Indian Minerals Yearbook 2018

(Part- I : GENERAL REVIEWS)

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EXPLORATION AND DEVELOPMENT

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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NATIONAL MINERAL POLICY

The Hon'ble Supreme Court in its judgement dated 2.8.2017 in the Writ Petition (Civil) No.114 of 2014 inter alia directed the Union of India to revisit the National Mineral Policy (NMP), 2008 and announce a fresh and more effective and meaningful policy.

In compliance with the directions of the Hon'ble Supreme Court, Ministry of Mines (MoM) vide its Order No. 15/1/2017-MV dated 14.08.2017 had constituted a Committee.

The Committee included representatives from Central Ministries, State Governments, Industry Associates, Professional Bodies and it also consulted NGOs and many other Stakeholders. The Committee went about the cosultative process with problem-solving approach and held four meetings wherein exhaustive discussions on the issues raised by the stakeholders were deliberated.

The Committee submitted its report to the Ministry on 31.12.2017. Based on the report submitted by the committee, Ministry of Mines prepared a draft National Mineral Policy (NMP), 2018 and uploaded it on the official website of the Ministry on 10.01.2018 for seeking comments/suggestions from the stakeholders.

Based on the Committee Report and the inputs received from stakeholders during subsequent consultations, the Ministry of Mines prepared the National Mineral Policy 2019. The Union Cabinet in its meeting held on 28.02.2019 approved the "National Mineral Policy 2019". The salient features of the "National Mineral Policy 2019" are as follows:

- It proposes to increase the production of major minerals by 200% in 7 years. It also proposes to reduce trade deficit in mineral sector by 50% in 7 years.
- It aims to attract private investment through incentives like financial package, right of first refusal at the time of auction etc. or any other appropriate incentive as per international practice.
- Introduces the concept of Exclusive Mining Zones having in-principle statutory clearances for grant of mining lease. It also proposes to identify critically fragile ecosystem and declare such areas as 'no-go areas'/inviolate areas.
- It emphasises implementation of all relevant Acts/Rules related to rehabilitation & resettlement and welfare of tribal communities while grant of mineral concessions.
- Encourages states to auction mineral blocks with pre-embedded statutory clearances.
- To institutionalise the mechanism for ensuring sustainable growth of Mining Sector an inter-ministerial body is proposed.
- Endeavors shall also be made to grant mining the status of Industry.
- In case of small deposits of precious metals and base metals, the establishment of common smelting and refining facilities shall be encouraged.
- It seeks to align downstream regulations for the exploration, development and acquisition of overseas mineral assets for ensuring its adequate supply which are not available in the country.
- It focuses on a long term export-import policy for the Mineral Sector to provide stability for investing in large scale commercial mining activity.
- Efforts shall be made to benchmark and harmonize royalty and all other levies and taxes with mining jurisdiction across the world.
- It also introduces the concept of Inter-Generational Equity which is also recognised by the Hon'ble Supreme Court in various judgments.

The complete report of NMP-2019 is given in the review on 'Mineral Policy and Legislation' in "General Reviews'.

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 2017-18.

The Oil and Natural Gas Corporation (ONGC) and Oil India Limited (OIL), the two National Oil Companies (NOC) and a few private and joint venture companies were engaged in exploration and production activities of oil and natural gas, including Coal-bed Methane in the country.

IBM

Indian Bureau of Mines (IBM), as a facilitator to the Mineral Industry, provides technical consultancy services for conducting feasibility studies, environment impact assessments, environment management plans, etc; to play the role of National Repository of mineral data through maintaining a data bank of mines and minerals by developing advanced IT based Mineral Information System; carries out mining research project on need-based aspects of mining; conducts mineral beneficiation studies, including mineralogical testing and chemical analysis and prepares mineral maps.

During 2017-18 (up to September, 2017), 98 multi - mineral lease hold maps on a scale of 1:50,000, with corresponding forest overlays in respect of various states were under finalisation.

To encourage value addition and mineral conservation, IBM carried out 2,425 ore dressing investigations, 21,092 chemical analysis, 1,254 mineralogical examinations and 5 in-plant study.

The Project on Mining Surveillance System (MSS) was undertaken by the Indian Bureau of Mines, Ministry of Mines and BISAG (Bhaskaracharya Institute for Space Applications and Geo-informatics) of Ministry of Electronics and Information Technology (MEITY) to develop a system for detection of incidence of illegal mining by use of space technology and Surveillance of area up to 500 m outside the lease boundary to check incidences of illegal mining.

IBM 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 and 1.4.2010 were updated and updating of NMI as on 1.4.2015 was completed for all 71 minerals including 25 minor minerals. Mineral wise chapters in respect of 71 minerals for “NMI:An Overview (As on 01.04.2015)" were prepared and uploaded on IBM web portal as a part of dissemination of information on resources of minerals in the country.

GSI

GSI pursued its most fundamental and basic mapping programme of systematic geological mapping in 2017-18 and had completed 9960.51 sq. km large-scale mapping, 112.3 sq. km detailed mapping and 1,29,710 m drilling as against previous year's achievement of 8043.10 sq. km large-scale mapping, 145.63 sq. km detailed mapping and 1,39,071.98 m drilling. Out of the total mappable areas of 3.146 million sq. km of the country, 3.119 million sq. km has been covered so far by systematic mapping bringing the total coverage to 99.14%.

Resources Established

Resources augmented by GSI during 2017-18 are given below:

i) A total resource of 113.53 million tonnes high grade iron ore (including 12.71 million tonnes low grade) has been estimated in Gandhalpada South-East, Part -B, Kendujhar district, Odisha.

ii) A total resource of 13.34 million tonnes of low grade iron ore (including 2.88 million tonnes high grade) has been estimated in Jhumka-Pathiriposhi, west block, Sundargarh district, Odisha.

iii) Iron ore resource of 16.20 million tonnes of high grade (including 1.13 million tonnes low grade) has been established in Rengalabehra North-East extension block in Kendujhar district, Odisha.

iv) Estimated iron ore resources in Gandhalpada South block, Kendujhar district, Odisha is 61.72 million tonnes at >45% Fe cut-off.

v) Estimated a net 361.909 million tonnes of limestone resources in Umkyrpong area, Litang Valley, East Jaintia Hills district, Meghalaya.

vi) Estimated 289.269 million tonnes of cement grade limestone resources in Samasi-Pala block, Litang Valley, East Jaintia Hills district, Meghalaya.

vii) Estimated 630.02 million tonnes of blendable/ beneficiable/portland cement grade limestone resources in East of Laphet area, Litang Valley, East Jaintia Hills district, Meghalaya.

Marine and Coastal Survey

Marine Survey

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

Marine and Coastal Survey Division (M&CSD) has completed seabed mapping of 1,32,585 sq. km out of 1,50,000 sq. km in 5 km × 2 km grid within Territorial Water and 18,42,552 sq. km out of 18,64,900 sq. km in the Exclusive Economic Zone beyond Territorial Waters on reconnaissance scale. Total EEZ coverage including TW is 19,99,784 sq. km out of a total EEZ area of 20,14,900 sq. km. During field session 2017-18, R.V. Samudra Ratnakar carried out 56,130 sq. km of multibeam bathymetry. Seabed survey of an area of 6,650 sq. km utilising coastal launch RV Samudra Shaudhikama in the areas off Gujarat and 1,295 sq. km in contiguous zone off Kerala were completed besides other parametric surveys. A total of 854 LKM of multichannel seismic survey was also carried out. Nine cruises onboard of RV Samudra Ratnakar including one spill over previous field session, seven cruises onboard of RV Samudra Kaustubh and RV Samudra Shaudhikama each, besides three coastal survey items and one RP item were taken up during 2017-18.

The following marine geoscientific surveys were carried out during 2017-18 field season:

R.V. Samudra Ratnakar

1. SR-026 (Spill over): Study of tectonic setup of Bay of Bengal and Andaman-Nicobar subduction complex within EEZ of India by systematic multi-channel seismic survey.
2. SR-031: Gas Hydrate investigation in Andaman Sea.
3. SR-032: Search for REY (Rare Earth Elements & Yttrium) in ferromanganese crust on the submerged ridges and surface/subsurface sediments east of Chetlat Island around Lakshadweep Group of Islands, Arabian Sea.
4. SR-033: Preliminary search for phosphorite over sea mount (Calicut Mt.) off Calicut, Kerala.
5. SR-034: Preliminary assessment of lime mud in the continental margin off Gujarat (Block IV).
6. SR-036: Preliminary assessment of lime mud in the continental margin off Gujarat (Block V).
7. SR-037: Swath bathymetric survey of the middle fan segment of Bengal Fan within the EEZ off Pentakota to Pudimadaka, Andhra Pradesh.
8. SR-038: Study of morphological and tectonic set up along with Geology of Andaman Sea within EEZ of India.
9. SR-039: Investigation for Rare Earth Elements & Yttrium (REY) in the Fe-Mn crust in the southern Part of the West Sewell Ridge.

RV Samudra Kaustubh

1. ST-259: Systematic shallow seismic surveys within the territorial waters in the shelf area off Dalhousie Island (Sunderban Delta), West Bengal.
2. ST-260: Systematic shallow seismic surveys within the territorial waters in the shelf area north of Shortt's Island, Odisha.
3. ST-262: Geophysical (Seismic) Survey within the Territorial Waters off Gangapatnam, Andhra Pradesh Coast, Bay of Bengal.
4. ST-263: Geophysical (Seismic) Surveys within the Territorial Waters off Ongole, Andhra Pradesh Coast, Bay of Bengal.
5. ST-258: Placer mineral and construction grade Sand resources evaluation in the Territorial waters, off Bheemunipatnam, Andhra Pradesh.
6. ST-261: Placer mineral resource evaluation in the territorial waters off Behuda River Mouth, Odisha.
7. ST-264: Search for both REE and Placer Mineral resource in the shelf area off Vedaranyam, Nagapattinam District, Tamil Nadu.

RV Samudra Shaudhikama

1. SD-276: Multi thematic mapping of Contiguous Zone by geological and geophysical surveys beyond Territorial Waters in Arabian Sea off Thiruvanthapuram, Kerala.

2. SD-277: Mapping of the seabed off Jakhau, Gujarat.
3. SD-278: Seabed mapping off Jhanjhmer, Gujarat (Block-IV) beyond TW of India.
4. SD-279: Seabed mapping off Alang, Gujarat (Block - V) beyond TW of India.
5. SD-280: Seabed mapping off Valsad, Gujarat (Block-VI) beyond TW of India.
6. SD-281: Evaluation of Heavy Mineral resources in marine sediments off Alang, Gujarat (Block 1).
7. SD-282: Multi thematic mapping of Contiguous Zone beyond Territorial Water in Arabian Sea off Kazhakuttam, Kerala.

Airborne Geophysical Survey

GSI pursued airborne geophysical survey for generating database by employing magnetic and raiometric techniques through Twin Otter Airborne Survey System (TOASS). 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, crustal structure, etc.

During 2017-18, the airborne magnetic and radiometric surveys data processing and interpretation over Alwar-Neem Ka Thana area in parts of Rajasthan, Haryana & Uttar Pradesh was in various stage of process. The study of this area was proposed for two field session i.e. 2016-18. The significant anomalies noticed in the area are: i) Magnetic anomalies of high frequencies along NE-SW occurring towards south of Dudu over the alluvium covered areas, appear to be due to the extension of causative sources of Archaean i.e., Bhilwara Supergroup (BSG) comprising Sandmata and Mangalwar Complex, ii) broad anomalies of low frequencies over the alluvium covered areas towards northeast of Dudu corresponding to deeper causative sources appear to indicate deeper basement features and iii) the anomalies of high frequencies with NE-SW trends observed towards northern part of the area around Shahpura, north of Duasa, west of Alwar and south of Narnaul indicating causative sources of shallower nature appear to be associated with the folded structures of Alwar basin, where several base metal prospects have been reported.

MECL

The highlights of exploration carried out by MECL during 2017-18 are given below:

i) The company has carried out 6.32 lakh metre of exploratory drilling for various minerals, out of which 5.12 lakh metre was through departmental resources and 1.19 lakh metre from outsourcing.

ii) A total of 215 sq. km area has been covered with detailed geological mapping for various minerals in different parts of the country. In addition to this about 3,447 sq. km of regional geological mapping has also been carried out in various minerals block explored through NMET funding and also carried out 3.53 lakh metre of geophysical logging.

iii) In laboratories, a total of 85,614 samples were analysed for chemical analysis and mineralogical analysis and petrographic studies.

iv) A total of 63 geological reports of detailed exploration, geophysical survey, environmental & remote sensing studies for different minerals were submitted which led to addition of 2,656 million tonnes of mineral resources.

v) During 2017-18, a total of 2,656 million tonnes of mineral resources were established. Mineral-wise details of resources estimated by MECL are as under:

- Coal - A total of 1,037.73 million tonnes of coal resources were established in Godavari valley, Jharia, Sonhat & Singrauli Coalfield in the states of Telangana, Jharkhand, Chhattisgarh & Madhya Pradesh.
- Lignite - 672.25 million tonnes of lignite resources were established in Rajasthan & Tamil Nadu.
- Iron Ore - 136.74 million tonnes of iron ore resources were established in Sandur Schist Belt, & Chitradurga Schist belt, Karnataka; Sundargarh, Odisha; and Purbanera belt, Rajasthan.

- Copper - 36.32 million tonnes of copper resources were established in Singhbhum, Jharkhand.
- Molybdenum - 5.65 million tonnes of molybdenum resources established in Harur-Uttangarai belt, Tamil Nadu.
- Gold - 32.262 million tonnes of gold ore resources were established in KGF, Karnataka.
- Limestone - 700.93 million tonnes of limestone resources were established in Palnadu basin in Telangana, Bilaspur in Chhattisgarh and Satna in Madhya Pradesh.
- Manganese ore - 0.29 million tonnes of manganese ore resources were established in Mandri Panchala, Bhandara, Maharashtra.
- Bauxite - 33.29 million tonnes of bauxite Chhattisgarh.

MINERAL-WISE EXPLORATION ACTIVITIES

Petroleum and Natural Gas

A number of new initiatives have been taken to promote Exploration and Production activities in the country. A multidimensional approach has been adopted for furthering the objective of enhancing energy security of the country through increased domestic production and improved investment climate in the country. Some of the policy initiatives taken by the Government for exploration and development of oil and gas in the country are as under:

The operator can explore and produce conventional as well as unconventional hydrocarbon such as Coal Bed Methane (CBM), Shale etc under a single license.

Opening up of India's sedimentary basins through open acreage policy will provide option for the companies for selection of Exploration blocks. They will also not be required to wait till the formal bid round is launched by the government as the open acreage area will be available throughout the year for bidding.

Exploration will be allowed through out the contract period. One of the major restrictions under Production Sharing Contract (PSC) was regarding exploration after the completion of exploration phase. The Hydrocarbon Exploration Licencing Policy (HELP) addresses the same and allows exploration throughout the contract period.

Exploration Phase for onshore areas have been increased from 7 years to 8 years and for offshore increased from 8 years to 10 years.

As part of the Government's effort to increase domestic production, Discovered Small Field (DSF) Policy was introduced for fast-tracking the monetisation of un-monetised small fields/ discoveries of Nationa Oil Companies (NOCs) under Nomination regime and relinquished discoveries under the PSC regime. Some of the notable features of DSF bid in addition to HELP features are: (i) No prior technical experience required enabling ease of entry for non-E&P players; (ii) No upfront bonus; (iii) Exploration allowed during the entire contract period; and (iv) Ready availability of nearby processing facilities. DSF Bid round-I was launched in 2016 which was a roaring success. Seeing the success of DSF round I, DSF round-II was launched in 2018 with 59 discoveries on offer with an in-place volume of 190 million tonnes of oil and oil equivalent gas.

During the year 2017-18, ONGC has made 12 discoveries (5 new prospects and 7 new pools). The major success was an Oil discovery from well WO-24-3 (WO-24-C) which has indicated potential of about 29.74 MMtoe of In-place Hydrocarbon Volume in the discovery area and the discovery is under further assessment through appraisal exploratory efforts.

During 2017-18, cumulative of 11,65,996 LKM of 2D seismic and 3,03,673 SKM of 3D seismic have been acquired and 6,766 exploratory wells have been drilled by PSUs. Indian private Exploration & Production companies (E & P) acquired a cumulative of 1,28,944 LKM of 2D seismic and 1,09,471 SKM of 3D seismic data and drilled 367 exploration wells. Foreign companies have carried out 64,790 LKM of 2D seismic survey, 22,143 SKM of 3D seismic survey and drilled 249 exploration wells.

Ultimate reserves of oil and oil equivalent of gas (O+OEG) established by ONGC, OIL and Pvt./JVs under PSC and CBM regime as on 31.03.2018 are placed at 4203.64 million metric tonnes. During 2017-18, accretion in ultimate reserve has been 108.76 million metric tonnes of O+OEG.

The area wise development drilling wells & meterage drilled by ONGC, OIL and private/joint ventures are given in Table -1 and exploratory efforts in nomination & PSC regime by ONGC, OIL and private/joint ventures are given in Table -2.

Details of oil and gas discoveries made during 2017-18 are given in Table -3.

Shale Gas

Shale gas and Oil exploration policy was announced on 14th October, 2013 by the Govt. of India for National Oil Companies to explore and exploit shale oil and gas resources in nomination areas. As per policy guidelines ONGC and OIL were supposed to carry out exploration in their PML and ML area in three phases. As per policy guidelines, ONGC and OIL India Ltd have to carry out Shale Gas and Oil exploration in 50 and 6 blocks respectively for assessment under Phase-I. ONGC identified 50 blocks in 4 basins viz. Assam, KG, Cauvery & Cambay basin in Phase-I and OIL identified 6 blocks in 2 basins viz. Jaisalmer and Assam basins in Phase-I. At the end of phase-I, out of the 22 wells in 18 blocks in four basins drilled by ONGC, 5 are exclusive shale gas wells. OIL has drilled 1 well in 1 block at the end of Phase -I.

Coal Bed Methane (CBM)

ONGC is operating in four CBM Blocks i.e. Jharia, Bokaro and North Karanpura in Jharkhand and Raniganj in West Bengal.

Table - 1: Area - wise Development of Wells & Meterage Drilled by ONGC, OIL & Private/ Joint Ventures, 2017-18

Agency	Onshore		Offshore		Total	
	Wells (Numbers)	Meterage (in'000)	Wells (Numbers)	Meterage (in'000)	Wells (Numbers)	Meterage (in'000)
(A) ONGC (Nomination)	277	497.69	104	226.01	381	723.70
(B) OIL (Nomination)	28	80.96	-	-	28	80.96
(C) Private/JVs	36	71.90	-	-	36	71.90
Total	**341**	**650.55**	**104**	**226.01**	**445**	**876.56**

Source: *Director General of Gas & Hydrocarbons Annual Report, 2017-18.*

Table - 2: Area - wise Exploratory Efforts by ONGC, OIL & Private/ Joint Ventures, 2017-18

Agency	Onshore		Offshore		Total	
	Wells (Numbers)	Meterage (in'000)	Wells (Numbers)	Meterage (in'000)	Wells (Numbers)	Meterage (in'000)
(A) ONGC (Nomination)	57	164.33	45	117.44	102	281.77
(B) OIL (Nomination)	11	52.28	-	-	11	52.28
(C) Private/JVs	17	48.39	14	31.22	31	79.61
Total	**85**	**265.00**	**59**	**148.66**	**144**	**413.66**

Source: *Director General of Gas & Hydrocarbons Annual Report, 2017-18.*

Table - 3: Oil & Gas Discoveries made by ONGC, Oil India Ltd and GAIL during 2017-18

Name of Basin	Well Name	Name of ML	Oil / Gas
A. ONGC			
Assam & Assam Arakan Basin	KU-8	Kunjaban PML	Gas
Assam & Assam Arakan Basin	BUAF/BU-6	Bhubandar PML	Gas
Cambay Basin	West Matar-1	Matar PML	Oil
Cambay Basin(NELP)	Anor-1	CB-ONN 2005/10	Oil
Cauvery Basin	Mattur West-1	L-II PML	Oil
Krishna Godavari Onshore Basin	VED-1	Godavari Onland PML	Gas
Krishna Godavari Offshore Basin	G-1-15	G -1 PML	Gas
Krishna Godavari Offshore Basin	GD-10-1	KG-OS-DW-IC3:J17II	Gas
Krishna Godavari Offshore Basin	GS-29-11	GS-29 Ext PML	Oil
Krishna Godavari Offshore Basin	GS-29-8	GS-29 Ext PML	Oil
Krishna Godavari Offshore Basin	GS-71-2	GS-15/23 PML	Oil
Mumbai Offshore Basin	WO-24-3	SW MH ML	Oil
B. Oil India LTD			
Assam Shelf	South Chandmari-5	Dumduma PML	Gas
Assam Shelf	South Chandmari-2	Baghjan PML	Oil
Assam Shelf	Lakwa-Gaon-1	Moran PML	Oil
Assam Shelf	Hukanguri-2	Dumduma PML	Oil
Assam Shelf	Borbhuibil-1	Moran PML	Oil
C. GAIL			
Cambay Basin (NELP)	GALIYANA-1	CB-ONN-2010/12	Oil

Source: *Director General of Gas & Hydrocarbons, Annual Report 2017-18.*

COAL

The agencies engaged in exploration for coal during 2017-18 were mainly GSI, CMPDI, SCCL, DGM Odisha and MECL.

GSI

In Assam, reconnaisance survey for Gondwana coal was taken up in Tatipara— Arateragaon area, Singrimari Coalfield in Dhubri district at the border of Assam and Meghalaya. During study an area of 2.73 sq. km area was mapped on 1:10000 scale and drilled one borehole to a depth of 301 m. The borehole intersected 148 m thick alluvium and comprises of loose sand, loose cobbles and pebbles of quartz, feldspars, quartzites and basic igneous rocks followed by tertiary sediments comprising of grey mudstone, carbonaceous mudstone, mottled mudstone and coaly horizons. Below the tertiary sediments, the basement occurs as weathered quartzo-feldspathic gneissic rocks at a depth of 287.00 m.

In Bihar, during general exploration (G2) for Gondwana coal under the cover of younger formations in Lakshmipur block, Rajmahal Coalfields in Bhagalpur district, a total of 1331.90 m was drilled in 3 boreholes (RBLP-1 to 3) and an area of 7 sq. km was mapped on 1:10000 scale. Four regional Barakar coal seam zone (A, B C & D in ascending order) have been intersected in the drilled boreholes. The total cumulative coal thickness encountered in three boreholes was 165.40 m with thickest coal seam of 10.00 m (RBLP-2) encountered at a roof depth of 597.95 m. Coal seam zone B having the highest cumulative thickness of 115.45 m (RBLP-2) is the most important for their regional persistence and thickness.

In Chhattisgarh, regional exploration for coal in Sendur block, Tatapani- Ramkola coalfield in Surguja district. The survey comprises drilling of 2,026.10 m with coal core samples of 52.85 m and geophysical logging of 1,224.65 m. Three regional Barakar coal seams (Seam-II to III & XIII in ascending order) and few local seams with thickness ranging from less than a metre to 29.86 m (cumulative thickness of Seam Zone III) have been intersected between the depths of 299.66 m and 762.13 m. Seam Zone III is the thickest. Geophysical logging shows good correlation with coal seams recorded by core logging. Exploration for coal was carried out in Tendumuri block, Mand-Raigarh coalfield in Raigarh district. Exploration involved large scale mapping of 3 sq. km area on 1:10000 scale, drilling of 2,306.85 m, geophysical logging of 1151.56 m and 169.84 m coal core sampling. Twelve regional Barakar coal seams/ zones (Seam I to X, XII & XIII in ascending order) have been intersected between the depths of 16.26 m to 659.61 m. Thickness of individual coal seam/ zone varies from 0.75 m to 14.67 m. Seam IV is the thickest seam with cumulative thickness of 14.67 m (in 2 split sections). Borehole data indicates three normal faults in the area. Exploration carried out for coal in Jobro (West) block, Mand-Raigarh coalfield in Raigarh district comprises a total drilling of 2,766.50 m in six boreholes, geophysical logging of 1,694.59 m, large scale mapping of 3.5 sq. km area on 1:10,000 scale and 158.09 m coal core sampling. Seven regional Barakar coal seams/ zones (Seam III, IV, V, VI+VII, VIII, IX & X in ascending order) and a few local coal seams within Raniganj Formation and Barren Measure have been intersected between the depths of 8.30 m and 576.95 m. Thickness of individual regional coal seam/ zone varies from 0.53 m to 17.09 m. Seam zone VI+VII is the thickest seam. The cumulative coal thickness varies from 7.69 m to 17.09 m. Seam V is another important and thick seam zone intersected in the block with a maximum coal thickness of 16.88 m.

In Madhya Pradesh, exploration for coal by scout drilling was carried out in Tummi-Kharsol area, Sohagpur Coalfield in Anuppur & Umaria districts. The study involved a total of 2,462.55 m drilling, mapping of 44 sq. km on 1:25,000 scale and geophysical logging of 1,359.58 m in three boreholes. Four regional coal seams (Seam-I to IV in ascending order) and few local seams, with cumulative individual seam thickness ranging from 0.50 m to 2.65 m, have been intersected between the depths of 269.00 m and 420.60 m. Seam-III occurs as the thickest seam i.e. 1.20 m to 1.75 m. Cumulative thickness of coal varies from 4 m to 5 m. In Shahdol district, preliminary study for generation of baseline data of in-situ gas content within shale horizons of Lower Gondwanas was taken up in Semra Area. The gas desorption test was conducted in borehole SSSG-1 of 981 m depth encompassing 471.30 m of Raniganj, 220.60 m of Barren Measures and 289.10 m of Barakar strata were intersected. A thick basic intrusive body (158.30 m thick) has been intruded within Raniganj Formation at shallow depth of 67.90 m. Occurrence of carbonaceous shale/siltstone is very rare throughout entire intersected lower Gondwana sequence in borehole SSSG-1. Twelve core samples of carbonaceous shale/ siltstone were collected within a depth range from 581.50 m to 909.00 m for gas desorption test. Desorbed gas content of all studied samples is very low (max. 22cc) whereas the weight of samples varies from 1615 gm to 2275 gm. Regional exploration for coal was taken up in Sarai – Uphradol block, Singrauli coalfield in Singrauli district. Drilling of 3,816.95 m in six boreholes, geophysical logging of 1465.28 m and core samples of about 102.75 m and large scale mapping of 7 sq. km on 1:10,000 scale was completed. All the six boreholes have been intersected Barren Measures with thickness ranging from 190.72 m to 230.84 m. The Talchir strata are encountered in four boreholes. Seven regional Barakar coal seams/ along with three local seams and one Raniganj coal seam have been intersected in the boreholes. The cumulative coal thickness ranges from 0.51 m to 6.42 m. Regional Barakar coal seams continuation was established for 3 km along strike and about 1.0 km along dip direction. In Chhindwara district, exploration for coal in Bamhanwara sector, Pench Valley Coal field was carried out comprising total drilling of 4,64,725 m in thirteen boreholes, mapping of 41.00 sq. km area on 1:10,000 scale and geophysical borehole logging of 948.75 m. Mapping reveals that the area is covered with Deccan Trap. Five numbers of flows have been delineated based on subsurface data. The three boreholes i.e. PBH-7, 8 & 10 which encounter Barakar Formation (25 m – 60 m) within a depth range from

262.60 m to 445.510 m were closed in a depth range of 286.60 m to 453.60 m. Cumulative thickness of coal (III, IV and V in descending order) varied from 10.85 m to 11.51 m.

In Nagaland, reconnaissance survey (G4) for coal was taken up around Alongtaki in Mokokchung district. Large - scale geological mapping of 50 sq. km area was carried out on 1:10000 scale. Coal occurrences reported in the form of seams, lenses, streaks and pockets within sandstones of Jenam, Bhuban and Tipam. The notable coal seams observed in the Jenam Formation includes: i) Near Alosi Tsu with a strike length of 3.3 m and thickness of about 12 cm, ii) East of Longtho village with a strike length of 2 m and 0.05 m thickness, iii) Near Tayeba Tsu with a strike length of 8 m and 15 m thick and iv) About 4 m thick on eastern bank of Dessoi River with a strike length of 20 m. Besides, a coal layer with a strike length of 7 m and thickness varying from 0.01 to 0.45 m is also seen along the road transect between Teyaba Tsu and Alongtaki village.

In Odisha, general exploration for coal was carried out in Kantaikoliya north block, Talcher coalfield, Angul district. Exploration comprises mapping of 2 sq. km area of on 1:10,000 scale and drilling of two boreholes to a total depth of 1083.90 m. A total area of 4 sq. km was mapped in 1:10000 scales and total meterage of 2260.10 m was drilled. The area is covered by rocks of Kamthi Formation. The lithounits of Kamthi Formation (max thickness 184.42 m), Barren Measure (max thickness 136.38 m), Barakar Formation (Max thickness 363.68 m) and Karharbari Formation (max thickness 115.13 m) have been intersected in the boreholes. Ten regional coal seam zones (II to XI in ascending order) were intersected between the depth ranges from 151.40 m to 518.85 m in Barakar Formation. The cumulative coal thickness varies from 44.62 m to 69.96 m. The seam zone IX is the thickest seam (14.08 m to 21.67 m) and it has been intersected between the depth ranges from 216.30 m to 328.31 m. In Jharsuguda district, a G2 level general exploration was carried out for coal in Teteliabahal Block, Ib-River coalfield. A total of 5 sq. km area was geologically mapped on 1:10,000 scale; 4,975.60 m drilling was carried out in 6 boreholes and 3,299 m geophysical borehole logging was done in four completed boreholes. A total of 716.49 m coal core samples were gathered. Four regional coal seam zones of Raniganj Formation i.e. R-IV, R-III, R-II, and R-I and four regional coal seam zones of Barakar Formation i.e. Belpahar, Parkhani, Lajkura and Rampur have been intersected in the boreholes. Coal seam zones of Raniganj Formation occur at shallow depth i.e. within 350 m, between 89.33 m and 312.43 m depth. Cumulative coal thickness of R-IV, R-III, R-II, and R-I intersected in the boreholes varies from 0.90 m to 14.45 m. The coal seam zones of Barakar Formation have been intersected between 280.89 m (IBTB-1) and 881.92 m (IBTB-6) depth. Cumulative coal thickness of Belpahar, Parkhani and Lajkura seam zones varies from 6.27 m to 10.65 m, 20.50 m to 25.79 m and 64.33 m to 71.33 m, respectively. Rampur seam zone has been intersected in boreholes IBTB-1, 5 and 6 with cumulative coal thickness varying from 4.84 m to 18.21 m. Lajkura is the thickest among the Barakar coal seam zones. In Sundargarh district, a G2 level general exploration was carried out for coal in Kendudihi block, Ib-river coalfield. A total of 3 sq. km area was geologically mapped on 1:10,000 scale. 2,766.10 m drilling was carried out in 4 boreholes; 392.27 m coal core samples were generated and 1,310.10 m borehole geophysical logging was done in two boreholes. The boreholes intersected the rocks of Raniganj, Barren Measure, Barakar and Karharbari. Two regional coal seam zones of Raniganj Formation i.e. R-II, and R-I and four regional coal seam zones of Barakar Formation i.e. Parkhani, Lajkura, Rampur and Ib have been intersected in the boreholes. Coal seam zones of Raniganj Formation occur at shallow depth i.e. within 300 m, between 7.90 m and 62.50 m depth. R-II seam (2.86 m cumulative thickness) has been intersected in borehole IBKD-1. Cumulative coal thickness of R-I varies from 4.50 m to 5.36 m. The coal seam zones of Barakar Formation have been intersected between 244.06 m and 747.24 m depth. Cumulative coal thickness of Parkhani, Lajkura, Rampur and Ib seam zones varies from 5.91 m to 7.74 m, 26.17 m to 37.35 m, 45.62 m to 55.92 m and 1.99 m to 13 m, respectively.

In Telangana state, a G3 stage exploration was taken up for coal by drilling in the western extension of Pagaderu west sector, southern part of main basin of Godavari valley coalfield. A total of 2,125.20 m of drilling has been drilled in four boreholes. A total of 136.61 m of coal has been sampled. The Lower Kamthi coal seam zones (V to I) and the Barakar coal seam zones (A&B, No I

seam, C and Thick seam) intersected within the depth range from 15.70 m to 695.00 m with individual seam thickness varying from 0.50 m to 3.92 m. Occurrence of coal has been proved along the strike extension of 2 km and dip extension of 5 km and estimated a tentative resource of 100 million tonnes with quality of coal varies from C to G grade.

In Telangana state, regional exploration for coal by scout drilling in north west of Dorli block, north-western part of Godavari valley coalfield in Adilabad district was taken up. The coal bearing Lower Gondwana sequence under the cover of Deccan trap was reported in the north western part of Dorli area during geological mapping on 1:25000 scale. The Barakar coal seams are exposed in the nala section of the area. The maximum thickness of traps established by geophysical survey using gravity and magnetic methods varies from 40 m to 150 m. Further north-west of Chintaguda area the trap thickness gradually increases with maximum thickness recorded 250 m.

In West Bengal, general exploration (G2) for Coal and Lignite was carried out in Rakshitpur north block, Raniganj Coalfield, Bardhaman district. A total of four boreholes were drilled to a cumulative depth of 2,179.90 m. Raniganj Formation hosts four regional coal seam/ seam zones (R-IX, R-VIII, R-VII & R-Basal) with cumulative thickness ranging from 0.67 m to 5.10 m were intersected in the depth range of 298.65 m to 710.35 m. One lignite seam of 0.40 m thickness had been encountered at the depth of 194.10 m in borehole no. RRKN-3. A fossiliferous zone of 6.10 m thickness had been intersected at the depth of 50.60 m in borehole no. RRKN-3. Large scale mapping of 4 sq. km on 1:10,000 scale was also carried out. A general exploration for Gondwana Coal under the cover of Rajmahal Formation was carried out in Agaya block within Dholkatha-Garia area, Rajmahal-Birbhum Coalfield, Birbhum district. Total five boreholes were drilled to a total depth of 2,550.05 m. Regional coal seam zone I and II have been encountered within the coal bearing Barakar Formation in the depth range of 197.70 m to 462.11 m. Total 147.32 m cumulative coal thickness has been intersected in five boreholes with thickest coal seam of 13.05 m. Maximum thickness of different formations reported in five boreholes are alluvium 9.20 m, Rajmahal Formation 192.80 m, Infratrappeans 24.78 m, Dubrajpur Formation 3.20 m, Barakar Formation 325.79 m, Talchir Formation 13.50 m, Basement metamorphic ~ 6 m and intrusive dyke +54 m.

Directorate of Geology, Odisha

Exploration for coal over an area of 7.56 sq. km was continued from previous field session in Madhupur block of Ib Valley coalfield, Jharsuguda district. Total 2,911.10 m drilling was carried out during the year 2017-18.

The Singareni Collieries Company Ltd (SCCL)

During 2017-18, SCCL has explored the area to locate the presence of economic viable coal deposits and established its nature, shape and grade. Total 350 exploratory boreholes were drilled to a cumulative depth of 1,09,109 m and established proved reserves of 72.64 million tonnes with cumulative reserves position at the end of 2017-18 at 10,474.90 million tonnes. The exploration work was carried out in the SCCL command area situated in Adilabad, Khammam, Karimnagar and Warangal districts of Telangana state.

CMPDI

During 2017-18, CMPDI continued its coal exploration activities mainly in CIL and Non-CIL/ Captive Mining Blocks. Exploration in CIL blocks was taken up to cater the needs of 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. A total of 140 to 160 drills were deployed in 2017-18, out of which 66 drills were departmental drills.

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

In 2016-17, CMPDI and its contractual agencies took up exploratory drilling in 118 blocks/mines spread over 18 coalfields in six states. Out of 118 blocks/mines, 42 were Non-CIL/Captive blocks and 76 CIL blocks/mines. Departmental drills of CMPDI took up exploratory drilling in 50 blocks/mines, whereas, contractual agencies drilled in 68 blocks/

mines. CMPDI extended its technical supervision in promotional/NMET exploration work undertaken by MECL in coal sector (CIL areas) in 8 blocks. On behalf of Ministry of Coal, DGM, Nagaland has also carried out promotional exploration in one block and CMPDIL in two coal blocks of a total of 1.347 lakh meter of promotional (regional) drilling was undertaken in coal and lignite during 2017-18 through, CMPDI.

A total of 13.661 lakh m of exploratory drilling was carried out by CMPDI in 2017-18 through departmental resources (4.750 lakh m) and outsourcing (9.156 lakh m) to State Governments/ MECL/Tendering (CIL/Non-CIL blocks). Details of exploratory drilling carried out by CMPDI in 2017-18 are given in Table - 4.

Table - 4: Exploratory Drilling by CMPDI (Departmental and Outsourcing) in 2017-18

Sl. No.	Agency	Target (lakh m)	Exploratory drilling achieved (lakh m)	Achieved (%)
1.	Departmental	4.750	4.505	95
2.	Outsourcing			
	i) State Govts.	0.030	0.021	71
	ii) MECL (MoU)	4.000	4.688	117
	iii) Tendering (CIL/Non-CIL Blocks)	3.720	4.446	120
Total		**12.500**	**13.661**	**109**

LIGNITE

GSI

The details of investigation for lignite during 2017-18 by GSI is given below:

In Tamil Nadu, a preliminary exploration for Lignite was carried out in Kalari East Sector, Ramanad sub-basin in Ramananthapuram district. A total of five vertical boreholes were completed for a cumulative drilling depth of 2,667.20 m Lignite seams intersected in all the five boreholes and individual seam thickness varies from 1.0 to 16.50 m. Cumulative thickness of lignite seams varies from 16.0 to 22.4 m and cumulative parting thickness varies from 29.30 to 39.00 m. Three main lignite seams intersected in the upper, middle and lower portion of the lignite zone. The top most seams are thicker admeasuring from 10.20 m to 16.50 m. The middle and bottom seams are generally thinner. The content of fixed carbon varies from 14.9 to 34.8% and the calorific value ranges from 1,848 to 3,510 K.cal/kg.

Directorate of Geology, Odisha

Exploration for coal over an area of 7.56 sq. km was continued from previous field session in Madhupur block of Ib valley coal field, Jharsuguda district. During the year 2017-18, total 2911.10 m drilling was carried out.

DGM, Rajasthan

During 2016-17, exploration for lignite was continued n/v Diyatra, Tehsil Kolayat, Bikaner district. Eleven boreholes were drilled to a cumulative depth of 1,976.40 m and estimated 0.36 million tonnes of lignite resources and 17.14 million tonnes of lignitic shale resources. In Bikaner district, regional mineral survey near villages Nathwato ki Dhani, Sewra, Nagarasar, Bera ki Dhani in Kolayat Tehsil was taken up with an objective to explore new lignite deposits in border region of Bikaner, Jaisalmer and Jodhpur districts. No indication of lignite was found during tubewell sludge study. During 2017-18 exploration programme a total 285.00 m of drilling in 3 boreholes were carried out and collected 10 samples. The thickness of lignite seam is 5.00 m and average thickness of overburden is 157.00 m. The progressive average of lignite/overburden ratio is 1:24.18. During the year, lignite shale reserves has been estimated at 1.04 million tonnes.

Neyveli Lignite Company India Ltd

In Tamil Nadu, exploration for lignite in Palayamkottai and Veeranam block, Cuddalor district was taken up through NMET scheme to bring the resources into proved category. In Palayamkottai block (32.00 sq. km area), 65 boreholes were drilled

to a total depth of 9,316.0 m and 550 samples were collected for chemical analysis. In Veeranam block (150.00 sq. km area), 55 boreholes were drilled to a total depth of 14,423.0 m and 208 samples were collected for chemical analysis. The drilling continuing at 400 m grid interval.

In Rajasthan, promotional exploration funded by Ministry of Coal was taken up in Kheduli, Matasukh-Lunsara and Pyau south blocks. In Kheduli block, 53 boreholes were drilled to a total depth of 13,518.30 m and collected 75 samples for chemical analysis. The block is promising. The exploration results of other two blocks i.e. Matasukh-Lunsara block, Nagaur district drilled and Pyau south block, Churu district are not promising blocks. The exploration in these two blocks were completed.

NON-FERROUS METALS

BASE METALS

GSI, MECL and Directorate of Geology, Odisha conducted investigations for copper, lead and zinc ores in different parts of the country during 2017-18.

GSI

The details of exploration activities carried out by GSI during 2017-18 are given in Table-5.

MECL

Exploration for copper in Sidheswar copper deposits east Singhbhum district, Jharkhand was taken up with an objective to establish i) the depth continuity of lodes at around 5th level , ii) continuity of lodes upto and beyond 8th level and estimate the total resources of copper and to carry out the deviation survey of the exploratory boreholes. The deposit extends over a strike length of about 2.0 km from the north-eastern of the Kendadih mine. During G1 level exploration, MECL mapped 2.59 sq. km area, 14 nos boreholes drilled to cumulative depth of 3,636.10 m and collected 866 nos primary samples for Cu, 29 nos check samples for Cu, 25 polished section and 16 petrographic study and 25 samples for specific gravity determination. Out of a total 8.923 million tonnes with 1.20% Cu estimated at 0.5% cut-off and 0.8% pay limit, about 3.283 million tonnes with 1.20% Cu estimated under measured category (331) , 3.029 million tonnes with 1.18% Cu under indicated category (332) and 2.611 million tonnes with 1.19% Cu under inferred category (332) [Estimated upto 9th level]. During G2 level exploration in Nandup (East)-Bayanbil (combined) block, East Singhbhum district, Jharkhand, MECL mapped 0.54 sq. km area an 1:1000 scale, drilled 10 boreholes to a cumulative depth of 1883.50 m and collected and analysed 1158 nos samples including 60 primary samples for Au, Ag & W and 37 composite samples for Cu, Ni, Co, Mo and W. A total resources of 6.5653 million tonnes under indicated category have been estimated with the grade of 1.19% Cu at 0.5% Cu cut-off and 12.315 million tonnes (332) with the grade of 0.89% Cu at 0.2% Cut-off. In Surda copper mine block, East Singhbhum district, a G1 level exploration was carried out with the objectives to establish i) the depth continuity of loads at around 17th level , ii) continuity of lodes up to and beyond 20th level and iii) deviation survey of the exploratory boreholes. Exploration involved mapping of 3.02 sq. km on 1:4,000 scale, 7,483.60 m drilling in 8 boreholes and sampling and chemical analysis of 1543 nos of primary samples for Cu, 74 nos check samples for Cu, 34 nos of composite samples for Cu, Ni and Co, 26 nos samples for Au, 26 nos samples for XRD and spectroscopy and 85 nos samples for minerogrphy, petrography and specific gravity determination. About 15.085 million tonnes resources with average thickness of 5.83 m and average grade of 1.00% Cu has been estimated at 0.5% cut-off with 0.8% pay limit under measured/indicated category. The exploration of Surda block and Sidheswar copper deposit was carried out for HCL whereas Nandup-Bayanbill (combined) for Ministry of Mines.

Directorate of Geology, Odisha

Geophysical investigation for base metal was taken up in north of Kesharpur, Mayurbhanj district. Exploration was carried by SP survey of 1 sq. km on 1:2000 scale and IP survey of 0.75 sq. km on 50 m x 20 m spacing . Anomalous zones of causative bodies were indentified for further investigation.

DMG, Rajasthan

Base Metal & Noble Metal

During 2016-17, investigation for locating base metal and noble metal was taken up n/v Jotri Peepal, Piruka Teski in Pahari Tehsil, Bharatpur district, Rajasthan. An area of 50.0 sq. km was mapped on 1:50,000 scale, 15.0 sq. km on 1:10000 scale and 2.0 sq. km on 1:4,000 scale. Lead mineralisation is

confined to the western intercalated quartzite and phyllite contact in the Khola Piruka in old pit admeasuring 40 m x 3 m x 2 m area and in the Gol Pahari area minerlisation is exposed to the surface of quartzite in old pits in the form of disseminated galena specks. Exploration will continue.

HZL

During 2017-18, HZL carried out about 140 km surface drilling and 6.5 km underground drilling across all its properties. Total ore resources of all mines owned by HZL in the country stand at 410.60 million tonnes with 26.70 millions tonnes of zinc metal, 8.90 millions tonnes of lead metal and 28.49 thousand tonnes of silver metal. The average metal content of zinc is about 7.03%, lead 2.17% and silver 78.67 g/t.

Zawar group of mines consist of four operating mines i.e. Mochia, Balaria, Zawarmala and Baroi mines. A total 1229 nos of boreholes were drilled to a cumulative depth of 83,611 m and 33,944 nos of samples for chemical analysis were collected from Zawar group of mines. The total gross reserves and resources added during the year (as on 01.04.2018) of Mochia, Balaria, Zawarmala, Baroi and Bara are placed at 105.835 millions tonnes with average grade of Pb-2.29%, Zn-4.51% and Ag-43g/t.

Table - 5: Exploration for Base Metals by GSI, 2017-18

State/District	Name of block	Details of exploration	Results
Andhra Pradesh			
Nellore	Around Udayagiri and Duttaluru	Mapping, Pitting & Trenching	During G4 stage reconnaissance survey for copper and associated mineralization, an area of 150 sq. km has been mapped on 1:12500 scale, besides 43 cu m pitting and trenching followed by collection of various types of samples.The Nellore Schist Belt (NSB) is divided into two litho-tectonic domains. The lower (Vinjamuru) dominated by amphibolites, hornblende schist, metabasalt and upper (Udayagiri) dominated by metapelites mainly quartz chlorite schist, quartz-biotite-garnet schist and quartzites. In Masayapetta tippa hillocks and Duttaluru hillocks, series of old pits have been identified for a cumulative length of 300 m and 250 m respectively with width varies from 10-30 m. The surface indications for mineralisation are manifested in the form of malachite stains, disseminated pyrite and chalcopyrite within the ferruginous quartzite and quartz vein.
Nellore	Around Garimanipenta and Vinjamuru	Geophysical Survey, Mapping & Sampling	Reconnaissance survey (G4) for copper and associated mineralisation in the Nellore Greenstone belt was taken up by large scale mapping of 200 sq. km on 1:12500 scale. The area is represented by migmatite gneiss. Malachite stains within pegmatite intruding into granite gneiss has been observed near Bhattinivaripalli area. Barite mineralisation is also noted as linear bodies with 5-6 m width in the south of Venkatadripalem. IP and resistivity surveys carried out in Garemanipenta block has brought out a few prominent geophysical anomalies. These anomalies may indicate the presence of sporadic occurrence of quartz/ pegmatite veins associated with malachite stringers within the garnetiferous mica schist. A total of 46 BRS, 50 PTS, 161 soil and 26 petrochemical samples were collected and sent for analysing Cu, Pb, Zn, Au, Ag, Sn, W, Co, Mo, As and Ni.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Arunachal Pradesh			
East Kameng and Papumpare	Around Bubiya-Laporiang area	Mapping	Reconnaissance survey for copper and possible associated gold mineralisation was taken up by large scale mapping of 52 sq. km on 1:12500 scale. A total of 3 major mineralised zones was delineated. A 500-700 m width shear zone (Zone I) has been recorded near Dedollo. Oxidation, limonitisation and boxworks have been observed in this zone. A 180-200 m width shear zone (Zone II) was seen near Leporiang. The host rock is quartzite with specks of pyrite grains. Another Zone of 80-100 m width (Zone III), recorded in the old Bubiya road near to Lodosho village, the rock type being phyllite. In this zone a quartz vein has been observed with pyrite, chalcopyrite and bornite mineralisation.
Gujarat			
Sabarkantha	Around Vadali area	Geophysical survey, Mapping & Sampling	Reconnaissance survey for Base metals in the area involves large scale mapping of 100 sq. km area on 1:12500 scale along with 15 LKM of geophysical survey. Total 28 pegmatite samples for REE/ RM analysis and 27 BRS for Nb-Ta analysis were collected. Two heavy minerals samples were also collected for base metal analysis. The main lithology of the study area is calc-silicate rocks.
Haryana			
Bhiwani	Around Khanak-Ratera-Kirawar-Jamalpur area	Drilling	Reconnaissance survey for multi-metal deposit in the North and West of Tosham, district, (G-4): The target was to intersect the geophysical causative body, which was estimated on the basis of magnetic and SP anomaly at a vertical depth of 350 m ±10. Borehole HBNT-1 was planned to intersect geophysical anomaly. The borehole was drilled up to a depth of 167 m, but due to continuous/persistent drilling problems the borehole was abandoned at a depth of 167 m within alluvium (Quaternary sediments). The scout borehole HBNT-01 was again drilled as borehole HBNT-01A. Again, due to continuous/persistent drilling problems borehole had been abandoned at the depth of 282.30 m. In Tirumalapuram hillock, disseminated sulphide i.e pyrite, chalcopyrite and covellite, malachite and azurite are seen in massive quartzite ± ferruginous. The trace elements like Co, Cr, Cu, Ni, Th, V and Ge are highly concentrated in Chintalgunta and Sarvarabad area over the lithology of meta-anorthosite, quartz chlorite schist and quartzite. The analytical results of 25 BRS channel samples indicated average copper content of 0.25% over 2 m.
Mahendragarh	North of Golwa	Mapping Drilling	General Exploration (G2)for Copper mineralisation in extended block, North of Golwa involved detailed mapping of 0.51 sq. km on 1:2000 scale. The calcareous quartz-biotite schist is host of copper

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
			sulphide mineralisation. A total of 3,429.40 m of drilling has been carried out. Three levels of boreholes have been drilled. Based on the analytical data, the strike length of copper sulphide mineralisation is approx. 800 m with average width varying between 8 m to 22 m. The content of copper varies between 0.3 to 0.42%. The principal ore minerals are chalcopyrite, bornite, chalcocite, covellite and pyrite. The mineralisation occurs as disseminations, thin veinlets along foliation/ fracture plane, stringers and fracture fillings.
Mahendragarh	Kalba-Thanawas-Nayan Area	Geophysical Survey Mapping & Drilling	Reconnaissance Survey for Copper and Associated Base Metals Mineralisation was taken up by large scale mapping of 130 sq. km on 1:12,500 scale. The investigated area is mainly occupied by the tremolite bearing impure marble, massive phyllite, interbedded phyllite and quartzite unit, interbedded phyllite and ash (pyrite bearing) bed. The veins are about 0.1 m to 2 m in thickness. The major sulphides seen in the area are pyrite, bornite, pyrrhotite and chalcopyrite. Geophysical Survey by Chargeability, Resistivity, Magnetic and SP methods was carried out in Kalba, Thanawas and Nayan area and showed magnetic anomaly of -450 gamma to the north of tremolite bearing impure marble and higher chargeability values in the south western corner near to the proximity of interbedded phyllite and ash beds. The chemical analysis of 76 samples for Cu, Pb, Zn and Ag shown the highest value of Cu.
	Narnaul, Raghunathpur, Dharsu, Bashirpur area	Mapping	Reconnaissance survey was taken up for copper and associated base metal mineralisation by geological mapping on 1:12500 scale. Major rock-types seen in the area include bedded quartzite interlayered with amphibole marble, garnetiferous quartz-biotite schist, etc are traversed by number of pegmatite bodies of varying dimensions as well as quartz, calcite veins. At two isolated hillocks near Raghunathpur, surface manifestations of mineralisation are found in the form of malachite stains, iron incrustations and rarely dissemination of chalcopyrite, bornite, pyrite within the garnetiferous quartz-biotite schist and amphibole marble.
	South of Gangutana extension	Mapping Drilling Pitting/ Trenching & Sampling	General exploration for copper mineralisation involved detailed mapping of 0.50 sq. km on 1:2000 scale. The mineralisation is hosted by the calcareous quartz-biotite schist.Total 538.40 m meter drilling in five boreholes were carried out. Study of drill holes cores show the sulphide mineralisation is in the form of specks, dissemination and fracture filling of chalcopyrite, bornite, covellite, pyrrhotite and pyrite, which are mostly associated with thin veins/veinlet of calcite and rarely with quartz veins. Visual estimation of copper mineralisation from various boreholes ranges from 0.01% to 0.2%. A total of 120 channel samples in eight channel lines of 1.00 m to 16.00 m length each were collected and the average grade of Cu mineralisation ranges from 0.02% to 0.4% Cu. 30 pitting and trenching samples shows significant value of copper mineralisation.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Jammu & Kashmir			
Kathua	Bani area	Mapping & Sampling	Reconnaissance survey for Copper and REE minerals was taken up in parts of Jamotha and Kaplas granites and its surrounding rocks by mapping 50 sq. km area on 1:12500 scale and 127 nos of BRS, 26 nos of PCS, 10 nos of HM, 15 nos of EPMA, 50 nos of PTS, 30 nos of soil samples and 19 nos of stream sediment samples were collected.
Ramban	Banihal-Shalgadali-Hale Maidan areas	Mapping	Reconnaissance survey for Copper and associated mineralisation was taken up in Cambrian sequence in and around Banihal-Shalgadali-Hale Maidan areas. Large scale mapping of 50 sq. km on 1:12,500 scale was carried out. Five old workings were observed from agglomerate and volcanic tuff near Dooligam village and slag dumps were also observed in the downslope. Presence of malachite stains in the rocks of old workings near Dooligam, Banihal were also observed. Copper mineralisation is noticed at some places in quartz veins, in Machal and Ramsu Formation, which are very irregular in nature and range from few millimeters to 1.27 m in width, the most common minerals found along these veins are chalcopyrite and bornite.
Karnataka			
Raichur	Machanur block	Mapping Drilling & Sampling	During preliminary exploration for delineation of Copper and REE mineralisation was in Lingasugur taluk, detailed mapping of 2.0 sq. km and drilling of 800 m was carried out. The different styles of mineralisation in the host granite comprise the disseminations of sulphides, stockwork zones and veinlets, represented mainly by 1 mm-thick veinlets with quartz-chlorite ± specularite ± pyrite and chalcopyrite and (2) cm-thick veins composed of quartz-chlorite-carbonate-pyrite ±chalcopyrite ±bornite ±sphalerite. The main sulphides in the area are present as chalcopyrite, pyrite and bornite. Three first level boreholes intersected mineralisation at vertical 60 m depth and drilled in 200 m. The fourth borehole of second level borehole is still running at 313.0 m inclined depth in the mineralised zone. Total 264 nos of samples was generated and sent for analysis. Chemical analysis of 46 samples has given weighted average 0.15% Cu over 23.0 m with maximum and minimum of 0.7 and 140 ppm respectively.
Chitradurga	Around Nerlakere, Maddakere, Gollarahalli & Kachipura area	Sampling	Reconnaissance survey for multi-metallic mineralisation was taken up in and around Nerlakere, Maddakere, Gollarahalli, Kachipura areas. The area is occupied by the gneisses with several enclaves of ultramafic rock. The conglomerate horizon is traced up to 50 to 100 m wide extending over a length of nearly 2 km. Samples collected from Banded Ferrugenious chert exhibits a few anomalous value for gold (180 ppb to 400 ppb). Chemical analysis of few stream sediment samples recorded Au values ranging from 49 to 64 ppb. Samples collected from talc chlorite schist showed Cr value ranging from 500 to 3300 ppm and Ni from 400 to 1300 ppm.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Madhya Pradesh			
Betul	Kehalpur (east) block	Drilling	During G3 level preliminary exploration for basemetal (Zn) mineralisation, a total of 9 boreholes were drilled to a cumulative depth of 1,284.75 m. All boreholes intersected the sulphide mineralisation except two. At 1% Zn cut-off, only one borehole MPBBK-07 could intersect a 4.77 m wide Zn zone with average 1.065% Zn. However, at 0.5% Zn cut-off, the borehole MPBBK-01 reveals presence of a 5.15 m wide Zn zone with 0.542% average zinc and borehole MPBBK-04 indicates 4.01 m wide Zn zone with 0.503% average Zn. The borehole MPBBK-05 reveals 3.12 m and 17.40 m wide Zn zones with 0.569% and 0.502% average Zn respectively and borehole MPBBK-07 indicates 12.30 m and 6.00 m wide Zn zones with 0.549% and 0.514% average Zn respectively at 0.5% Zn cut-off.
Maharashtra			
Chandrapur	Minjhari North block	Drilling	Preliminary exploration for copper and associated mineralisation was carried out in Minjhari north block by drilling six boreholes upto a total depth of 1,249.70 m. Initially four boreholes were drilled at shallower level (120 m and 90 m vertical depth of intersection). However, significant mineralisation could not be intersected in these four boreholes except faint chalcopyrite dissemination. Subsequently, the fifth borehole drilled at deeper level could intersect very good sulphide mineralisation from 241.50 m to 259.80 m & 267.00 to 281.30 m depth. This has given a signature of deep seated mineralisation. Therefore, another borehole is drilled up to 205.70 m depth.
	Wassera-Seoni area	Mapping & Sampling	During reconnaissance survey for establishing copper and associated mineralisation, an area of 50 sq. km was mapped on 1:12,500 scale. Two prominent quartz veins were mapped. The Wassera quartz vein is continuously exposed for about 2.0 km length and width ranging from 5-40 m. The Seoni quartz vein is exposed towards SE of village for strike length of about 1 km width varying from 5 to 30 m. The Wassera quartz vein shows very sparse primary chalcopyrite mineralisation in dissemination form and secondary malachite encrustations. Soil sample (100 nos) is collected from the soil covered area. Chemical results of 30 BRS show Cu values ranging from 10 ppm to 1000 ppm with most of the values below 200 ppm. Southern part of quartz vein is comparatively rich in Cu than northern part.
Gadchiroli & Chandrapur	Ghanpur-Mudholi-West block	Geophysical Survey Mapping, Drilling & Sampling	A G3 level exploration for establishing zones of copper and associated mineralisation was carried out by Geophysical survey for 12.44 LKM and detailed mapping for 1 sq. km on 1:2,000 scale. Total 2,000.5 m drilling was completed in 11 boreholes. Out of 11 boreholes, 9 boreholes are first level and two boreholes are second level. Based on the intersection of mineralized zones of first level boreholes, three second level boreholes were drilled for 120 m vertical depth. All mineralised boreholes were sampled at 0.5 m length and sent for chemical analysis. Bedrock samples of quartz chlorite veins show copper value ranging from 15 ppm to 0.69%. Selected trench samples show copper value ranging from 20 ppm to 555 ppm.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Sikkim			
East Sikkim	Pachekhani-Pakyong-Mamring-Assam	Mapping	A reconnaissance survey for base metals was taken up by large scale mapping of 50 sq. km on 1:12500 scale. Visible metallic lustre (pyrite) specks are seen in mica schist/ phyllitic rocks along with quartz veins at Aho-Yangtam, Andheri Khola sections. Quartz veins within the amphibolite bands exposed in Selele Khola section show specks of pyrite. Malachite, azurite stains were observed within garnetiferous mica schist of Gorubathan Formation at Kadamtam, Assam and Samdur areas. Intense leaching within the mica schist and phyllitic rocks was observed at Adampul and Lower Shari areas.
	Rolep-Chuzachen-Barapathang area	Mapping	During reconnaissance survey for base metal mineralisation in Rolep-Chuzachen-Barapathang area, an area of 50 sq. km was mapped on 1:12500 scale. The signature of mineralisation i.e. sulphide mineralisation in the form of leaching effects, visible metallic luster and specks of pyrite and chalcopyrite was seen within Darjeeling Gneiss at North Rigu area, Dokchin, Subeni Dara and Lingtam-Kuikhola road section. In the area around Dokchin, sulphide mineralisation is observed within Darjeeling gneiss, whereas around South Rigu, leaching effect is observed in calc-silicate rocks associated with amphibolites. Leaching effect is also observed at the contact between Lingtse Granite Gneiss and phyllite at Dalapchand - Arithar - Rhenock road junction area.
Rajasthan			
Alwar	Pai ka Guwara block	Mapping, Drilling & Sampling	Preliminary exploration (G3) for base metals and associated precious metals was carried out in Tehla-Bighota area, Rajgarh tehsil. An area of 2.0 sq. km was mapped on 1:2000 scale. Drilling in two boreholes were completed and one in progress. Mineralisation is observed in the form of pyrite, pyrrhotite, chalcopyrite and chalcocite. The analytical results of BRS indicate maximum 0.3% Cu, 0.20% Zn, 0.34 ppm Au and 470 ppm Ni. Two mineralized zones viz. MZ-1 & MZ-II based on surface manifestations including presence of intense malachite stains and fresh sulphides in the form of pyrite, pyrrhotite, chalcopyrite and chalcocite were demarcated.
	Khera North block	Mapping	Preliminary Exploration (G3) for base metals and associated precious metals in Mundiyawas-Khera area was carried out involving mapping of 0.9 sq. km area by detailed geological mapping. The host rocks of Cu mineralisation viz. felsic meta-volcanic, tremolite bearing dolomitic marble and cherty quartzite are observed. Surface manifestations of mineralisation marked by malachite stains and presence of fresh sulphides in form of chalcopyrite, arsenopyrite, pyrrhotite, and galena were observed within felsic volcanics as well as tremolite bearing dolomitic marble. A scapolite bearing zone was observed in western part of detailed mapping area.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Rajasthan			
Alwar	Mundiyawas block	Drilling, Pitting/ Trenching & Sampling	General exploration (G2) for copper and associated precious metals was carried out in Mundiyawas - Khera area. A total of 2,435 m of drilling covering a strike length of 470 m, besides 100 cu m of pitting-trenching carried out along 8 nos of channels were completed. All the boreholes drilled intersected considerable sulphide mineralisation in the form of specks, stringers, disseminations, vein filled and occasionally massive chalcopyrite, pyrrhotite and arsenopyrite. The analytical results of channel samples indicate a 7 m zone with 0.41% Cu. The part analytical results of borehole RJMU-12 indicate a 2.05 m x 0.37% Cu (at 0.2% cut-off) between 110.80 m to 112.85 m depth. The part analytical results of borehole RJMU-127 indicate a 2.50 m x 0.23% Cu (at 0.2% cut-off) between 92.10 m to 94.60 m depth.
	Khera SE block	Drilling, Pitting/ Trenching & Sampling	General exploration for copper and associated gold and silver mineralisation was carried out in Mundiyawas-Khera area. A total of 1,963.75 m of drilling covering a strike length of 260 m besides 105 cu m of pitting-trenching with collection of 100 PTS were completed. All the boreholes drilled have intersected significant sulphide mineralisation in the form of specks, stringers, disseminations, vein filled and foliation parallel pyrrhotite, chalcopyrite and arsenopyrite. A borehole analytical results indicate a 9.35 m x 0.35% Cu (at 0.2% cut-off) between 52.55 m -61.90 m depth. Drilling is continuing.
	Jhiri-Piplai-Kalaid-Lothawas block	Mapping Trenching & Sampling	Reconnaissance survey for copper and associated precious metals involved mapping of 107 sq. km area on 1:12,500 scale with collection of 312 BRS, 51 PTS, 20 PCS, 35 PS, 21 OM, 10 XRD and 11 EPMA samples. The surface indication of mineralisation is observed in the form of old working, ferruginisation, brecciation and occasional occurrences of malachite staining. The grab samples collected from ferruginized rocks show high value of Cu ranging from 0.14 to 0.43%. Channel/ trench laid over the mineralised zone show 40 m x 0.35% Cu and Co ranging from 230 ppm to 0.4%.
Alwar & Dausa	Kaled, Jaisinghpura Nimla areas	Mapping & Sampling	Reconnaissance survey for base metal involved large scale mapping of 50 sq. km area on 1:12,500 scale with collection of 200 BRS, 20 PCS, 22 PS, 20 OM, 5 XRD and 5 EPMA samples. In Kaled and Jaisinghpura and Paimpura areas, mineralisation has been seen in the form of malachite staining, limonitisation, ferruginous encrustation, specks of pyrite and chalcopyrite. Chalcopyrite, covellite and pyrrhotite occur as smaller, disseminated isolated primary grains.
Chittaurgarh	Jashma ridge area	Mapping & Sampling	During reconnaissance survey (G4) for base metal an area of 1.52 sq. km was mapped on 1:2,000 scale and collected of 320 BRS, 106 PTS, 16 PS and 06 samples each for OM and XRD samples. The massive quartzite in the central part of the Jashma Ridge is brecciated at places along NW-SE trending fractures is ferruginised and oxidised at places. Bedrock samples have been collected from the ferruginized unit for basemetal and Au analysis.

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Table - 5 (Contd)

State/District	Name of block	Details of exploration	Results
Dungarpur	Dewal-Methali (Metali)-Khan mine area	Mapping & Sampling	Reconnaissance survey (G4) for base metal mineralisation involved mapping of 100 sq. km on 1:12500 scale with collection of 259 BRS, 50 PTS, 7 PCS, 12 samples each for PS & OM and 10 XRD samples. The surface evidences of copper mineralisation were observed in the form of malachite stains, gossanization within magnetite quartzite and associated phyllite and ultramafics. Development of magnetite was also observed within serpentinite. A band of Wollastonite with length of 300 m and width of about 50 m was recorded in the western part of Dewal village.
Jhunjhunu	Between Bokri and Malwali prospects	Drilling & Sampling	During preliminary exploration for copper mineralisation of the Eastern Khetri Metallotect a total of six boreholes were drilled to a total depth of 1,054.2 m and collected 550 CS and 20 PCS. The Babai-Tonda Lineament is the host rock for copper mineralisation. The boreholes were planned to intersect mineralised zone at 60 m vertical depth. Chalcopyrite is the main ore mineral in the mineralised zone and it occurs as specks and disseminations within the brecciated rock, both in clast as well as matrix.
	Malwali block	Mapping & Sampling	Preliminary exploration for copper and associated mineralisation in the northeast continuity of Malwali block, eastern Khetri Metallotect involved mapping of 0.75 sq. km on 1:2000 scale and collection of 350 BRS, 20PS, 10 OM and 5 EPMA samples. Silicified quartzite, brecciated rock, amphibolite, banded amphibole quartzite, calc-silicate rock, quartz mica schist, hornblende schist, banded magnetite quartzite, pegmatite, quartz and albitite vein are the main rock types identified. Six old workings were marked. Mineralisation in the form of malachite staining continues to occur in the brecciated rock.
Rajsamand	Gangas block	Drilling & Sampling	General Exploration (G2) for Copper and associated mineralisation in Mangalwar Complex involving a total 3,665.45 m drilling in 15 boreholes with collection of 1,409 CS. Out of 15 nos of boreholes, 7 nos of boreholes were of first level, 6 boreholes of second level intersections and 2 boreholes of third level intersections. All fifteen boreholes except one borehole have intersected significant copper mineralisation.
Sikar	Khora block	Drilling & Sampling	Preliminary exploration for base metal mineralisation in Bhudoli-Basadi area comprises drilling of 11 boreholes to a total depth of 2,278 m and collection of 787 CS. The general strike of bedding is N10°E-S10° W with steep dip on both sides. The mineralisation is in the form of fine specks of chalcocite, bornite and native copper as dissemination, later remobilized along veins/ veinlets of quartz/ calcite/ epidote/ albite/ K-feldspar occasionally with covellite and chalcopyrite
Sikar	Dhabala West block	Drilling	Preliminary Exploration (G3) for base metal mineralisation in Kharagbinjpur area involved a total of 1088 m drilling in 07 boreholes. All the boreholes intersected impure marble with calcite and quartz veins/ veinlets. The mineralisation is in the form of very fine specks of bornite and chalcocite dissemination, occasionally with chalcopyrite, native copper and covellite.

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Table - 5 (Concld)

State/District	Name of block	Details of exploration	Results
Sikar	Eastern part of southern extension of Nanagwas block	Drilling & Sampling	Preliminary exploration (G3) for base metal was taken up by drilling 9 boreholes to a total depth of 1,632.80 m. Five boreholes were of first level and 4 boreholes of second level. The analytical results of first level boreholes RJSNE-01 indicate the significant mineralized zones. Borehole RJSNW-01 intersected mineralised zone between 76.25 m to 82.5 m of Cu 0.23%; Borehole RJSNW-03 intersected mineralised zone between 47.75 m to 60.05 m of Cu 0.35%; Borehole RJSNE-04 intersected mineralised zone between 63.25 m to 69.35 m of Cu 0.4%.
	Ganeshwar-Dariba area	Mapping & Sampling	Reconnaissance Survey (G4) for base metal in Nim Ka Thana involved large scale mapping of 117 sq. km on 1: 12500 scale with collection of 400 BRS, 21 PCS, 12 PS, 23 OM, 05 each XRD and EPMA samples. The area is represented by the quartzite with patches of mica schist. Copper mineralisation in the form of malachite, chalcopyrite and bornite is present within the impure micaceous marble. Copper mineralisation in the form of malachite stains and specks of chalcopyrite observed in the impure marble, quartzite and malachite stains in mica schist in Hirwala area.
	South Ghatiwala block	Mapping & Sampling	Preliminary exploration (G3) for copper involved detailed geological mapping on 1:2000 scale covering an area of 1.50 sq. km besides 482 nos. of BRS including 200 nos. of channel sample from 10 nos of channels and 51 cu m of pitting- trenching. Five prominent mineralised zones viz. MZ-I to MZ-V have been demarcated on the basis of surface indication of copper mineralisation in the form of malachite stains, fresh sulphides i.e. chalcocite, bornite and chalcopyrite. The width of mineralised zones on surface varies from <1 to 40 m. The chemical analytical results of channel-01 indicate three mineralised zones viz. 07 m x 0.19% Cu; 05 m x 0.36% Cu and 02 m x 0.11% Cu; channel-02 indicates one mineralised zone 12 m x 0.13% Cu and channel-03 indicate 01 m x 0.10% Cu and 01 m x 0.11% Cu.
	Western part of southern Nanagvas block	Drilling	General exploration (G2) for base metal mineralisation was taken up by drilling 15 boreholes to a cumulative depth of 2618.6 m. Sulphide mineralisation intersected in the form of disseminated and vein filled chalco pyrite, borite, pyrite and chalcopyrite. Copper mineralisation also occur in the form of vug and vein filled bornite and covellite. Part analytical results shows copper values vary from 0.23% to 0.4%.
Udaipur	Ladana Extension area	Mapping & Sampling	Reconnaissance survey (G4) for copper mineralisation was taken up involving large scale mapping of 50 sq. km area on 1:12500 scale with collection of 155 BRS, 56 PTS, 55 SS, 15 PS, 5 each for OM and XRD samples. The mineralisation is seen within quartz veins. Four mineralised fragmentary quartz veins with encrustations of malachite and specks of pyrite & chalcopyrite were noted around Ladana village. A mineralised limonitised quartz vein of size 10 m x 70 m with encrustations of malachite and specks of pyrite & chalcopyrite has been recorded. Another ferruginous quartz vein of dimension 10 m x 120 m with encrustations of malachite and disseminations of pyrite, bornite, chalcopyrite has been observed. Towards the north of Khartana village, metasedimentary sequence occurs including quartz mica schist, gritty quartzite, amphibole schist, dolomite, garnetiferous amphibolites, etc.

BAUXITE

GSI

In Chhattisgarh, general exploration for bauxite was carried out in Sardhapat block, Jashpur district. Detailed mapping of 4.0 sq. km area was completed. A total of 88 boreholes were drilled to a cumulative depth of 1336.00 m and collected 435 core samples, 10 each of BRS, PCS, XRD and 5 ore petrography samples. Total 48 boreholes had encountered bauxite of thickness varying from 30 cm to 3.00 m.

In Gujarat, reconnaissance survey for lateritic bauxite and lithomargic clay was taken up around Umarsar and Guneri areas in western Kachchh district. The survey comprises mapping of 5.1 sq. km on 1:5000 scale with collection of 250 BRS/PTS samples, 10 XRD, 20 TS/ OS samples besides 5 section measurements and 125.38 cu m pitting/ trenching. The oldest rock units are represented by feldspathic sandstone, ferruginous sandstone, ironstone, glauconitic sandstone-shale, fossiliferous ironstone and trigonia bed. Basalt is highly altered due to lateralisation.

In Jharkhand, preliminary exploration for bauxite and associated minerals (Ti, V, Ga etc) in Risahattoli block, Serangdag plateau, Gumla district was carried out. An area of 4.80 sq. km area was mapped on 1:4000 scale. The litho units mapped are granite/ granite gneiss, bauxite, variegated clay, laterite and lateritic soil. A total of 22 boreholes were drilled. The thickness of bauxite zone intersected in the boreholes varied from 1.00 m to 7.25 m. Analytical results of two boreholes show Al_2O_3 values vary from 36.87 - 45.58 % and SiO_2% values vary from 3.42 - 7.75%. In Pakur and Sahebganj districts, preliminary exploration (G3) for bauxite and associated minerals (Ti, V, Ga etc.) was carried out in Karmatanr sector. The promising area for bauxite and associated minerals (Ti, V, Ga etc.) was drilled for 800 m by 29 boreholes and mapped around 4.0 sq. km area on 1:4000 scale with collection of 50 BRS, 200 CS samples. The different lithounits intersected in the boreholes include lateritic soil, laterite, lateritic bauxite, clay.

In Kerala, during general exploration for bauxite in Narala block, Mulleri, Kasargod district an area of 1.5 sq. km was mapped on 1:4000 scale, drilled 48 bore holes for a total depth of 600 m and collected a total of 224 number of core samples, 10 PS, 5 PCS and for analysis. Besides, thirty pit samples and one bauxite sample for XRD studies were also collected. Boreholes were drilled to a depth ranging from 8.40 m to 18.80 m.

In Meghalaya, preliminary exploration (G3) for lateritic bauxite and associated minerals in the eastern part of Umsung area, West Khasi Hills district was carried out involving mapping of 50 sq. km on 1:12500 scale and 1.5 sq. km on 1:2000 scale. Significant high level bauxite deposits were delineated which includes 09 major bodies and 06 small bodies of lateritic bauxite. Bauxite profile thickness varies from 3 m to more than 7 m. The chemical results from 35 BRS samples shows Al_2O_3 content varying from 30.99% to 67.15% (average 50.29%), SiO_2 content varying from 0.10% to 45.51% (average 9.65%) and Fe_2O_3 content varying from 3.79% to 37.81% (average 16.98%) with associated gallium values in the range of 36 to 113 ppm, avg. 84.14 ppm.

Directorate of Geology and Mining, Chhattisgarh

During 2017-18, G2 level exploration for bauxite in Sarbhanja block, Mainpat tehsil, Surguja district, Chhattisgarh was carried out. Bauxite deposits of Mainpat plateau is confined within lateritic profile. and concentrated up to upper limit of lithomarge within lateritic profile. Exploration involved mapping of 100.00 sq. km on 1:50000 scale and 1.00 sq. km on 1:4000 scale; drilling of 1,377.50 m in 136 borehole; pitting of 38 cu m and collected 1154 samples. Resources estimated under indicated category at 0.30 million tonnes. In Pathrai & Pathrai-East block, an area of 70.00 sq. km was mapped on 1:50000 scale and 0.80 sq. km on 1:4000 scale. About 402 cu m material was excavated in 20 pits and 94 nos of drill holes were drilled to a cumulative depth of 985.45 m. Total 670 samples were collected for analysis. Total resources estimated at about 0.60 million tonnes under indicated category.

Directorate of Geology and Mining, Jharkhand

In Gumla district, G2 level exploration was carried in Lodhapat, Bisunpur block with an objective to demarcate and delineate the potential deposit of bauxite. An area of 0.743 sq. km was mapped on 1:4000 scale and 17 boreholes drilled for a cumulative depth of 273.55 m. Total 351 samples were collected

for chemical analysis. About 4.0 million tonnes of bauxite resources under indicated category was estimated in the area.

MECL

In Chhattisgarh, a G4 stage exploration in Saraipani Dadar and Sendurkhar blocks, Kabirdham district was carried out with the objectives to i) prove existence of bauxite both along the longer axis and shorter axis of the plateau and ii) know the quality and the thickness of bauxite horizons to assess the bauxite resources in the blocks both quantitatively and qualitatively etc. During exploration in Saripani Dadar block, MECL carried out mapping of 0.80 sq. km area on 1:2000 scale, drilling of 5 boreholes for cumulative meterage of 146.00 m; sampling and analysis of 10 nos outcrop & 118 nos of primary core samples for Al_2O_3 , SiO_2, Fe_2O_3,TiO_2, LOI; 6 nos composite samples were analysed for CaO, MgO, Al_2O_3 , SiO_2, Fe_2O_3, TiO_2, SO_3, P_2O_5, V_2O_5, Na_2O, K_2O and LOI; 18 nos samples were sent for REE analysis. Estimated about i) 1.29 million tonnes net in situ bauxite resources with an average grade of 43.89% Al_2O_3 , 6.86%, SiO_2, 18.53% Fe_2O_3, 5.62% TiO_2 and 24.00% LIO at 40% Al_2O_3 and 8% SiO_2 cut-off under reconnaissance category, ii) 1.55 million tonnes net insitu bauxite resources with an average grade of 34.45% Al_2O_3 , 6.47% SiO_2, 27.44% Fe_2O_3, 4.69% TiO_2 and 18.58% LOI at 30% Al_2O_3 (Threshold value) under reconnaissance category. In Sendurkhar block, exploration work comprised 133.00 m core drilling in 5 boreholes, 0.80 sq. km area mapping on 1:2000 scale, sampling and analysis of 30 nos outcrop and 90 nos primary core samples for Al_2O_3 , SiO_2, Fe_2O_3, TiO_2, LOI, 10 nos composite samples were analysed for CaO, MgO Al_2O_3 , SiO_2, Fe_2O_3, TiO_2, SO_3, P_2O_5, V_2O_5, Na_2O, K_2O and LOI. Besides, 25 nos samples were sent for REE analysis. About 32.00 million tonnes net insitu resources of reconnaissance categories at +30% Al_2O_3 (Threshold value) has been estimated with average grade of 16.27% SiO_2 and 34.35% Al_2O_3. The exploration in these two blocks were funded by National Mineral Exploration Trust .

FERROUS MINERALS

CHROMITE

GSI

In Nagaland, preliminary exploration (G3) for chromium, nickel, copper and associated base metal was taken up in Naga Hills Ophiolite, Phek district. A total of 1.5 sq. km area was studied. The litho units exposed in the study area are peridotite, serpentinised peridotite, basalt, polymictic conglomerate and oceanic pelagic sediment. The analytical results show Cr values range from 175 to 3,556 ppm and Ni from 15 to 2966 ppm. Magnetic survey of 10.4 L km indicated four zones of moderate to high anomaly over cumulate and/or serpentinite. The anomaly value ranges from -1809 nT to 2174 nT.

In Odisha, during reconnaissance survey (G4) for chromite around Asurbandha-Mahupal area, Dhenkanal district an area of 100 sq. km was mapped on 1:12500 scale along with pitting/ trenching and collection of 200 BRS, 10 petro-chemical samples and 37 pit samples. Chromiferous laterite was noticed in south of Kanchanbahali village. Chromite pebbles in a pit near Bhusal area are seen within laterite. Magnetite floats are seen over laterite around Baruan village. The occurrence of chromite is pocket type and distribution is erratic. The places that are showing indication of chromite are soil covered. During reconnaissance survey for chromite ore in Mangobindapur - Dangadi area, an area of 100 sq. km was mapped on 1:12500 scale with collection of 214 BRS/SS and 50 PTS samples. Thin bands of talc-schist are also observed near Garhpur area. Most parts of the mapped area are covered by alluvium and laterite. The thickness of the laterite observed in the quarries, ponds and also inferred from local borewells varies from 2 to 20 m. Analytical results of 26 samples show the Cr value ranging from 0.02 % to 0.62 % and Ni value ranging from 0.005% to 0.15%. 18 samples show Au value <0.05 ppm.

Directorate of Geology, Odisha

In Odisha, Directorate of Geology, carried out exploration for chromite in Madhuban area in Keonjhar district. The work includes mapping of 2.08 sq. km on 1:5000 scale and excavation of 76 cu m. Total 56 samples for chemical analysis were collected. No perceptible chromite mineralisation was noticed.

OMC

During 2017-18, OMC carried out exploration for chromite in mining leases held by OMC in Jajpur district - i) South Kaliapani: mapping on 1:1000/1:2000 scale in 16 ha/103 ha, respectively, chemical analysis of 558 nos of samples and 4,885.60 m core drilling in 25 bore holes; ii) Sukrangi: mapping on 1:1000 scale in 32 ha, chemical analysis of 105 nos samples and 306.40 m core drilling in 6 boreholes, one is feebly potential; iii) Saruabil and Sukrangi: Total core drilling of 1,033.30 m in 6 boreholes, analysed 21 nos samples; In Keonjhar district- Bangur mine: mapping on 1:200 scale in 0.03

Ha, chemical analysis of 117 nos samples and 5,379 m core drilling in 19 boreholes.

IRON ORE

GSI

In Andhra Pradesh, preliminary exploration (G3) for iron ore and gold was carried out in Velligallu schist belt, Chittoor district. Exploration comprised detailed mapping of 3.0 sq. km, bed rock sampling and drilling. The lithounit studied in the area are banded magnetite quartzite (BMQ), dolerite dyke, pegmatite and granite, etc. BMQ occurs at the crestal part of the ridge. Several younger granitic apophyses, dolerite dykes and pegmatite cut across the BMQ bands all along the block area. 210 nos BRS, 10 nos OM, 10 nos PS and 10 nos of petrochemical samples were collected. BIF band on Errakonda hill was analysed and 200 ppb value of Au was obtained. The average Fe content in this BIF is 38.05% Fe over 15 m width.

In Assam, preliminary exploration (G3) for low grade iron ore was carried out in Chandradinga area, Goalpara district. Three distinct bands of BMQ-BHQ have been delineated in the study area. Two boreholes were intersected iron formation in the form of BMQ-BHQ and powdery iron ore from 0.0 m to 41 m and 0.0 m to 32 m, respectively. The iron formations have disseminated sulphide grains mainly pyrite, chalcopyrite, bornite and malachite. Iron formation is low grade in which total Fe in BMQ varies from 25 wt.% to 46.82% and few reach up to 59.40% in powdery iron ore (black ferruginous sand). The rocks belonging to mafic-ultramafic suite have been reported which consists of gabbro as the dominant lithounit along with peridotite, tremolite actinolite schist and pyroxenite. Peridotite shows cumulus texture in which intercumulus phase is pyroxene. A broad magnetic anomaly fluctuating in nature has been observed with values varying from 7,804 nT to -4,926 nT. Smooth magnetic anomaly, in increasing trend, has been observed towards north. In Bongaigaon, Dhubri and Kokrajhar districts, a reconnaissance survey was carried out for iron ore in Chakrasila, Nadangiri and Bhumeswar area. The study area comprises of granite gneisses, migmatites, Banded Magnetite Quartzite (BMQ) and amphibolites which is further intruded by later pegmatite and quartz veins and surrounded with the loose yellowish gritty soil of quaternary Chappar Formation. In Lalmati block, BMQ occurs as discontinuous patches and extend for a cumulative strike length of 300 m with average lateral extension of 2-4 m and maximum depth extension of 10 m. BMQ in Shiljan block occurs as patchy boulders for a cumulative strike length of 200 m and depth continuity 1-2 m. The rock composed of 30-35% magnetite, 20-25% hornblende and 40-50% quartz. Dark bands mainly composed of two generations of magnetite. Highest magnetic value recorded from Lalmati block is 1,187 nT and Shiljan block is 557.3 nT.

In Bihar, preliminary exploration for magnetite was carried out around Majos, Jamui district. A total of 3.0 sq. km detailed mapping i.e.1:2000 scale was carried out. During mapping discontinuous bands of BMQ was seen for a strike length of 350 m with width varying from 50 m to 100 m. Majority of the area is covered by alluvium. Magnetite also occurs in crystal form within quartzite indicating re-crystallization. Small dumps of slag are present around Majos and Jalai. Analytical results of 48 BRS samples show >45% Fe content with maximum concentration of 56.08%. Analytical results of 28 PTS samples show more than 45% Fe with maximum content of 54.13%. A total of 1000.60 m was drilled in 11 nos of boreholes. All the boreholes show Fe value >40% and maximum and minimum Fe content is 45.9% over 6.15 m in borehole MJ-01 and 35.28% over 8 m in borehole MJ-07.

In Jharkhand, preliminary exploration for iron ore and manganese ore was carried out in the gap areas of iron ore concentrated locales near Baraiburu in the north-western part of horse-shoe syncline, West Singhbhum district. Detailed mapping of 2 sq. km area on 1:4000 scale was carried out in Baraiburu block. The ore body is mostly of hematite which contains pockets of blue dust. Two bands of BHJ are present in the form of thin and discontinuous band and occur as small outcrop in the central portion of the block. At places clast (hematite, BHJ, jasper) supported conglomerate with gritty nature, and conglomerate which is lateritised and contains manganese is present. Mn-ore occurs as pockets within the upper shale. Analytical results of 30 nos of BRS and 6 nos of pitting/ trenching samples indicate Fe value ranging from 21.30% (min) in Fe laterite to 60.44% (max) in hard lumpy ore and Mn value ranging from 4.89% (min) in Mn-laterite to 43.05% (max) in Mn-ore.

In Madhya Pradesh, reconnaissance survey for low grade iron ore was taken up in Mahakoshal belt in Gandhigram, Parakhuri, Chauphal & Baheraha and Kochita-Bhatha-Pokhra-Bharuhi areas of Sidhi district. In Gandhigram, Parakhuri, Chauphal & Baheraha area, large scale mapping of 100 sq. km on 1:12500 scale and detailed mapping of 2 sq. km on 1:4,000 scale was completed. The different lithologies identified were intrusives, BIF/BHQ/ BJQ, phyllite bearing andalusite and biotite, chlorite schist/ talc chlorite schist/ chlorite-biotite schist and patch of dolomite. Jungel group of rocks was also mapped overlying the Mahakoshal group of rocks and represented by purple shale/ phyllite and quartzite with pebbly horizon. During the survey, total 220 nos BRS, 100 nos PTS, 25 nos PS and 10 nos OM and channel samples were collected for study. In Kochita-Bhatha-Pokhra-Bharuhi areas, four bands of BIF have been identified in the mapped area in which 1st and 3rd bands are continuous and have strike extension of about 10 km with average thickness of 5 m, at places around 50 m. Another two bands of BIF have been noticed with thinly laminated iron bands intercalated with phyllite, quartzite and chert layers. The cumulative thickness of each band varies from 10 m to 50 m. The composition of iron layer is mostly hematite. Proto-ore is predominant and observed throughout the study area. The chemical analysis of 35 BRS indicate content of Fe_2O_3 varies from 6.51 to 81.25%. In Madhya Pradesh during preliminary exploration for iron ore mineralisation in Dhaurra - Urdaurra block of Bundelkhand gneissic complex in Tikamgarh district, a total 10 boreholes were drilled to a total meterage of 1,226 m. Among them 08 nos of boreholes were planned as 1st level boreholes at 50 m vertical depth with 200 m borehole spacing and two 2nd level boreholes were drilled at 100 m vertical depth. Specks of sulphides mainly pyrite and minor chalcopyrite and pyrrhotite are seen along these veins. The true thickness of ore body intersected in the boreholes varies from 15.40 to 70.84 m. The grade of iron ore visually estimated varies from 35 to 55% Fe. In Tikamgarh district, G2 level general exploration for iron ore mineralisation in Dhaukan block of Bundelkhand Gneissic Complex, was carried out by drilling 6 boreholes to a total depth of 962 m. Thickness of ore body varies from boreholes to boreholes. The visual grade estimate varies from 40 to 55% Fe. Specks of sulphides mainly pyrite & chalcopyrite were noticed in BMQ. The total strike length of ore body is about 950 m in this block and surface width varies from 40-60 m.

In Maharashtra, reconnaissance survey (G4) for delineating low-grade iron ore and associated elements was taken up in Laterites of Shiroda area of Sindhudurg district. During study detached BIF bands, manganese rich laterites and remnants/ relicts of BIF bands within laterites were seen at many places. Six BIF bands and two manganiferous bands were observed. The chemical results of BRS samples from BIF show 56-60% Fe and laterites show 26-40% Fe. The values of associated elements viz. manganese and chromium are also encouraging. BIF samples show 4% Mn in Sateli area, 3.2% Mn in SW of Kondura and 3.7% Mn in Aros area while laterite samples show Mn values of 19,650 ppm and 18,776 ppm in and around Aros, 2,965 ppm in Guldube, 2,550 ppm in Agralvadi, 1,440 and 2,080 ppm in and around Kondura and 1300 ppm in Sunsuravadi areas. Higher values of Au are 32 6ppb from BIF of Tiroda area, 44 ppb to the south of Guldube, 201 ppb in Sateli, 142 ppb in BIF and 32 ppb and 46 ppb in laterite of Aros area, 32 ppb in laterite of Talavna area. Anomalous Cr values are observed in laterite of Arauli area (10,000 ppm), Talavna area (5,075 ppm) and in Guldube area (2,043, 3,540 & 5,214 ppm). XRD analyses of samples collected from Tiroda Iron ore mine area indicate presence of ramsbeckite. Sample collected from north of Kondura indicate presence of anandite and from north of Aros market indicate presence of wroewolfeite.

In Meghalaya, reconnaissance survey (G4) for Titaniferous Vanadiferous–Magnetite was taken up around Mawkyndoor area in West Jaintia Hills district. Large scale geological mapping on 1:12500 scale covering 50 sq. km area was carried out in Sung Valley Ultramafic-Alkaline–Carbonatite Complex (SUACC) and its adjacent areas. A total of 110 nos of samples were collected for analysis of major oxides and trace elements. Analytical results of different rock types except apatite magnetite rocks show Fe_2O_3 values less

than 20%, Ti up to 5.83% and vanadium up to a maximum of 273 ppm.

In Odisha, preliminary exploration (G3) for iron ore was carried out in Gandhalpada South-East, part – B in Kendujhar district. The exploration comprises detailed mapping of 0.12 sq. km and drilling of 960.55 m in 11 boreholes. These boreholes were closed at depths of 108.10 m, 60.00 m, 79.20 m, 75.00 m, 93.10 m, 95.20 m, 134.00 m, 90.45 m, 73.00 m, 79.50 m and 73.00 m respectively and have intersected thick ore zone of 99.00 m, 35.00 m, 18.00 m, 52.40 m, 93.00 m, 55.00 m, 122.00 m, 61.00 m, 21.00 m, 30.00 m and 66.00 m respectively. The mapped area comprises lateritised hard laminated ore (HLO) and soft laminated ore (SLO) rich soil and laterite. Preliminary iron ore resources estimated over 0.81 sq. km area in the block is placed at 113.53 million tonnes, which includes 98.90 million tonnes of high grade powdery ore, 1.90 million tonnes of high grade lumpy ore and 12.71 million tonnes of low grade ore. General Exploration for iron ore was carried out in Rengalaberha North-East extension block, Kendujhar district. Detailed mapping of 0.28 sq. km on scale 1:2000 and drilling of 1501.05 m in 15 boreholes were completed. The rock types exposed are mainly Fe-laterite iron ore (Hard Laminated Ore, Soft Laminated Ore and lateritic ore/ lateritised laminated ore and fragmentary ore). The cumulative thickness of ore zones intersected are 58.55 m, 48.55 m, 98.50 m, 130.50 m, 53.05 m, 26.50 m, 86.00 m, 70.00 m, 83.90 m, 72.90 m, 32.35 m, 44.60 m, and 19.45 m in boreholes OKR-23, to OKR-34 and OKR-37 respectively. The intersected ore zones include hard laminated ore, purple powdery ore, lateritised ore and soft laminated ore with intercalations of shale/ ferruginous shale with minor pieces of chert. The ore zones thickness intersected in the boreholes varies from 19.45 m to 130.50 m. The preliminary iron ore resource estimated at 16.20 million tonnes which includes 15.07 million tonnes high grade iron ore and 1.13 million tonnes low grade iron ore. General exploration for iron ore was carried out in Gandhalpada South block in Kendujhar district. During study detailed mapping in 0.85 sq. km area with 50 cu m of trenching and pitting and collection of 1,424 core samples, 50 PTS, 37 CS for P_2O_5 and 52 check samples were carried out. A total of 2,246.50 m of drilling was carried out in 20 boreholes with depth varies from 73.40 m to 140.95 m. The cumulative thickness of the ore zone encountered in boreholes varies from 11.00 m to 111.00 m. The main litho units exposed are shale, iron ore (hard laminated ore, soft laminated ore, lateritic iron ore and powdery iron ore), laterite/ Fe-laterite, float ore and soil. Preliminary resource estimated over an area of 0.45 sq. km is placed at 61.72 million tonnes with >45% Fe cut-off. An area of 1.28 sq. km was mapped on 1:4000 scale during preliminary exploration for iron ore in Jhumka-Pathiriposhi west block in Sundargarh district. The study was continuation of previous field work. The mapped area comprises of lateritised BHJ. A total of 407.50 m drilling was carried out in 06 boreholes i.e. from SJP-1 to SJP-6. The width of the ore zone intersected in boreholes are 30.00 m, 25.00 m, 31.45 m, 28.00 m, 18.90 m and 6.70 m respectively. A total drilling of 359.02 m was carried out till March, 2018, which includes 259.90 m of in-house spill over drilling and 99.12 m of out sourced drilling. Ore zone thickness intersected in boreholes SJP-7 to SJP-14 varies from 9.80 m to 54.65 m. Preliminary iron ore resources estimated over 0.64 sq. km area is placed at 13.34 million tonnes which includes 2.88 million tonnes of high grade iron ore and 10.46 million tonnes of low grade iron ore.

In Tamil Nadu, recconnaissance survey for Iron ore in banded magnetite quartzite was taken up between Vellalakundam-Singipuram in Salem district. The study involved large scale mapping of 100 sq. km on 1:12500 scale and 124 cu m of pitting and trenching. The BMQ band of Godumalai hills (Band-I) is extending from Agrahara Nattarmangalam to 970 m hills NW of Seshanchavadi. The BMQ band is 8 km long with width of 6 m to 86 m. BMQ bands of Singipuram and Vepillaipatti area are the two major bands in the southern block. Width of Singipuram Band (Band-II) varies from 3 m to 11 m with strike length of 6 km and the width of Vepillaipatti band (Band-III) from 4 m to 8 m with strike length of 3.5 km. BMQ bands are massive and the width of individual magnetite band varies from 0.1 cm to 0.7 cm. The magnetite quartzite ratio is 1:1 to 1:3. Apart from these bands, five minor bands M1, M2, M3, M4 and M5 with strike length 1 km, 875 m,

750 m, 750 m and 560 m respectively were mapped in the area.

In Uttar Pradesh, preliminary exploration (G3) for iron ore was carried out in Mahakoshal Group, block 'A' Bharhari area in Sonbhadra district. Exploration involved detailed mapping of 1.5 sq. km on 1:2000 scale and drilling. The rock types exposed in extended Block 'A' are variegated phyllite, felsic tuff, Banded Hematite Chert / Jasper (BIF), banded ferruginous phyllite and dolerite dykes. The strike length of BIF band is 2.62 km. The BIF band exposed at the hilltop has thickness of 8-25 m. A total of 307.25 m drilling was carried out in 3 boreholes i.e. SBE-1, SBE-2 and SBE-3. A 0.80 m fractured BIF was intersected at 67.90 m depth in SBE-1. SBE-2 borehole was drilled to a depth of 94.05 m, which revealed the presence of BIF at the depth from 41.5 to 42 m (0.5 m) and fractured BIF with limonitic/goethetic and chart bands from 86.01 m to 94.05 m. The SBE-3 borehole was drilled to a depth of 93.10 m, in which BIF has been intersected from 70 m to 89 m (19 m).

MECL / NMDC

The details of exploration for iron ore carried out by MECL and NMDC during 2017-18 are given in Table -6.

Directorate of Geology and Mining, Jharkhand

In West Singhbhun district, exploration was carried out in Diriburu, Raika area involving mapping of 2.94 sq. km area on 1:4000 scale and drilling of 02 boreholes for cumulative depth of 182.0 m. Total 70 nos samples were collected for chemical analysis. Resources will be estimated after completion of drilling. In Thakura, Nuia area, 3.63 sq. km area was mapped on 1:4000 scale and five boreholes were drilled to a cumulative depth of 163.10 m. Besides, 72 core samples also collected for chemical analysis. The resoruces will be estimated after completing of drilling.

Directorate of Geology, Odisha

During 2017-18, Directorate of Geology, Odisha has taken up exploration to assess iron ore resources in Dholtapahar, Sundergarh district. An area of 0.60 sq. km was mapped on 1:2000 scale. Cumulative drilling of 700.25 m was completed and collected 216 samples for chemical analysis.

Directorate of Mining & Geology, Rajasthan

In Jaipur dirstict, exploration to prove iron ore reserves was taken up near village Morija, Tehsil Chomu. During exploration work, iron ore bands and open pit of iron have been marked. The area covering 100 sq. km was mapped on 1:50000, 20.00 sq. km on 1:10000 scale and 2.10 sq. km on 1:4000 and collected 28 nos samples for chemical analysis. Besides, 30 LKM covered in geophysical survey. In Bhilwara district, exploration for iron and clay was continued from FS 2015-16 near village Siyar, Dalesing Ka Kheda, Kalundiya and Arjankheri. An area of 15.0 sq. km was mapped on 1:10000 scale and 4 boreholes were drilled for a total depth of 201.0 m. An area of 1.5 sq. km was mapped around villages Bhakliya-Chandgarh-Adsipura-Rebbariyo ki Dhani-Jeewakera-Downi. Total 27 nos of samples were analysed for iron and clay. Drilling is contiuning. In Karuli district, exploration to locate iron ore body was taken up near village Karwari to Rara Shahur, Kalyanpur Sayater, Jatwara in Hindaun tehsil. Regional mineral survey of 125.0 sq. km area on 1:10000 scale and 1.0 sq. km area on 1:4000 scale was carried out. The iron ore occur in the form of thin banding with intercalated quartzite. Total 12 samples for chemical analysis were collected. Resources were not estimated as depth persistence of breciated ferruginous quartzite is not clearly known. In Alwar district, state directorate has carried out exploration for iron ore, manganese ore and other economic minerals near villages Nalpur, Sanoli, Dughera, Tehsil Behror. Exploration involved mapping of 100 sq. km on 1:50000 scale, 10 sq. km on 1:10000 scale, 1 sq. km on 1:4000 scale and collected 8 samples.

Earlier during 2016-17, exploration to prove iron ore reserves was taken up near village Morija, Tehsil Chomu, Jaipur district, Rajasthan. During exploration work, iron ore bands and open pit of iron have been marked. The area covering 100 sq. km was mapped on 1:50000, 20.00 sq. km on 1:10000 scale and 2.10 sq. km on 1:4000 scale and collected 28 nos samples for chemical analysis. Besides, 30 LKM covered in geophysical survey. In Bhilwara district, exploration for iron and clay

was continued from field session 2015-16 near village Siyar, Dalesing Ka Kheda, Kalundiya and Arjankheri. An area of 15.0 sq. km was mapped on 1:10000 scale and 4 boreholes were drilled for a total depth of 201.0 m. An area of 1.5 sq. km on 1:4000 scale was mapped around villages Bhakliya-Chandgarh-Adsipura-Rebbariyo ki Dhani-Jeewakhera-Downi. Total 27 samples were analysed for iron and clay. Drilling is continuing. In Karauli district, exploration to locate iron ore body was taken up n/v Karwari to Rara Shahur, Kalyanpur Sayata, Jatwara in Hindaun tehsil, Regional mineral survey of 125.0 sq. km area was carried out together with mapping of 10.0 sq. km on 1:10000 scale and 1.0 sq. km area on 1:4000 scale. The iron ore occurs in the form of thin banding with intercalated quartzite. Total 12 samples for chemical analysis were collected. Resources were not estimated as depth persistence of brecciated ferruginous quartzite is not clearly known.

Directorate of Geology & Mining, Uttar Pradesh

In Uttar Pradesh, a G4 level exploration was taken up with the objective to explore iron ore deposit in solda-uudana area, Lalitpur district. An area of about 61.87 sq. km has been covered under geological traversing and the same was mapped on 1:12500 scale. About 121 cu m pitting and trenching work was done in 4 pits and one trench. About 0.56 sq. km area has been covered by Magnetic and S.P. survey. Total 309 samples were collected for chemical analysis. About 10 sq. km area seems to be potential for detailed iron ore exploration.

OMC

During 2017-18, OMC carried out exploration in its nine iron mines and two iron & magnanese mines located in Keonjhar and sundargarh districts, Odisha. Exploration activities carried out in i) Daitari mine with an objective to prove the ore body up to a depth on 810 mRL for detail mine planning. Quarry area of 24 ha was mappled on 1:2000 scale. Re-assessed resources of the mine placed at 187.21 million tonnes with (+)45% Fe; ii) Kumritar mine with an objective to delineate the ore disposition and assessement of reserves. An area of 21 ha was mapped on 1:2000 scale and total resources of the mine is placed at 180.85 million tonnes including 42.85 million tonnes of (+)45% Fe resources; iii) Rantha mine - An area of 22.0 ha was mapped on 1:2000 scale and re-assessed resources are placed at 18.701 million tonnes including 2.466 million tonnes of 45-58% Fe: iv) Koira-Kasira mine- An area of 20 ha was mapped on 1:2000 scale and total resources estimated at 7.77 million tonnes including 4.97 million tonnes of (+)45% Fe: v) Koira-Bhanjapalli mine-An area 22.0 ha was mapped on 1:2000 scale and resources estimated at 6.948 million tonnes including 2.138 million tonnes of 45-58% Fe: vi) Tiringpahar mine-An area of 79.3 ha was mapped on 1:1000 scale; vii) Khandbandh mine-An area of 45 ha was mapped on 1:1000 scale; viii) Dubna-Sekradihi Fe-Mn mine-24.00 ha area mapped on 1:1000 scale; ix) Seremda Bhadrasahi Fe-Mn mine- An area of 13.0 ha was mapped on 1:500/1:1000 scale, drilled 16 boreholes for cumulative depth of 677.0 m. and 745 nos samples analysed. Total resources in the area are placed at 11.92 million tonnes.

MANGANESE ORE

GSI

In Andhra Pradesh, general exploration for manganese ore was carried out in Devada Area, Vijayanagaram district. The survey entangled mapping of 1 sq. km on 1:2000 scale, 100 BRS, 10 petrochemical sampling, 30 PS, 20 OM, 5 XRD, 10 EPMA, 2 ore beneficiation, 100 PTS and 600 m drilling and 200 core sampling and 10 LKM geophysical survey. The Khondalite suite comprises of lower feldspathic quartzite unit followed by quartzite, garnet-sillimanite gneiss and calc-granulite. Petrographic study of selected khondalite sample shows presence of quartz, feldspar and almandine garnet and opaques i.e. Mn ores. Ore petrographic study shows presence of mostly two types of Mn ores i.e. pyrolusite and psilomelane. There are various types of replacement texture seen to occur between pyrolusite and psilomelane such as gradual, inward, skeletal, and complete. Poikilitic inclusion of pyrolusite is noted within psilomelane.

In Madhya Pradesh, preliminary exploration of manganese mineralisation in Gudma block, an extension of Western Ukwa block, Balaghat

district was carried out involving drilling of 7 boreholes to a cumulative depth of 1009.7 m and collection of 20 BRS, 10 samples each for PS and PCS, 10 nos of samples for REE and 5 nos of samples for XRF. A total of 5.74 m ore horizon including manganiferous quartzite was intersected. The thickness of ore horizon varies from 0.25 m to 1.38 m. It was seen that though the ore horizon is persisting there is decrease in width of ore body in strike continuity in western direction and as well as in dip direction. In Jabalpur and Katni districts, reconnaissance survey (G4) for manganese ore was taken up in Tola Block, Sihora and Dheemarkhera Tehsil. Detailed geological mapping on 1:4000 scale for 2 sq. km area and 10 Line km of geophysical survey was taken up. The main rock types in the area are banded quartzite, cherty quartzite, brecciated jasper quartzite which occurs as detached and isolated bodies dotted around Tola-Gada Itwa area that is largely covered by laterite, soil and alluvium. A total of nine trenches and thirteen numbers of test pits were carried out.

In Odisha, preliminary exploration for Manganese ore in Tala-Chhelianal Block in the central sector of the Eastern Ghats Granulite Belt, Rayagada district was carried out entangling detailed geological mapping of 1 sq. km area along with 65cu m of pitting/ trenching and 384.4 m drilling in seven boreholes. Three discontinuous manganese ore bands were delineated for a strike length of 150 m, 50 m and 50 m respectively with width varying from 6 to 20 m. Manganese ore band was intersected in a borehole for a cumulative width of 4.4 m and is mainly powdery in nature. The manganese minerals found in ore are generally pyrolusite, psilomelane and cyrptomelane. Chemical analysis of 50 bedrock samples shows Mn content varies from 0.42% to 39.60%. Chemical analysis of 151 trench samples shows Mn content varies from 0.01% to 33.52 % in which 75 nos of samples have shown >10% Mn values and 28 samples have shown Mn values >20%. Mn content in the ore zone varies from 2.19% to 33.52%. The average grade as determined from the ore zone in 12 trenches is 16.45% Mn over 8 m width. During preliminary exploration in Anujurhi Block in the central sector of the Eastern Ghats Granulite Belt, Rayagada district an area of 1.5 sq. km was covered by detailed mapping and 213.80 m drilling in three boreholes. The manganiferous ore body of 800 m strike length with an average width of 10 m within khondalite and quartzite was demarcated. The ore zone could be traceable with discontinuous /detached outcrops showing varying width ranging from 8 to 24 m. The chief minerals are pyrolusite, psilomelane, cryptomelane and todorokite. Total 64 CS was collected. Analytical results of 85 bedrock samples indicate Mn content varies from 0.25% to 30.76 %, Fe 2.27% to 33.97%, P 0.14% to 1.65% and SiO_2 11.56 to 80.22%. Analytical results of PTS show Mn in the range of 0.21% - 22.51% with an average grade 13.25% over 5.0 m width. Preliminary exploration in Rukunibori - Loharpadar block in the central sector of eastern ghats granulite belt, Rayagada district was carried out involving mapping of 1.5 sq. km area on 1:2000 scale and 500 m drilling. The manganese ore zone with strike length of 180 m and width varying up to 8 m have been delineated. The ore is hard and lumpy and Mn content in ore zone ranges from 12.42 – 28.91% Mn with an average of 18.18%. The value of P2O5 remains <3.5% in this area. Three boreholes intersected the ore zone at 30 m vertical depth. The ore zone in Loharpadar block has 500 m length with width varying up to 12 m. The manganese ore is hard, siliceous with intercalations of quartz and having Mn content of 11.38 - 39.55% with mean value of 20.2% in bed rock samples. 6 nos of boreholes were completed which have intersected the ore zone at 30 m vertical depth having maximum width intersected at 16 m. In Kalahandi district, reconnaissance survey for manganese ore was taken up in Tekartola-Brahmani area. An area of 100 sq. km was mapped on 1:12500 scale and collection of 100 bed rock samples, 50 pitting / trenching samples, 5 OM sample and 10 XRD samples were completed. Manganese ore minerals are concentrated within the manganiferous quartzite. A discontinuous ore zone was delineated in the western slope of 519 hill range near Tekartola and the ore bodies occur in the form of lenses, stringers and as fragmented bands. Four linear bands of manganese mineralisation of dimension

i) 30 m X 13 m trending NW-SE, ii) 60 m X 15 m trending NE-SW, iii) 15 m X 10 m trending NW-SE and iv) 50 m X 09 m trending NW-SE were located in the area. A Reconnaissance survey (G4) was taken up in and around Raidanipadar – Kundeijharan area in eastern ghats granulite belt, Kalahandi district. An area of 100 sq. km was mapped on 1:12500 scale along with 50 cu m of trenching. The rock types exposed are khondalite, pyroxene granulite, quartzite, amphibolites, garnetiferous granite-gneiss, calc silicate, pegmatite, quartz veins. Manganese mineralisation in the Bazargarh reserve forest near Taprang village has been traced for a strike length nearly 500 m with an average width of 15 m. Few trench samples (5 nos) show Mn content from 9% to 18%.

In Telangana, a preliminary exploration (G4) was taken up in the Pranhita-Godavari basin, Adilabad district. Two horizons of manganese mineralisation are observed within the massive limestone. Lower manganese horizon extends over 35 km with thickness of 0.4 m to 1 m. Upper manganese horizon is poorly developed showing thickness of about 0.1 m and is discontinuous in nature. An area of 100 sq. km was mapped on 1:12500 scale in two blocks i.e. Gurra-Rampur block and Kanpa-Junapani block. Further, 102 BRS, 20 PCS, 10 PS, 20 ORM and 48 PT samples were collected. Geophysical survey and scout drilling of 200 m was also carried out. Three boreholes were drilled in Gurra-Rampur block and one in Kanpa-Junapani block. However, manganese mineralisation was encountered only in one borehole of Gurra-Rampur block at a depth of 25 m which suggest that depth continuation of manganese horizon is irregular/erratic and not potential for further exploration.

Directorate of Geology and Mining, Rajasthan

During 2016-17, G4 level exploration to locate manganese ore mineralisation was taken n/v Rupkhera, Wagaicha, Nawagaon in Sajjangarh tehsil, Banswara district, Rajasthan. An area of 5.0 sq. km was mapped on 1:10000 scale and 1.0 sq. km on 1:4000 scale. Manganese ore minerlisation in the area was traced over a strike length of about 2.0 km. Results of chemical analysis are awaited.

MECL

In Maharashtra, a G4 level exploration in Lanjera-Futala block, Bhandara district and Mandri-Panchala block, Nagpur district was carried out with the objectives to i) geological mapping on 12500 scale and to demarcate the rock types of manganese bearing Mansar formation, ii) collect samples and analyse them for Mn content, iii) estimate Mn ore resources as per minerals (Evidence of Mineral Contents) Rules 2015, etc. In Bhandara district, exploration involved mapping of 8 sq. km area on 1:12500 scale, drilling of 7 boreholes to a cumulative depth of 518.00 m and sampling & chemical analysis of 151 nos Estimated about 75.67 thousand tonnes of Mn ore resources with average grade of 14.37% Mn at cut-off 10% Mn. In Nagpur district, exploration was carried by mapping of 2.50 sq. km area on 1:12500 scale, drilling to a cumulative depth 500 m in 4 boreholes. Sampling and analysis of 165 samples were carried out. Estimated about 213.87 thousand tonnes of Mn ore resources with an average grade of 23.21% Mn, 0.98% P_2O_5, 8.58% MnO_2, 12.86% Fe_2O_3 and 31.76% SiO_2, at cut-off 10% Mn. Aforesaid two exploration work were funded through NMET.

MOIL

During 2017-18, a total of 23,468 m exploratory drilling involving 98 boreholes in 12 maganese ore mines were carried out. Among these 12 mines, two mines viz, Dongri buzurg & Chikla manganese mines are situated in district Bhandara & six mines vix, Kandri, Mansar, Beldongri, Gumgaon, Old Satuk & New Satuk mines were situated in district Nagpur, Maharashtra State. Four mines viz, Ukwa, Balaghat, Tirodi and Sitapatore/Sukli mines were situated in district Balaghat, Madhya Pradesh. The reported reserves/resources of manganese ore as on 1.4.2018 of all the mines owned by MOIL were estimated at 87.25 million tonnes. Ukwa (13.84 million tonnes), Bharweli (24.77 million tonnes), Tirodi (0.75 million tonnes), Sitapatore & Sukli (0.15 million tonnes & 0.16 million tonnes), Chikla (4.67 million tonnes), Dongri Buzurg (18.06 million tonnes), Kandri (12.17 million tonnes), Mansar (5.65 million tonnes), Beldongri (0.19 million tonnes), Old Satuk (0.50 million tonnes), New Satuk (0.03 million tonnes) and Gumgaon (6.31 million tonnes). Total 831 samples were analysed.

Table - 6:Exploration for Iron Ore by MECL & NMDC 2017-18

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (ha)	Boreholes	Meterage		
MECL							
Karnataka							
Tumkuru	M/s Milan-Minerals (ML-1842), K.K.Kaval village, Hosadurga Taluka	1:1000	0.9955	28	2114.0	2762	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. The manganese ore reserves were estimated at 11.133 million tonnes with the average grade of 13.99% Mn, 29.11% Fe, 24.89% SiO_2 and 1.92% Al_2O_3 at10% Mn cut-off. Iron ore reserves were estimated at 0.436 million tonnes with average grade of 47.32% Fe, 13.74% SiO_2, 3.11 Al_2O_3, 5.87% Mn and 5.78% MnO_2 at 45% Fe cut-off.
Chitradurgai	Smt. R.Razian Khanum, (ML-2557), Dodda Byalodakere Village, Hosadurga Taluka.	1:1000	0.1254	14	885.0	1179	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. A net reserves/resources of 0.985 million tonnes have been estimated over a strike length of 600 m with average grade of Fe 48.25%, SiO_2 17.59% and Al_2O_3 3.93% at 45% Fe cut-off. Besides, a net reserves/ resources of 0.548 million tonnes of manganese ore with 13.66% Mn, 26.32% SiO_2 and 25.19% Al_2O_3 have been estimated at 10% Mn cut-off.

(Contd)

Table - 6 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (ha)	Boreholes	Meterage		
Karnataka							
Ballari	Shri P.Abu Bakar Mine lease area (ML-2183) Siddapur village of NEB Range, Sandur Taluka.	1:1000	0.1385	10	965.0	1068	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. The iron ore resources were estimated at 0.343 million tonnes over a strike length of 165.0 m with 48.84% Fe, 19.40% SiO_2 and 5.42% Al_2O_3 under measured and indicated categories (331/332).
	M/s Associated Mining Company (ML-2434), Near Ramandurg village of Ramandurg range, Sundur Taluka.	1:1000	0.1014	6	615.5	593	A G2 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. The iron ore reserves/ resources were estimated at 0.787 million tonnes over a strike length of 178.0 m with Fe 52.05%, SiO_2 14.01% and Al_2O_3 6.70% at 45% cut-off. Resources at 35% Fe cut-off has been estimated at 5.611 million tonnes with grade of Fe 39.99%, SiO_2 34.4% and Al_2O_3 4.29% under indicated category (332).
	M/s S.B. Minerals (ML-2515), Vysankera village, Ramgad Range, Sundur Taluka.	1:1000	0.7125	5	474.0	558	A G3 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map on the mine lease area, to assess the strike and depth continuity of iron ore in the lease

(Contd)

Table - 6 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (ha)	Boreholes	Meterage		
							area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. A total of 0.322 million tonnes of iron ore reserves/resources have been estimated with 54.38% Fe, 17.72% SiO_2 and 3.36% Al_2O_3 at 45% Fe cut-off and 7.328 million tonnes with average grade of 37.80% Fe, 39.53% SiO_2 and 2.58% Al_2O_3 at 35% Fe cut off.
Tumkuru (Manganese ore)	Smt.Kamalabai (ML-1442) Manchikatte village Chickanayakanahalli Taluka.	1:1000	0.1344	5	460.0	865	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. A total of 0.639 million tonnes net reserves/ resources with average grade of 6.85% Mn, 7.25% MnO_2 have been estimated at 10% Mn cut-off.
	M/s.Matha Minerals (ML- 2600), Kondli & Mudalpalya Village, Gubbi Taluka	1:1000	1.2916	23	1723.0	3854	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map of the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of reserves/resources etc. Iron ore net reserves of 0.995 million tonnes has been estimated with average

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Table - 6 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (ha)	Boreholes	Meterage		
							grade 48.05% Fe, 15.98% SiO_2 and 5.58% Al_2O_3 at 45% Fe cut-off. A total of 2.795 million tonnes net reserves/resources with average grade 36.57% Fe, 33.69% SiO_2 and 4.55% Al_2O_3 have been estimated at 35% Fe cut-off. Manganese ore reserves/ resources have been estimated at 1.442 million tonnes with average grade of 10.97% Mn.
	M/s.Canara Minerals (ML-2635) Gubbi village Shillandra Taluka	1:1000	0.1152	13	1196.0	3353	A G1 level of exploration was carried out with the objective of boreholes fixation, preparation of geological map on the mine lease area, to assess the strike and depth continuity of iron ore in the lease area, determination of lumps and fines ratio, determination of mineralised area and associated minerals with quantification as per threshold values, exploration in accordance with Mineral (Evidence of Mineral Contents) Rules-2015 and estimation of resources etc. A net reserves/resources of 1.387 million tonnes with average grade of 51.78% Fe, 11.46% SiO_2 and 4.89% Al_2O_3 have been estimated at 45% cut-off. At 35% Fe cut-off, a net 2.579 million tonnes reserves/resources have been estimated with average grade of 44.47% Fe, 21.71% SiO_2 and 4.14% Al_2O_3, Manganese ore reserves have been estimated at 0.718 million tonnes with average grade of 11.08% Mn under measured/indicated category (331/332).
Odisha							
Sundargarh	Chandi-poshi Block	1:2000	0.89	12	781.0	1461	A G2 level exploration was carried out with the objective to generate additional sub-surface data by drilling in-filling boreholes between earlier drilled GSI boreholes and to upgrade the earlier estimation of grade and ore resources. The exploration / project was funded by NMET. The gross reserves/resources at 55% Fe cut-off has been estimated as 35.86 million tonnes and the net reserves/resources as 32.27 million tonnes after considering 10% depreciation factor. Similarly, 11.21 million tonnes of gross reserves/resources and 10.09 million tonnes of net resources at > 45% to <55% Fe cut-off is estimated separately.

(Contd)

Table - 6 (Concld)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (ha)	Boreholes	Meterage		
Sundargarh	Purhei-bahal block	1:2000	0.36	6	449.0	672	A G2 level exploration was carried out with the objectives to generate additional sub-surface data by drilling in-filling boreholes between earlier drilled GSI boreholes and to upgrade the earlier estimation of grade and ore resources. The exploration / project was funded by NMET. The gross reserves/resources at 55% Fe cut-off has been estimated as 44.04 million tonnes and the net reserves/ resources as 39.64 million tonnes after considering 10% depreciation factor. Similarly, 2.76 million tonnes of gross resources and 2.48 million tonnes of net resources at ≥45% to <55% Fe cut-off is estimated separately.
Rajasthan							
Bhilwara	RINL Block I&II, Phase II	-	-	16	1462.0	1648	A G2 level exploration was carried out with the objective to explore the presence of ore body and estimation of available resources in the Block I and II. Out of the total estimated iron ore reserves/ resources of 27.18 million tonnes, about 3.566 million tonnes with 22.58% Fe has been estimated under indicated category (332) and about 23.602 million tonnes with 22.55% Fe under inferred category (333).
NMDC							
Karnataka							
Ballari	Kumaraswamy iron ore mine- B and C block	-	-	31	2644.00	907	Reserves/Resources were estimated at 22.07 million tonnes.
Chattisgarh							
Dantewada (South Bastar)	Bailadila Iron ore Mines Bacheli D-5	-	-	52	5451	-	
	D-10	-	-	14	1010.5	-	
	Kirandul complex Deposit-11ML (11B,11C)	1:2000	-	24	2079	-	Entire lease area mapped on 1:2000 scale. Reserves estimation is under process.
	Kirandul complex Deposit-14 (Area 322.368H)	1:2000	-	9	992	-	Reserves estimation is under process.
	Kirandul complex Deposit-14 NMZ (Area 506.742H)	1:2000	-	10	727	-	Reserves estimation is under process.

RARE EARTHS ELEMENTS (REE)

GSI

In Bihar, reconnaissance survey for rare earth elements (REE) and rare metals (RM) was carried out in and around Simaltala and Katoriya area, Bihar Mica belt within Chhotanagpur gneissic complex, Jamui and Banka districts. During survey an area of 200 sq. km was mapped on large scale in Block - I and Block-II with 100 cu m of pitting/ trenching. Besides, collected 151 BRS, 100 samples each of PTS and stream sediment/ soil samples, 35 nos of PS, 20 nos of PCS, 10 nos for EPMA, 15 samples each of SEM-EDX and XRD samples. The analytical results of BRS from Block-I reveal that the tREE (La-Lu) concentration varies from 1 ppm to 919 ppm with average tREE of 194.83 ppm. Out of these samples 72 nos of samples are having tREE concentration higher than 146 ppm and varies from 146.15 ppm to 919 ppm while 14 nos of samples have tREE concentration of > 500 ppm.

In Chhattisgarh, reconnaissance survey for REE and associated minerals in and around Gobra-Salebhat areas, Gariaband district was carried. The mapped area comprises of granite, grey granite, biotite rich granite, brecciated quartz reef, quartzo-feldspathic vein/ reef and dolerite/ gabbro dykes. The maximum value of tREE received so far is 879 ppm. LREE bearing mineral called allanite is observed which is scattered all over the slide in good amount.

In Gujarat, reconnaissance survey for REE mineralisation and other RM was carried out in Godhra Granitoids of Chhota Udepur district. The survey involves mapping of 100 sq. km on 1:12,500 scale and collected 100 nos BRS, 50 SS, 10 regolith, 50 PTS, 30 PS, 8 OM, and 10 XRD samples. Preliminary exploration for REE and other RM was carried out in Ambadungar Carbonatite Complex, Kawant Taluka, Chhota Udepur district. The area comprises different varieties of carbonatite, carbonate sandstone, phonolite, basalt, dolerite dyke and quartz veins. A total of eight boreholes were drilled to a cumulative of 1075 m and collected 928 core samples. The analytical results of sample showed encouraging value (0.3% average grade with 0.25% cut-off) for REE and Nb (300 ppm average grade with 200 ppm cut-off) concentration.

In Kerala, during reconnaissance survey for the possible occurrence of REE and other RM mineralisation in Ambalavayal granite, Wayanad district large scale mapping of 100 sq. km on 1:12500 scale was carried out. Besides, a total of 120 of BRS, 61 of channel samples, 16 of petrochemical samples, 55 of regolith samples and 15 of petrographical samples were collected. The litho units in the area are metapyroxenite, talc-tremolite-sericite schist, and banded magnetite quartzite. PGC is represented by hornblende-biotite gneiss which is the main litho unit in the study area. 78 nos of pegmatite were identified and mapped. Total REE ranges from 82.3 ppm to 1,632.7 ppm with mean of 563.1 ppm in 24 nos of granite and 35.8 ppm to 1,781.5 ppm with mean of 364.6 ppm in 22 of pegmatites. Cu and Mo value range from 10 ppm to 4,382 ppm with mean of 161 ppm and 40 ppm to 1,590 ppm with mean of 677 ppm in granite. Two metapyroxenite samples show Ni value 1,877 ppm and 593 ppm.

In Karnataka, reconnaissance survey for Delineating the REE bearing zone around Koppal Syenite, Koppal district was taken up by mapping of 150 sq. km on 1:12500 scale with systematic 200 cu m trenching (100 trench samples), 101 BRS, 13 petrochemical samples, 10 XRD, 46 PS, 25 soil and 25 HM has been completed. The area exposes rocks of migmatite, alkali pyroxenite/ amphibolite, variants of syenite, basic dykes like gabbro and dolerite and acidic younger intrusive like quartz, aplite and pegmatite vein. The analytical result revealed total REE (tREE) in BRS varies from 43.58 to 2469.41 ppm. Highest values are noticed over mafic rock in the southern part of the area. In trench samples REE value varies from 178.33 ppm to 1801.72 ppm. The tREE value in the soil sample varies from 313.48 to 2991.38 ppm. In Raichur & Gulbarga districts, reconnaissance survey for delineating the REE bearing zones around Shorapur, Rastapur, Jalibenchi, Wanadurg and Hosakeri was carried out by mapping of 100 sq. km area on 1:12500 scale along with pitting/ trenching of 200 cu m, besides collection of 101 BRS, 107 PTS, 50 SS, 44 PS, 32 petrochemical study and 10 for EPMA samples. The major litho-domains exposed in the area are Peninsular gneissic complex-II, closepet granite, younger intrusives and Bhima group, more dominantly occupied by closepet granite.

In Madhya Pradesh, reconnaissance survey for REE and RM mineralisation was carried out in parts of Murha- Bhawargarh Fort- Nishana-Chopardhana areas, Betul district by large scale mapping of 100 sq. km area on 1:12500 scale. The mapping reveals

presence of garnetiferous quartz mica schist, porphyritic augen gneiss, grey granite gneiss, hornblende-biotite pink granite and biotite rich grey granite and mafic rocks. The granitoids are intruded by quartz and pegmatite veins. Beryl crystals are found in quartz and pegmatite veins in the area. The analytical results of samples indicate Be varying from <1 ppm to 20.9 ppm, Sc from 5.9 ppm to 11.5 ppm, Rb from 12.6 ppm to 1579.0 ppm, Sr from 1.6 ppm to 380.9 ppm, Y from 1.4 ppm to 193.8 ppm, Nb from 1.3 ppm to 518.0 ppm, Mo <5 ppm to 28.9 ppm, Sn from <5 ppm to 22.3 ppm, Cs from 0.49 ppm to 62.81 ppm, Ta from <0.2 ppm to 140.3 ppm and W from <5 ppm to 12.8 ppm. The total REE value in these samples varies from 10.64 ppm to 1611.5 ppm. The LREE values vary from 9.96 ppm to 1498.74 ppm and HREE value varies from 0.63 ppm to 112.79 ppm.

In Maharashtra, reconnaissance survey for locating REE and RM mineralisation in Granite and associated pegmatite veins of Sausar Mobile Belt, in Khapa-Alesur area, Bhandara district was carried out involving large scale mapping of 50 sq. km area, pitting/ trenching and sampling. Four numbers of complex and zoned pegmatites was demarcated having beryl mineralisation apart from garnet, tourmaline and micas making likely hosts for Be, Li and REE. Pit samples were collected from the talus horizons of pegmatites and stream channels near granite. The heavy fraction of stream sediments and talus material was also collected from the 1st and 2nd order streams of the area under study. During reconnassaince survey in Nawegaon-Goreghat-Chawari areas, Nagpur district an area of 50 sq. km was mapped on large scale and pitting/trenching and sampling were also carried out. Four numbers of complex and zoned pegmatites have been delineated and mapped. These pegmatites have beryl mineralisation apart from garnet, tourmaline and micas. Apatite and xenotime grain are also observd in pegmatites. Tungsten (scheelite) mineralisation has been reported in foliated granites. Reconnaissance survey for REE & RM mineralisation in granitoids and pegmatite bodies was carried out in Kinwat and Sendgi area, Nanded and Yavatmal districts. An area of 50 sq. km was mapped on 1:12500 scale and collected 75 nos BRS, 50 nos samples each of SSS and PTS, 15 nos of petrochemical samples. BRS of K-feldspar granite have yielded a total REE value of 1,100 ppm and tungsten value showed maximum of 300 ppm. In Sindhudurg district, a reconnaissance survey for delineating REE rich and associated minerals in Kaladgi supergroup was carried out involving large scale mapping of 80 sq. km along with the collection of 122 nos of talus/ regolith, 35 nos of SSS 15 nos of pit samples, 10 samples each of BRS, PCS & XRD and 15 PS. The area comprises mainly of BIF, tremolite schist, serpentinite and amphibolite, basement gneiss, mafic and felsic intrusives, etc. The target lithologies were granitoids and pegmatites. The analytical results indicate REE from 500 to 1,120 ppm from 14 nos of talus/ regolith samples. The zirconium (Zr) value ranges from 85 ppm to 3,226 ppm. In SSS samples, total REE ranges between 200 ppm to 500 ppm and highest value of Zr is 1,816 ppm.

In Meghalaya, reconnaissance survey for REE in was carried out in the area around Jirang and area between Umsophria-Warmawsaw, Ri-Bhoi district. The study involved mapping of 50 sq. km on 1:12500 scale. The main litho units noted in the area are granite gneiss, cordierite gneiss and migmatites. The analytical results of 50 bedrock samples show that the tREE values of range from 198 ppm to 1,067 ppm. Soil samples collected from the weathered granitic rocks near Jirang area shows tREE values of 397 ppm to 1,075 ppm. The tREE values of the pit samples collected from "A" horizon and "B" soil horizons ranges from 203 ppm to 780 ppm. In West Khasi Hills district, reconnaissance survey for REE and associated elements in laterite in Nongbyrki block was carried out by large scale mapping of 50 sq. km on 1:12500 scale followed by surface exploration of 25 cu m by pitting/ trenching. Analytical results show average alumina (Al_2O_3 ~ 45%) concentration in laterite. ICP-MS results of five bedrock samples show high anomaly of tREE (Total REE ~ 2500 ppm) in A, B & C horizon on top of potash rich porphyritic granite of South Khasi batholith. During reconnaissance survey in Nongjyllieh block laterite for REE and associated elements an area of 50 sq. km was mapped on 1:12500 scale and three bauxite bodies, over gneissic charnockite, covering an area of 0.033 sq. km were identified in Lawse (0.019 sq. km), Mawduh (0.003 sq. km) and Nongjyllieh (0.011 sq. km) villages. In Lawse, the bauxite body contains 37.17 to 27.04% of Al_2O_3 . The tREE value of Lawse section ranges from 154.06 to 1799.74 ppm.

In Odisha, reconnaissance survey for REE in the alkaline rocks and associated pegmatites in association with the Eastern Ghats rocks around Rairakhol area, Sambalpur district was carried out with mapping of 100 sq. km on 1:12500 scale. The alkaline units exposed mainly include nepheline syenite and syenite. Petrography, SEM-EDX and EPMA study indicate that nepheline syenite and syenites are the host rock for REE. The REE phases are mainly observed in association with feldspar, apatite, amphibole, sphene and zircon; along their grain margins, as crack fillings and occasionally within the grains. Total 276 nos of samples was collected for analysis.

In Rajasthan, reconnaissance survey for REE and RM mineralisation in and around Redana area, Barmer district was carried out by mapping of 100 sq. km on 1:12500 scale. The rocks of Malani Igneous Suite and Unclassified Delhi supergroup are exposed in the area. The major litho-units in the area are pink granite, leucocratic granite and E-W trending later felsic and mafic bodies/ dykes.Intertonguing relationship between the Siwana type granite and basement pink granite was recorded. Felsic and basic bodies range in width from 2 m to about 50 m with lateral extension of 100 m to 1.5 km. Bedrock samples were collected from different litho-units. Petrographic studies of intrusive Siwana type granite reveals that the rocks are mainly composed of feldspar, quartz along with alkali amphibole. During reconnaissance survey for REE mineralisation in Siwana area, Barmer district, an area of 100 sq. km was mapped on 1:12500 scale and collected 200 BRS, 25 PTS, 21 PS, PCS & EPMA 10 samples each and 5 XRD samples. Two major rock suites i.e. plutonic phase and volcanic phase were observed. The plutonic phase consists of coarse grained porphyritic granite and is the youngest unit in the area. Volcanic phase consists of three rock types. In Bhilwara district, reconnaissance survey for REE and associated mineralisation in Phulia –Umedpura - Bhimpura area was carried out involving mapping of 100 sq. km on 1:12500 scale. The area exposes mainly composite gneisses and migmatites. Composite gneisses include banded gneisses, streaky gneisses and porphyritic/ augen gneisses. One gabbroic body showing spheroidal weathering is noted in south of Phullya. The general trend of gneissosity is NE-SW dipping at high angle towards NW. Three new basic intrusive bodies were identified. Total 250 BRS, 52 PTS, 16 PS, 11 XRD, 15 OM and 09 PCS were collected. In Sirohi district, reconnaissance survey for rare metals mineralisation was carried out in Sibagaon area The survey comprised detailed mapping of 1.5 sq. km on 1:1000 scale with collection of 564 BRS samples, 50 PTS and 10 PCS samples. The rock types in the study area are mainly calc-silicate, quartzite, dolomitic marble, mica schist, granite gneiss and pegmatite. Other rare metal rich minerals such as lepidolite, spodumene and beryl are also present in pegmatites. Chemical analyses by hand held XRF has revealed very high value ranging fron1,098 ppm to 5,141 ppm of Rb in pegmatites only. Sr mineralisation is also present in pegmatites and in calc-silicates. Sr value in ranges from 36.40 ppm to 1,618 ppm and in in pegmatites it varies from 0 to 407.14. Reconnassance survey for REE and Tungsten in Jaswantpura – Pander area, Jalore/Bhilwara districts involving large scale mapping of 100 sq. km on 1:12500 scale and collection of 215 BRS, 30 PTS and 4 XRD samples were carried out. The rock types exposed in the area are mainly migmatite gneiss/ augen gneiss, calc-scilicate rock/ calc gneiss, and garnetiferous mica schist, dolomite and amphibolite which are intruded by pegmatite and quartz veins. Pegmatite thickness ranges from few cm to 5 m.

In Tamil Nadu, during reconnaissance survey for RM and REE in the southern extension of alkaline carbonatite complex in parts of Mechchery and Perumbalai taluks, Salem and Dharmapuri districts an area of 100 sq. km was mapped on 1:12500 with collection of 106 BRS, 25 PS, 15 nos each of PCS & OM, 10 EPMA, 16 XRD and regolith & colluvial 50 samples each. Besides, 30 nos of sample were collected from pyroxenite to assess the potential of platinum group of elements. The major litho units demarcated in the area includes fuchsite quartzite, amphibolite, banded magnetite quartzite, meta-gabbro, hornblende biotite gneiss, epidote hornblende gneiss, migmatite gneiss, quartzo- feldspathic gneiss,

pyroxenite, syenite, carbonatite, quartz reef and quartz pegmatite veins. Pyroxenite, syenite, carbonatite occurs as intrusive and quartz reef and quartz pegmatite vein occurs as acid intrusive. Two carbonatite bodies are also delineated. Carbonatite body from about 500 m south of Pottaneri shows an average value of REE up to 2447.48 ppm. Total REE ranges from 465.46 to 3941.40 ppm which includes range of LREE 438.79 to 3785.33 ppm and HREE 26.67 to156.06 ppm. In Vellore and Dharmapuri districts, reconnaissance survey for rare metals and REE was carried in Koratti complex involving large scale mapping of 100 sq. km. The various rock types mapped with an emphasis on REE mineralisation in the area are syenites, carbonatite, syenitoidal pegmatite, pyroxenite and hornblende biotite gneiss. The intrusive carbonatite body extends for a strike length of 1 km with width varies from 30 m to 120 m. Carbonatite is intruded into the pyroxenite in the north and has syenite and gneiss in the southern contact. Samples from syenite variety show REE values ranging from 83 ppm to 412 ppm, pegmatite samples show REE value from 86 ppm to 131 ppm. One sample from pyroxenite shows REE value up to 644 ppm. Eleven bedrock samples collected from the carbonatite show total REE varying from 632 to 2,066 ppm.

In Uttar Pradesh, reconnaissance survey for REE and tungsten mineralisation in Dudhi granitoid complex, Gulaljharia-Sagoban area, Sonbhadra district was taken up. Large scale mapping of 135 sq. km on 1:12500 scale was carried out. The major lithological units identified are K-feldspar granite gneiss, biotite granite, K-feldspar granite, unakite, amphibolite and marble. The younger intrusives occur in the form of milky white quartz vein and pegmatite vein. The K-feldspar granite gneiss is pink colour, deformed, rich in K-feldspar porphyroclasts, exposed in most part of study area. Pegmatite veins in K-feldspar granite gneiss is pink colour, medium to coarse grained rich in K-feldspar while pegmatites in sheared biotite granite is light grey colour, very coarse to pegmatitic nature. The columbite grains are associated with pegmatite vein and may be a source for REE and associated rare metals in the study area. The pegmatite veins in Kudri, Anjangira & Deohar area show yellowish green fluorescence under UV light that may be powellite.

STATE DIRECTORATES

Directorate Mining & Geology, Rajasthan

During 2016-17, regional mineral survey in Bambdi nadi area near village Sevron Kin Dhani and Sodha kin Dhani area, Rajasthan was taken up with an objective to search for Rare Earth Elements. An area of 120 sq. km was covered on 1:50000 scale and 18 nos of samples were collected during survey. Two carbonatite dykes are observed in and around Bambdi Nadi, Sevron ki Dhani. One carbonatite dyke is exposed up to 30 m in length and 1.0 to 2.0 m in width. Second carbonatite dyke is 42.0 m in length and 2.70 m in width. Three carbonatite samples have indicated REE values near Bambdi, Sodha Ki Dhani in Sindhari tehsil. The REE value ranging from 0.02% to 0.05%. Yttrium ranges from 27.69 to 51.10. The area seems to be anomalous zone having high values of REE.

STRATEGIC METALS

TUNGSTEN

GSI

In Chhattisgarh, reconnaissance survey (G4) for tungsten and associated mineralisation in Nawadih-Pendari-Uskoni-Atauri area, Balrampur district was carried out. An area of 100 sq. km was mapped on 1:12,500 scale. The main lithologies observed are biotite granite, ortho-gneisses and meta-sedimentaries of Chhotanagpur Gneissic Complex. The meta-sedimentaries comprise mainly of massive & schistose quartzites, calc-silicate, garnet-quartz-mica schist and meta-conglomerate. The general trend of the rocks is NW-SE with moderate to steep dips toward SW and NE. A total of 109 BRS were collected. The results of chemical analyses reveal very low values of tungsten (W<20 ppm) except three samples being analysed more than 20 ppm. The highest value of tungsten is 153.6 ppm from a sample of pegmatite from Pendari area. Monazite, xenotime and allanite grains were detected in augen gneiss and quartz-tourmaline vein. Few grains of xenotime are identified in association with rutile and Th-silicate in a quartz-tourmaline vein sample. Zircon grains observed in granite, augen gneiss, pegmatite, quartz-tourmaline vein, tourmalinite and calc-silicate samples. Pyrite, gold, copper, chalcopyrite grains were identified in calc-silicate samples.

In Rajasthan, reconnaissance survey for Tungsten, gold and silver mineralisation in and around Daganwada area, Jaipur district was carried out involving mapping of 100 sq. km on 1:12,500 scale with collection of 203 BRS, 25 PTS, 8 SS, 27 PS, 10 ORM/OM, 51 PCS, 5 EPMA and 05 XRD samples. The rocks present in the area are represented by silicified/ ferruginised quartzite, granite gneiss, chlorite schist, gritty/ feldspathic quartzite and dolomitic/ impure marble with thin bands of grey quartzite, vitreous white quartzite. These rocks are intruded by thin quartz veins and basic dykes. Granites are exposed in the form of scanty outcrops within the thick alluvium cover. Two varieties of granite i.e. porphyritic and non-porphyritic are exposed in the study area. Preliminary exploration for tungsten and associated mineralisation was carried out around Rewat hill, Degana, Nagaur district. A total 1,754 m of drilling and collection of 450 core samples from 36 drilled boreholes has been completed. Rock types exposed in the area mainly include granite. Numerous quartz and pegmatite veins intrude the granite. Wolframite mineralisation has been observed within quartz veins. Concentration of tungsten mineralisation is more along quartz veins/ pegmatite veins intruded in granite. Analytical result of 70 core samples of borehole RJDB-1 indicate that W values ranges between 86.60 ppm to 4,924.37 ppm with an average of 782.21 ppm. XRD analysis shows two phases of tungsten bearing minerals present in the area viz. Ferberite ($FeWO_4$) and Huebnerite ($MnWO_4$). In Sirohi district, reconnaissance survey for W, Sn and associated rare metals mineralisation was taken up in Dewa-Ka-Bera, Saliyon ka Bera & Bara Bera area. G-4 stage investigation comprising of large scale mapping of 100 sq. km area on 1: 12,500 scale with collection of 226 nos BRS and 20 nos PCS samples have been carried out. The Delhi Supergroup is constituted of phyllite intercalated with schist/ quartzite, calc silicate, quartzite & mica schist. In the south-eastern part, coarse to medium grained tourmaline rich pegmatite were sampled for tin & tungsten mineralisation. Scheelite mineralisation is associated with the intrusive contact of granite & calc silicate rocks. A reconnaissance survey for tungsten and lithium was taken up in Sohela-Karola area. The survey comprises large scale mapping of 100 sq. km on 1:12,500 scale with collection of 252 nos BRS, 50 nos PTS, 305 nos PCS and 50 nos PS samples. The different lithology demarcated include gneisses, quartzite, mica- schist, amphibolite and amphibole marble rocks. These are intruded by pegmatite, metabasic dyke and quartz-tourmaline veins. Surface indications of mineralisation are in the form of malachite stains in the quartzite and calc silicate rocks and magnetite rich bands within the quartzites. Samples from pegmatite rich zones have been collected to know the presence of tungsten and associated mineralisation. A reconnaissance survey for tungsten and lithium was taken up in Kotariya-Pipaliya-Gurha area. The project involved large scale mapping of 130 sq. km on 1:12,500 scale with collection of 30 PTS samples. The major litho units exposed in the area are granite, mica schist, conglomerate and pegmatites. Well developed tourmaline crystals (few mm to 4cm along longer axis), feldspar, muscovite and quartz are very common within pegmatite. Trenches have been laid in pegmatites intruding biotite bearing granite and biotite-muscovite schist. Clusters of large tourmaline crystals have been identified in pegmatite. Lepidolite (?) bearing pegmatite bodies are recorded in south west of Koliyon Ki Dhani. Pillow basalt is recorded west of Hemandai village.

In Uttarakhand, a reconnaissance survey for tungsten, molybdenum, rare-metal and REE mineralisation was taken up in tertiary granites and Central Crystallines of Higher Himalaya, Chamoli district. An area of 51 sq. km was covered by large scale mapping on 1:12,500 scale. The geology of the area comprises of migmatites, garnet-sillimanite gneiss, quartzite and phyllites. Seven bodies of granite have been mapped around Malari area. The rock types mapped are calc-gneiss, micaceous quartzite and migmatites. Migmatites are observed to the north of Mana area and along tract of Badrinath-Hanuman Chatti sector. A small patch of mica granite with minor tourmaline granite vein was seen on the vertical cliff to the north-west of Mana area. A small patch of tourmaline granite was observed in the calc-gneiss to the east of Badrinath area.

TITANIUM, VANADIUM & GALLIUM

GSI

In Bihar, reconnaissance survey was taken up for strategic minerals i.e. Titanium (Ti), Vanadium (V) & Gallium (Ga) in laterite exposed in and around Adhaura area, parts of toposheet no. 63P/9 & 10, Kaimur district. The study involved large scale mapping of 124 sq. km on 1:12500 scale in Block- A and Block-B, along with pitting/ trenching and collection of BRS, PCS and SSS. Three major lateritic bodies were delineated in Block-A having maximum dimension 2.5 km x 0.3 km, 1.5 km x 0.5 km and 3.5 km x 0.9 km, respectively. The laterite bodies are very closely associated with lineaments where ground evidences like silicification, slickensides & ferruginisation/ limonitisation have been observed in sandstone. In Block-B, isolated patches of laterite bodies were observed. Analytical results of 44 laterite samples show TiO_2 varying from 1.05% to 12.71%, V varying from 109 ppm to 1365 ppm and Ga varying from 19 ppm to 112 ppm.

MOLYBDENUM

GSI

In Madhya Pradesh, a reconnaissance survey for molybdenum and related sulphide mineralisation was carried out in Bundelkhand granitic complex (BGC) in Sandna- Garha area, Chhatarpur district. Molybdenum and related sulphide mineralisation indications have been seen in migmatite, non-porphyritic, pink granite, quartz veins/ reefs and pegmatites. Molybdenite mineralisation is characterised by studded orange yellow hallows. Indication of sulphide mineralisation in the form of specks of chalcopyrite, pyrite, malachite and azurite was noticed in fractures planes.

MECL

In Tamil Nadu, exploration was carried out in Vellammpatti south block, a part of Harur-Uttangarai belt, Dharamapuri district with an objective to ascertain the conformity of molybdenum mineralised zones intersected in the earlier drilled boreholes by GSI & MECL and to increase the confidence level of resources estimation. An area of 1.10 sq. km was mapped on 1:1000 scale and 9 boreholes were drilled to a total depth of 1251 m. Study further involved sampling and chemical analysis of 685 nos of primary and check samples (595 samples for Mo, Pb & Cu), 50 nos for W & Co, 21 nos of composite samples for Mo, Pb, Cu, W, Co, Au, Ag & Re (Rhenium). Geotechnical study was carried out in one borehole. Total resources estimated at 3.128 million tonnes with an average grade of 0.081% Mo at 0.03% Mo cut-off up to vertical depth of 325 m over a strike length of about 1,150.0 m out of 1,350.0 m total strike length of the block. Out of these, measured resources estimated at 1.504 million tonnes and indicated resources at 1.213 million tonnes with an average grade of 0.079% Mo and inferred resources at 0.411 million tonnes with an average grade of 0.093% Mo. In Marudipatti central block which is located in the Harur-Uttangarai belt and lies in the south-eastern part of Dharmapuri district, MECL carried out mapping of 0.5 sq. km area on 1:1000 scale with an objective to ascertain the thickness of ore body/mineralised zones intersected in boreholes drilled by GSI and to test the depth extension of body with consistency and reliability of the grade of ore zones over a promising strike length of 400 m to 450 m up to 100-150 m vertical depth together with increasing the confidence level of resource estimation up to G2 level. During investigation, 9 boreholes were drilled of cumulative depth of 1,335 m over an area of 0.5 sq. km and collected & analysed 585 nos of primary and check samples (493 primary samples for Mo, Pb, Cu, Zn), 60 nos of primary samples each for W & Co and Au & Ag, 15 nos composite samples for Mo, Pb, Cu, W, Co, Au, Ag. Besides, samples for XRD and spectroscopic studies, petrological and mineralogical studies were also collected. Geotechnical studies was carried out in one borehole. Total resources estimated at 2.094 million tonnes with an average grade of 0.036% Mo at 0.01% Mo cut-off. Out of the total resources, measured resources estimated at 0.842 million tonnes with an average grade of 0.039% Mo, indicated resources at 1.08 million tonnes with average grade of 0.032% Mo and inferred resources at 0.172 million tonnes with an average grade of 0.043% Mo. In Vellempatti central block, Dharmapuri district exploration was carried out with an objective to i) ascertain the thickness of ore body/mineralised zones intersected in boreholes of GSI, ii) test the depth extension of the ore body intersected in GSI boreholes at shallow levels, iii) establish the consistency and reliability of grade of ore zone over a promising strike length of 1,300 m and up to vertical depth of 100 to 125 m, iv) exploration work to be carried out as per minerals (Evidence of Mineral Contents) Rules, 2015 and v) increase confidence

level of resource estimation. An area of 1.33 sq. km was mapped on 1:1000 scale and 13 boreholes were drilled to a cumulative depth of 2,112.0 m. Total 927 nos of samples were collected and analysed for Mo, Pb, Cu, W, Sn, Ta, Nb, Co, Au and Ag. Besides, petrological and mineralogical studies and specific gravity determination were also undertaken. Geotechnical study of one borehole carried out. The quartz reef with associated molybdenite mineralisation is exposed in the north-south and NNE-SSW to NNW-SSE trending low ridges and intersects the gabbroic dyke. Total resources estimation in this block are placed at 1.9107 million tonnes with 0.038% Mo at 0.01% Mo cut-off. Out of total resources, 0.4069 million tonnes with 0.035% Mo estimated under indicated category and remaining 1.5038 million tonnes with 0.039% Mo under inferred category.

MARINE & COASTAL SURVEY

GSI

During investigations for Rare Earth Elements & Yttrium (REY) in the Fe-Mn Crust in the southern part of the Sewell Ridge, Andaman Sea, a survey covering an area of 3,200 sq. km was carried. The exploration methodologies involved multibeam echo sounder survey along with gravity and magnetic survey. Fe-Mn crust/ nodules were collected from 10 locations from the north south trending ridge (WSR) and one recovered from an inactive volcanic cone adjacent to WSR. The average Fe content is around 18%, while average Mn content lies in between 18% - 20%. The Ni content generally lies in between 3,000 - 3,800 ppm, while Co content ranges in between 900-1,500 ppm. Apart from this the total average REE values in Sewell ridge is approximately 1,000 ppm. A grab sample revealed the presence of heavy minerals like ilmenite, magnetite, mica, tourmaline, zircon and monazite.

Placer mineral resource evaluation was taken up in the Territorial Waters off Gopalpur, Odisha. A total of 5 water samples at two levels of 5 m and 15 m were collected. In total 11 vibro cores and 55 grab samples were collected. The sediments mainly consists of coarse, medium and fine sand, silty sand, clayey sand and clay. The bulk total average wt% of heavy mineral off Gopalpur area is ~6.42 %. Minerals identified are ilmenite, garnet, sillimanite, zircon, monazite, rutile, while other non-economic heavy minerals are hornblende, pyroxenes etc.

During preliminary search for Phosphorite over Sea Mount (Calicut Mt.) off Calicut, Kerala, swath bathymetry, sub-bottom profiling and magnetic surveys along with grab, core and dredge sampling operations were carried out in 2,700 sq. km. Flat topped region of Mount-1 is as shallow as 20 m, while Elikalpeni bank summit is just 12 m below sea level. A total of 45 grab and 2 core samples were collected from the area. Ferromanganese crust and phosphorites were recovered from both the slopes of the sea mount from depths between 500 and 800 m. Mineralised crust occurs as 1-4 mm coating over weathered basic rock of basaltic composition. On preliminary analysis ferromanganese crust is seen enriched in Fe (67%), Mn (3885 ppm), Zn (245 ppm), Ni (158 ppm) and Co (81 ppm) and phosphorite with P_2O_5 content of 21%.

An area of 6,950 sq. km was surveyed in search of REY in ferromanganese crust on the submerged ridges and surface/ subsurface sediments east of Chetlat Island around Lakshadweep group of Islands, Arabian Sea. The area can be divided into 2 distinct parts based on seafloor topography. The eastern part has a smooth monotonous seafloor with few isolated very small topographic high. The western part has prominent topographic highs represented as ridges. Magnetic data varies from 40,315 to 40,806nT. A strong magnetic linear feature oriented in NW-SE with more than 100nT gradient observed. Total 60 nos of surface sediment samples and one gravity core were collected. The topographic highs/ top of ridges had very poor to no recovery of sample due to hard nature of bottom. A gravity core of 250 cm length collected at water depth of 2,100 m is made up of very loose, brown clay (0–6cm) to grey sticky clay with microforms.

During search for both REE and placer mineral resource in the shelf area off Vedaranyam, Nagapattinam district, Tamil Nadu, an area of 250 sq. km was covered with 142 lkm of bathymetric survey and collected 68 vibro cores, 11 grab sediment samples and 5 nos of water samples. The bathymetric data reveals that from east to west, the sea bottom is gently sloping varying in water depths from 4.0 to 14.8 m. A total of 150 sub samples were generated for sedimentological and geochemical studies. Presence of heavy minerals is noticed in both surface and bottom sediments.

An area of 50 sq. km was surveyed to assess the resources of placer mineral and construction grade sand in the Territorial waters, off Bhimunipatnam, Andhra Pradesh. 55 coast parallel traverses and the 2D and 3D grid models were prepared. A total of 66 vibro core samples were collected. The onboard observation indicated that the sea bed is blanketed by grayish brown fine sand at shallower depths and brownish medium sand within the depths from 16 to 22 m with patches of coarse sand and fine sand at deeper depths in southern part. The total non-magnetic heavy mineral resources computed vary from 1.68 to 10.12 wt% with an average of 4.30 wt%.

During evaluation of heavy mineral resources in marine sediments off Alang, Gujarat (Block-1), good concentration of heavies especially ilmenite & magnetite were reported along the sandy beach of northern part. Monazite also occurs in considerable amount. The heavy mineral percentage varies from 0.039 to 91.18. The total economic heavies ranges from 0 to 38% and includes ilmenite, magnetite, leucoxene, pyroboles, zircon, rutile, kyanite, monazite, epidote, etc. About 93 lkm of bathymetric survey were carried out. A total of 18 vibro cores and 54 gravity cores were collected.

During preliminary evaluation of heavy mineral resource potential in the near shore area off Portonova (Parangipettai) Cuddalore district, Tamil Nadu, an area of 56 sq. km of near shore sea bed was covered with systematic bathymetric survey and sediment sampling at 1.0 km x 0.5 km grid pattern. A total of 17 beach profiles were taken perpendicular to the coast at 4 km interval. During the post monsoon survey 21 nos of onshore sediment samples and 07 nos of pit samples (17 sub samples) were collected. Pits were taken with the range of depth varying from 1.5 m to 2.0 m. Magnetic minerals weight percentage in the samples varies from 0.46 to 10.52% with the average of 4.55%. An area of 56 sq. km was covered in the near-shore domain with 130 lkm of single beam bathymetric survey along the coast extending from Pudupettai to Toduvai. A total of 110 grab samples from near shore area and 29 samples from the shoreline domain were collected. Water samples were collected from five stations. Electrical conductivity varies from 47.72 to 48.1 with the average of 47.72 mS/cm.

A preliminary survey for heavy mineral occurrence in the near shore area off Santapalle-Bhimunipatnam, North Andhra Pradesh coast was carried out by boat survey covering an area of 50 sq. km by taking 50 lkm traverses from 0 to 10 m isobath. Forty four sea bed sediment grab samples were collected for sedimentological and heavy mineral studies. The grab samples collected revealed that the weight percent of offshore non-magnetic heavy minerals show variation from 1.6 to 19.33 % with an average of 7.52%.

During reconnaissance survey of heavy minerals occurrence along the beaches and shallow offshore between Ambika and Auranga River, South Gujarat, systematic collection of samples was carried out in approximately 10 sq. km. A total of 30 samples representing beaches, berm and dunes have been collected. About 24 grab samples were also collected from offshore. Total 10 water samples were collected during boat survey.

PLATINUM GROUP OF METALS (PGM)

GSI

In Kerala, preliminary exploration for Platinum Group of Minerals (PGM) in Vellamari block, Attapadi Valley, Palakkad district, was carried out involving mapping of about 0.75 sq. km on 1:1000 scale and identification of the important rock units in the area. Sulphide mineralisation in the form of fresh specks of pyrite, chalcopyrite and pyrrhotite has been noticed mainly in metapyroxenite and the contacts of meta pyroxenite with meta-gabbro and amphibolite. This sulphide rich zone demarcated is the main target lithology for PGE exploration. Pitting/ trenching of 50 cu m was carried out and collected 66 nos of trench samples and also collected 87 nos of BRS and 50 nos of SSS 25 nos of PS, 10 nos of PCS, 15 nos of ORM, 06 nos of EPMA, 06 nos of SEM and 10 nos of XRD samples. A total of 121 m drilling have been carrieded in scout boreholes with a maximum depth of about 80 m. The important litho units intersected in borehole are quartzo feldspathic gneiss, amphibolites, meta gabbro and meta pyroxenite with sulphide mineralisation. An important PGE mineralised zone was traced for 300 m strike length further NE. Total 10 nos of BRS were collected and analysed for PGE (Pt+Pd) and values ranges from 170 ppb to 3,759 ppb with weighted average of 1,926.40 ppb in a 5 m wide zone. Besides one additional PGE bearing

metapyroxenite zone was establish in Trench-17 just 100 m to 120 m south of the northern PGE bearing zone. In this band a 0.50 m wide PGE bearing zone i.e. Pt=1668 ppb and Pd=2378 ppb a total of 4046 ppb Pt+ Pd established. A total of 5 nos of scout boreholes are proposed in PGE zone.

In Tamil Nadu, reconnaissance survey for PGE mineralisation in Torrapadi Ultramafic complex, Tiruvannamalai area, Tiruvannamalai district was carried out involving mapping of 110 sq. km on 1:12500 scale and collected 148 nos of BRS, 100 nos of PTS, 20 nos of PS, 25 nos of petrochemical, 25 nos of OM, 15 nos of EPMA and 15 nos of SEM-EDEX samples. The area is mainly represented by charnockite, quartzo-feldspathic rocks and ultramafic rocks i.e. pyroxenite, gabbro, gabbro norite and gabbroic anorthosite. Two types of pyroxenes are observed here one is green to bottle green and second one is black in colour. Rhythmic layering is observed in the form of alternate layers of pyroxene and plagioclase feldspar in gabbro and pyroxenite in Torappadi hill. Quartz veins are also observed in gabbro in eastern part of the hill. Ni values ranges from 155 ppm to 921 ppm while Cr ranges from 0.03 % to 0.85%.

In Uttar Pradesh, reconnaissance survey for PGE mineralisation and associated Ni and Co was carried out in Jungel ultramafics around Garda-Bhitri area, Sonbhadra district. The survey involved large mapping of 125 sq. km on 1:12500 scale. The area is mainly represented by basalt, vesicular/ amygdular and olivine rich basalts, agglomerate and lamprophyre along with sporadic occurrence of serpentinite and ultramafics. The olivine rich basalt in Harsadand and Baheradand, the ultramafic body near Baheradand, serpentinite in Jarkarhwa and gabbro in Sobna-Bhitri are the mafic and ultramafic lithounits which have been mapped and sampled for PGE mineralisation.

Directorate of Geology & Mining, Uttar Pradesh

DGM, UP taken up a exploration work in Ikauna area, Lalitpur district. An area of 0.4 sq. km was mapped on 1:1000 scale with digging of two trenches of dimensions 18 m x 1.0 m x1.5 m and 23 m x 1.0 m x 1.5 m and analysed 336 nos of samples. PGE is hosted by peridotite & tale actinolite schist over a strike length of 2 km with depth persistence of 60 m in Ikauna area. A borehole was drilled to a depth of 180 m and estimated about 7.0 million tonnes of PGE ore (@ 0.49 ppm PGE) under indicated category. In eastern extension of Ikauna ultramafic tract, geological mapping of 36 sq. km on 1:12500 scale was carried out and G4 level exploration is in progress.

DIAMOND

GSI

In Andhra Pradesh, reconnaissance survey for kimberlite in the Wajrakarur Kimberlite field Anantapur district was taken up. An area of 750 sq. km was covered in reconnaissance survey and collected 204 systematic stream sediment sampling. The EPMA results of the heavies confirmed its Kimberlite affinity. An anomalous area of 4.5 sq. km was covered by ground magnetic survey and a total of 31 traverses were taken for detailed magnetic surveys in continuous recording mode to locate hidden kimberlite bodies and suggested 12 locations for testing. In the catchment area of Krishna - Munneru –Paleru rivers along Krishna river alluvial tracts, an aerial reconnaissance studies and geological survey of 1500 sq. km on 1:50000 scale was carried out for Primary source rocks of secondary diamonds. The rock types observed in the area are hornblende biotite granite, alkali feldspar granite, pegmatite veins, lamproite dykes, gabbro and dolerite dykes with secondary carbonate veins, etc. Most of the mafic dykes came across during mapping are associated with secondary carbonate veins. A new gabbro dyke of strike length of 2.5 km with varying width from 50 m to 100 m was identified in west of Nallabandagudem village. A total 302 nos of stream sediment samples were systematically collected and processed. 173 nos of heavy mineral grains were submitted for EPMA analysis. On the basis of semi quantitative data received for 35 nos of samples in the form of oxides, the grains were identified as Cr-pyroxene, clinopyroxene, orthopyroxene, ilmenite, epidote, etc. The Cr-pyroxene grains were recovered from 3rd order stream sediment sample. Rock samples were collected from ultramafic bodies and 8 nos of sample submitted each for petrological studies and XRD analysis. In Cuddapah district, a reconnaissance survey was carried out by covering an area of 750 sq. km to locate primary source for diamonds in the Penneru and Papaghni river basins, between Pulivendla and Khajipet. An integrated structural lineament map has been prepared. Key element dispersion maps were prepared for the target elements and its paragenetic group using NGCM data. Rocks of PGC-II, Cuddapah supergroup and Kurnool group are exposed. During the survey, a total of 203 nos of stream sediment samples were collected and processed for the recovery of heavy mineral concentrates. Total 49 suspected grains were submitted for EPMA analysis which reveals non-kimberlitic affinity viz., almandine garnet, Mn-ilmenite, etc.

In Chhattisgarh, during reconnaissance survey for Kimberlite clan rocks (KCR) in Gariaband and Dhamtari districts, a total of 150 nos of stream sediment samples were collected and processed. The petrochemical data of two samples shows SiO_2 values range from 46.91% to 50.65% with high alumina (9.27% to 10.56%), Fe_2O_3 (11.3 % to 12%) and CaO (7.69% to 5.84%). These rocks are also composed of high MgO (12.41% to 15.4%), high Cr values (1500 ppm to 1100 ppm), Ni values (425 to 490 ppm) and Co values with low K_2O values (0.51% to 0.71%). The area shows presence of chromite bearing rocks in the vicinity due to the presence of high chromium and nickel. The samples of garnets in the termite hills near Dhawalpur Girhola and Gaurghat areas were collected for analysis. In Mahasamund, Gariaband and Raipur districts, reconnaissance survey for KCR was carried out over an area of 700 sq. km. Four target blocks T-1 to T-4 were demarcated for detailed ground checks and systematic stream sediment sampling. A total of 20 nos of PS, 20 nos of PCS and 10 nos of PTS from mafic and ultramafic rocks were collected. Besides, a total of 150 stream sediment samples were collected and processed for heavy mineral separation and a total of 450 heavy mineral were selected for SEM-EDX and EPMA studies. Glauconitic sandstone observed sporadic as well as in layered nature. The KCR are suspected based upon recovered Cr- spinel, Ilmenite & Cr- diopside. Gold occurrence was reported from 2nd order nala, west of Rajpalpur.

In Karnataka, reconnaissance survey was carried out to locate Kimberlite in Kotturu Block, Ballari and Chitradurga districts. Lineament map and drainage map of the study area were prepared. A total of 154 nos SSS, 5 no. PS and 5 nos petrochemical samples have been collected. An outcrop of Talc-tremolite-actinolite schist rock was noted 800 meter SW of Hunsekotte village. Samples processing carried out and only 1 mm to 0.5 mm and 0.5 mm to 0.3 mm size factions were taken up for further concentration and heavy mineral studies. Heavy mineral study carried out to identify the kimberlite indicator. 24 nos of suspected grains from SSS were studied by EPMA. In Raichur district, reconnaissance survey to locate KCR in Gabbur block was carried out based on a few geophysical anomalous zones reported by the airborne magnetic and spectrometric studies of the Narayanpet - Raichur area. Most of the heavy minerals recovered are non-kimberlitic and of crustal origin and include amphibole, pyroxene, ilmenite, spinel, tourmaline, zircon, etc. The analytical result showed the presence of microdiamond with nitrogen impurities. The cathodoluminicence imaging for the suspected grains were carried out to study the details and growth structures of the grains.

In Bagalkot district, reconnaissance survey (G4) to locate Kimberlites in Bagalkot block was carried out by aerial reconnaissance studies of 750 sq. km area and reconnaissance survey of 720 sq. km area on 1:50000 scale. A total of 182 stream sediment samples were systematically collected and processed for heavy minerals. A total of 8 petrological samples were collected and studied and 5 rock samples were analysed for whole rock and trace elements. About 20 grains belonging to 9 stream sediment samples were analysed by EPMA. Those suspected grains include garnet, ilmenite and diopside.

In Telangana, a reconnaissance survey (G4) was taken up for locating primary source rocks of diamond in Kodangal-Parigi block, Mahabubnagar and Vikarabad districts. Aerial reconnaissance and satellite imagery study of 1500 sq. km and field reconnaissance survey of 780 sq. km was carried out on 1:50000 scale and collected 218 stream sediment samples, 218 heavy mineral samples, 25 petrological samples and 6 petrochemical samples. The stream sediment samples were processed for recovery of kimberlite indicator minerals/heavy minerals. Microscopic study and EPMA analysis were carried out. Source rock could not be identified.

PRECIOUS MINERALS

GOLD

The GSI, MECL & DGM, UP were engaged in the exploration for gold during 2017-18. An account of exploration work done by GSI is given in Table-7.

MECL

In Karnataka, G2 level exploration in Kolar Gold Field (KGF), Kolar was carried out with the objectives i) resources estimation of 6 dumps (except Kennedy's dump) to the measured/indicated categories, ii) explored smaller dumps, iii) re-assessing of existing tonnage and grade, iv) value addition of BGML assests and v) firming of gold recovery through beneficiation and recovery of by-products, if any. The study area lied in KGF extending from mine dump no.13 in the north to mysore mine dump (Dump No.1) in south. An area of 1.55 sq. km mapped on 1:1000 scale. Total 66 boreholes were drilled to a cumulative depth of 1055.80 m. Shallow pitting of 25 cu m was done in 25 pits of dimension 1 m*1 m*1 m and collected 2175 samples for various analysis. Besides, beneficiation study was also carried out in 5 nos of samples. The resources estimated by 2D grid model through MINEX software in dumps is placed at 32.262 million tonnes with an average grade of 0.75 g/t Au under indicated category. The project was taken up by MECL for Ministry of Mines.

Directorate of Geology & Mining, Uttar Pradesh

In Uttar Pradesh, DGM has taken up exploration work in Hardi area (western block), Sonbhadra district with an objective to search for gold deposit in Hardi area. Detailed investigation of eastern block showed a gold deposit extending over a strike length of 1.2 km with average width and depth of 15.5 m and 18 m, respectively. The average grade of the ore is 0.30 ppm. On the basis of encouraging results in Hardi eastern block, the exploration comprised geological mapping of 0.75 sq. km area on 1:2000 scale, excavation of 110 cu m through 7 trenches, geochemical sampling – 150 nos chemical analysis of 12 samples, petrological study of 10 samples and 04 bulk samples was carried out in Hardi western block. In Berwar area, Lalitpur district search for placer gold was carried out by geological mapping of 2.3 sq. km on 1:5000 scale and about 0.66 sq. km on 1:2000 scale. The S.P., magnetic and resistivity survey of about 0.25 sq. km area was completed. About 117 cu m material has been excavated in two trenches. Two boreholes were drilled for a cumulative depth of 98.21 m and collected 216 samples for analysis. An average grade of 0.16 g/t Au was recorded based on chemical analysis.

INDUSTRIAL MINERALS

The details of exploration carried out for industrial minerals by GSI, State governments and Central/State Undertakings during 2017-18 are given in Table - 8. Exploration work carried out by Govt. of Rajasthan during 2017-18 is also furnished in said table.

Table - 7: Exploration for Gold by GSI, 2017-18

State/District	Location	Details of work done	Results obtained/Remarks
Arunachal Pradesh			
Lower Subansiri	Poss-Kamcha area	Mapping	During reconnaissance survey for gold and associated mineralisation in the metasedimentary sequence of Bomdila Group in Possa-Kamcha area, an area of 50 sq. km was mapped on 1:12500 scale. Two iron sulphide mineralised zones have been delineated. Iron-sulphide mineralised zone within grey phyllite and carbonaceous phyllite has been observed within the discontinuous outcrops having width of 2 to 4 m over a strike length of 0.5 km. The iron bands are <1 cm to 4 cm thick and occur as intercalations with phyllite. At places the sulphide concentration is significantly high where in pyrite, chalcopyrite is observed to occur as clusters, smears and disseminated within the carbonaceous phyllite. A sulphide-rich zone in the form of rich disseminations of pyrite, chalcopyrite and other sulphides within mafic-rich phyllite rock has also been delineated southeast of Peti along Pith Pabung nala. The mineralised zone has a NE-SW strike and is exposed at two places having width of 3 to 6 m over a strike length of 1 km with intervening soil covered tract.
Andhra Pradesh			
Cuddapah & Ananthapur	Northern part of Veligallu Schist belt & adjoining areas,	Mapping & Sampling	During reconnaissance survey for gold and associated minerals in northern part of Veligallu schist belt and adjoining areas, parts of Cuddapah and Ananthapur district, an area of 312 sq. km was covered in reconnaissance survey and large scale mapping of 150 sq. km on 1:12500 scale was carried out. A total of 355 samples were collected. A significant zone of mineralisation was identified in the northern part of the NERP block. The quartz vein in the mineralised zone is characterised by malachite stains and presence of sulphides in the form of disseminated pyrite and bornite. Ore microscopic studies revealed that chalcocite and chalcopyrite are the main copper sulphide phases. (Contd)

Table - 7 (Contd)

State/District	Location	Details of work done	Results obtained/Remarks
			A dolerite dyke observed to the west of the alteration zone is rich in sericite and quartz. Three bedrock samples collected from the mineralised zone assayed Cu values ranging from 0.17% to 1.13%. Subsequently, channel sampling was carried at an interval of 1 m, and two samples analysed 1.26% & 1.07% for Cu.
Andhra Pradesh and Karnataka			
Kurnool and Raichur	Block I, Block-II, Block-III	Mapping & Sampling	A reconnaissance survey for gold, silver and associated minerals was taken up in the parts of Kurnool district, Andhra Pradesh and Raichur district, Karnataka. Large scale mapping of 156 sq. km on 1:12500 scale in four blocks namely Block I, Block-II, Block-III and Block-IV was carried out and demarcated a 1.2 km long and 280 m wide zone of sulphide bearing metavolcanic near Madhavaram area that falls to the west of Block-I. Near Idipunur area, sheared sulphide mineralised quartz reef characterised by the presence of pyrite and chalcopyrite with minor covellite and measuring 130 m X 60 m has been identified. Channel sampling of the Idipunur quartz reef indicated that the concentration of sulphides is more in its central portion. In the trench quartz with pyrite and other yellowish sulphides is observed. Analytical results of 8 channel samples show low incidence of gold mineralisation with gold values ranging from 40 ppb to 189 ppb. In the NW part of Block-I, the malachite bearing boulders are spread over an area of 0.5 sq. km indicating concealed zone of copper mineralisation. Tourmaline bearing pegmatite has been identified in NNE of Buddinni area in Block 1 for a length of about 1.5 km with thickness of 8 m. In Mirzapur area Block-1, highly altered quartz reef showing evidences of mineralisation in the form of numerous anastomizing quartz vein as well as carbonatite vein has been observed with length of 210 m and width 60 m.
Chhattisgarh			
Mahasamund	Dongripali, Jamjuri & Kurupali area	Mapping Trenching & Sampling	Reconnaissance survey for gold and associated sulphide mineralisation in Dongripali, Jamjuri & Kurlupali area comprising large scale mapping of 100 sq. km on 1:12500 scale and ASTER data study was taken up. Gabbro dyke with sulphide mineralisation and quartz vein with pyrite, galena mineralisation is found in the area. The rocks have suffered three phases of deformation. S_1 and S_2 are at low angle in most of the area. The trend of schistosity varies from NNE-SSW to NNW-SSE, with steep westerly and easterly dips. The outcrop pattern is controlled by S_2 schistosity. The later dykes and most of the quartz veins intruded along S_2 planes. 50 cu m of trenching and sampling has been carried out in 8 locations across strike to expose BIF and quartz veins. Total 50 nos of BRS, 145 nos of stream sediments and 15 nos of soil samples were collected for analysis. Gold grains were retrieved from one location through panning and the heavies were sent to the laboratory for analysis. Beryl mineralisation is found in granite and the sample has been submitted for REE analysis.
Jharkhand			
East Singhbhum	Bhitar dari block	Drilling	During preliminary exploration for gold in Bhitar Dari block a total of 475.15 m drilling was carried out. The suspected gold mineralisation is found associated with sulphide (dissemination, stringers and veins type), wall rock alterations, shearing, silicification (quartz veins/ veinlets) within sheared conglomerate, tuffaceous phyllite, ultramafics, talc-tremolite schist, phyllite, slaty phyllite,

(Contd)

Table - 7 (Contd)

State/District	Location	Details of work done	Results obtained/Remarks
			quartz-sericite schist (?) and main sulphides viz., pyrite, chalcopyrite, arsenopyite, pyrrhotite. In borehole JEB-1, sulphide mineralisation has been noticed from 39.40 m - 39.58 m for about 0.18 m length. This 18 cm zone has very high specific gravity and yielded up to 13.7 ppm of Au and values ranges from 310 ppb -800 ppb. Base metals, show concentration in the range of Cu: 8 - 8400 ppm, Pb: 9 - 575 ppm and Zn: 8ppm - 1.28%. Gold grains were found in the 18 cm zone within tuffaceous phyllite in borehole JEB-1. Nano gold grains in the order of 2 µm - 3 µm were also observed in slaty phyllite.
Gujarat			
Jamnagar	Jamjodhpur Block (Alech Hills)	Mapping Pitting Sampling	Reconnaissance survey for Gold and associated minerals in Jamjodhpur Block (Alech Hills) was carried out. The study involved mapping of 100 sq. km on 1:12500 scale and collection of 25 nos of pitting/ channel/ groove samples and 108 nos of BRS. Total 6 carbonate veins/ dyke have been delineated and channel samples at regular interval were collected. Samples both from basalt and granophyre near the basalt-granophyre contact were also collected. Few shining minerals, white in colour, visible through pocket lens, were observed within basalt at the granophyre and basalt contact near Bhojakua Ness, north of Malvada village. A small chert vein is exposed around south of Andhariya Ness within the Rhyolite which extends up to Bochvdi Ness. Systematic sampling with 10 m interval was carried out.
Karnataka			
Ballari	Sirigiri block	Mapping Sampling	During reconnaissance survey for gold and associated minerals in Sirigiri block in parts of Bellary district, large scale mapping of 132 sq. km on 1:12500 scale with collection of 364 samples was carried out. A total of five bands of BIF have been observed in the schist belt intercalated with meta-argillite, phyllite, greywacke and acid volcanics. The area has undergone at least three phases of deformation. The possible zones of gold mineralisation are marked by hydrothermal alterations in the form of wide spread epidotisation, sulphidisation, carbonatisation and silicification in pink granite. The analytical results of 80 bed rock samples do not show any encouraging gold values except three spot values i.e. 62 ppb, 88 ppb and 400 ppb collected from sheared pink granite.
Chitradurga	North of Madanyakk-anahalli and Bullanahalli-Chikkannanahalli area	Mapping geological survey scout drilling sampling	During reconnaissance survey (G4) for gold and polymetals, north of Madanyakkanahalli in and around Bullanahalli-Chikkannanahalli areas, mapping of 100 sq. km area on 1:12500 scale was carried out besides systematic pitting/ trenching, bedrock sampling and scout drilling. A total of 1.00 sq. km area on 1:1000 scale was covered by detailed mapping in two blocks viz., Lingnannahalli North and South blocks. The litho units in the area are phyllite, BIF, granophyre, banded magnetite quartzite and few blue quartz veins. Two BRS samples from Lingnannahalli South Block showed gold values of 2500 ppb and 450 ppb. A borehole drilled to a depth of 110 m depth and encountered four mineralised zone having pyrite and arsenopyrite as disseminated. Total 25 nos of core samples were collected for analysis.

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Table - 7 (Contd)

State/District	Location	Details of work done	Results obtained/Remarks
Raichur	Chikka-Honakuni area	Mapping, Geological surveys Drilling sampling	Reconnaissance survey (G4) for gold and associated minerals was taken up around Chikka-Honakuni area. An area 100 sq. km on 1:12500 scale and 1.02 sq. km area on 1:1000 scale was mapped for the study. The lithologies identified are felsic volcanic rock and granite intruded by quartz reef and basic dyke. The litho-units exposed in this area are felsic volcanic, pegmatitic granite and metabasic rock. The felsic volcanic is light to dark grey and is enriched in magnetite and is intruded by numerous linear pink, K-feldspar bearing, porphyritic granite which are pegmatitic at places. During Ground Geophysical surveys, 20 L.km IP & resistivity and 27 L.km of magnetic survey was carried out in the area. The anomaly maps show 3 NNW-SSE high chargeability zones with the old working situated in the south-east part of the central IP anomaly. Scout drilling of 468 m was completed. BRS samples have shown Au values < 25 ppb. 93 PTS were analysed with two samples having Au values 5.6 ppm and 2.5 ppm while the remaining samples have given Au values less than 150 ppb.
Tumakuru	Ajjanahalli Block F	Mapping Sampling	G3 stage preliminary exploration for Gold was carried out in Ajjanahalli Block-F. Ajjanahalli Block-F, is characterised by several higher order congruous antiform and synform with relatively low inter limb angle. The mineralisation is characterised by sulphide dissemination along with quartz-carbonate veins/vein lets within the sheared BIF. Total 1201.40 m of drilling was carried out in 8 boreholes (KTAF-1 to 8) and collected 450 core samples. Chemical analysis of boreholes KTAF-1 showed high gold values as 0.112 ppm / 0.5 m (42.75 m to 43.25 m), 0.324 ppm/ 0.5 m (85.35 m to 85.85 m) and 0.13 ppm/ 0.5 m (139.50 m to 140.0 m) in the borehole KTAF-1. In borehole KTAF-2, the high gold values are 0.16 ppm / 1.5 m (102 m to 103.5 m), and 0.14 ppm / 2 m (107.5 m to 109.5 m). The Au mineralisation is confined to sheared/ brecciated BIF with quartz-carbonate veins/ veinlets having sulphides like pyrrhotite, pyrite, arsenopyrite and chalcopyrite. The favourable loci for mineralisation are low strain domains.
Rangaswamy Betta Yemmebetta Lakshmipura & Tarikers area		Drilling Sampling	Reconnaissance survey was carried out for gold around Rangaswamy Betta, Yemmebetta, Lakshmipura and Tarikere areas, in Kunigal Schist Belt. An area of 114 sq. km was mapped on 1:12500 scale with collection of total 508 samples. The major rock units exposed in the area are granite gneiss and migmatites while the schist belt comprises of amphibolites, talc-tremolite-actinolite schist, calc-silicates, metapelites, banded magnetite quartzite, grunerite bearing BIF, banded manganiferous formation with intermittent ferruginous phyllite and chlorite schist. Gold mineralisation is mostly associated with BIF along with sheared quartz veins and pegmatites. Alteration is seen in the form of limonitisation, sericitization and sulphidisation. The Au values in BRS samples near Laxmipura area varies from 100 ppb to 565 ppb.

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Table - 7 (Contd)

State/District	Location	Details of work done	Results obtained/Remarks
Tumakuru	Timmanahalli Block, Sleemanabad areas	Mapping Sampling	A reconnaisance Survey for Gold was carried out in Timmanahalli block. An area of 1.5 sq. km was mapped on 1:1000 scale and collected of 325 samples. Gold mineralisation is sporadic in nature. Out of 290 nos of samples, only 07 samples have shown encouraging Au value of >100 ppb and the highest value recorded was 975 ppb. All the gold values were reported from BIF samples collected from different bands indicating that the mineralisation is restricted to BIF. The BIF samples which yielded values were characterised by the presence of fine disseminated pyrites. The other sulphides associated with mineralised BIF were arsenopyrite and chalcopyrite. The ore microscopic and EPMA studies carried out suggest the presence of invisible gold (lattice gold) associated with pyrite.
	Yemmebetta, Lakshmipura & Tarikere area	Mapping Sampling	Reconnaissance survey was carried out for gold around Rangaswamy Betta, Yemmebetta, Lakshmipura and Tarikere areas, in Kunigal Schist Belt. An area of 114 sq. km was mapped on 1:12500 scale with collection of total 508 samples. The major rock units exposed in the area are granite gneiss and migmatites while the schist belt comprises of amphibolites, talc-tremolite-actinolite schist, calc-silicates, metapelites, banded magnetite quartzite, grunerite bearing BIF, banded manganiferous formation with intermittent ferruginous phyllite and chlorite schist. Gold mineralisation is mostly associated with BIF along with sheared quartz veins and pegmatites. Alteration is seen in the form of limonitisation, sericitisation and sulphidisation. The Au values in BRS samples near Laxmipura area varies from 100 ppb to 565 ppb.
Kerala			
Malappuram	Mattattur-Ponmala area	Mapping Sampling	Reconnaissance survey for gold in and around Mattattur-Ponmala area, Malappuram district,: The project involves LSM of 100 sq. km on 1:12500. The rocks identified in the study area are mafic granulite, charnockite, quartzo feldspathic rock, migmatite/hornblende gneiss, granite, pegmatite, vein quartz, dolerite and laterite. Sulphide bearing quartz veins have been mapped, in which pyrite, chalcopyrite and bornite are observed as disseminations. Fifteen old workings in the form of lateral excavation within laterite have been mapped in and around Ponmala-Mattattur area. Out of the total 363 samples collected, analytical results of 181 samples have yielded gold value ranging from <0.05 ppm to 0.07 ppm, while the arsenic content ranges from <1.00 to 1000 ppm.
	Karimpuzha-Thalipuzha sector of Nilambur	Mapping Trenching/ pitting Sampling	Reconnaissance survey was carried out for gold in the Karimpuzha-Thalipuzha sector of Nilambur. An area of 132 sq. km was mapped on 1:12500 scale. Quartz veins and pegmatites are emplaced mainly in the gneisses. Trenching & pitting, soil sampling and geophysical survey were carried out in the area. A total of 362 samples were collected for study. During panning of stream sediment samples, 3-4 visible specks of gold were reported in most of the samples. Analytical results of two BIF samples from Tumbi Mala showed gold values 0.18 ppm and 0.07 ppm.

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Table - 7 (Contd)

State/District	Location	Details of work done	Results obtained/Remarks
Madhya Pradesh			
Sidhi	Thapna-Garhor Baghara area	Mapping Sampling	Reconnaissance Survey of Gold and associated sulphide mineralisation was taken up in mafic/ ultramafic rocks in Thapna-Garhor-Baghara area. LSM of 100 sq. km on 1:12500 scale revealed the presence of phyllites, ferruginous quartzite, banded iron formation (BIF) with ferruginous chert, chert breccia, dolomite, metabasics, mafic and ultramafic rocks and conglomerate, sandstone and porcellanite unit. Mafic/ultramafic rocks are fine to coarse grained, meso-melanocratic in nature and show some evidences of sulphide mineralisation in the form of pyrite and chalcopyrite specks. The regional trend of rocks is E-W to ENE-WSW direction with south-easterly dip direction. The BIF bands are characterised by laminations of hematite and/or magnetite alternate with quartzite and chert bands. Collected 150 samples from study area. PTS samples were also collected and sent for analysis.
Odisha			
Keonjhar and Dhenkanal	Kantalasua-Kulanga area	Mapping & Sampling	During reconnaissance survey for Gold in the volcano-sedimentary rocks of Bonai-Keonjhar belt in Kantalasua-Kulanga areas, an area of 110.0 sq. km was mapped on 1:12500 scale. The rock types indentified in the study area are quartzite, quartz mica schist, amphibolite, metavolcanics, quartz vein, pegmatite, dolerite and laterite. Pyrite cubes are occasionally noticed in the contact zone of sheared quartzite. The contact zone between the metavolcanics and sheared quartzite is marked by alteration with development of fuchsite and sericite. Analytical result received so far shows silver (Ag) value ranging from <0.2 to 0.28 ppm in 3 stream sediment samples and <0.2 ppm to 0.42 ppm in 13 soil samples. One bed rock sample has yielded value of 0.75 ppm of Ag in quartz vein.
Rajasthan			
Pratapgarh & Udaipur	Devla Pal & Narwari	Mapping & Sampling	Reconnaissance survey for gold and associated metals mineralisation was taken up in areas between Devla Pal and Narwari. The survey involved large scale mapping of 100 sq. km on 1:12500 scale with collection of 445 samples. Major rock types exposed in the area include quartzite, phyllitic dolomite, slate, dolomite, dolomitic marble, dolomitic phyllite and carbonaceous phyllite. Surface indication of mineralisation is observed in the form of ferruginisation, malachite stainings, sulphide dissemination and presence of old workings. Based on surface evidences, two mineralised zones was delineated and systemically sampled.
Udaipur	Nandavel & Dhandawali areas	Mapping & Sampling	Reconnaissance survey for gold and associated mineralisation was taken up between Nandavel and Dhandawali areas. The investigation involved LSM of 100 sq. km on 1:12500 scale along with collection of 445 samples. The rocks exposed comprises of mainly garnet mica schist, quartzite and amphibolites which are intruded by quartz and pegmatite veins. On the basis of old workings, malachite staining and wall rock alteration, a 1.5 km long and 2 m to 5 m wide zone has been demarcated in chlorite schist about 1.25 km northwest of Nandavel village. This zone has been systemically sampled.

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Table - 7 (Concld)

State/District	Location	Details of work done	Results obtained/Remarks
Uttar Pradesh			
Sonbhadra	Kumphiya-Haripur area	Mapping & Sampling	Reconnaissance survey was taken up for gold mineralisation in southern and western extension of the Sonapahari prospect, Kumbhiya-Haripur area. An area of 125 sq. km was mapped on 1:12500 scale. The desultory presence of sulphide minerals such as pyrite, bornite and galena along with the leaching of sulphide minerals, presence of yellow streaks in quartz veins as well as the boxwork structures were noticed in phyllites.
Sonbhadra	Kishunpurva area	Mapping	Reconnaissance survey was taken up for gold mineralsation in Kishunpurva area. The area was covered by large scale mapping of 100 sq. km area on 1:12500 scale. The surface manifestation of mineralisation in the area was seen in form of brown, green and black oxidation surfaces in void space of quartz veins along with the specks of pyrite, chalcopyrite, bornite and arsenopyrite in smoky quartz veins.
	Gurmura-Gurbani area	Sampling	Reconnaissance survey was taken up for gold mineralisation in Gurmura-Gurbani area. The survey involves large scale mapping of 110 sq. km on 1:12500 scale. The area comprises of phyllites and meta-greywacke. The phyllites are intruded by milky white/smoky quartz veins/reefs and cut across by dolerite dykes. Signatures of mineralisation are found in form of scorodite, specks of galena, arsenopyrite, pyrite and arsenian-pyrite in quartz veins/reefs. Scorodite is found in quartz veins/reefs and occurs as fracture and joint filling.
	Phaphrakund-Amarsoti area	Mapping Trenching/ pitting Sampling	Reconnaissance survey for gold mineralisation was carried out in Phaphrakund - Amarsoti area. The study involves large scale mapping on 1:12500 scale, along with bedrock sampling, pitting and trenching. The area comprises of variegated phyllite, chlorite phyllite with thin chert bands, meta-greywacke, impersistent quartzite bands, all intruded by quartz and dolerite dykes. Scorodite, a path finder of gold, was seen at 8 locations as fracture/cavity filling in the quartz veins, around Jurra, Obra village, Mangrauha and Kondari. Arsenopyrite and gossanised quartz veins was also noted north-west of Sonpahari.
West Bengal			
Purulia	Urma-Puriara-Damda-Bamundiha area	Mapping & Sampling	Reconnaissance Survey for gold and associated basemetal mineralisation was carried out within granite gneiss and amphibolite of Chhotanagpur gneissic complex in and around Bara Urma-Puriara-Damda-Bamundiha area. Large scale mapping of about 100 sq. km area on 1:12500 scale was carried out along with the collection of 246 samples. Disseminated oxides and sulphides was noticed in the meta-basic rocks exposed near Kandoya. The quartz vein exposed near Rajapela also bears considerable sulphides and oxides. Sulphide minerals present are mainly represented by chalcopyrite, pyrite and arsenopyrite, whereas, oxides are magnetite and ilmenite. The analytical results of 8 nos of BRS from amphibolites and calc-silicate rock show Au values ranging between 50 ppb and 58 ppb. The Au values of 4 soil samples collected from smoky quartz vein and amphibolite ranges between 50 ppb and 70 ppb. Out of 16 nos of unit cell samples 7 nos of samples, from unit cell 111 and 112, show Au value ranging from 50 ppb to 65 ppb.

Table - 8: Exploration for Industrial Minerals by GSI, DMG/DGM, MECL & GMDC, 2017-18

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
GSI							
Andalusite							
Uttar Pradesh							
Sonbhadra	'C' Block of Pulwar area ,	1:2000	1.50	9	500.00	-	A G3 stage preliminary exploration was carried out in this area, Mahakoshal Group. The litho units reported in the area are andalusite bearing phyllite and intrusives viz. leucogranite and quartz-tourmaline/ quartz veins, pegmatite veins and dolerite dyke shows andalusite crystals in the rocks. Study of the drill cores and surface investigations suggests that andalusite mineralisation is present from the surface to the 35 m vertical drilled depth and the host rock is andalusite bearing phyllite.
	'D' Block of Pulwar area	1:2000	1.50	-	500.00	-	G3 stage preliminary exploration in Mahakoshal Group was carried out. The investigated area exposes alumina rich meta sediments in the form of andalusite bearing phyllites and/ or schists. The andalusite crystals occur as porphyroblasts within a matrix of mica, chlorite and quartz within the phyllites or schists.
Barytes							
Maharashtra							
Chandrapur	Naleswar-Tukum area	-	100.0	-	-	-	During G4 stage reconnaissance survey has been carried out for baryte and associated mineralisation. The various rock types exposed in the area are pink granite, Pakhal sandstone, etc. Baryte occurs as veins and veinlets in pink granite. Analytical results of 75 BRS samples show Barium (Ba) varies from 24.36% to 58.39% with an average of 48.74%. Baryte of Phutana shows 55 to 57% of Ba with minor sulphides, such as Cu value ranges between 10 ppm to 55 ppm, Pb ranging from 10 ppm to 20 ppm. In Dongar Haldi area, Ba content varies from 36.95% to 55.91%. In 25 pit and trench samples, Ba value ranges from 47.36% to 58.65%.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Glauconite							
Bihar							
Rohtas	Chutia--Nauhatta area	1:4000	4.0	10	1000.0	672	G3 stage preliminary exploration for fertilizer mineral (Glauconite) was carried out alongwith pitting/ trenching of 50 cu m material. The rock types in the area include fawn limestone, glauconitic sandstone, welded felsic tuff, etc. Glauconite occurs as squeezed grains pellets, coatings over sand grains and as inter-granular filling in glauconitic sandstone. Bed rock samples shows 2.43% to 4.65% K_2O whereas fine grained sandstone intercalated with shale indicated 2.73% to 5.37% K_2O and welded felsic tuff analysed K_2O content in the range of 4.40% to 5.22%. In core samples K_2O ranging from 3.27% to 5.67%. The K_2O content in the first borehole ranges from 3.90% to 5.61% in fine grained sandstone intercalated with black shale; in second borehole it ranges from 4.34% to 4.36% in glauconitic sandstone and 4.55% to 5.67% in fine grained sandstone intercalated with black shale. In the third borehole K_2O values range from 3.27% to 3.91% in fine grained glauconitic sandstone, from 4.58% to 5.06% in fine grained sandstone intercalated with green shale and 4.30% to 5.66% in fine grained sandstone intercalated with black shale.
	Around Khari Ghata	1:12500	100.0	-	-	-	G4 stage reconnaissance survey has been carried out for glauconitic sandstone and Limestone. The study area exposes limestone and shale/ clay intercalated sequences having well developed horizontal laminations. The maximum exposed thickness of limestone is 35-45 m with wide lateral extent. Analytical results indicate an average CaO% of 44.15%. Al_2O_3, Fe_2O_3, P_2O_5 and SiO_2 are within desirable limits.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Rohtas	Shahpur-Akbarpur area	1:12500	50.0	5	500.0	206	G4 stage reconnaissance survey for glauconite has been carried out in this area. Glauconite mineralised zones were intersected at 14.5 m depth in a borehole and the depth persistence of the mineralised zone was observed upto 110 m in other borehole. Analytical results indicates K_2O values ranging from 4.71% to 5.99% in sandstone intercalated with glauconite. The glauconite intersected in different boreholes occurs mainly in two forms viz. pelletal forms (found in medium to coarse sandstone) and as layered form, found in most of the rocks having finer grain size (siltstone/ shale/ limestone).
Chhattisgarh							
Mahasamund	Around Bhalukona, Khairmal area	1:12500	100.0	-	-	-	G4 stage reconnaissance survey has been carried out for glauconite and associated mineralisation in this area which is represented by reddish brown and greyish white glauconitic as well as non-glauconitic quartz arenite and green to reddish-brown shale. The strike length of glauconite bearing sandstone extends for about 14 km with width of about 150 to 400 m. The glauconitic band shows glauconites of various sizes (1 mm to 4 mm) and shapes (mainly elliptical), colour of glauconite grains varies from pale green to dark green to greenish black. The K2O percentage in the glauconitic sandstone varies from 0.35 to 1.08% in BRS, 0.56 to 1.15% in PTS and 0.54 to 0.95% in PCS.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Madhya Pradesh							
Singrauli	Barhat block, Chitrangi Tehsil	-	-	-	-	-	G3 stage preliminary investigation has been carried for glauconitic shale/ sandstone. Mapping of area unveiled the presence of sandstone, limestone and glauconitic shale. The maximum thickness of the glauconite shale is up to 5 m and minimum varies from 15 to 16 cm. Three bands were traced along with thin limestone intercalations. Fawn limestone is underlain by bluish-green colour glauconitic shale, which is well exposed all along the strike length.
Graphite							
Andhra Pradesh							
East Godavari	Area between Utla and Gangavaram	1:2000	1.03	-	-	-	G4 stage reconnaissance survey was taken up along with detailed mapping for locating graphite and possible tungsten mineralisation in the Eastern Ghat. Pitting and trenching of 167 cu m were carried out. The study area exposes various litho-units such as Khondalite Group and Charnockite Group which are in turn traversed by various pegmatite and quartz veins and Migmatite Group of rocks. A mineralised body of graphite has been traced for a strike length nearly 70 m with width of 1 to 2 m near old working no. 8. Two BRS sample show uranium value 7.03 ppm in khondalite and 9.40 ppm in migmatite. Tungsten values are <5 ppm in all BRS samples. Fixed carbon value ranges from 4.54% to 10.8%.
Arunachal Pradesh							
Upper Subansiri	Around Taliha	-	-	-	-	-	During G3 level preliminary investigation, four discontinuous lenses of quartz schist and carbonaceous phyllite/ schist associated graphite were delineated. In Dupit area an enriched band of graphite-quartz schist was delineated for a strike length of 400 m with an average width of 20 m. A band of intensely crenulated quartz mica schist with flakes of graphite (2 – 5 mm) was also delineated extending up to a strike length of 60 m. One

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
							borehole intersected graphitic schist from 7 to 8.5 m; graphitic marble from 17 to 33 m, 38 to 63 m and 73 to 86 m along borehole length. Preliminary beneficiation studies indicated about 10% fixed carbon content in the graphitic marble.
Chhattisgarh							
Surguja	Kennapara, Tolkipara and Manikpur area	-	107.0	-	-	-	G4 level reconnaissance survey comprising mapping followed by 46.52 cu m trenching and 10 L.km geophysical survey along with collection of bedrock samples, petrochemical samples and trench samples were carried out. The graphite schist occurs associated with quartz sericite schist, grey quartzite and calc silicates. The graphite schist reported as small lenses in the area with inconsiderable strike continuity. The graphite schist varies in length from less than 3 m to 50 m and width from less than 50 cm to 1.5 m. Fixed carbon content in few samples varies from 7.6 to 25.2%.
Jharkhand							
Ranchi	Around Papirda-Jopno-Kubasai areas	1:12500	100.0	-	-	245	G4 stage reconnaissance survey for graphite mineralisation in carbonaceous phyllite was carried out involving mapping, sampling and 100 cu m trenching. Two bands of carbonaceous phyllite have been delineated. In second band, sulphide mineralisation also noticed. Analytical results of 10 BRS samples indicate more than 4% fixed carbon value. Maximum value of fixed carbon is 6.1% and minimum value of fixed carbon is 0.1%, rest 56 samples show fixed carbon value ranging from 0.2% to 6.0%. Out of 100 PTS samples collected, 30 samples yielded fixed carbon value ranging from 0.3% to 2.8%. Vanadium value from 41 BRS ranges from 178 ppm to 1231 ppm. In five BRS samples the vanadium values ranges from 583 ppm to 1231 ppm and in one PTS, it is reported 688 ppm.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Madhya Pradesh							
Betul	Golighat – Junawani -Borgaon and Rathipur-Chikhli-Bhopali areas	1:12500	102.0	-	-	-	During G4 stage reconnaissance survey for graphite in this area, three graphite bands in Golighat-Junawani-Borgaon area (Block-I) and three graphitic schist bands in Rathipur-Chikhli-Bhopali area (Block-II) were delineated. Near Golighat village a graphite schist band occurs as lensoidal body within the granite gneiss. The fixed carbon (FC) values ranges from 3.49% to 18.14%. Another graphite schist band, is noticed in the southeast of Makra village. In Rathipur-Chikhli-Bhopali area, three graphitic schist bands area delineated. A graphitic band (Band-I) with micaceous and phyllitic partings is exposed near Baba Mandir for a strike length of about 1.2 to 1.35 km with thickness varying from 4 to 12 m. The average fixed carbon value recorded in this band-I is 7%-8%. Another graphitic band (Band-II) is exposed SW of Bhopali and extends for a strike length of about 1.7 to 1.8 km with average value of fixed carbon varying from 6% to 8%. One more graphitic band (Band-III) exposed for about 3.5 km to 4 km in SW of Bhopali have recorded average fixed carbon value of 9%.
Odisha							
Angul	Dandatapa block	-	1.5	4	328.1	152	During G3 level preliminary exploration for graphite, 35 cu m of trenching was done in the area. Graphite mineralisation has been delineated through pitting and trenching for a length of 40-45 m with width of about 4-5 m. All the four boreholes intersected sporadic graphite mineralisation at different depths along the boreholes except 1.0 m graphite zone in borehole ODDAN-01 and 10 cm in borehole ODDAN-4 with minor sulphides in the form of specks, stringers and occasional disseminations of pyrite, pyrrhotite and chalcopyrite.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Potash							
Rajasthan							
Ganganagar	Satipura sub-basin of Nagaur-Ganganagar basin	-	-	8	6250.60	2604	G3 level preliminary exploration has been carried out. Two core sample of borehole RJNGS-01B indicates significant K_2O value of 13.85% and 13.73%. Again two core samples of borehole RJNGS-04A also indicates high values of K_2O i.e. 20.72% and 25.29%.Core sample of borehole RJNGS-02 also indicates significant 20.72% K_2O.
Phosphorite							
Himachal Pradesh							
Sirmaur	Lower Tal Korgai Syncline	1:12500 1:1000	50.0 0.5	-	-	-	G4 level reconnaissance survey has been taken up in Shaliyan Formation, which comprises of black chert, dark brown to black shale, phosphatic shale, phosphatic granular chert and grey siltstone and shale. In the trench samples value of P2O5 has been reported less than 1%. The Cambrian succession of Regional Korgai Syncline contains ichnofossils. Ten ichnogenera identified include: Cruziana tenella, Diplichnites isp., Rusothycus isp., Diplocraterion, Palaeophycus isp., Skolithos isp., Dimorphicus obliques, Diplichnites gouldi, Rusophycus isp., and Palaeophycus tubularis.
Jharkhand							
Garhwa	Around Muskaniya-Sinduria area	1:12500	100.0	-	-	125	G4 level reconnaissance survey for phosphate and potash fertilizer mineral has been carried out by large scale mapping. Four major folding structures viz; Panda anticline, Amrora syncline, Konmandra anticline, Ghagra syncline, were demarcated in the area. Brecciated, ferruginised variety of cherty (porcelainitic) shale, black splintery calcareous shale, dolomitic limestone, arkosic sandstone and black chert showed good phosphatic values. Chemical analysis of green shale, cherty shale, black and green chert indicates the presence of significant potash (5-8% K_2O).

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Odisha							
Sundargarh	Around Chhatabar-Surulata area	1:12500	100.0	-	-	-	G4 stage survey for phosphorite was carried out in the Ib River Coalfield. The phosphorite occurs as nodules upto 20 cm in size and sporadic in nature has been reported within siltstone and claystone and within fine grained sandstone. At some places, the siltstone and claystone itself found to be phosphatic.The phosphorite has a maximum thickness of 0.5 m.
Limestone							
Chhattisgarh							
Raigarh	Laladhurwa-Jognipali block	1:4000	4.0	33	1301.5	1162	G2 stage general exploration for limestone was carried out in this area which comprises of limestone, at places it is traversed by calcite veins. The limestone has been intersected on an average depth of 1 m to 6 m. Out of the 33 boreholes drilled, 22 boreholes are considered positive. Pyrite crystals and calcite veins are noted in cores. The types of samples like core samples, BRS, PCS, XRD collected were sent for analysis. The analytical results of 3 BRS samples and 10 PCS samples have shown CaO value upto 45.34%. Analytical results of 110 nos of core samples reported CaO value upto 51.43%.
Karnataka							
Gulbarga	Wadi area	1:4000	5.5	-	-	-	G2 stage general exploration for flux grade limestone was carried out by detailed mapping. Drilling of 36 boreholes was planned at 400 m x 400 m grid pattern in flaggy limestone. The north eastern part of the area has been occupied by the flaggy limestone. The top limestone layer up to 17 m depth is of flux grade, followed by cement grade limestone. The cement grade limestone is reported up to 45 m depth in the southern part of the area.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Bagalkot	Hanamaneri block	1:4000	4.3	24	1200.0	594	G2 stage general exploration for Limestone was carried out in NW of Hanamaneri block. The area is comprised of grey limestone, variegated limestone, grey/ white dolomite and argillite. All the lithounits contain limited intercalated marl and argillite. The grey limestone occurring as bands are varying from a few mm to 30 cm alternating with marl. Carbonate veins are traversed along/ across grey limestone. Eighteen boreholes had intersected grey limestone, variegated limestone with intercalation of marl/ dolomite/ argillite bands/ laminae; grey/ white dolomite in four boreholes and weathered limestone/ dolomite in three boreholes. Analytical results show CaO value ranging between 38.42% and 52.40% / 26.10% and 48.60% respectively.
	Varchagal area	1:4000	3.4	17	817.0	29	G3 level preliminary exploration for limestone/ dolomite was carried out in west of Varchagal area. During drilling, seven boreholes have intersected the dolomite unit, six boreholes have intersected alternating units of dolomite and soil horizon, three boreholes intersected ferruginous/ calcretised/ lateritic zone with soil horizon and one borehole has intersected an argillite dominant unit with thin lamellae of limestone. The analytical results of 4 core samples indicates the CaO value ranging between 25 to 39.04%, MgO between 16.02 to 19.05%, SiO_2 is around 1%, Al_2O_3 from 0.19 to 0.31%, Fe_2O_3 from 0.24 to 0.40%, Na_2O from 0.13 to 0.18%, K_2O from 0.09 to 0.18%, MnO is 0.01 and P_2O_5 is <0.01%.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Bagalkot	East of Varchagal	1:4000	2.2	-	809.5	-	G3 level preliminary exploration for SMS grade limestone was carried out in this area. Lithology includes limestone, dolomite and shale. All the boreholes intersected limestone units comprises of grey limestone, pink limestone, argillite units and variegated limestone. Based on the drilling data of boreholes, it is observed that the eastern portion of the block has a thick soil cover of around 5-7 m while western portion has an average soil thickness of 3 m. It is followed by a fractured/ weathered/ eroded (pothole) zone of around 20 m thick overlying limestone/ dolomite/ shale. Grey limestone samples have analysed CaO values up to 52%.
Gulbarga	Bahmanhalli area	-	-	20	916.75	-	G2 stage general exploration for Flux Grade Limestone was carried out around Bahmanhalli area. A block measuring 5 sq. km area was proposed for study. Stylolitic limestone is intersected in almost all the boreholes. The depth range of intersection of stylolitic limestone varies from 4 m to 36 m with an average thickness of 15 to 20 m. Towards the northern part of the block intersection of stylolitic unit is at higher depths.
Meghalaya							
East Jaintia Hills	In Samasi-Pala block (Litang Valley)	1:4000	3.0	15	1267.12	-	G3 stage preliminary exploration for limestone was carried out in this block. The Prang limestone is the target horizon and has an average thickness of 70.93 m. The common foraminifers are Nummulites sp., Discocyclina sp., Assilina sp., Alveolina sp., and Nummulites. The overall grade of limestone is Cement (Portland) grade and resources were estimated at 289.27 million tonnes.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
East Jaintia Hills	Umkyrpong area	-	-	9	959.10	-	G3 stage preliminary exploration for limestone has been carried out in this area. The major litho-units exposed are splintery shale, siltstone and marl which are underlain by a very thick highly fossiliferous Upper Sylhet (Prang) Limestone. The average thickness of Upper Sylhet limestone intersected along nine boreholes is 93 m. A net reserves of 361.909 million tonnes has been estimated. Very enriched phosphorite nodules horizons in lower part of Kopili Formation have been noticed. The phosphatic nodules are of various shape and size varies from 2 mm to 8 cms. Chemical analysis of marl and phosphate nodules shows P_2O_5 of 4.4% and 15.75%, respectively.
	East of Laphet area (Litang Valley)	1:4000	3.0	-	953.2	-	During G3 level preliminary exploration, it is observed that upper Sylhet limestone is overlain by Kopili Formation and underlain by upper Sylhet sandstone. The thickness of limestone varies from 60.05 m to 115.2 m. The Kopili Formation overlying Upper Sylhet limestone was encountered in four boreholes with an average thickness of 25.97 m. Limestone resources in the area have been estimated at 630.02 million tonnes mostly of blendable/ beneficiable cement /portland grade.
	South of Akshe area (Litang Valley)	1:4000	3.0	5	662.3	-	G3 level preliminary exploration for Prang limestone in Litang Valley shows an average thickness of 120 m. The common foraminifers are Nummulites sp. , Discocyclina sp., etc studies show that the bio-clast is represented mainly by foraminifera shells and broken shell fragments which forms a coarser framework of grains and are cemented by calcite and have carbonate mud as the matrix.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Rajasthan							
Jaisalmer	Area South of Khuiala	-	125.0	13	-	123	G4 stage reconnaissance survey for SMS/cement grade limestone was taken up in this area by large scale mapping. Limestone/clayey limestone were intersected in eight boreholes. In borehole RJK 05, 8.10 m thick hard and compact limestone was intersected from the ground level and clayey limestone of 11.80 m thickness intersected upto a depth of 21.30 m with thin clay partings. In borehole RJK-10 a total width of 29.50 m clayey limestone was intersected.
	Pohar area	-	125.0	15	-	123	G4 level reconnaissance survey for SMS/ cement grade limestone was taken up in Pohar area. Boreholes were drilled between 30 m to 50 m in depth. Low silica limestone was intersected in upper 10 m depth. The thickness of individual bands of limestone varies from 0.20 m to 1.50 m. At some places presence of very thin arenaceous bands were noticed within low silica limestone.
	Tanasar (east) block	-	9.6	15	747.0	224	G3 level preliminary exploration for low silica SMS grade limestone was carried out. The grey brownish shale and greyish-white coarse grained foraminiferal limestone is seen in the south-western part. Limestone of Bandah Formation cumulative thickness varies from 2.99 m to 16.66 m and intersected clay thickness ranges from 14.59 m to 39.40 m. Intersected thickness (cumulative) of limestone of Khuiala Formation varies from 0.7 m to 12.00 m.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Jaisalmer	Tanasar (west) block	-	6.4	10	501.0	112	G3 level preliminary exploration for low silica SMS/ Cement grade limestone was carried out in the study area. Limestone of Bandah Formation intersected ranges in thickness (cumulative) from 6.99 m to 16.61 m and intersected cumulative thickness of clay ranges from 26.95 m to 38.01 m. Intersected cumulative thickness of limestone of Khuiala Formation ranges from 0.97 m to 3.66 m. In one borehole pyritiferous shale containing forams and carbonized remains of plant was intersected at 27.40 m depth.
Decorative Stone							
Odisha							
Gajapati	Antarba & Kandha Adaba	1:25000	210.0	-	-	57	Four nos of deposits i.e. i) Derab : 1600 m x 900 m, ii) Tentulikhunta : 700 m x 500 m, iii) Barupada : 200 m x 150 m and iv) Baharpada-Jamurhiha : 2300 m x 500 m were identified.
Dhenkanal & Angul	Tulsipal, Nalatangra, Nuagaon & Sarapa	1:25000	213.0	-	-	66	The surface area of four decorative stone ocurrences are i) Tulsipal-30,350.055 sq.m ii)Nalatangra-23,280.337 sq.m,iii) Nuagaon- 4,719.4642 sq. m and iv) Sarapa - 18,399.734 sq. m.
Pyrophyllile							
Kendujhar	Roduan	1:2000	0.508	-	-	20	Pyrophyllite occurs in the old abandoned mines below quartzite having thickness of 30 m. The thickness of ore body is about 4 to 5 m.
Garnet							
Angul & Kendujhar	Birlamunda & Sarai villages	1:2000	1.145	-	-	42	In situ garnet mineralised zone extends for a cumulative length of 100 m and width of 50 m with thickness proved up to 4 m depth. Total 4810 kg samples were collected. The garnet is of abrasive grade.
Graphite							
Rayagada	Jagdalpur	1:2000	0.297	24	515.0	140	The thickness of dissiminated graphite varied from 1.20 m to 18.80 m and encountered up to maximum depth of 29.50 m.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Directorate of Mining & Geology, Jharkhand							
Graphite							
Palamu	Ponchi area, Satbarwa block	1:2000	0.10	5	270.00	100	During G2 stage exploration, 4 pitting/trenching were carried out. The carbon content in surface samples varied from 3.55% to 46.28% and in core samples it varies between 2.03% to 10.51%. Resources estimated at 0.243 million tonnes under indicated category.
	Dulsulma, Satbarwa block	1:2000	0.40	23	1004.50	292	Analysis report of the surface samples shows carbon content varied between 2.3% to 13.44% and in core samples it varied between 2.56% to 12.23%. Resources estimated at 1.48 million tonnes under indicated category.
	Rewaratu	1:4000	0.70	7	313.50	86	Six trenches were digged and excavated 180 cu m material. Resources estimated at 0.17 million tonnes.
	Bhusariatola	1:2000	1.50	-	-	9	Four trenches were digged and excavated 28 cu m material. The area falls under eco-sensitive zone.
	Chanpi	1:4000	0.07	-	-	10	Five trenches were digged and excavated 100 cu m material. Further investigation will be proposed after completion of mapping.
Limestone/Dolomite							
Garhwa	Village-Khutia Block-Dhurki	1:4000	1.17	21	705.9	485	i)Total indicated category resources of dolomite estimated at 25.87 thousand tonnes with an average grade of MgO-1.4%, CaO-41.86% and SiO_2-14.67%. ii)Dolomite resources estimated at 1.528 million tonnes under indicated category with an average grade of MgO -18.95%, CaO-30.28% and SiO_2-4.58%.
Ranchi	Piyartanr, Block-Khalari	1:4000	1.12	12	551.8	452	Resources estimated at about 0.54 million tonnes.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Directorate of Mining & Geology, Kerala							
Aluminous laterite/China clay							
Kannur	Karakundu area, Alakkad Desham, Panappuzha village, Thaliparamba Taluka	-	-	16	414.50	104	The lithology of area mainly comprises aluminous laterite over burden followed by lateritic clay, variegated clay. The average thickness of aluminous laterite overburden is about 4 m and that of low grade china clay is about 8.5 m. The tentative indicated category resources of low grade china clay were estimated in the area at 11.00 million tonnes and that of aluminous laterite at 5.00 million tonnes.
	Ezhum Vayal area, Alakkad Desham, Panappuzha village, Thaliparamba Taluka.	-	-	4	140.50	46	The average thickness of aluminous laterite overburden is about 6 m and that of low grade china clay is about 18 m. The tentative indicated category resources of low grade china clay in the area estimated at 4.00 million tonnes and that of aluminous laterite at 2.00 million tonnes.
	Ooradipara, Koipra area, Vellora Desham, Vellora village, Thaliparamba Taluka.	-	-	20	591.00	170	The average thickness of overburden is about 5 m and that of low grade china clay is about 13 m. The tentative indicated category resources of low grade china clay in the area were estimated at 20.00 million tonnes and aluminous laterite at 7.5 million tonnes.
Directorate of Mining & Geology, Rajasthan							
Dolomite and other economic minerals							
Rajsamand	N/v Unwas, Khamnor, Semal,Semalli Bhagal, Asi Bavri, etc., Khamnor Tehsil, Nathdwara.	1:10000 1:4000	20.00 1.00	-	-	14	Two dolomite bands have been mapped i.e. one from village Khamnor is Kalore of strike length of 7.5 km with an average width of 1.5 km and another from Karoli Ki Dhani to Asi Bavri of strike length of 7.00 km with an average width of 1.00 km. Chemical analysis result awaited.
Yellow Limestone							
Jaisalmer	Jajiya Kuldhra Bhojaniyon Ki dhani, etc..	1:50000 1:10000 1:2000	50.00 10.00 2.00	-	-	-	Thickness of SMS grade limestone varies from 6.75 m to 15.00 m and underlying chalky cement grade limestone varies from 27.00 m to 38.00 m. The exploration will contiune.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Limestone-SMS and cement grade							
Jaisalmer	N/v Sam	1:10000 1:6336	15.00 3.00	15	600.00	500	Thickness of SMS and cement grade limestone varies from 6.75 m to 15.00 m and chalky grade limestone from 27.00 m to 38.00 m. The exploration will continue. Resources will be calculated after receiving complete chemical analysis of core samples.
Limestone							
Ajmer and Nagaur	Around villages Pilwa, Chinwali, Dhandota, etc.	1:50000 1:6000 1:4000	150.0 15.0 02.0	-	-	16	The limestone exposed to east of village Jhak. Few isolated outcrops of impure limestone was exposed due east of Jakholai.
Chittorgarh	Samriya Kalan, Nalhuramji Ka Khera, Meghniwas and Mandna Begun-Taluka.	1:10000 1:4000	5.00 3.00	-	-	-	The limestone mapped in the area having strike length of 8.5 km with width of more than 2 km. The exploration will contiune. Reserves were not estimated.
Bhilwara	Ratiyakhera, Dhakarkhedi, Dola ka Jhopda, Biharipura, Rampuriya, Daulji ka Khera and Ladpura, Mandalgarh Tehsil.	1:10000 1:4000	30.00 6.75	6	324.00	261	Exploration will continue in field session 2018-19.
Nagaur	N/v Desh, Jayal Tehsil.	-	-	7	313.00	-	Exploration by drilling has been carried out on 800 m x 800 m and 1600 m x 1600 m grid pattern and resources were estimated at about 149.65 million tonnes of cement grade limestone. Further drilling will continue in field session 2018-19.
Limestone, Marble, Granite							
Pali	N/v Sarangawas, Sonana and Aana, Tehsil Desuri	1:5000 1:1000 1:4000	100.00 10.00 2.00	2	190.00	38	Limestone encountered in boreholes is grayish to dark grayish in colour and medium grained and crystalline. Limestone seems to be of cement grade. Bands of Marble have been located west of village Sarangawas over a strike length of 500 m with width varying from 100 m - 215 m. The second phase drilling will be carried on 400 m x 400 m grid pattern in field session 2018-19.

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Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Alwar	N/v Badh Beleta, Raini	-	-	2	51.5	-	Limestone possibilitise could not be establilshed in the area.
Jaipur and Alwar	N/v Bithloda, Mandha, Bhankri, Karoi, Nayabas, etc.	1:4000	3.20	1	33.0	06	Exploration was taken up to prove concealed limestone reserves in gap areas of Kotputli limestone belt.
Jhunjhun and Sikar	N/v Parasrampura, Gothra	1:4000	2.00	-	-	-	-
Sirohi	Aburoad Tehsil, Pindwara	1:10000 1:4000	10.00 1.00	6	400.00	64	The marginal cement grade limestone resources estimated at 1.69 million tonnes under indicated category and 0.79 million tonnes under inferred category.
Limestone and Dolomite							
Ajmer	Shyamgarh, Pakriyawas, Kanakheda, Kesarpura, etc Tehsil Beawar.	1:10000 1:4000	10.0 2.0	-	-	36	Limestone with calc schist have been mapped in an area of 3650 m x 40-800 m near villages Shivpuraghata, Rawal-Ka-Bariya, Jhak, etc. Similarly seven limestone bands have been mapped near village Kotra-Ka-Bariya and Banola, Tehsil Beawar.
Tonk	N/v Khalilpura, Dodwari, Davri, Jabriya, etc.	1:10000 1:4000	5.0 2.0	-	-	06	N/v Jaberiya, two impure limestone bands of dimensions 250 m x 30 to 40 m and 200 m x 20-40 m was mapped.
Dolomite							
Pratapgarh	N/v Pipliya, Karnal, Bikalwas, Vijaniya, etc Tehsil Dariyawad	1:50000 1:10000 1:4000	50.0 10.0 1.0	-	-	-	The dolomite is intermittently exposed for about a strike length of 4.4 km with width of 50-150 m. Limestone occurring as thin band of 1-2 m and seems to be siliceous in nature.
Yellow limestone							
Jaisalmer	N/v Jajiya	1:50000 1:10000 1:40000	50.0 10.0 02.0	-	-	-	About 0.5 sq. km potential area of yellow limestone suitable for dimensional stone having thickness from 0.5 m to 1.50 m have been located n/v Jajiya Dedha, Bhojaniyon Ki Dhani.
Gypsum							
Nagaur	N/v Jodhyasi, Mandha, Hinguniya, Titri and Chau	1:50000	300.0	-	-	06	-
Marble							
Banswara	N/v Asoda, Gara Himmatshing, Bassi Chandsing and Lasara. Tehsil Garhi	1:2000	2.25	-	-	-	The marble band is intermittently exposed for about 7 km strike length with width of 30 to 240 m. Near village Asoda, three marble area of each 4 ha were delineated for auction.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Sandstone							
Jaisalmer	N/v Sattasar, Tehsil Pokaran	1:10000 1:2000	10.0 1.0	6	400.00	64	The area comprised of maroon to reddish brownish coloured sandstone suitable for masonary stone/dimensional stone. Reserves were not calculated.
Granite							
Rajsamand	N/vAnoppura Jemakhera, Hirakheda, etc. Deogarh-Tehsil.	1:10000 1:4000	205.0 1.0	-	-	-	N/v Jaberiya, two impure limestone bands of dimension 250 m x 30 to 40 m and 200 m x 20 to 40 m was mapped.
Clay, red Ochre and other economic minerals							
Chittorgarh	Pavli, Baru, Karithra, Muroli, Rud, Bamina, Tehsil Rashmi	1:50000 1:10000 1:4000	100.0 12.0 1.70	-	-	11	Two bands of banded haematite quartzite & ferruginous quartzite were noticed. First band observed from south of Karithra to north of Pavli for about 5.7 km in length and width varying up to 200 m. Chemical result of spot samples shows FeO 0.12%-0.38%, Fe_2O_3 content varying from 42.06% to 48.28%, Al_2O_3 from 1.70% to 2.95%, Co from 27.4 to 89 ppm, Mn from 40 ppm to 0.05%. Other band observed near south of Baru village for about 400-500 m in length and width upto 200 m. Chemical result show FeO 0.25%, Fe 27.50%, Fe_2O_3 38.69%, Al_2O_3 4.95%, Mn 2.28%, Co 154 ppm. Reserves were not calculated.
Clay, ochre, iron, granite, etc.							
Bhilwara	N/v Chandgarh,, Raghunathpura, and Jeeva ka Khera, etc. Tehsil-Kotri	1:50000 1:10000 1:4000	250.0 35.0 3.75	6	287.0	13	Reserves/Resources were not calculated.
Quartz, feldspar and other economic minerals							
Bhilwara	Tiloli, Devthari, Amdala, Jhalriya, etc.	1:50000 1:1000 1:4000	400.0 10.0 1.0	-	-	15	Reserves/Resources were not calculated.
	Bhunas,Mahendra-garh, Shivartiya, etc.	1:10000 1:4000	20.0 1.0	-	-	-	-
	N/v Chnadgarh, Raghunathpura, and Jeeva Ka Khera, etc. Tehsil Kotri	- 1:10000	- 20.0	2	86.0	-	Prospecting results are not encouraging.

(Contd)

Table - 8(Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Clay, Lignite, Silica Sand, etc.							
Nagaur & Churu	Lalgarh, Surpaliya and, Jogalsar, etc.	1:50000	300.0	-	-	01	Reserves were not estimated.
Sandstone							
Jodhpur	N/v Kasti, Tehsil Baori,	1:50000 1:10000 1:4000	200.00 10.00 2.00	-	-	15	Occurences of bedded & jointed sandstone were noticed N/v Kasti width varying from 350-850 mm which is of creamish colour & compact in nature.
Baran	N/v Nahargarh, Motipura, Durjanpura, Gigchi, Badiura, Tehsil-Kishanganj	1:50000 1:10000 1:4000	150.0 25.00 3.00	-	-	-	Reserves were not estimated.
Bikaner	N/v Dulmera, Tehsil Lunkaransar	1:50000	300.00	-	-	02	Reserves were not estimated.
Silica sand							
Karauli	N/v Bariya, Gothra, Rampura, Kodai, Tehsil Karauli & Sapotra	1:50000 1:10000 1:4000	150.00 30.00 2.00	-	-	12	Silica sand resources estimated at 20.225 million tonnes.
Directorate of Geology, Odisha							
Limestone							
Odisha							
Bolangir	Lukapada	1:1000	0.51	21	644.1	218	Exploration was taken up to assess limestone resources. Drilling data of 21 boreholes indicates the limestone is of crystalline in nature and occurs as irregular and impersistent bands within the host rock. Maximum and minimum thickness of limestone varies from 34.97 m to 8.25 m with maximum depth up to 37.30 m.
Quartz							
Boudh	Eastern bank of Bagh river around Lumurajhala-Sialimunda villages	1:2000	0.14	-	-	21	The average length and width of four quartz cores of disintegrated zoned pegmatite are i) North of Lumurajhal : 25m x 11 m, ii) South of Lumurajhala : 48 m x 32 m, iii) SW of Lumurajhala : 50 m x 10 m and iv) SE of Lumurajhala 70 m x 30 m. Total 101 cu m material was excavated by pitting/ trenching.
Quartz & Quartzite							
Mayurbhanj	Mundrajodi Pokharia in Sadar sub Division	1:5000	0.5	-	-	28	The length of quartz body is 120 m and width 70 m. Total 100.4 cu m excavation was carried out.

(Contd)

Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Decorative Stone							
Gajapati	Around Taraba & Lubarsing	1:25,000 1:4000	200.0 0.65	-	-	46	Four number of deposits were identified i.e. i) Nuagan : 420 m x 400 m, ii) Betarsing : 630 m x 600 m, iii) Damba : 380 m x 270 m and iv) Padmapur : 100 m x 70 m. Total 16 cu m material was excavated. Reserves/Resources estimation is under progress.
	Antarba & Kandha Adaba	1:25000	210.0	-	-	57	Five nos. of deposits i.e. i) Derab : 1600 m x 900 m, ii) Tentulikhunta : 700 m x 500 m, iii) Barupada : 200 m x 150 m and iv) Baharpada-Jamurhiha : 2300 m x 500 m were identified. i) Derab (E) : 25.56 million tonnes, ii) Derab (W) : 23.47 million tonnes, iii) Tentulikhunta : 6.58 million tonnes, iv) Baharpada-Jamurhiha (E) : 12.66 million tonne and v) Baharpada-Jamurhiha (W) : 10.71 million tonnes.
Dhenkanal & Angul	Tulsipal, Nalatangra, Nuagaon & Sarapa	1:25000	213.0	-	-	66	The surface area of four docorative stone ocurrences are i) Tulsipal-30350.06 sq. m, ii) Nalatangra-23280.34 sq. m, iii) Nuagaon- 4719.46 sq. m and iv) Sarapa - 18399.73 sq. m.
Pyrophyllile							
Kendujhar	Roduan	1:2000	0.508	-	-	20	Pyrophyllite occurs in the old abandoned mines below quartzite having thickness of 30 m. The thickness of ore body is about 4 to 5 m.
Garnet							
Angul & Kendujhar	Birlamunda & Sarai villages	1:2000	1.145	-	-	42	In-situ garnet mineralised zone extends for a cumulative length of 100 m and width of 50 m with thickness proved upto 4 m depth. Total 4810 kg samples were collected. The garnet is of abrasive grade.
Graphite							
Rayagada	Jagdalpur	1:2000	0.297	24	515.0	140	The thickness of dissiminated graphite varied from 1.20 m to 18.80 m and encountered upto maximum depth of 29.50 m.
DGM, Chhattisgarh							
Limestone							
Bhatapara-Balodabazar	Sarseni-Guma area	1:50000 1:4000	60.0 2.70	35	1014.50	920	In a borehole limestone deposit is recorded upto a depth of 47.50 m. Resources were estimated at about 135.00 million tonnes, tentatively.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Raipur	Kathia-Pachri, Bharuadih area	1:50000 1:4000	70.0 3.61	46	1619.80	1585	Limestone in a borehole is recorded upto a depth of 60.40 m from surface. Resources were estimated at about 180.00 million tonnes tentatively.
Jangir-Champa	Ghutia block, Tehsil Nawagarh	1:50000 1:4000	95.00 1.08	19	406.00	406	Limestone deposits in this block occurs from surface to 35.00 m below ground. Resources were estimated at 16.35 million tonnes under indicated category.
Bilaspur	Rahtator-Manwa block, Tehsil Masturi	1:50000 1:4000	95.00 0.36	6	135.50	160	Limestone deposits of this block recorded from surface to a depth of 31.00 m. Resources were estimated at 13.33 million tonnes under inferred category.
Raigarh	Kutela-Durgapali block, Tehsil Sarangarh	1:50000 1:4000	100.00 1.16	20	459.00	386	Limestone recorded from surface to a depth of 32.00 m. Resources were estimated at 34.70 million tonnes under indicated category.
Bastar	Ichhapur area area	1:50000 1:4000	143.0 3.51	35	1113.15	981	The depth persistence of limestone deposit recorded at a depth of 50 m. Resources were estimated at about 105.00 million tonnes .
DGM, Uttar Pradesh							
Barytes							
Lalitpur	Mathara-Dang area	1:12,500	60.00	-	-	160	A G4 level exploration was taken up in the area. Digging on 07 nos pit of dimension 2mx2mx2.5m and 02 nos. trench of dimension 13.3m x 1.0m x 1.5m were carried out during the exploratory work. Further exploration will be carried out during 2018-19 in the adjacent area to Mathara-Dang.
Rock phosphate							
Lalitpur	Semarkhera, Tori, Pisnari, & Sonrai area	1:2000	1.89	-	-	15	A G3 level exploration was taken up to assess rock phosphate resources in the eastern most Vth block as per MMRD, Act 2015. During regional traversing while tracing extension of rock phosphate in eastern part, suphide mineralisation was noticed in Jaitupura area. Chemical analysis of samples show good indication of Cu values.
Dimensional stone							
Lalitpur	Parts of Madawara & Pali of southern part of Latitpur	1:50000	50	-	-	-	Different varieties of dimensional stones in 17 new blocks aggregating 300 acres area has been indentified and over 20 samples of different sizes were colleced for evaluation of quality, cutting, polishing characteristics, market acceptatility and other geotechnical properties.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
MECL							
Chhattisgarh							
Bilaspur	Ranigaon Gondaiya block Kota Tehsil	1:10000	6.5	15	492.5	167	A G3 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 40 m x 400 m grid interval, ii) find out quantity and quality/grade of limestone, etc. The exploration was funded by NMET. The major rock formation of the area are dolomite, shaly limestone/ dolomitic limestone and limestone of Raipur group. Reserves/Resources estimated 43.65 millon tonnes of limestone with an average grade of CaO 44.54%, MgO 1.41%, SiO_2 8.18%, Al_2O_3 1.05%, Fe_2O_3 1.53% and LOI 38.16% under inferred category (333).
Madhya Pradesh							
Satna	Naubasta-Kolard block Nagod Tehsil	1:10000	15	7	305.00	111	A G3 level exploration was carried out with an objective to i)demarcate the limestone occurrences at shallow depth by drilling at 800 m x 800 m grid interval, ii) find out quality of limestone and iii) carry out exploration as per Mineral (Evidence of Mineral contents) Rule 2015, etc. The exploration work was funded by NMET. Reserves/Resources were estimated at 131.10 million tonnes of limestone with CaO 45.26%, MgO 2.04%, SiO_2 10.05%, Al_2O_3 1.58%, Fe_2O_3 1.18% and LOI 38.09% under inferred category (333).
Satna	Gunchihai block, Rampur Baghelan Tehsil	1:5000	6.5	38	1461.0	549	A G2 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 400m x 400 m grid intervel, ii) estimate the quantity and quality/grade of limestone and iii) carry out exploration as per Mineral (Evidance of Mineral contents) Rule, 2015, Mineral Auction Rule, 2015, etc. The work was funded by NMET. The rock formation of the area comprises sandstone, shale and limestone. Reserves/ Resources of limestone were estimated at 68.02 million tonnes with an average grade of CaO 44.71%, MgO 2.33%, SiO_2 10.50%, Al_2O_3 1.68%, Fe_2O_3 1.61% and LOI 37.43% under inferred category. (332)

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Satna	Jamodi-Mahanna block, Khamriya,Pasiyan, Phutainaha, Phutondhi and Ramsthan areas, Raghurajnagar-Tehsil.	1:10000	31	83	3731.00	1641	A G3 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 400 x 400 m grid intervel, ii) estimate the quantity and quality/grade of limestone and iii) carry out exploration as per Mineral (Evidence of Mineral contents) Rule, 2015, Mineral Auction Rule, 2015, etc. The projcet was funded by NMET. Reserves/Resources of limestone were estimated at 264.4051 million tonnes with an average grade of CaO 44.46%, MgO 2.17%, SiO_2 9.55% Al_2O_3 1.97%, Fe_2O_3 1.48% and LOI 37.59% under indicated & inferred categories.
Telangana							
Suryapet	Pasupulsbodu block, Janpahad village, Nereducherla Mandal	1:5000	1.36	3	108.0	95	A G3 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 800 m x 800 m grid interval, ii) estimate the quantity and quality/grade of limestone and iii) carry out exploration as per Mineral (Evidence of Mineral Contents) Rule, 2015, Mineral Auction Rule, 2015, etc. The project was funded by NMET. Reserves/Resources of limestone were estimated at 41.68 million tonnes with an average chemical composition of CaO 46.39%, MgO 0.73%, SiO_2 10.90%, Al_2O_3 1.30%, Fe_2O_3 1.09% and LOI 38.01% under inferred category.
	Sultanpur block, Mattampally Mandal.	1:5000	1.39	3	130.0	142	A G3 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 800m x 800 m grid interval, ii) find out the quantity and quality/grade of limestone and iii) carry out exploration as per Mineral (Evidence of Mineral Contents)Rule, 2015, Mineral (Auction) Rule, 2015, etc. The exploration was funded by NMET. Reserves/Resources of estimated at 80.21 million tonnes with an average grade of CaO 47.10%, MgO 1.22%, SiO_2 9.75%, Al_2O_3 1.32%, Fe_2O_3 1.00% and LOI 38.22% under inferred category.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Suryapet	Saidulnama block,Mahanadi Gudem village, Palakeedu Mandal	1:5000	1.70	3	127.0	136	A G3 level exploration was carried out with an objective to i) demarcate the limestone occurrence in the area by drilling boreholes at 800 x 800 m grid interval, ii) find out the quantity/grade and quality of limestone and iii) carry out exploration as per Mineral (Evidence of Mineral contents) Rule, 2015, Mineral (Auction) Rule, 2015, etc. The exploration was funded by NMET. Reserves/Resources estimated at 71.86 million tonnes with an average grade of CaO 46.79%, MgO 0.84%, SiO_2 10.02% Al_2O_3 1.22%, Fe_2O_3 1.01% and LOI 38.03%.
GMDC							
Bauxite							
Gujarat							
Sirmaur	Naredil	-	-	14	28.5	06	About 0.07 millions tonnes resources were estimated.
Lignite							
Gujarat							
Sirmaur	Tagadi Block-A, Block-B	-	-	14	28.5	06	Lignite is brownish black, in colour, amorphous and fine grained in nature.The total resources were estimated at 114.72 million tonnes.Out of this the total resources estimated in block - A is 89.56 million tonnes and in block B has been estimated at 25.16 million tonnes.
	Mevase	-	-	-	-	-	Resources were about 19 million tonnes.
	Tadkeshwar	1:5000	-	-	-	-	Resources were about 14.85 million tonnes at the end of March, 2018.
Kachchh	-	1:5000	-	-	-	-	Resources were about 14.85 million tonnes at the end of March, 2017.
	Mata no Madh	1:5000	-	-	-	-	
Fluorite							
Chhota Udepur	Ambadonger mine	1:5000	-	-	-	-	Resources were not estimated.

(contd)

Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
DGM, 2016-17							
Rajasthan							
Ajmer	Around Mehgaon, Nituti,Gingoli, Jajota,Jhak,etc. village, Border area of Ajmer & Nagaur	1:50000 1:10000 1:2000	150 15 3	-	-	26	An exploration of around 200 sq. km area was taken up with an objective to locate limestone, dolomite, flourite, baryte, soapstone, white quartzite and other economic minerals. Ferruginous gossanised zone was observed in silicified quartizite/ amphibolites, calc silicate n/v Mahegaon in the south to village Gingoli in north over a strike length of 11 km with width of 4.5 km. Specks of pyrite, chalcopyrite and pyrrhotite have been observed in quartzite, amphibolite and calc silicate.
	N/v Shyamgarh, Pakriyawas, Kanakheda, Kesarpura, etc. Tehsil Beawar	1:10000 1:2000	10.0 4.0	4 -	600 -	557 -	During exploration of area, three bands in impure limestone admeasuring about 4500 m x 200-350 m, 800 m x 8-13 m, 635 m x 19-28 m were mapped n/v Kotra-Ka-Bariya-Banola, Shivpura-ghata, Gowaliya and Dhandhiya, etc. Similarly five bands of limestone measuring about 1000 m x 30-85 m, 110 m x 10-23 m, 620 m x 12-42 m, 1270 m x 110-400 m and 1910 m x 3 00-840 m were mapped n/v Kanakhera, Khetakhera and Kasarpur. Limestone in the area is fine to medium grained, hard, compact, fractured, jointed and weathered at surface.
Tonk	N/v Khalilpura, Dodwari, Devri Jabriya, etc. Tehsil-Tonk	1:50000 1:10000 1:2000	50.0 10.0 4.0	12	600.0	219	A search for cement grade limestone was taken up in the area. Two limestone bands were mapped around Devri and Kurera. The first band is about 500 m north of village Devri extends for a strike length of 700 m with 45-50 m. width. The second band is about 350 m east of village Devri and extend to a strike length of 500 m with width of about 8-10 m. The limestone is grayish-white to greenish gray in colour, medium grained and crystalline in nature.
Alwar/ Jaipur	N/v Bithoda, Mandha, Bhankri, Karoi, Nayabas,etc. Tehsil-Kotputali Jaipur distt and Tehsil-Thanagazi Alwar-distt	1:4000	2.10	4	269	53	Total reasources were estimated at about 50.17 million tonnes.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Jhunjhunu/ Sikar	N/v Parasrampura, Gothra area, etc. Tehsil-Nawalgarh, Jhunjhunu distt	1:4000	3.0	-	-	26	Further exploration by outsourcing or under NMET fund is proposed.
Udaipur	N/v Bikarni-Kagwas-Sandmaria, Tehsil-Kotra	1:50000 1:10000 1:4000	100.0 10.0 1.0	-	-	10	N/v kyara and Bikarni, medium grained limestone, at places siliceous in nature are continued in southern side extended for 500 m and 1700 m in length with width varies form 50-300 m. Total length of limestone is 4 to 4.5 km including extension of old explored band. Limestone is intruded by small pegmatite vein.
Dungarpur	Rama,Dad, Padla-jani, Nandli Ahara, Bhatoli, Munger, Sabla,Tehsil-Aspur	1:4000	2.0	4	596	338	The exploration in this area was commenced in 2014-15. The light pinkish grey to grayish white coloured fine to medium grained, hard and compact intermittently exposed crystalline limestone band was geologically mapped in detail n/v Bhatoli. Limestone band is exposed over a length of about 3 km with varied width of 10 m to 15 m from North East to South West of village Bhatoli.
Bhilwara	Phul ji ki Kheri-Sopura-Shyamgarh-Amartiya-Bharnda-Ratiya Kheda-Dhakad Kheri Shamgarh-Phulji ki Khera-Amartiya-Chitauriya-Bharenda	1:10000 1:4000	20.0 2.75	-	-	-	Limestone band mapped in the area extends for a strike length of about 7 km with width varying from 2 km to 2.4 km. The project will continue in FS 2017-18.
Pali	N/v Virampura, Ki Bhagal, Tehsil-Bali	1:50000 1:10000 1:4000	300.0 20.0 2.0	-	-	37	Two limestone band have been mapped in the area i.e. one band extends for about 1700 m with width varying from 150 m to 500 m and other limestone band extends for a strike length of 1500 m with width varying from 200 m to 500 m.
Jaisalmer	N/v Kam al ka, Goal of Sam area tehsil	1:10000 1:2000	15.0 4.0	26	1217.0	800	Resources were estimated at about 355 million tonnes of cement grade limestone and 65 millon tonnes of SMS grade limestone.
Limestone, Masonry stone, Bajri and other economic minerals							
Bikanar	N/V Soniyasar, Kumpalsar, Dhaneru, Badela, etc., Dungargarh Tehsil	1:50000 1:10000	250.0 10.0	-	-	-	The area is occupied with sand and medium to high sand dunes. Project discontinued due to non-encountering of promising limestone.

(Contd)

Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Limestone							
Bikaner	N/v Soniyasar, Kumpalsar, Dhaneru, Badela, etc., Dungargarh Tehsil	1:50000 1:10000	250.0 10.0	-	-	-	The area is occupied with sand and medium to high sand dunes. Project discontinued due to non-encountering to promising limestone.
Bikaner	Sarunda, Bhadla and Sobhana village of Nokha Tehsil	1:10000	15.0	-	-	-	The area is concealed and no esposures of limestone were found on surface. The project was not considered for next field season.
Alwar	N/v Dangarwara, Dhamrer,Thonsra, Digaora,Toda Gyan Singh, Chhillori, etc Tehsil-Rajgarh	1:50000 1:10000 1:4000	150.0 10.0 3.0	-	-	15	Limestone and ferruginous quartzite were reported in the area. Limestone found n/v Fatehpura, Simbhu ka bas, Patan, Andhwadi, etc. Ferruginous brecciated quartzite is associated with limestone. The CaO is less than 33% and iron is up to 44% in brecciated ferruginous quartzites n/v Kharkhari Chawand Singh, tehsil Reni.
Nagaur	N/v Taras & Khorwa, Tehsil Khinwsar	-	-	26	1000.0	698	In the block (No.4) area drilling was carried out on 800 m x 800 m and 1600 m x 1600 m grid pattern and established the occurrence and depth persistence of limestone. Resources were estimated at about 516.66 million tonnes of cement grade limestone.
Sawai Madhopur	N/v Padra, Aniyala, Barod Tehsil-Khandar	1:50000 1:10000 1:4000	125.0 10.0 2.0	-	-	36	The limestone was seen along chambal river in 4000 m x 500-1200 m area n/v Padra-Aniyala and 1200 m x 200-250 m area n/v Barod. The limestone appeared to cement grade. Resources were not estimated due to lack of data on depth persistence of limestone. The project will continue.

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Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Chittorgarh	Rasulpura, Bansa & Pirkhera, Phachar Ahiran, Tehsil-Nimbahera	-	-	4	209.0	119	Exploration was started in 2014-15 with an objective to locate cement grade limestone deposit in the area. About 119 m cummulative thickness of grey limestone with thin shale intersection were reported in all boreholes. Cement/ blendable grade limestone exist in the area. Resources will be estimated after the receipt of chemical analysis data.
Chittorgarh	Samriya kalan, Nathuramji ka Khera, Meghniwas and Mandna Tehsil-Begun	1:10000 1:4000	17.50 2.0	-	-	22	The limestone band mapped in the area having strike length of about 8.5 km with width of more than 2.0 km. It is massive, non crystalline, compact and fine grained with greyesh colour and varigated in upper part and purplish-pink and argillaceous in lower part. Limestone seems to be of cement grade. The project will continue.
Sirohi	Tehsil-Aburoad Pindwara	1:10000 1:4000	10.0 2.25	4	222.0	64	i) A limestone band near village Nitaura was mapped for a strike length of about 220 m with exposed width up to 50-80. The limestone seems to be cement grade; ii) A limestone band extend for the strike length of more than 5.5 km with exposed width of 500 m-700 m was seen from village or to north of Derna; iii) A limestone band extend for the strike length of more than 1.0 km with exposed width of 30 m - 200 m was mapped around Naijamin village; iv) Jharoli-Laj-Phulera-Nitaura limestone band is intermittently extends for strike length of more than 25 km with exposed width up to 300.0 m. The detailed chemical analysis results of Derna Wada area shows average CaO content of limestone is 50.26% with about 4% SiO_2 & MgO and about 1% to less than 1% Fe_2O_3. The limestone band around Derna to south of Wara village is cement grade to high grade. (Contd)

Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Nagaur	N/v Awad and Khera, Tehsil-Jayal	-	-	26	1000.0	739	The boreholes drilled in the area intersected limestone for a cumulative thickness of 0.50 m to 24.85 m. The limestone of area is of good quality high grade limestone. Resources estimated in the area are placed at 371.696 million tonnes of cement grade limestone. Exploratory drilling will continue.
Limestone, Clay, Silica Sand, etc.							
Bundi	N/v Kathoda, Mani,Bishan Pura, Sodanpura,Kalyani, Karwar, Antarda, etc Tehsil-Nainwa	1:50000 1:10000 1:4000	150.0 15.0 1.5	-	-	-	-
Laterite,Clay, Red ochre, Glauconitic shale, etc.							
Baran	N/v Bhanpur Pureni, Semri, Baseri, Amrod, Majola, Thana Kasba, Tehsil-Shahbad	1:50000 1:10000 1:4000	150.0 15.0 1.5	-	-	-	-
Laterite, high-grade Limestone, Bentonite, Clays, Ochre, etc							
Jhalawar	Deccan Trap areas of tehsil Jhalrapatan, Pirawa, Pach-Pahar, Gangdhar, Aklera, Manoharthana and Khanpur.	1:50000 1:10000 1:4000	150.0 15.0 1.5	-	-	-	-
Decorative and Masonry Stone							
Udaipur	N/v Lunk, Tehsil-Kotra .	1:50000 1:10000 1:4000	100.0 10.0 1.0	-	-	-	N/v Lunk medium to coarse grained, hard and compact, greenish grey to grey coloured Erinpura granite is exposed and porphyritic in nature seems to bear good blockablity in boulders, knobs and sheets.

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Table - 8(Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Minor Minerals and other economic minerals							
Dungarpur	N/v Ganeshpur, Tehsil-Aspur, Ghughra & Inder Khet(Rampur) Tehsil-Dungarpur .	1:50000 1:10000 1:4000	200.0 10.0 2.5	-	-	6	An area of 2.0 sq. km was covered under detailed mapping in three blocks namely a) Ganeshpur block, b) Gughra block and c)Inderkhet block. In Ganeshpur block, in an area of 1.0 sq. km, the light yellow coloured, fine to medium grained, hard and compact quartzite with fractures, etc is exposed for about 1,100 m in length and 150 m to 300 m of average width. In Gughra block, light yellowish coloured fine to medium grained, hard quartzite is exposed over an area of 1.0 sq. km. The quartzite may be useful for building construction purpose. In Inderkhet block, light yellowish to brownish coloured, medium grained, hard quartzite is exposed over an area of 0.50 sq. km. No new mineral found. Project Completed.
Granite							
Jalore	N/v Nosara, and Nosra ki dhani Tehsil-Ahore .	1:4000	2.0	-	-	11	Outcrop of granite having dimension of 500 m x100 m n/v Nosara and 250x150 m n/v Nosra ki Dhani were mapped. Granite is brownish to creamish in colour, medium to coarse grained and blockable in nature.
Silica Sand							
Jaisalmer	N/v Neran, Nehari Talai etc Tehsil-Pokaran .	1:50000 1:10000 1:2000	100.0 10.0 2.0	-	-	12	About 1.0 sq. km area have been identified for white friable sand stone of 1 m to 2 m exposed thickness. Few chemical analysis showed SiO_2 content varies from 85.72% to 92.70% and Fe_2O_3 content varies from 0.42% to 1.06%.
Sand stone (Building stone and masonary)							
Jodhpur	N/v Kumaro, ki dhani and Joganion ka Bhakar, Tehsil-Balesar	1:50000 1:10000 1:4000	130.0 10.0 2.0	-	-	35	Isolated outcrops of sand stone were mapped to north of village Kumaro ki Dhani in 600 m x 800 m area. Massive and jointed and sandstone is exposed n/v Joganion Ka Bhakar (3 km x 2 km), Devatu (122m x 119 m and 146 m x 107 m) and Raikon Ki Dhani (1000 m x 750 m), etc. It is creamish to pink coloured, medium to coarse grained, bedded and compact sandstone and can be used as building/masonry stone.

(Contd)

Table - 8 (Contd)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Rhyolite							
Jaisalmer	N/v Lawan, Tehsil-Pokaran	1:50000 1:10000 1:2000	100.0 10.0 1.0	-	-	19	About 0.50 sq. km pontential area of brownish coloured rhyolite was mapped in this area. At depth rhyolite is hard and compact and suitable for stone grit.
Slate Stone							
Alwar	N/v Mandhan, Anandpur, Khundroth, Shivdansingh pura, etc.Tehsil-Behror	1:50000 1:10000 1:4000	150.0 10.0 3.0	-	-	20	-
Sand stone							
Dholpur	N/v Bhiramad, Pipret, Padampura, Dangripura, Jorgarhi, Kacchpura, Kankret, Rajpura, Rahrai,etc. Tehsil-Basedi	1:50000 1:10000 1:4000	100.0 10.0 1.0	-	-	-	Total resources were estimated at 22.20 million tonnes of splittable sand stone n/v Bhiramad, Chandpura, Teja Ka Pura & Dadraunipura, Tehsil-Sarmathura.
Silica Sand, Clay, Quartz							
Bharatpur	N/v Sita, Lakhanpura, Bhagora, Kharairi, Sonpur, Madpur, Bijepura, Dhurairi, etc.Tehsil-Bayana	1:50000 1:10000 1:4000	100.0 10.0 1.0	-	-	-	Copper staining have been noticed in old working n/v Kair and Khankheda. Project continues.
Masonary stone							
Sirohi	Tehsil-Aburoad	1:10000 1:4000	5.0 1.0	-	-	-	-
Granite/Rhyolite							
Sirohi	N/v Mungeria	1:50000 1:10000 1:4000	200.0 10.0 2.0	-	-	-	Granite exposure were located to about 2 km towards N-NNE of Mungeria village. Outcrops of rhyolite are exposed to the south of village Mungeria in 300 m x 200 m area.
Siliceous earth, Sand Stone							
Barmer	N/v Mandai	1:50000 1:10000 1:4000	200.0 10.0 2.0	-	-	-	The siliceous earth is exposed at three localities i.e. i) towards NE direction and 560 m from Mandai Nadi, ii) towards NE direction and 990 m from Mandai Nadi and iii) towards NE direction and 1600 m from Mandai Nadi. The above pits location covers length of 1100 m. The siliceous earth is concealed under sand & alluvium and hence continuity could not be confirmed. Sand stone of Devka, Rajral area is suitable for masonry stone.

(Contd)

Table - 8 (Concld)

Agency/ Mineral/ State/District	Location	Geological mapping		Drilling		Sampling	Remarks
		Scale	Area (sq. km)	Boreholes	Meterage		
Clay, Red ochre, Silica sand							
Chittorgarh	Bhadesar, Hatipura, Sand, Palri, Pagara,etc. Tehsil-Bhadesar	1:50000 1:10000 1:4000	200.0 11.50 1.0	-	-	33	The regional mineral survey of the area revealed i) the ferruginous cherty brecciated quartzite (hosting red ochre and china clay) intermittently exposed for about 18 km in length and 200 m to 500 m in width from north of Hattipur Minana in south. The silica sand band was observed n/v Tejpura/Tejpura ki dhani; ii) another band was exposed intermittently for about 12.50 km in length with width of 200 m to 2.50 km from north of Japharkheda tosand in south. Apart from this, silica sand band having dimension 70 m x 10-15 m was also seen at the foot hills n/v sand, Shergarh area; iii) A laterite bed was noted in the west of Palri village to sand. Prospecting work completed.
Granite							
Jalore	N/v Panchota, and Tarwara, Tehsil-Ahore.	1:4000	2.00	-	-	11	-
Barmer and Jaisalmer	N/v Ranakdev, Mehrari area.	1:50000 1:10000 1:4000	150.00 10.0 2.00	-	-	-	-
Barmer	N/v Gujron Ka Talla (Chuli Dungri)	1:50000 1:10000 1:4000	150.00 10.00 1.00	-	-	07	-
Phyllite, Limestone, Clay, Silica sand, etc.							
Bundi	Chainpuriya, Bheemganj, Tarkia, Deroli, Narayanpura, Tonkra, etc. Tehsil Hindoli.	1:50000	100.0	-	-	-	-
Quartz, feldspar and Granite							
Sirohi	Tehsil Shivganj	1:10000 1:4000	10.0 1.00	-	-	01	-