin ramified veins within the pegmatites were observed and mapped

near Peramallapodu area. Thirteen pegmatite bodies were observed and mapped in the Kalichedu block. The samples collected from Kalichedu block reveals that the rocks are metaluminous to peraluminous. They possess sub - alkaline character and rarely alkaline character. Bedrock samples of mainly pegmatite and quartzite shows the presence of hafnium. Three hundred samples were submitted for ICP-MES study (for REE and trace elements) at chemical division, GSI, SR, Hyderabad.

In Jharkhand, a reconnaissance stage investigation was carried out in Dublabetoli - Sundil area, Ranchi district in potential pegmatites hosted within the Chhotanagpur Gneissic Complex to assess rare earth and REE potentiality. The study area is a part of Chhotanagpur Gneissic Complex and forms the Western extension of North Purulia shear zone. Detailed mapping over 0.50 sq km was carried out on 1:500 scale to delineate the individual pegmatite bodies. Pegmatite body of length of 1.5 km and width of 20 m was demarcated East of Dublabetoli village. The pegmatites are of mixed type in which finer fraction is surrounded by coarser fraction. The pegmatites are associated with following three associations: 1) The enclaves are represented by calc-silicate, hornblende schist, mica schist, amphibolites and quartzites 2) The gneiss suite which includes porphyritic granite gneiss and biotite granite gneiss and 3) Intrusives represented by aplitic granite, pegmatite and quartz veins. The pegmatites mostly intrude calc-silicates and amphibolites. The presence of allanite, columbite, pollucite, spodumene, fluorite, and barite are reported in the granite and pegmatites of the area. A preliminary stage investigation (G4) was carried out to assess the potentiality of RM & REE in Chhotanagpur Gneissic Complex in and around Kasidih area, Ranchi district. Detailed mapping on 1:500 scale over an area of 0.5 sq km along with pitting & trenching of 8 cu m was accomplished. The lithounits present in the area are granite gneiss, calc-silicate and pegmatite. A pegmatite body is identified in the Mahujana and eastern part of Kasidih villages with a dimension of approximately 1,000 m x 200 m with E - W trend. The pegmatite contains quartz, felspar, muscovite, tourmaline along with tiny crystals of garnet.

Twenty-one nos. of BRS, 8 nos. PTS, 10 nos. of petrological samples were collected for heavy mineral studies by XRD and chemical analysis.

In Madhya Pradesh, reconnaissance stage (G-4) investigation was carried out in Sarkana - Malguwan - Gairwar area in Chhatarpur district to evaluate the potentiality of REE mineralisation of the carbonatite-syenite lamprophyre and felsic intrusives within Banded Gneissic Complex. The area comprises three types of granitoids: (i) Hornblende bearing granitoids (ii) Biotite bearing granitoids and (iii) Leucocratic granitoids with numerous pegmatites and quartz veins. The basic and ultrabasic dykes have intruded into different granitoids of BGC. Thin syenite bodies are recorded near Angore village. Sulphide mineralisation is recorded in granitoids and basic rocks in the area. The syenite bodies vary in length from 200 m to 500 m and occur in discontinuous pattern. The composition of syenite varies from syenite - quartz, syenite - monzo syenite. The emplacement of NE-SW, N-S and E-W trending pegmatite and quartz veins occur within Bundelkhand Granitoid Complex. These pegmatite veins are mostly unzoned and are comprised by quartz, orthoclase and minor biotite. The quartz veins are devoid of any mineralisation. Bedrock samples are collected from the pegmatite and syenite bodies for estimation of REE.

In Maharashtra, reconnaissance stage investigation (G-4) was carried out in Sausar mobile belt for regional assessment of REE & RM with the objective to delineate pegmatite bodies within Sausar mobile belt and petrochemical characterisation of the pegmatites for evaluation of REE and RM potentiality. An area of 80 sq km was mapped on 1:10,000 scale. The area comprises dolomitic marble, quartzite, quartz mica schist, calc-silicates and marble, which are occasionally intruded by granite, pegmatite and quartz veins. The pegmatites are aligned both along and across the regional foliation of the country rocks and varies in length from few cm to more than 0.5 km and width varying between 1 m to 50 m. Pegmatites are of simple and complex types and are composed of quartz, K-felspar, plagioclase and muscovite with or without tourmaline, garnet and beryl. Big columns of yellowish green coloured beryl are also reported from the pegmatite of Mehandi village.

The accessory minerals are zircon, monazite and opaque. SEM-EDX studies indicated the presence of REE minerals viz. monazite and xenotime. The analytical results indicate that the highest concentration of Σ REE is 2,470.48 ppm in the foliated granite from Ghuksi area. Pegmatite vein assay highest concentration of Σ REE to be 1,173.50 ppm. One stream sediment sample from north of Satrapur area shows Σ REE of 1,468.53 ppm. Analytical results also indicate Be and Rb concentration up to 601.7 ppm and 565 ppm.

In Meghalaya, reconnaissance stage investigation (G-4) was carried out in areas between Lailad and Umling in Ri-Bhoi district to evaluate potentiality of REE and presence of lamproite within Pre-Cambrian Gneissic Complex. An area of 50 sq km was mapped on 1:12,500 scale. In course of mapping, four suspected NE-SW to N-S trending lamprophyre bodies intruding dioritic-granodioritic rock was identified. The lamprophyre bodies range in length from 10 m -100 m with ~15 m in width. The petrographic and analytical data indicate that these lamprophyres are presumably akin to Kersantite. Range of Σ REE values in the analysed granite, stream sediment and soil profile cover vary between 489.47 ppm and 5,776.45 ppm.

In Rajasthan, reconnaissance stage investigation (G-4) was carried out in the Dhani granite in Pali district to assess the REE potential. The investigation involved detailed mapping (1:2,000) of 1.01 sq km supplemented by channel sampling. In addition, a quantum of 393.10 m of drilling has been accomplished. The area is predominantly represented by Erinpura granite and Dhani granite with ramifying veins of pseudotachylite. Highly silicified and brecciated iron rich rock and quartz veins also comprise the area. The contact between Erinpura granite and Dhani granite is faulted. The trend of the fault is NE-SW with moderate dip towards SE. Thirteen channel samples out of 28 collected from hydrothermally altered Dhani granite indicates Σ REE of more than 0.1%. Five zones of REE mineralisation have been identified with 1 m - 2 m width and assay values of REE between 0.10 -0.64 percent. The mineralised zones intersected in boreholes vary in width from 0.53 m - 2.35 m with assay values of REE between 0.13 - 0.28 percent. The EPMA studies indicate presence of monazite

in Dhani and medium grained granite with major concentration around muscovite clusters presumably indicating the role of hydrothermal activity in REE concentration. Reconnaissance stage investigation (G-4) was carried out in Sendra-Chitar area within South Delhi fold belt in Pali and Ajmer districts to identify and locate rare metal-bearing intrusive granites and also to delineate probable zones of Sn-W mineralisation in the granite. Three skarn zones have been identified along the western contact of the Chang Pluton, which presumably is the locale for Sn and W mineralisation. However, night traverses with the help of UV lamp did not yield any indication of scheelite mineralisation in the skarn zones. Surface indications of base metal mineralisation are recorded in the form of malachite stains within the banded calc-schist rock. A quantum of 48 cu m of trenching was carried out in the soil covered areas. The various litho units identified are pebbly schist, quartz-mica schist, biotite-bearing foliated calc-silicate, epidote-bearing calc-biotite schist, quartz-mica schist with iron staining, slaty schist, actinolite schist and highly limonitised quartz-biotite schist.

In West Bengal, reconnaissance stage investigation (G-4) was carried out around Parga and Alkhusa areas, Purulia district to delineate potential zones of Cs enrichment in the targetted rare metal enriched pegmatites and aplite host rocks for evaluation of RM/ REE potential within Chhotanagpur Gneissic Complex. An area of 12 sq km has been covered by LSM (1:12,500). The area is comprised by garnetiferous sillimanite gneiss, garnetiferous mica schist, quartz felspathic biotite gneiss, very coarse pink porphyroclastic granite gneiss, quartzites, amphibolites and calc-silicate. Numerous pegmatite bodies trending E-W to ENE-WSW, varying in length from 5 m to 200 m and width from 50 cm to 35 m are present in the area and these pegmatites are mostly clustered near Damrughutu, Tatuwara and along Parga, Alkhusa and Chapainala sections. These pegmatites are associated with quartzo - felspathic biotite gneiss and micas-schist and are composed of quartz, feldspar, tourmaline, muscovite with minor amounts of garnet and biotite. A quantum of 100 nos. channel samples, 50 nos. BRS and 70 PTS were collected from the area for chemical analysis.

State Directorate

During 2012-13, Directorate of Geology & Mining, Uttar Pradesh carried out exploration for REE near Khajraha Buzurg village, Jhansi district by mapping on 1: 10,000 scale in 1.6 sq km area.

BEACH SAND MINERALS

GSI

(i) As a part of coastal survey between Kasargod and Nileshwaram, Kerala for identification of heavy mineral occurrences survey was carried out in the coastal regions in the Kasargod- Chittari sector, Kasargod district. An area of 68 sq km (30 sq km onshore & 38 sq km offshore) was covered in the sector. Beach profile measurements along with beach sampling was carried out to understand the seasonal variations in morphology, heavy mineral content and sediment grain properties and also to demarcate the zone of active erosion. Apart from the beach studies, offshore region up to 10 m isobath was surveyed for collection of bathymetry data and seabed samples on 1 km grid. In addition to the beach samples along the profile lines, auger samples from beach area was collected on 1 km grid for assessment of heavy mineral content and mineralogy. The preliminary analysis indicated heavy mineral rich zones in beach zones with >35% THM content. Ilmenite, pyroboles and sillimanite ore dominant in the HM rich sand dunes.

(ii) During close spaced bathymetric survey and geoenvironment evaluation of the near shore zone off Puri 14 nos. grab samples and 6 nos. dune samples were collected. All dune samples are moderate to very well sorted fine sand with rich in HM concentration. Grab samples have been studied for heavy mineral analysis which shows average finer sand with more concentration of HM than the coarse fraction. Average bulk wt% of HM is 6.83%. Preliminary identification of heavy minerals indicate presence of ilmenite, sillimanite and garnet.

(iii) Reconnaissance stage investigation (G-4) was carried out for preliminary assesment of heavy minerals in beach sand along the coast between Dumas, Surat district and Tithal, Valsad district to locate and study heavy mineral potential of the

area. Preliminary study was carried out in five coastal stretches based on river confluences in the area with sea. So far, four pockets of black sand bearing dunes are identified within the dune complex/beach sand. The pockets are 1 km - 15 km, long and up to 150 m wide pockets of magnetic black sand-bearing dune was identified. The magnetic black sand is generally concentrated in the very fine sand portion.

IREL

During 2012-13, IREL carried out exploration for ilmenite, rutile, zircon, monazite, sillimanite and garnet in Chatrapur Sand Deposit, Ganjam dist. Odisha by mineralogical analysis of 2,349 nos. samples, 3,236 m drilling in 394 boreholes with estimation of 205.21 million tonnes reserves under proved and probable categories.

PLATINUM GROUP OF METALS

GSI

Reconnaissance stage (G-4) investigation for reappraisal of PGE in Chimakurthi Igneous Complex in Prakasam district, Andhra Pradesh was carried out with an objective of delineating PGE potential zones by aerial reconnaissance and PGRS study, large scale mapping, pitting and trenching. The quantum of exploration work accomplished includes large scale mapping (1: 12,500 scale) of 100 sq km area, pitting and trenching of 100 cu m and collection of 105 pitting and trenching samples, 155 bedrock samples, 34 petrological samples, 20 petro - chemical samples, 20 SEM samples, 20 EPMA samples and 20 ore microscopy samples. Litho packages observed are Khondalite Group consisting of quartzite and garnet - sillimanite - cordierite - K - felspar- quartz gneiss, granulite and meta - pelite, Chimakurthi Igneous Complex consisting of pyroxenite, leuco - gabbro/norite, gabbro/norite, nepheline syenite and quartz monzonite and Peninsular Gneissic Complex comprising of hybrid granite gneiss/grey migmatite. Samples were collected from the pyroxenite and leuco - gabbro units and their contact zone with each other and with gabbro/norite unit. The preliminary whole rock analysis of 10 petro- chemical samples have been received out of which two pyroxenite samples have yielded MgO values 18.52% and 22.45%, respectively and

one leuco gabbro/norite sample has yielded MgO value 33.97%. Among 58 BRS samples of pyroxenite, 13 samples have yielded anomalous values of Cr ranging from 2,026 ppm to 3,189.5 ppm and 26 samples have yielded anomalous values of Ni ranging from 1,006.3 ppm to 2,055 ppm. The preliminary analysis results have pointed that the pyroxenite and leuco gabbro/norite units are favourable locales for PGE mineralisation. Spinel (hercynite and magnetite) is found to be present in stream sediment sample as identified through binocular microscope, which indicates the PGE potentiality of the area.

In Arunachal Pradesh, reconnaissance stage investigation (G-4) was carried out to search for PGE and gold mineralisation in mafic-ultramafic suites, Anjaw, Lohit and Lower Dibang Valley districts. An area of 41 sq km was covered by Large Scale Mapping (1:12,500 scale) along with 2.5 sq km of detailed mapping (1:2,000 scale). The study area lies in the Trans-Himalayan belt comprising two different litho packages of Suture zone. The first is the Yang Sang Chu Formation and Tidding Formation with serpentinites and the second, the Lohit Granitoid Complex. The metavolcanics of the Tidding Formation are predominantly tremolite-chlorite-schist to chlorite-schist associated with crystalline limestone and graphitic schist. Dykes and sills of amphibolite and ultramafics are noted occasionally. The analytical result of some bedrock sample so far received shows anomalous values of Cr i.e., 2291 ppm, 3102 ppm and 7658 ppm and Ni 2,179 ppm, 2221 ppm, 2314 ppm, 2383 ppm and 2529 ppm.

In Chhattisgarh, reconnaissance stage investigation (G-4) was carried out in Mayurnacha-Kanpara, Jamjhor and Madhuban areas in Jashpur district to search for PGE mineralisation in Raigarh-Bilaspur-Surguja belt. The quantum of work includes 100 sq km of Large Scale Mapping (1:12,500) supplemented by a quantum of 50 cu m of pitting/trenching and collection of 30 nos. of SSS, 50 nos. of BRS and 50 nos. of PTS. In addition to these, collection of 30 nos. of PS, 20 nos. of PCS and 40 nos. of samples for PGE analysis were also accomplished. The area exposes Precambrian rocks comprising mica-

schist, quartzite, talc-chlorite schist, magnetite-quartz schist and actinolite-chlorite schist forming a parts of Raigarh-Bilaspur-Surguja metamorphic belt. These rocks are intruded by basic and ultrabasic rocks. The available PCS data indicates that the MgO content in ultramafic rocks vary between 18.5% - 37.26%. In AFM diagram, the granites depict calc-alkaline trend whereas the mafic and ultramafic shows Tholeiite trend. In R1-R2 plot by Batchelor and Bowden, (1985) granitoids indicate the syn-collisional signature. The partly received analytical results of 105 samples indicate Au content 50 ppb-100 ppb, Ni :4 ppm to 0.22%, Co:<2 ppm-385 ppm, and Cr:5 ppm - 0.32%. Reconnaissance stage investigation (G-4) was carried out in Chandranagar-Lohardadar areas, Raipur district to delineate zones of PGE and nickel mineralisation within Sonakhan-Granite Greenstone belt. Detailed mapping of 1.8 sq km (1:2,000) in Chandranagar and 1.2 sq, km, (1:2000) in Lohardadar block supplemented by 50 cu m of pitting/trenching and collection of 50 nos. of PTS was carried out. In addition to these, 50 nos. each of BRS, SSS and SS were collected. The study area covers a part of Sonakhan Granite Greenstone belt. The lithounits exposed in Chandranagar block are ultrabasics, gabbro and acid volcanics. Two ultrabasic bodies have been identified in Chandranagar block namely, Chandranagar East and Chandranagar West. The Lohardadar block is mainly occupied by ultrabasic rock; gabbro, acid volcanic and Chhattisgarh cover sediments. The Chhattisgarh cover sediments cover the ultrabasic rock. The analytical results so far received indicated Cr value up to 435 ppm and Au value less than 50 ppb. The ore microscopic and SEM-EDX study revealed the presence of pentlandite, millerite, chalcopyrite, pyrite, ilmenite and magnetite in peridotite.

In Kerala, reconnaissance stage investigation (G-4) was carried out in the ultramafic-mafic rocks of Nilambur valley to delineate the ultramafics/mafic bands and to identify PGE for targeting follow up investigation. Aerial reconnaissance and PGRS studies have been carried out over 300 sq km area with ErDAS image processing software. Large scale mapping on 1:12,500 scale was carried out over an area of 45 sq km in and around

Manapara, Manaipadam, Karakkody, Mundapotti, Putharipadam, Maruda, Vendanukumpotti, Kanappada valley, Vallikadu, Vetuukathikota, Vazhikadavu, Paralunda, Kuttipara, Narokkavu and Kariam Reserve Forest area in Nilambur valley. The predominant rock types, which form the country rock in the study area are hornblende - biotite gneiss and biotite-hornblende gneiss with migmatite structures at places. The Archaean Supracrustals exposed in the area include amphibolites, meta-gabbro, meta-pyroxenite, talc-tremolite actinolite schist, banded magnetite quartzite + grunerite, quartz + sericite, fuchsite, kyanite quartz -mica schist, felsic volcanics (?) and calc-gneiss, gabbro/dolerite dykes. The auriferous quartz / pegmatite veins are the younger intrusive. Meta-pyroxenite / talc-tremolite - actinolite rocks occur as linear conformable bands to the regional foliation and vary in length from few tens of metres to several kilometers and in width from ten meters to more than 30 m. Ninety (90) nos. of bedrock samples have been collected from these mafic-ultramafic bodies for PGE analysis.

In Maharashtra, reconnaissance stage investigation (G-4) was carried out in Akeri and Khardewadi areas in Sindhudurg district for preliminary assessment for PGE, Ni and chromium with the objective to delineate the zones of PGE, Ni and Cr and to evaluate its potentiality in the mafic-ultramafic rocks of the Sindhudurg belt. The gneiss - migmatite rocks containing the dismembered lenticular bodies of mafic-ultramafic suite of rocks of Precambrian age represent the investigation area. The length of these bodies ranges from few hundred meters to nearly more than a kilometre. An ultramafic body with strike length of more than a kilometre was brought out during Large Scale Mapping and it is located to the south of major Akeri ultramafic body. Disseminations of chromite were recorded along some randomly oriented weak planes as well as along schistosity planes. Another ultramafic rock essentially composed of serpentine showed the presence of nearly 50 micron sized gold grain (under EPMA). Few rock-cut groove samples in the ultramafic body have yielded Ni values of 0.2% to 1%. One sample has yielded a significant PGE value of 275 ppb amongst many other samples. A

coarse grained amphibolite occurring on the northern peripheral zone of Akeri ultramafic body showed the presence of multiple sulphide phases viz., pyrrhotite millerite - pentlandite - chalcopyrite. Micro-probing, ore microscopy, SEM studies, etc. are carried out. XRD analysis showed the presence of tremolite, serpentine, chabazite, chlorite, nimite (nickel mineral), jahnsite in the ultramafic rocks. Reconnaissance stage investigation (G-4) was carried out in Deccan basalt in Nandurbar and Dhule districts to locate and assess PGE and gold mineralisation and its potentiality of dykes from Deccan trap terrain. IRS-1D (FCC) images were studied as a part of the investigation. Based on the observations made in the aerial as well as ground reconnaissance, three blocks with higher frequency of dykes were identified for further study and sampling. The identified blocks are Vadbare, Shanimandal and Khondaimali. An area of 75 sq km area was covered by large scale mapping (on 1:12,500) in the three blocks. A total of fifty eight (58) dykes have been mapped with cumulative length of over 90 km. Minor pyrite and chalcopyrite are present in some of the dykes. SEM - EDX and EPMA studies of selected dyke rock samples revealed occurrence of PGE mineral (Sudburyite hosted in Niccolite) in dyke - Vd 03 of Vadbare and an gold speck in dyke - Sh 01 of Shanimandal. Normally, bedrock samples (BRS) are collected from each dyke maintaining the groove length of about 10 m. Considering that the dyke Vd 03 manifests visible mineral layering, smaller groove lengths of 2 m and 0.5 m have been maintained for collection of bed rock sample which were collected to identify and assess PGE potential of the dykes. In addition, colluvial material and the first - order stream sediments originating from the dykes have been collected. However, during panning, no visible grains of gold have been noticed. The analytical results of elements are: Co - 10-24 ppm, Cu - 65-704 ppm, Cr - 10-41 ppm, Ni - 11-49 ppm, Au - 20-220 ppb, Ag - 100 - 165 ppb and PGE - 26.5 - 78 ppb.

In Nagaland, reconnaissance stage investigation (G-4) was taken up in ophiolite belt of Nagaland to search for PGE mineralisation through reconatory traverse mapping and detailed sampling. An area of 150 sq km was

covered by reconnaissance geological traverses and samples were collected for analysis. The ultramafic and mafics are highly sheared, brecciated and serpentinised. Sulphide mineralisation in the form of pyrite and chalcopyrite in peridotite and basalt was recorded in areas to the SE of Thewati, Luthur and Zonger road section. Pillow structure is well exposed near Reguri. Deep blue stains possibly of azurite were noticed in peridotite and basalt in Phokphur and Moya. Analytical results so far received from peridotite are as follows: Pt - 2.5-10 ppb, Pd - 7-35 ppb, Ir - 1.5-4 ppb, Ru - 1.5-6 ppb, Rh - 0-1.5 ppb, Ni - 1258-2508 ppm and Cr - 598 - 3939 ppm. Micro probe studies were carried out from ophiolite suite of rocks. Five different mineral phases were identified, namely- Pyroxene (orthopyroxene & clino-pyroxene), olivine, feldspar, serpentine and opaque. Chromite ores were analysed in which two different phases were identified i.e. chromite phase and chromium - spinel phase. During the course of study, sulphides were also identified mostly pyrite and chalcopyrite but no PGE grain was identified.

In Odisha, a reconnaissance stage investigation was carried out in Kamakhyanagar - Chandar sector in the marginal zone between Eastern Ghat Mobile Belt and Singhbhum craton, Dhenkanal district to search for potential of PGE mineralisation and identify potential blocks for targeting follow up investigation. The quantum of field achievement includes coverage of 150 sq km by large scale mapping (1: 12,500 scale) followed by collection of 50 nos. each of GCS, BRS and SS. In addition to these, 50 cu m of pitting /trenching along with collection of 50 nos. of PTA were accomplished. A total of 100 nos. of samples were collected for petrographic studies.

In Tamil Nadu, a prospecting stage (G-3) investigation for Platinum Group of Elements was carried out in T1 and T2 sectors of Tasampalaiyam Block in Sitampundi Complex in Namakkal district. The work was oriented to prove the depth persistence of the PGE mineralisation in the eastern part of Tasampalaiyam Block (T1 and T2 Sectors) and to evaluate the resource potential of this block. The Sitampundi Anorthosite Complex (SAC) exposes hornblende anorthosite gneiss with bands and lenses of

chromitite/chromiferous meta - pyroxenite, garnet-pyroxene granite and amphibolites within the Bhavani Gneissic Complex. The Sitampundi Anorthosite Complex has been divided into three blocks (East to West) viz Karungalpatti, Chettiyampalaiyam and Tasampalaiyam for the purpose of exploration. Preliminary investigation (2009 -10) for PGE in Tasampalaiyam Block led to the delineation of a prominent zone of chromitite and chromiferous metapyroxenite bands for a cumulative strike length of about 2.5 km in T1 and T2 Sectors. Trench samples from the zone have analysed Pt + Pd values ranging from 0.5 ppm - 2.0 ppm with occasional high values of 21 ppm. PGE mineralisation is mostly confined to the chromitite and chromiferous meta-pyroxenite bands /layers within the meta-anorthosite. Eight scout boreholes drilled in T1 and T2 Sectors along positive trench profiles to test the depth persistence of these mineralised zones at 30 m vertical depth. In order to bring out the subsurface configuration of the mineralised zone, it was proposed to intersect the mineralised zone at two levels (a) at 30 m vertical depth with spacing of 100 m (b) at 60 m vertical depth with spacing of 200 m. A total of nine boreholes (BH-1 to BH-9) were drilled in T1 Sector involving 869.80 m of drilling and these boreholes intersected bands/layers of chromite/chromiferous meta-pyroxenite bands and sulphide rich zones. The core logging and sampling of six boreholes (BH-1 to BH-6) were completed and 226 core samples prepared from these boreholes were submitted for PGE analysis. Two more boreholes will be drilled in T1 Sector and nine boreholes were planned in T1 Sector. A prospecting stage (G-3) investigation for PGE was carried out in Solavanur Block in Mettupalaiyam mafic-ultramafic complex in Erode district to systematically prove the persistence of the PGE mineralised zone. The Mettupalaiyam Ultramafic Complex (MUC) is characterised by a group of mafic ultramafic rock ranging in composition from dunite through peridotite, meta-pyroxenite, amphibolites, garnetiferous gabbro, gabbroic anorthosite to anorthosite with or without chromite layers occurring as large enclaves within the Bhavani Gneissic Complex. Initially, an area of about 213 sq km has been covered by large scale mapping during 2006-08. The samples collected from different segments have given

higher PGE values of 484 ppb. Scout drilling was initiated in 2009-10 & 2010-12 to ascertain the depth persistence of the mineralised zone in Solavanur, Mallanayakan Palayam and Karappadi blocks. Four boreholes have been completed along positive trench profiles. All the boreholes have been intersected the mineralisation at expected depth. As a follow up of this, systematic drilling of the Solavanur block was carried out during the year to test the depth wise persistence of mineralisation at two levels: 1st level (10 boreholes/ 30 m depth) and 2nd level (5 boreholes/60 m depth) at 100 m & 200 m spacing, respectively. Seven boreholes (BH-1, 2, 3,4,6,7 &8) have been drilled. Reconnaissance stage (G-4) investigation for Platinum Group of Element (PGE) was carried out in Solavanur Extension block, Mettupalaiyam Mafic - Ultramafic Complex in Erode district to prove the persistence of the PGE mineralised zone in Solavanur Block and to trace PGE mineralised meta-pyroxenite bands in Solavanur Extension Blocks. Field traverses were taken in parts of toposheet no. 58E/3 in and around Solavanur area. The area is mostly soil covered with scanty outcrops. The meta gabbro with its variants gabbroic anorthosite and anorthositic gabbro dominate the mafic-ultramafic sequence. The garnetiferous meta gabbro also occurs within the mafic-ultramafic suite and was observed in the Solavanur area. An area of 0.5 sq km was covered by detailed mapping. The various litho units belonging to mafic -ultramafic differentiated sequence are present as discontinuous lensoidal bodies running parallel to regional foliation. Meta gabbro, gabbroic anorthosite and anorthositic gabbro dominate the mafic-ultramafic sequence. Discontinuous bands of meta-pyroxenite are also common. The hornblend biotite gneiss is another major unit. Quartz veins traverse all the rocks types. A total of 270 cu m of trenching has been completed and 180 P&T samples have been collected and sent for PGE analysis. Reconnaissance stage (G-4) investigation for Platinum Group of Element (PGE) was carried out in Karattadipalaiyam-Gopichettipalaiyam Dasampalaiyam sector, Mettupalaiyam Ultramafics Belt (MUB), Erode district with the objective to map all the ultramafic bodies within MUB and to assess the PGE potential. The Major rocks are banded gneiss, biotite gneiss, hornblende-biotite

gneiss (HBG), dunite, peridotite, pyroxenite, gabbro, tremolite - actinolite schist, charnockite, K-felspar rich pegmatoids, granite and quartz veins. An area of 100 sq km was covered by large scale mapping on 1:12,500 scale and a total of seven (7) mafic-ultramafic bodies are demarcated. These are located mainly in the central part of the study area namely, Polavakkalipalaiyam, Kamrajnagar, Pavalamalai, Pachchamali, North East of Vellalpalaiyam, North of Chinnakolltupalaiyam and Komal Karady with strike length ranging from 150 m to 1000 m and thickness varying from 10 m to 100 m. A quantum of 500 cu m of pitting / trenching was carried out and pit /trench samples were collected and submitted for PGE analysis. Geophysical surveys comprising gravity, magnetic and IP were carried out in the block. Reconnaissance stage (G-4) investigation for Platinum Group of Element (PGE) was carried out in Tirumankaradu area , Tirupur district to delineate the potential zones of PGE mineralisation. A total of 75 sq km was mapped. The various litho units mapped include peridotite, pyroxenite, charnockite, pegmatoidal granite, banded magnetite, quartzite (BMQ) and younger pegmatite intrusives. The general foliation direction in the area is N70°- 80° E to S70°- 80° W and dip vertically. Tirumankaradu area exposes one ultramafic body. The body comprises dark pyroxenite and peridotite, made up of olivine, opx and hornblende with minor constituents of biotite and contains pyrite, magnetite and chalcopyrite. A total no. of thirteen (13) trenches with a cumulative volume of 230 cu m were opened in Tirumankaradu to examine the strike continuity of peridotite body. Trenches (TT-1 to TT-10) yielded rich peridotite / pyroxenite bodies in the Northern part, whereas poor peridotites/pyroxenites occur in the trenches in the South Western part. A total of 120 nos. of trench samples were collected, processed and sent for PGE analysis.

State Directorate

During 2012-13, DGM, Uttar Pradesh carried out exploration for platinum near village Ikauna, Lalitpur district by mapping on 1:1000 scale in 0.40 sq km area, trenching - 02 nos - 150 cu m and 339.26 m drilling in two boreholes. Tentative reserves of about 0.01 million tonnes estimated.

DIAMOND

GSI, continued with its engagement in exploration for diamond during 2012-13.

GSI

In Andhra Pradesh, reconnaissance stage (G-4) investigation was carried out for search of kimberlite / lamproite in Koilkonda - Devarakadra Block in Mahabubnagar and Rangareddy districts. A total of 1,440 sq km area falling in toposheet number 56 H/13 bounded by latitudes 16° 45' N to 17° 00' N and longitudes 77° 45' E to 78° 00' E was covered. An integrated structural lineament map was prepared with the aid of satellite imagery, aerial photographs, toposheet and geological map. Additional inputs, like structural trends of the known kimberlite occurrences from adjoining areas were taken into consideration for during preparation of integrated map. A total of 160 nos. of stream sediment samples from appropriate trap sites from 2nd, 3rd, 4th and 5th order streams were collected. The heavy mineral study indicated assemblages of magnetite, spinels, epidote, garnet, zircon, amphibole, ilmenite, goethite hematite which are typical of granitoids and gneiss - migmatite provenance. Few ilmenite (KIM) grains were identified as Mn-ilmenite (pyrophanite) after EPMA examination. The Mn-ilmenites can be suspected as possible kimberlite indicator mineral as it has been seen in adjoining Narayanpet field. To target the source of the Mn-ilmenite (kimberlites) additional stream samples were collected to narrow down the target area coupled with close spaced intense ground check in those upstream area from where Mn-ilmenite were recovered. Reconnaissance stage (G-4) investigation in Andhra Pradesh, reconnaissance stage (G-4) investigation was carried out for search of kimberlite / lamproite in Koilkonda - Devarakadra Block in Mahabubnagar and Rangareddy districts. A total of 1,440 sq km area was covered. An integrated structural lineament map was prepared with the aid of satellite imagery, aerial photographs, toposheet and geological map. Additional inputs, like structural trends of the known kimberlite occurrences from adjoining areas were taken into consideration for preparation of integrated map. A total of 160 nos. of stream sediment samples from appropriate trap sites from 2nd, 3rd, 4th and 5th order streams were collected. The heavy mineral study indicated assemblages of magnetite, spinels, epidote, garnet, zircon, amphibole, ilmenite, goethite hematite which are typical of granitoids and gneiss - migmatite provenance. Few ilmenite a kimberlite indicator mineral (KIM) grains were identified as Mn-ilmenite

(pyrophanite) after EPMA examination. The Mn-ilmenites can be suspected as possible kimberlite indicator mineral as it has been seen in adjoining Narayanpet field. To target the source of the Mn-ilmenite (kimberlites) additional stream samples were collected to narrow down the target area coupled with close spaced intense ground check in those upstream area from where Mn-ilmenite were recovered. Reconnaissance stage (G-4) investigation was carried out for search of kimberlite / lamproite in Chelima and Veligodu blocks in Kurnool district. Total 150 stream sediment samples were collected from Chelima block from suitable trap sites covering an area of 720 sq km. The major heavy mineral population recovered after processing includes magnetite, spinels, epidote, garnet, zircon, amphibole, ilmenite, hematite and iron hydroxide. The stream sediment samples no. CH-8, CH-63 and CH-150 yielded chrome spinels. Few of the analytical results of chrome spinel suggest it to be coming from close to diamond stability field. Besides, systematic stream sediment sampling, close spaced traverses were also carried out in the study area which led to the discovery of a new lamproite body 3 km South of Pachcharla village and small outcrops of lamproite in old working, 3 km East of Sarva Narasimha Swami temple.

In Chhattisgarh, reconnaissance stage investigation (G-4) was taken up in Raipur Kimberlite field to search for kimberlite clan rocks in Dhamtari, Kanker and Durg districts to locate kimberlite clan rocks in the granitic basement along the high permeable zones characterised by mafic dykes. Reconnaissance survey of 700 sq km was carried out around Dhamtari area in parts of T.S. No.64H/10 in Dhamtari and Kanker districts. A total of 150 nos. of stream sediment samples, 20 nos. of petrological samples, 20 nos. of PCS samples were collected for further studies. Regional reconnaissance was conducted in the priority zone within the mafic dyke swarms. The stream sediment samples were processed through HMS and binocular studies and the heavy minerals were separated. The PCS samples were submitted for chemical analysis and further characterisation. A total of 100 grains of garnet, ilmenite, spinel, pyroxenes were analysed at PPOD laboratory, Bangalore. The garnet grains were identified as almandine garnet. Reconnaissance stage investigation (G-4) was carried out in Raipur Kimberlite Field to search for kimberlite clan rocks in Dhamtari and Kanker districts in the granitic basement along the high permeable zones characterised by mafic dykes. An area

of 700 sq km was taken up for reconnaissance mapping and stream sediment survey. PGRS studies of IRS LISS III data for 700 sq km was carried out. A total of 161 nos. of stream sediment sample were collected from the area and processed through the heavy mineral separation procedure (panning, jigging and bromoform separation) and the heavy minerals were subjected to magnetic separation followed by studies under binocular microscope. The heavy minerals identified are garnet, ilmenite and spinel. The other minerals identified were quartz, felspar, limonite, tourmaline, etc. A total of 24 nos. of PS were collected for thin section studies. The contact between the Chhattisgarh sediments and the crystallines was traced and zones of intersecting lineaments were identified for ground checks. A total of 23 nos. PCS samples were collected and 20 nos. PCS samples were submitted for whole rock and trace element analysis. Fifty grains of garnet, spinel, ilmenite and gem ruby including one thin section was studied by EPMA. The ruby grains are of high chrome-bearing (Cr_2O_3 upto 8.0%) and is of gem quality. One grain of garnet has analysed 50.10% pyrope with MgO up to 12.94% and is typically a G5 garnet. This garnet may be interesting for search for kimberlite clan rock. One thin section was also studied for mineral phases. The rock contains plagioclase (albite), clino-pyroxene (chrome diopside with 0.38% Cr_2O_3), amphiboles, ilmenite and spinels indicating a deep source.

In Karnataka, reconnaissance stage investigation (G-4) was carried out in Dharwar craton in Maski block in parts of Raichur, Koppal and Bellary districts to locate kimberlites in the area. The area is part of Archaean granite greenstone terrain of the Eastern Dharwar Craton (EDC) exposing the meta-volcanics and associated meta-sedimentary rocks of the greenstone belts, (Kushtagi, Hutti Maski, Deodurg- Raichur belts), migmatite gneisses, syenite, pink/ grey granite and granodiorite of Peninsular Gneissic Complex. There are quartz veins, gabbro and dolerite dykes. Regional as well as detailed stream sampling has been carried out. The processing of samples for heavies have been carried out and studied under binocular microscope and EPMA. No positive signature has been recorded for kimberlite indicator minerals (KIMs) within the samples so far generated. Reconnaissance stage (G-4) investigation in Tawargeri Block in parts of Koppal and Bellary districts was carried out with an objective to search for kimberlites through indicator mineral survey and geological traverses. The Tawargeri Block exposes rocks of Peninsular Gneissic Complex (PGC) comprising granodiorite and granite. This granodiorite granite suite includes remnants of supra crustals belonging to Dharwar super group. These gneisses and supra crustals have been intruded by

pegmatite, quartz veins and dykes of dolerite, gabbro and pyroxenite composition. Regional as well as detailed stream sediment sampling was done from available trap sites. Samples were processed for heavy minerals and examined under binocular microscope for kimberlite indicator minerals. The samples were studied under binocular microscope and EPMA did not give any positive signatures for kimberlite indicator minerals.

In Maharashtra, reconnaissance stage investigation (G-4) was carried out for search of kimberlite clan of rocks based on diamond indicator minerals in Tirodi and Amgaon gneiss, Nagpur and Bhandara districts. Regionally, the area exposes Tirodi Gneissic Complex in the southern part and Amgaon Gneissic Complex in the South-Eastern part. Rocks of Sausar Group are exposed in the northern part. Sulphide mineralisation (chalcopyrite & pyrite) was observed in mafic enclaves within the gneiss near Kindgipar area. One hundred fifty one nos. of stream sediment samples, 40 petrographic samples and 20 petrochemical samples were collected during the period. The stream sediment samples were processed for heavy mineral separation at Dhargaon beneficiation plant. Magnetic minerals were separated from the processed stream sediment samples by hand held magnet. The remaining part was treated with bromoform for separation of heavy minerals. Under binocular microscope, 85 grains of red & light pink garnet, diopside and ilmenite were picked up from stream sediment samples (SSS) and analysed by SEM - EDX. The garnet grains are of low magnesian variety, while two grains show MgO content up to 7%. A diopside grain was identified. However, no chrome diopside have been recovered. EPMA study will be done for another 35 grains of garnet, ilmenite and spinel.

GOLD

The GSI, HGML and DGM, Uttar Pradesh were engaged in the exploration for gold during 2012-13. An account of exploration work done by GSI is given in Table-8. The details of exploration carried out by HGML and DGM, Uttar Pradesh are given in Table- 9.

INDUSTRIAL MINERALS

The details of exploration work carried out for industrial minerals by GSI, State Governments and Central/State Undertakings during 2012-13 are given in Table - 10.

DECORATIVE DIMENSION STONES State Directorates

The details of exploration work carried out for granite, sandstone and decorative dimension stones by State DGMs during 2012-13 are furnished in Table - 11.

EXPLORATION & DEVELOPMENT

Table - 8: Exploration for Gold by GSI, 2012-13

State/District	Location	Details of work done	Results obtained/Remarks
Andhra Pradesh			
Anantapur	Area between Tanakallu & Kandukuru, Kadiri Schist Belt	Mapping, trenching and sampling	Reconnaissance stage (G-4) investigation for gold and associated minerals was initiated during 2012-13 to identify any auriferous zones in the area. A total of 200 sq km was covered by large scale geological mapping on 1:12,500 scale 403 nos. of bedrock/soil samples, 30 nos. of stream sediment samples were collected along with 100 cu m of trenching and sampling. Besides, 20 nos. of PS, 10 nos. of samples for ore microscopic studies, 05 nos. for XRD, EPMA and SEM studies were collected. The Kadiri Schist Belt consists of acid to basic volcanic rocks which are intruded by younger granites, quartz veins/reefs, pegmatite and basic dykes. The sulphide mineralisation mainly pyrite manifested in the form of fine disseminations, veins noticed in all the rocks of schist belt. The chemical analyses of the samples so far has yielded >25 ppb - 65 ppb of Au (65 ppb in one sample of quartz felspar porphyry, south of Kama). The quartz reef emplaced along the N40°E-S40°W trending fault west of Marlapalle has analysed 1.64% of Cu.
Bihar			
Gaya	Gere-Kewti area	Mapping, pitting, and sampling	Reconnaissance stage (G4) investigation was carried out in the volcano-sedimentary sequence and associated rocks to identify gold mineralisation. Some prospective blocks for gold mineralisation for detailed sub-surface probing were established during 2010-12. An area of 50 sq km was covered by Large scale mapping. The area under investigation exposes highly foliated quartzite, granites which include homophanous granite at Salempur & Kapildhara, microgranite near Abgira and coarse granite at Gere village, rhyolite near Mirzapur and tuffite / tuffaceous phyllite near Lodhipur and Kewti – Imlachak villages. Second generation smoky to milky white quartz veins parallel to the shear foliation at Gandhar shows mineralisation in the form of arsenopyrite, chalcopyrite and minor pyrite grains. A total of 200 nos. of bedrock samples, 14 nos. of SSS, 13 nos. of PTS, 15 PCS along with 30 nos. of PS have been collected. On the basis of presence of sulphide mineralisation and nature of alteration, prospective blocks were selected near Gandhar, Abgila, Gere and Kewti-Imlachak villages.

(Contd.)

EXPLORATION & DEVELOPMENT

Table - 8 (Contd.)

State/District	Location	Details of work done	Results obtained/Remarks
Jamui	Korwadih and Jhajha areas, Sono block	Mapping, pitting and sampling	Reconnaissance stage (G4) investigation was carried out to search for gold mineralisation for targeting potential block. The area forms the northern continuity of Kaimaha area where gold rush has been reported in 1982. Based on available information, two sectors (West of Korwadih & Jhajha sections) have been identified for Large scale mapping (LSM) on 1:12,500 scale. LSM covering an area of 30 sq km and detail mapping on 1,000 scale over an area of 1sq km were carried out in the area to the West of Korwadih village. The litho units exposed in the area are amphibolite, banded ferruginous quartzite, micaceous quartzite, garnetiferous quartz-mica schist, porphyritic granite, biotite granite, leucogranite, pegmatites and quartz veins. Sulphide mineralisation in the form of disseminated specks and stringers of pyrite, specks of chalcopyrite, arsenopyrite have been recorded in banded ferruginous quartzite. Detailed geochemical sampling on 100 m x 500 m grid pattern has been carried out and 250 nos. bedrock samples are collected. In addition to these, 100 cu m of pitting/trenching coupled with collection of 100 nos. of PTS were accomplished.
Jharkhand			
Ranchi	Sindauri-Ghanashyampur block	Pitting/trenching, sampling and drilling	Prospecting stage investigation (G-3) was carried out to assess their gold potentiality. This area is the eastern continuity of Lungtu-Hepsel-Parasi block where gold resources have been established. The exposed rock belongs to Singhbhum Group bounded by Chhotanagpur Gneissic Complex in the north and Singhbhum Granite in the south. 23 nos. of geochemical samples, 50 nos. of PTS samples, 25 nos. of petrological samples and 650 nos. of core samples were collected. A total of five (5) boreholes (BH-10 - BH 14) were drilled involving 820.35 m of drilling.
Seraikela-Kharsawan	Largadih-Balidih block	-do-	Prospecting stage investigation (G-3) was carried out to assess the gold potentiality. This was a new item initiated during 2012-13 as a follow up of request received from DMG, Jharkhand and will be continued in 2013-14. The Rudiya-Largadih-Balidih block comprises part of Dalma volcanics and meta-sedimentaries of Singhbhum Group. A total of 40 nos. of geochemical samples, 40 nos. of P&T samples were collected. A total of 823.70 m of drilling has been accomplished in five boreholes. NRB-2A: intersected Siliceous-tuff, Brecciated quartzite, Quartz chlorite schist, NRB-5: Brecciated quartzite, Quartz chlorite schist, Brecciated quartzite, LRG - 1: Siliceous tuff, Brecciated quartzite, Quartz chlorite schist, LRG-2 : Brecciated quartzite, Quartz chlorite schist.

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EXPLORATION & DEVELOPMENT

Table - 8 (Contd.)

State/District	Location	Details of work done	Results obtained/Remarks
Karnataka			
Haveri	Kakol and adjoining areas	Pitting, trenching, and sampling	Reconnaissance stage investigation (G-4) was taken up to assess the potential of the area for gold mineralisation and to characterise the associated alteration pattern. Greywacke, argillites, BIF and acid to intermediate meta-volcanics belonging to Chitradurga Group of Dharwar Super Group are exposed in the area between Tungabhadra and Bhadra rivers. A total of 150 BRS and 250 PTS were collected. The analytical results indicate that majority of the gold values is below 25 ppb.
Tumkur	Ajjanahalli Block-E	Drilling, sampling, and chemical analysis	Prospecting stage investigation (G-3) for gold was taken up where earlier investigation identified mineralisation in BIF and adjacent country rocks. During 2010-12, detailed mapping, trenching and bedrock sampling was carried out. A total of eight (8) mineralised BIF bands (band I to VIII) with a cumulative strike length of 6,500 m had been identified. The Ajjanahalli Block-E lies to the South of Block-C and North of Block-F. The present work indicates gold potentiality similar to mineralised zones found in other blocks of Ajjanahalli area. (Northern block A, B & C and Southern block F). The main lithounit are metabasalt, argillite, BIF intruded by quartz vein and basic intrusives. A major old working is noticed at the western limb of the band. The old working is confined to the BIF band extending for a length of 25 m along strike with a width of 4 m. The BIF band is sheared / brecciated and limonitised. A total of 523 nos. of core samples have been sent to chemical laboratory for analysis, out of which the results for 127 samples have been received which indicate encouraging values. In borehole BH-2, the assay value of mineralised zone - IV is 0.64 gpt/3.5 m. (Max value 0.89 g/ t), mineralised zone- V is 0.33 gpt/1 m and mineralised zone- VI is 0.31 gpt/1.3m.
-do-	Ajjanahalli Block-G	Mapping, trenching and sampling	Reconnaissance stage (G-4) investigation was carried out for assessment of gold mineralisation. During 2012-13, mapping over an area of 0.80 sq km along with 275 cu m of trenching were carried out and 164 nos. of trench samples and 81 nos. of BRS were collected. The main lithounits noticed in the area are BIF/BMC, metabasalt, argillite /greywacke of Hiriyur Formation of Chitradurga Group belonging to Dharwar Super group. There are three major shear zones extending from North of Ansedri to South of Bellara (25 km) of which central shear zone passes through the Ajjanahalli Block-G. A total of eight parallel to sub-parallel BIF bands (I to VIII) within a width of 800 m over a cumulative strike length of 6,800 m has been identified. The average width of the bands varies from 2 m - 15 m. Gold mineralisation is confined to sheared BIF containing sulphides like pyrite, pyrrhotite, arsenopyrite and minor chalcopyrite. Surface manifestations also include old workings and highly limonitised BIF bands. The gold values of trench samples vary from 0.12 gpt/1.5 m to 6.0 gpt/1.5 m (AGT 23), 0.16 gpt/1.00 m to 5.00 gpt/0.6 (AGT 26) and the bedrock samples vary from 0.29 gpt/1m (BRG 156), 1.3 gpt/1.50 m (BRG 188) and 1.5 gpt/1.5 m (BRG 191).

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EXPLORATION & DEVELOPMENT

Table - 8 (Contd.)

State/District	Location	Details of work done	Results obtained/Remarks
Madhya Pradesh			
Katni	Nanhwara-Vilayat Kalan area	Mapping pitting, trenching, sampling and geochemical analysis	Reconnaissance stage investigation (G-4) was carried out for delineation of auriferous zones for follow up probing. The area exposes an interbanded sequence of dolomitic marble, chert, quartzite and meta-basalt (Agori Formation) in the Northern part and phyllite with bands of QPC and quartz-wacke (Parsoi Formation) in the Southern part. The regional trend of the formational units is ENE-WSW with moderate to steep dip to South-East. The rocks of Mahakoshal Group are traversed by quartz veins/ reef of variable thickness. Large scale mapping (on 1:12,500 scale) was carried out over an area of 75 sq km. Besides, 75 cu m of pitting and trenching along with collection of 75 nos. each of bedrock and stream sediment samples were also done. The Agori Formation of Mahakoshal Group is exposed in the area. It is represented by grey to green phyllite, meta-volcanics and dolomite with thin chert bands and quartzite intruded by quartz veins. Six prominent sulphide-bearing quartz veins were identified in the area which trend in NNW-SSE to N-S direction. The quartz veins are greyish white to brown; oxidized at places and are emplaced within phyllite, dolomite and meta-volcanics. The sulphide mineralisation was also recorded within meta-volcanics, dolomite and quartz veins. The pyrite occurs as disseminations in meta-volcanics, dolomite, phyllite and quartz veins. The analytical results of 35 samples so far received indicate gold content varying from 100 ppb to 180 ppb. One bedrock sample from chert band shows 0.42% Cu. The investigation will be continued in 2013-14.
Maharashtra			
Nagpur	Gothangaon-Goharli area	Mapping, pitting/trenching, sampling and geo-physical survey	Reconnaissance stage investigation (G-4) was carried out to explore the noble metal potentiality in the acid volcanic vents. Large scale mapping of 50 sq km on 1:10,000 scale was carried out and an area of 1 sq km area was selected for detailed mapping on 1:2,000 scale in the area NW of Gothangaon. The area exposes massive rhyolite with flow banding, tadpole quartz and sulphide-bearing quartz vein in foliated rhyolite, which indicates the proximal part of volcanic vent. Quartz veins contain pyrite, arsenopyrite and chalcopyrite, which are traced for 120 m. Sulphide mineralisation has been identified near old working of Rengatur and Marupar area within foliated rhyolite and quartz chlorite mica schist. The quantum of work done includes collection of 201 nos. of soil samples, 100 cu m of pitting/trenching and ground geophysical survey of 20.79 Lkm (gravity, magnetic, IP & resistivity). The analytical results indicate Ag and Au values <2ppm and <2 ppb, respectively. Different ore phases like pyrite, chalcopyrite, arsenopyrite, covellite as well as Au and Ag alloy phase were identified in SEM-EDX study. The item has been terminated as the operational areas are within Tiger Reserve Forest.

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EXPLORATION & DEVELOPMENT

Table - 8 (Contd.)

State/District	Location	Details of work done	Results obtained/Remarks
Odisha			
Mayurbhanj	Barkeram-Chalkadisahi and Champani-Hatia Blocks	Mapping and sampling	Reconnaissance stage (G-4) investigation was carried out to search for potential blocks for gold mineralisation. Large scale mapping was carried out on 1:12,500 scale over an area of 100 sq km in Hatia-Champani block. The area is occupied by rocks belonging to the Pre-Cambrian Badampahar / Gorumahisani Group fringed by the granitoids belonging to Singhbhum Granite Complex. Mineralisation in the form of sulphide specks were recorded in meta-gabbro and smoky quartz veins. The oxidised patches with sulphide minerals (pyrite - chalcopyrite - pyrrhotite and arsenopyrite) are present in most of the litho units of the schist belt and in the gneissic granite near the contact in the western part. Thin quartz-carbonate veins permeating almost all the rock carry oxidised patches with sulphide minerals. Bedrock and soil sampling has been carried out on 500 m x 100 m grid in Hatia-Champani block and 600 nos. of both bedrock and soil samples were collected.
Rajasthan			
Banswara	Gundelpara West Block	Sampling and geo-chemical analysis	Reconnaissance stage investigation (G-4) was carried to delineate and assess the potential zones of gold and associated base metals for follow up investigation. An area of 1sq km was mapped on 1:2,000 scale and a total of 604 nos. of geochemical samples were collected from nineteen channels. The rock types which are exposed this block are a part of Jagpura Formation of Debari Group of Aravalli Super group. Three mineralised zones were delineated during investigation. The first zone is located in eastern part of the mapped area within impure marble over a strike length of 400 m and 10-30 m width. This zone is characterised by the presence of NNW-SSE trending gossans. The second zone is present in the South-Western part of the area in impure marble, which is 200 m in strike length and 5 m - 20 m width. The third zone is developed at the contact of amphibolites and impure marble on the western part, & are characterised by occurrence of malachite. Analytical results of the channel samples so far received indicate two anomalous copper zones with thickness varying from 2 m - 5 m, with about 0.1 % Cu. The investigation has been completed.
Dungarpur	Bharkundi area	Drilling and geochemical analysis	Prospecting stage investigation (G-3) was carried out to assess the potentiality of gold-copper mineralisation. Rocks exposed in the area forms a part of Debari Group of Aravalli Super group which include quartz-chlorite muscovite schist, coarse grained marble, banded dolomitic marble and dolomitic marble. Basement rocks are exposed in the western part of the area and have tectonic contact with the rocks of Aravalli Supergroup. The mineralisation in the form of sulphides zones has been noticed in both the drill holes. The sulphides zones are recorded in dolomitic marble, banded marble and mylonite zone. Tourmaline interbands in the cordierite-staurolite-mica schist were also contain sulphides which include chalcopyrite. The predominant sulphide minerals are pyrite, pyrrhotite, chalcopyrite and arsenopyrite. The sulphide minerals are medium to fine grained and occur as veins, veinlets, stringers and as fine disseminations. Arsenopyrite is the mainly fine grained and present in fractures of dolomitic marble. The borehole BH-2 has intersected a total of 28.80 m sulphide mineralisation. The borehole BH-3 has intersected a total of 20.35 m sulphide mineralisation.

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EXPLORATION & DEVELOPMENT

Table - 8 (Concl.d.)

State/District	Location	Details of work done	Results obtained/Remarks
Dungarpur and Udaipur	Areas between Bhukia to Dagocha	Mapping and sampling	Reconnaissance stage investigation (G-4) was carried out to delineate target areas of gold-copper mineralisation. Pyrrhotite-bearing marble unit having of 3 km strike length and up to 300 m width is located near village Kuldla. The units also contain a few specks of arsenopyrite and chalcopyrite. Analysis of one grab sample of pyrrhotite-bearing marble has shown presence of anomalous cobalt (up to 0.1%) and nickel (up to 0.1%). Another grab sample of pyrrhotite-bearing marble analysed 2 ppm gold. Some, hitherto unexplored gossan patches are recorded over amphibolite and marble. In order to locate new targets areas for gold exploration between the Bhukia and Dagocha gold-copper prospects investigation was carried out in 18 km long and 4 km wide tract extending from Dudka in the South-East to Rathri in the North-West. 70 sq km of large scale geological mapping on 1:10,000 and collection of 412 nos. of bedrock samples, 50 nos. of geochemical samples and 206 nos. of channel samples has been carried out. Three gossan bodies up to 300 m length along with several smaller gossans were recorded.
Uttarakhand Rudraprayag	Chopra-Bhatwari areas	Dileneation of mineralised zones, sampling and geo-chemical analysis	Reconnaissance stage investigation (G-4) was carried out for gold and associated mineralisation to delineate the mineral potentiality of the area. The area comprises of meta-volcano sedimentary sequence of Garhwal Group represented by quartz mica schist, chlorite schist, granite gneiss with interbands of mica schist, carbonaceous phyllite, dolomitic marble, and quartzite. Some small old workings, retorts and slag also have been recorded in Jagtoli and Agar areas. The sulphide mineralisation is manifested by occurrence of pyrite, chalcopyrite & with few bornite specks. Dolomitic marble bands with sulphide-bearing quartz-calcite veins have been delineated for a strike length of 500 m with width varying from 10 m - 15 m. Analytical values of Au are < 50 ppb, while Cu ranges from 193 ppm to 0.96%. Two feeble mineralised zones of copper have been delineated in Jagtoli-Agar area.
Uttar Pradesh Sonbhadra	Contact zone of Mahakoshal Group and Dudhi Granitoid Complex	Night surveys with UV lamps, sampling and geo-chemical analysis	Reconnaissance stage investigation(G-4) was carried out for gold and tungsten mineralisation. Night surveys with UV lamp have indicated the incidences of scheelite and powellite in pink granite. The analytical results of grab samples indicate very low gold values varying from < 50 ppb - 85 ppb while the tungsten values range from < 50 ppm - 894.2 ppm. The maximum 894.2 ppm value of tungsten is recorded from quartz veins within andalusitic phyllite. In stream sediment sample, one sample yielded high value of tungsten 384.9 ppm. Five samples of granite yielded high values of REE. The value of lanthanum (La) ranges from 103.73 ppm -353.21 ppm and that of Cerium (Ce) ranges from 194.42 ppm - 622.19 ppm. The investigation has been completed.
-do-	Parsoi area	Mapping, drilling and geo-chemical analysis	Prospecting stage investigation (G-3) was carried out to assess the auriferous mineralised zones belonging to Mahakoshal Group. The investigation involved large scale mapping (1:12,500), detailed mapping (1:2,000) and drilling. Large scale mapping has established three discontinuous sulphide-bearing mineralised lenses with arsenopyrite, scorodite, pyrite along with galena in Rohinohwa-Magardah- Nayatola area. The lenses vary from 50 m-650 m in strike length with width of 5 m - 10 m. Sulphide mineralisation is predominantly in quartz veins. In the detailed map prepared for Phaphrakund area, two sulphide-bearing mineralised lenses having width of 4 m - 8 m and individual length of 8 - 20 m were delineated over an extent of 350 m and 500 m. Analytical values of Au vary from < 50 ppb to 2.7 ppm in Paphrakund area. Drilling has been done in Parsoi area in six inclined boreholes in South-western and South-eastern mineralised lenses. Available results indicate an Au zone of 1.05 g/tx 1.96 m, between inclined depths of 147 m and 149 m in borehole PRS-1.

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Table – 9 : Exploration for Gold by HGML and State Directorates, 2012-13

State / District	Location	Agency	Details of work done	Results obtained
Karnataka				
Raichur	Hutti	HGML	Underground mapping-1761.30 m on 1:400 scale; trenching-6nos-177.75 cu m; underground drilling-1954.45 m in 51 boreholes and collection samples 8121 nos.	A total of 17.25 million tonnes of resources of gold ore with 5.13 g/t Au were estimated.
- do -	Hira-Buddini	-do-	Exploratory mining - 101.8 m and samples were analysed - 613	About 0.57 million tonnes prove resources of gold ore with 4.27 g/t Au were estimated.
- do -	Uti	-do-	Exploratory mining -308.5 m and samples analysed - 1,388	Total mineable resources were estimated at 2.18 million tonnes ore with 2.50 g/t to 2.91 g/t Au.
Uttar Pradesh				
Lalitpur	Girar	DGM	-	Total 142 kg proved and 1,687 kg probable resources were estimated.
Sonbhadra	Hardi area	-do-	-	About 250 kg tentative resources were estimated.

Table - 10: Exploration for Industrial Minerals by GSI, DGMs and Central/State Undertakings, 2012-13

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Geological Survey of India							
BARYTES							
Karnataka							
Bagalkot,	Gadisankapura	1:12,500	100	-	-	-	More than 20 barytes veins with width varying from 2 cm to 4 cm and length varying from 8 m to 20 m were identified within pink porphyritic granite. Five barytes veins were denoted as B1, B2, B3, B4 and B5. The width of barytes veins ranges from 0.5 m - 8 m with 100 m - 300 m length. One sample PCS-3 analysed BaO at 51.58%.

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EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
CLAY							
Karnataka							
Udupi	Around Paduatady,- Parika and Hiriyadka	100	-	-	-	-	Clay occurs as lenses or pockets below laterite. A large clay unit with 5 m - 8 m in thickness occupies nearly 300 sq km area along North-West of Hiriyadka. Clay bands are also recorded in Kukkehalli and Kukkegutta areas.
CHINA CLAY							
Rajasthan							
Bhilwara	Jahazpur- Mangrop area	1:12,500	50	-	-	110	Photo geological study of 1,000 sq km, along with large scale mapping and 25 cu m of pitting/trenching were carried out. The china clay bodies in the area generally occur at a depth of about 20 m below the surface as studied from dug wells. Four blocks have been demarcated on the basis of china clay occurrences.
GRAPHITE							
Madhya Pradesh							
Betul	Around Tikri, Gauthana and Chiklar areas	1:12,500 1:2000	75 1	- -	- -	- -	The graphite-bearing zones located were traced for a strike length of 3.5 km with exposed width varying from 5 m - 130 m hosted in quartz-mica schist. The surface geochemical sampling has indicated the fixed carbon content ranging from 1% to a maximum of 15.4%. More than 50% of the chemical analytical data received indicate fixed carbon values between 5% - 15.4% and the remaining samples contain fixed carbon between 1% - 5 percent.
LIMESTONE							
Andhra Pradesh							
Guntur	Between Pulipadu and Gurjala areas	1:5000	5	20			A total number of 20 bore holes of 60 m depth have been drilled in 500 m x 500 m grid. In all the boreholes presence of limestone is present beyond the depth of 60 m has been noticed. In northern part of the areas the soil and weathered limestone thickness is very high ~90 ft). Colour of limestone is gray (up to 5-7 mm depth), variegated (up to ~30 m depth), and gray to dark gray at higher depth. Chemical analysis of 50% of bedrock samples shows > 40% CaO but the SiO ₂ content is inversely proportional with CaO.

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EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Guntur	Areas between Macherla-Rentachintala Gurajala	1:12,500	200	-	-	390	A total of 300 bedrock samples, 20 petrochemical samples, 50 pitting renching samples and 20 petrological samples were collected. Out of 200 analysed samples, 100 samples have shown encouraging CaO values (40 52.5%) with corresponding low (<18%) SiO ₂ value.
Himachal Pradesh							
Sirmaur & Solan	Saindhar, Nigalidhar and Korgai synclines	1:25,000	126	-	-	175	Total 100 nos. of bedrock, 50 nos. of channel and 25 nos. of trench samples were collected from Lower, Middle and Upper members of Kauriyala Formation. As per BIS-(10346: 2004) two zones of Grade-II as per BIS (10346:2004) limestone were delineated in Korgai syncline. Limestone samples from Lower and Upper members of Kauriyala Formation in the three synclines analysed CaO-22.43% (min) to 46.98% (max.) and MgO-2.28% (min) to 17.03% (max.).
Meghalaya							
Jaintia Hills	Umphyrluh block	-	-	14	1837	607	An inferred resources (333) of 389.68 million tonnes of unclassified limestone were estimated from 12 boreholes of Umphyrluh block, thus augmenting the total resources in all the 12 blocks of Litang Valley including Umphyrluh block to 9,071 million tonnes of different grades of limestone.
Rajasthan							
Jaisalmer	North-East of Minyum-Ki-Dhani	1:5,000	2.5	9	450	355	To locate low silica SMS (LD grade) limestone, Borehole drilled, 50 m depth in each with 500 m interval and in all the boreholes the limestone have been intersected.

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EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Jaisalmer	Sabbu-ka-Toba, Asu-Tar area	-	-	-	-	-	Small patches of limestone are exposed in arcuate shape exposures covering an area of about 0.24 sq km and belong to the Khuiala Formation. Its physical and chemical properties tentatively conforms with specifications for the low silica SMS grade (LD grade) limestone. In the block, 1.25 sq km and 2.5 sq km areas were covered by large scale and detailed mapping, respectively.
PHOSPHORITE							
Andhra Pradesh							
Kurnool & Anantapur	Between Ankireddypalle and Owk areas	1:12,500	200	-	-	-	In the area Owk Shales host the phosphatic bands mainly associated with lower calcareous Khaki green shale and about 5 cm - 35 cm thick phosphatic bands were recorded. Total twelve thin phosphatic bands were delineated in Kalina Konda and Veduru Konda hill. Out of 200 bedrock samples analysed, 84 samples indicated P ₂ O ₅ - 5.02-19.08% and from 55 trench samples, 18 samples gave P ₂ O ₅ - 5.6-15.1 percent. The presence of fluorapatite in phosphatic bands is confirmed by XRD analysis. Large scale mapping revealed that phosphatic bands are sheet like bodies with maximum thickness up to 35 cm.
Madhya Pradesh							
Chhatarpur & Sagar	Tauro-Surajpura block	1:2,000	0.75 50	- -	- -	- -	Ten phosphatic bodies were delineated within Hirapur Formation and P ₂ O ₅ content ranges from 10% to 30%. Ten (10) mineralised zones two in Tauro block & eight in Surajpura block were demarcated. The total cumulative strike length of ore body was 1,699 m, width varies from 1m to 10 m and maximum exposed thickness was recorded to be 5.69 m. The analytical results of pit trench samples so far received indicate P ₂ O ₅ content from 5.85% to 34.26%.

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Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Khandwa	Modri, Sadkhera and surround- ing areas	1:12,500	150	-	-	-	Phosphorite is associated with chert espically ferruginous and the mineralisation is confined to lenses, distributed in highly irregular form. In Modri area, a band of ferruginous chert with specularite shows P ₂ O ₅ values from 8% to 27.44%. Analytical results of P ₂ O ₅ received so far indicates that the ferruginous chert in Modri indicates P ₂ O ₅ values from <0.1% to 27.44% with a resource of nearly 36,500 tonnes of rock phosphate.
Rajasthan							
Jaisalmer	Areas South of Fatehgarh	1:50,000 1:10,000	200 50	-	-	256	The phosphatic band was exposed over a distance of 20 km in which phosphate occurs as replacement of shells of gasteropods, ostracods, nummulites and bone fragments. The P ₂ O ₅ content varies from <5% to >15%. Samples include - 151 bedrock, 50 nos. each from pitting/ trenching & channel and 5 nos. clay samples. Analytical results of samples so far received yielded an average of 8% P ₂ O ₅ content.
WOLLASTONITE							
Gujarat							
Banaskantha	Dhanpura Ghoda area	1:10,000	33	-	-	-	Major parts of the mapped area are covered with different varieties of granites and calc-silicates. Wollastonite is developed near Bhameriya, Ghoda and Dhanpura villages at the contact of granite and calc-silicates/calc-gneiss. Calc-silicate is composed of calcite, amphibole, tourmaline, diopside and minor amount of wollastonite, garnet and iron oxides.

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EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Mineral Exploration Corporation Ltd							
DOLOMITE							
Arunachal Pradesh							
West Kameng	Rupa dolomite Prospect	1:5,000	3.20	06	594	-	A total of 626 nos. of primary and check samples were analysed for 6 radicals viz. SiO ₂ , CaO, MgO, Al ₂ O ₃ , K ₂ O & LOI. Similarly, a total of 76 nos. of composite samples analysed for 7 radicals; 21 nos. for 14 radicals; 23 nos. for spectroscopy and 10 nos. XRD were studied. A total of 561.26 million tonnes dolomite resources with grade SiO ₂ - 1.37%, CaO - 30.50%, MgO - 20.95% were estimated. Out of 561.26 million tonnes, 151.91 million tonnes and 409.35 million tonnes resources were placed under 332 & 333 categories, respectively.
DUNITE/SERPENTINITE HIGH MgO ROCK							
Odisha							
Sundergarh	Rajabasa Block	1:1000	1.00	08	770	-	A total of 544 primary primary and 36 check samples were analysed for 13 radicals; 32 composite samples were analysed for minor & trace elements and XRD and 15 nos. of samples were analysed for PGE. A total of 41.12 million tonnes resources of high MgO flux grade rock with 28.59% MgO & 34.30% SiO ₂ at >25% MgO & <50% SiO ₂ cut off and about 15.36 million tonnes of high MgO flux grade rock with 31.69% MgO & 33.82% SiO ₂ at >30% MgO and <50% SiO ₂ cut off were estimated.

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EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
LIMESTONE							
Meghalaya							
Jaintia Hills	Litang River Valley, Tongnub South-East Sub-Block	1:5,000	1.10	08	1148.50	-	A total of 483 nos. primary core samples for 6 radicals and 37 nos. composite samples were analysed by 11 radicals. A total of 274.04 million tonnes of net in situ limestone resources with average grade of 2.27% SiO ₂ , 50.79% CaO, 1.57% MgO, 0.95% Al ₂ O ₃ , 1.17% Fe ₂ O ₃ and 41.57% LOI were estimated and placed under 332 & 333 categories of UNFC.
Gujarat Mineral Development Corporation Ltd.							
BALL CLAY & SILICA SAND							
Gujarat							
Bharuch	N/v Amod, Maljipura and Bhuri	-	-	-	-	-	Mapping, plans and location of boreholes. Production was at 1.07 lakh tonnes for ball clay and 0.40 lakh tonnes for silica sand.
LIMESTONE							
Kutch	Panandhro	1:50,000	-	-	-	-	Limestone encounters in overburden with lignite.
Rajasthan State Mines & Minerals Ltd							
ROCK PHOSPHATE							
Rajasthan							
Udaipur	Jhamarkotra Mines	-	-	-	-	-	Balance geological reserves available as on 1.4.2013 are 50. 532 million tonnes.
State Directorate of Geology and Mining							
ASBESTOS							
Uttar Pradesh							
Jhansi	Mauranipur area	1:2,000	0.22	03	126	-	Two nos. trenching with 86.5 cu m excavation and 0.3 million tonnes tentative resources were estimated.
CHINA CLAY							
Kerala							
Kannur	Aravanchal area	-	02		41.5	-	A cumulative depths of 187 m was achieved in the area for seven boreholes since the commencement. The average thickness of variegated clay is 9 m.

(Contd.)

EXPLORATION & DEVELOPMENT

Table - 10 (Contd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Kannur	Peringome East & West areas	-	-	40	791.5	-	The average thickness of china clay/variegated clay is about 11 m and that of overburden laterite is about 7 m. Resources will be estimated on the completion of the investigation & receipt of the chemical analysis report.
Kollam	Kanjiracode area	-	-	09	407	-	A tentative resource of 0.97 million tonnes of dull white to slightly greyish sandy clay were estimated in North-East & North-West areas of Kanjiracode clay mine.
-do-	Pattamukku areas	-	-	01	17	-	The average thickness of sandy clay / variegated clay is about 8 m. About 0.25 million tonnes tentative resources of sandy clay were estimated.
CLAY							
Karnataka							
Hassan	Nandihalli Clay mine	1:1,000	121	-	-	-	To prove the persistence and lateral extension, 02 trial pits were proposed of 5x5x2 m size.
DOLOMITE							
Chhattisgarh							
Janjgir-Champa	Pachri-Bhalwahi area	1:50,000 1:4,000	100 2.20	27 -	819.70 -	670 -	Dolomite is grey & sub-horizontally bedded. Total 30 area million tonnes of dolomite resources were estimated.
GYPSUM							
Rajasthan							
Nagaur	N/v Kherrat & Sarau-Nasar	-	-	-	-	-	N/v Kherrat to Sarau-Nasar 1 m thick bed of gypsum was mapped and occurrences of gypsum were found in 5 sq km area.
LATERITE							
Kerala							
Kannur	Peringome East & West	-	-	40	791.5	-	The average thickness of overburden laterite is about 7 m.
Kasargod	Area between Vidyanagar & Manjeshwaram	-	-	-	-	101	Aluminous laterite in the area occurs in the form of massive sheets or blankets capping plateau.
LIMESTONE							
Chhattisgarh							
Bastar	Bastar area	1:50,000 1:4,000	50	-	-	15	Deposits of cement grade limestone demarcated around Chitapur village and about five lakh tonnes cement grade limestone resources were inferred.
Raipur	Kesla area	1:50,000 1:4000	60 1.76	24	805.90	874	Total 54.88 million tonnes resources of limestone have been inferred.
do-	Tekapar-Kalkasa area	1:50,000 1:4000	90 2	9	249	265	Total 16.5 million tonnes resources of limestone have been inferred.
Sukma	Birsatpal area	1:50,000 1:4000	285 2.44	- -	- -	85 -	Total 2 lakh tonnes of cement grade has limestone resources have been inferred.

(Contd.)

EXPLORATION & DEVELOPMENT

Table - 10 (Concl'd.)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
Himachal Pradesh							
Mandi	Dhara-Badhu area	-	-	03	151.4	-	Geological wing, Department of Industries, Himachal Pradesh carried out drilling on behalf of M/s ACC Ltd.
Shimla	Gumma-Rohana area	-	-	04	365.2	-	Geological wing, Department of Industries, Himachal Pradesh carried out drilling on behalf of M/s India Cements Pvt. Ltd.
Rajasthan							
Jaipur & Alwar	N/v Bhankari & Baragaon	1 :4,000	01	-	600	01	Limestone was reported from the tube wells N/v Baragon and carbonate rocks grey to black coloured were also mapped N/v Bhankari.
Jhunjhunu	N/V Dumoli kalan, Sihorian - ki Dhani, Dhani Dochina and Khatipur.	1: 50,000 1: 10,000 1:4,000	50 10 01	-	-	10	Resources were not estimated.
Nagaur	N/v Harima	1:2,000	02	21	611	386	Cement grade limestone was intersected in all the boreholes having cumulative thickness of 7.50 m - 25 m. and about 76.60 million tonnes of geological resources were estimated.
-do-	N/v Jathera Kherrat & Surpalia	1:10,000	10	-	-	17	Occurrences of limestone were located East of Jathera and South of Janjolai area.
-do-	N/v Bher & Godhan	1:10,000 1: 2,000	10 02	19 -	755.5 -	494 -	Two to seven zones of fine to medium grained grey colour & crystalline limestone having thickness from 1.50 to 19.25 m were intersected in the boreholes and about 25.16 million tonnes of resources of cement grade limestone were visually assessed.
POTASH							
Uttar Pradesh	Chitrakoot	-	-	-	-	-	About 50 million tonnes tentative resources of potash were estimated.
QUARTZ-FELSPAR AND QUARTZITE							
Rajasthan	Jaipur	1:4,000	10.25	-	-	01	-
	N/v Buchara & Chotkiyan-Ki-Dhani.						

EXPLORATION & DEVELOPMENT

**Table - 11 : Exploration for Granite and Other Dimension Stones
by State Directorates in 2012-13**

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq km)	Boreholes	Meterage		
BAJRI							
Rajasthan Dhaulpur	N/v Thekuli & Tasimo	RMS 1:10,000 1:3,600	150 10 01 -	- - -	- -	20	About 1.05 million tonnes of bajri deposition were tentatively assessed.
GRANITE							
Chhattisgarh Bastar/Kanker	Charama, Kanker and Keshkal areas	1:50,000	280	-	-	79	Total 28 lakh cu m black granite (dolerite) which is suitable for cutting/polishing were estimated.
Dantewada	Chingavaram- Bhusavas areas	1:50,000	278	-	-	11 +2	11 nos. rock samples and 2 nos. samples for cutting/polishing were collected. Total 4 lakh cu m black granite (dolerite) which is suitable for cutting/polishing were estimated.
Kondagaon/ Kanker	Keshkal, Jagarpali areas	1:50,000	165	-	-	29	Total 29 nos. rock samples (14 nos. for cutting/polishing testing) were collected.
GRANITE AND MASONRY STONE							
Rajasthan Jhunjhunu	N/v Nand-Rijhani Rasora-Maragsar, Jhadayanagar, etc.	1:10,000 1:4,000	10 03	- -	- -	07 -	Granite of the mapped area is pink-red to grey, coarse grained and porphyritic Quartzite to be used as masonry stone has been delineated.
MARBLE							
Nagaland Phek	Moke	-	-	-	-	-	Three boreholes have been released and drilling machineries have been shifted for drilling operation to assess the depth of the limestone/marble deposit.
MASONRY STONE AND SANDSTONE							
Rajasthan Alwar & Bharatpur	N/v Aipur, Dhanwara, Chinawara, etc.	-	-	-	-	14	Twenty nine nos. of plots of 1 ha. size have been delineated for masonry stone.
SANDSTONE							
Rajasthan Nagaur	N/v Chabutra, Manjara, Baswani etc.	1:50,000 1: 1,000	150 15	-	-	-	Occurrences of ferruginous fine grained, whitish brown, massive sandstone were observed.
SAND STONE AND GRANITE							
Rajasthan Pali & Jodhpur	N/v Moklawas, Bhopalgarh, Narlai, etc.	1 :2,000	02	-	-	-	Sandstone and granite bearing areas were delineated at various places. Moklawas area comprises with thick beds of horizontally bedded brown coloured fine to medium grained sandstone and the granites of Narlai area are greyish in colour, fine to medium grained having sporadic xenoliths.