Geology and Mineral Resources of Orissa

Orissa, situated on the eastern seaboard of India is one of the gifted parts of the world, where a gamut of mineral resources exist in bounty. The state is endowed with large reserves of bauxite, chinaclay, chromite, coal, dolomite, fireclay, graphite, gemstones, iron ore, limestone, manganese ore, mineral sand, nickel ore, pyrophylite and quartz. Recent discovery of diamond in the Dharambandha area of Nuapada district by the State Directorate of Geology has added a coloured feather in the cap of the state. Other minerals of the state include copper ore, lead ore, titanium bearing vanadiferous magnetite, talc/soap stone and high magnesia igneous rocks. Recent boom of the mineral industry has turned the state into a hotspot, with entrepreneurs from all over the world crowding for their share of fortune.

The rich mineral wealth of the state is attributed to its favourable geological setup. Situated on the eastern fringe of the peninsular India, Orissa has about 72.5% of the area occupied by Precambrian metamorphic rocks (of Archaean and Proterozoic age) which host the majority of the minerals. The Gondwanas hosting the coal resources occur over about 8% of the land mass. The Tertiary and Quaternary formations, occupying rest of the area, provide avenues for aluminous/ nickeliferous laterite and heavy minerals (in beach sand).

The Archaean rocks in northern Orissa include the Supracrustal belts of metasedimentary rocks including Iron Ore Super Group having deposits of iron, manganese, gold and basemetals. These are also represented by the gneisses, granite, migmatite (Singhbhum, Bonai and Mayurbhanj Plutons) and mafic/ultramafic intrusives. These intrusives are associated with the chromite, titaniferous vanadiferous magnetite and PGM. The Bastar cratonic complex of Archaean age in the Western Orissa includes gneisses, granite, migmatite and Strontium-Tantalum-Niobium bearing pegmatites.

Proterozoic rocks in the western Orissa exhibit platformal sedimentary formations and associated limestone deposits. In north-western Orissa they contain metasediments of low to medium metamorphic grade classified as the Gangpur Group, which host manganese, limestone and Lead-Zinc deposits. In central and southern Orissa, the Proterozoics are represented by the Easternghats granulite belt comprising
of khondalite, charnockite, migmatite, anorthosite and alkaline rocks accounting for the mineralisation of bauxite, manganese, graphite and gemstones.

The Mesozoic rocks of Gondwana Super Group host the major coal resources of the state.

Formations of Cenozoic age occupy the eastern coastal plains in form of alluvial sediments, ash beds and low level laterite, providing avenues for occurrence of beach sand minerals and building materials. The deltaic fans extending into offshore regions play hosts for oil and gas.

Orissa has a lion’s share of the Country’s mineral reserves. The chromite, nickel, bauxite, iron ore and coal resources of the state respectively stand at a staggering 83, 92, 55, 38 and 26 percent of India’s total reserves. Some of these minerals also account for a visible spot in the world’s mineral map. The state’s mining revenue during 2009-10 amounted to Rs.2020.71 crore.

Several mineral based industries have already come up in the state. The major ones include Rourkela Steel Plant, Alumina refinery and smelter of Nalco at Damanjodi and Anugul, Charge chrome plants at Baminipal, Bhadrak, Choudwar and Theruvali by OMC, FACOR, ICCL and IMFA respectively, Mineral sand separation unit at Chhatrapur by IRE. Many cement and sponge iron plants have been set up. Coal based thermal power plants have been set up at Talcher, Kanihan and Banaharpali. Captive thermal power plants have also been set up by NALCO, RSP, ICCL, INDAL etc. and many more are in the pipeline.

The dynamic State Government of Orissa has left no stone unturned in cashing in on the attention it has been getting from different business houses in recent times. The visionary Chief Minister with his view on the future development of the state has signed 79 MoUs with various companies to setup mineral based industries with a total proposed investment of Rs 3,65,327.20 crores, which is supposed to provide value addition to the mineral wealth thereby augmenting employment and enhancing the economic standard of the public. The huge mineral resources of the state, 480 km long coastal stretch, the liberalised economic policy of Govt. of India, Industrial Policy 2007 and availability of infrastructural support makes the state an investor’s paradise.
<table>
<thead>
<tr>
<th>MINERAL</th>
<th>DISTRIBUTION</th>
<th>LOCATION</th>
<th>GEOLOGY</th>
<th>RESERVE</th>
<th>USES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauxite</td>
<td>Koraput District</td>
<td>Panchpatmali, Pottangi, Maliparbat, Ballada, Kodingamali, Hatimali, Kakrimali, Chintangundi, Kornapadikonda, Medamgundi etc.</td>
<td>Associated with Eastern Ghat Super Group of Rocks i.e. Khondalites and Charnockites; Occur as blankets capping the parent rocks on plateau tops.</td>
<td>1810 Million tonnes with &gt;40% Al₂O₃ and &lt;0.5% SiO₂</td>
<td>Aluminium industry, Refractory industry, Chemical industry, Petroleum industry</td>
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<tr>
<td>Bauxite</td>
<td>Raygada District</td>
<td>Baphilimali, Sasubohumali, Pasangmali, Majhigaonmali, Sijimali, Tikrimali, Budharajamali, Taljhir, Dabuguda, Nangalghatmali etc.</td>
<td>Occur as blankets capping the parent rocks on plateau tops.</td>
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<tr>
<td>Bauxite</td>
<td>Malkangiri District</td>
<td>Korkanda, Sitkapalli and Korparli</td>
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<tr>
<td>Bauxite</td>
<td>Kalahandi District</td>
<td>Karlapat-Pollingpadar,Kutrumali-Tangridongar,Lanjigarh Niyamgiri,Keluamali, Krishunikmali etc</td>
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<tr>
<td>Bauxite</td>
<td>Kandhamal District</td>
<td>Anamini Parbat, RukuniCuttack, Demoli, Ushabali etc.</td>
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<tr>
<td>Bauxite</td>
<td>Kendujhar District</td>
<td>Dholkata pahar</td>
<td>Occur over metabasaltic basalt.</td>
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<tr>
<td>Bauxite</td>
<td>Sundargada District</td>
<td>Tantra, Kodalia, Jaldhi, Kusumdihi etc.</td>
<td>Assocaited with manganiferous shales, shales, phyllites of Nuamundi Group</td>
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<tr>
<td>Iron Ore</td>
<td>Kendujhar District</td>
<td>Roida-Bhadrasahi, Unchabali, Jajang, Jurudi, Belkundi, Bolani, Khandbandh, Katamati, Thakurani, Gandhamardan, Joda-East, Haromoto, Guali, Kasia, Malangtoli etc.</td>
<td>Iron ore bands occur in layered BIF along with volcano-sedimentary rock piles known as Iron Ore Super Group</td>
<td>5153 million tonnes</td>
<td>Pig iron, Sponge iron, Steel, Blast Furnace, Alloys</td>
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<tr>
<td>Iron Ore</td>
<td>Sundargada District</td>
<td>Barsuan,Taldihi, Kalta, Khajuridihi, Ganua, Koira, Kurmitapahar, Rantha, Mankarnacha, Badamgarh pahar, Balipahar Mithithurda-Basada etc.</td>
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<tr>
<td>Iron Ore</td>
<td>Mayurbhanj District</td>
<td>Suleipat, Ghusura, Gorumasani, Badampahar, etc.</td>
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<tr>
<td>Iron Ore</td>
<td>Jajpur District</td>
<td>Daitari-Tomka</td>
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</tbody>
</table>
| Mineral | District | Source | Description | Quantity | Industry
|---------|----------|--------|-------------|----------|-----------------
| CHROMITE | Jajpur District | Sukinda Ultramafic complex. | Occur as intrusive into Precambrian metamorphites as well as differentiated layered igneous complexes | 173.80 million tonnes of all categories with 40 to 45% Cr₂O₃ | Chromium metal, Various alloys with iron, nickel, cobalt, tungsten etc. Chromium compounds Refractory industry
| Kendujhar District | Boula-Nuasahi Igneous complex. | | | |
| Baleswar District | Bhalukasuni | | | |
| MANGANESE | Kendujhar District | Joda, Chormalda, Katasahi, Jurudi, Parelipado, Roida, Sidhamata, Dubna, Jaribahal (Palsa), Katasahi-Kolha-Rudkela, Gurd | Confined to Shale formation of Horse shoe synclinorium belonging to Precambrian Iron Ore Super Group | 119.81 million tonnes | Iron and Steel Industry Ferromanganese industry Dry cell (battery) Chemical industry
| Sundargada District | Orahari, Patamunda, Malda, Mahulsukha, Nuagaon, Teheral, Sarkundo, Kusumdihi, Gonua, Dendulo, Kanthor-Koira, Oraghat, Kolmong | | | |
| | Ghariajor-Manmunda area | Associated with Gangpur Group of rocks | | |
| | | | | |
| | Rayagada District | Nishikhal, Podakana, Khurigaon, Anajori, Liliguma, Ambadola, Rukunibari, Loharapara, Bhalumaska | Associated with Eastern Ghats Super Group of Rocks i.e. quartzites, Khondalites calc-gneiss and calc-granulites as tabular bodies. | | |
| | Balangir District | Champasar, Bharatbahal, Rengali, Tamiya, Babja, Uchhabapali, Banipali, Biarpali, Gadashankar, Bhaludungri | | | |
| COPPER | Debagada District | Adash | Associated with Eastern Ghats Super Group of Rocks i.e. Khondalites and Charnockites. Pyroxene granulite is the main host rock. | 3.09 million tonnes with cut-off grades of 0.8% Cu, | Electrical equipment, conductive wires, Auto ancilliary, semis &alloys
<p>| Mayurbhanj District | Kesarpur | Occur within sheared metabasics belonging to Proterozoic s of Eastern Singbhum | | |</p>
<table>
<thead>
<tr>
<th>MINERAL</th>
<th>LEAD AND ZINC</th>
<th>SAND</th>
<th>NICKEL ORE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sundargada District</td>
<td>Sargipalli – Galena, Chalcopyrite, Sphalerite, Cerussite, Azurite, Malachite, Covellite.</td>
<td>Confined to Garnetiferous biotite schist within Gangpurs</td>
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<td></td>
<td>Sargipalli – Galena, Chalcopyrite, Sphalerite, Cerussite, Azurite, Malachite, Covellite.</td>
<td>Sargipalli deposit – 1.89 million tonnes between 220 m &amp; 60 m with 6.73% Pb, 0.33% Cu and 51 PPM of Ag at 3% cut off. *Sargipalli mine has been closed since 2001-02</td>
<td>Stainless steel, nickel plating, coil making, electronic industry</td>
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<td></td>
<td>Balangir District</td>
<td>Saintala area</td>
<td>Occur as fracture fillings in quartz veins</td>
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<td></td>
<td>Baragada District</td>
<td>Kermeli area.</td>
<td>Eastern Ghats Super Group of rocks on weathering release the heavy minerals, which are carried into the sea by many rivers, tidal waves, littoral drift, wind action etc. have played their part in the concentration of heavy minerals.</td>
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<tr>
<td></td>
<td>Kalahandi District</td>
<td>Sisakhal area.</td>
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<td></td>
<td>Debagada District</td>
<td>Gangajal area.</td>
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<td>Ganjam Coast</td>
<td>All along Ganjam coast from A.P.-Orissa border to Ganjam-Puri border. Important Sector are: Gopalpur Sector, Chhatrapur Sector and Prayagi Sector</td>
<td>On both side of Chilka lake Paikirapur- Bajrakot Sector and Brahmagiri Sector</td>
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<td></td>
<td>Puri Coast</td>
<td>Eastern Ghats Super Group of rocks on weathering release the heavy minerals, which are carried into the sea by many rivers, tidal waves, littoral drift, wind action etc. have played their part in the concentration of heavy minerals.</td>
<td>Occur as nickeliferous laterite (as over-burden in chromite mines) overlying the serpentinitised dunite-peridotite bed rock</td>
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</tbody>
</table>

(i) Ilmenite: Source of titanium, used for manufacture of titanium dioxide & ferro-titanium alloys

(ii) Rutile: Source of titanium used for titanium dioxide pigment welding electrodes production of titanium sponge & metal

(iii) Zircon: Foundaries, ceramics, refractories

(iv) Sillimanite: Manufacture of high temperature refractories

(v) Garnet: Used as abrasive

(vi) Monazite: Production of Rare Earth Compounds – Thorium, Uranium Helium
<table>
<thead>
<tr>
<th>PLATINUM</th>
<th>Location</th>
<th>Description</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Kendujhar</td>
<td>Baula_Nuasahi complex, Amjori sill</td>
<td>Associated with Singhbhum-Orissa craton comprising high grade schist and gneiss intruded by layered mafics and ultramafics</td>
<td>Auto catalyst, Jewellery, dentistry, industrial application.</td>
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<tr>
<td>Jajpur</td>
<td>Sukinda valley</td>
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<td>Baleswar</td>
<td>Bhalukasuni</td>
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<tr>
<td>Dhenkanal</td>
<td>Bhuban, Asurba, Maulabhanj, Kathpal and Ostapal</td>
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<thead>
<tr>
<th>TIN ORE (Cassiterite)</th>
<th>Location</th>
<th>Description</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Malkangiri District</td>
<td>Bijapadar, Vederupalli, Durmaguda, Mohapadar, Kurumpalli, Gurupada, Permanasu</td>
<td>Associated with metasedimentaries and metabasics of Bengpal Group intruded by pegmatites and quartz veins and also as secondary placers</td>
<td>Tin metal, packing material, tin plates, alloys with other metals, chemical use</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>ASBESTOS</th>
<th>Location</th>
<th>Description</th>
<th>Status</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malkangiri District</td>
<td>MV – 76 Uruvalley Madatalguda Billiguda Maharajpalli MV-114 MV-96</td>
<td>Occur in the contact of granite gneiss and amphibolite</td>
<td>Not estimated</td>
<td>Used for asbestos cement products such as asbestos cement sheets, pipes, brake linings, insulation mill boards, asbestos paper, and fire proof paints, clothes etc.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CHINA CLAY</th>
<th>Location</th>
<th>Description</th>
<th>Quantity</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayurbhanj District</td>
<td>Joshipur, Chanchbani, Dumuria, Jamda, Kadodiha, Jamkeswar &amp; Thakurmunda Dhabadiha, Kalapathuria, Sorisbari, Jamkesar, Kalikapur, Ramchandrapur, Kathkaranjia, Nanua, Nijli, Mangalpur, Tikasil etc.</td>
<td>Occur in a long belt stretching from southern Singhbhum to Mayurbhanj extending upto Kendujhar in the Singhbhum Granite belt</td>
<td>314 mt.</td>
<td>Ceramic, pottery industry, cement industry, textile, paper, rubber, paint</td>
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<tr>
<td>Kendujhar District</td>
<td>Unchheibera, Guras, Bholpara, Pradhanpara</td>
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<tr>
<td>Nawarangpur District</td>
<td>Devdhara, Sorispadar, Ambagan</td>
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<tr>
<td>Rayagada District</td>
<td>Kudimgmali</td>
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<tr>
<td>Baragada District</td>
<td>Khola</td>
<td></td>
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<tr>
<td>COAL</td>
<td>Anugul - Dhenkanal District</td>
<td>Talcher Coalfield</td>
<td>In the Barakar and Karaharbari formation of Lower Gondwana</td>
<td>65226.86 million tonnes non-coking coal.</td>
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<tr>
<td></td>
<td>Sambalpur-Jharsuguda Dist.</td>
<td>Ib River Coalfield</td>
<td>Kamthi/Raniganj Formation</td>
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<tr>
<td></td>
<td>Other areas</td>
<td></td>
<td>Uneconomic coal occurrences are found in following basins- Athgarh basin, Gaisilat basin, Athmallick basin, Katrinja Basin.</td>
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<tr>
<td>FIRE CLAY</td>
<td>Cuttack District</td>
<td>Taibasta, Brahmagota, Ghantikhal.</td>
<td>Athgarh Formation of Upper Gondwana</td>
<td>175.53 million tonnes</td>
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<td></td>
<td>Khurda District</td>
<td>Jagannath Prasad, Andharua, Bantal</td>
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<td></td>
<td>Anugul District</td>
<td>Confined to Talcher Coalfields Jagannath Colliery, South Baland Colliery, Kaniha, Telisinga</td>
<td>In the Barakar and Karaharbari formation of Lower Gondwana</td>
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<td></td>
<td>Baragada District</td>
<td>Telipali, Buramunda, Gaisilat</td>
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<tr>
<td></td>
<td>Ib River Coalfield area</td>
<td>Beipahar, Jurabaga, Darlipali, Rampur, Kuropali, Baria pahar, Lukopoli, Khinda, Rail, Ainalapali, Kirwara, Beipur, Siarmal, Kulda, Ratansera, Lankanpur, Bundi, Bholamal etc.</td>
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<tr>
<td><strong>LIMESTONE</strong></td>
<td>District</td>
<td>Occurrence</td>
<td>Associated with</td>
<td>Quantity</td>
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<tr>
<td>Sundargada</td>
<td>Biramitrap-Raibaga, Hatibari-Purnapani, Gatitangar, Lanjiberna, Khatkurbahal, Kiringsera, Bimta, Khairtola</td>
<td>Associated with Biramitrapur Formation of Gangpur Group</td>
<td>1007.2 million tonnes</td>
<td>Cement Industry, Iron and Steel Industry, Glass industry, Chemical industry, Sugar industry, Fertiliser industry</td>
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<tr>
<td>Koraput</td>
<td>Sunki, Dumajodi, Kundajodi, Parasagudi, Binsuli, Gupteswar</td>
<td>Associated with Eastern Ghats Super Group of rocks</td>
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<tr>
<td>Malkangiri</td>
<td>Kottametta, Nandiveda, Uskalavagu</td>
<td>Limestone occur interbanded with shale, phyllite and quartzite of Vindyan Super Group</td>
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<tr>
<td>Nuapada</td>
<td>Chandpala, Sagundunguri, Deobahal, Rohapadar, Gorramura.</td>
<td>Associated with Eastern Ghats Super Group of Rocks and in Khariar Highland Group of rocks</td>
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<tr>
<td>Balangir</td>
<td>Dhamandanga, Kuliadaha, Hial</td>
<td>Associated with Eastern Ghats Super Group of Rocks</td>
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<tr>
<td>Baragada</td>
<td>Dungri, Banjipalli, Jampalli Putka-Saramsil</td>
<td>Associated with Proterozoic cover sediments</td>
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<thead>
<tr>
<th><strong>DOLOMITE</strong></th>
<th>District</th>
<th>Occurrence</th>
<th>Associated with</th>
<th>Quantity</th>
<th>Industry</th>
</tr>
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<tbody>
<tr>
<td>Sundargada</td>
<td>Biramitrap-Raibaga, Gamardhi, Turmura, Lefripara, Dublabera, Sapai river section, Litibera</td>
<td>Associated with Biramitrapur Formation of Gangpur Group</td>
<td>330.90 million tonnes</td>
<td>Refractory Industry (Blast Furnace Lining), Alloys industry, Glass Industry, Steel Industry</td>
<td></td>
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<tr>
<td>Baragada</td>
<td>Nuapara - Putka</td>
<td>Associated with Proterozoic cover sediments</td>
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<tr>
<td>GRAPHITE</td>
<td>Anugul</td>
<td>Dandatopa, Akharkata, Adeswara Kamalpur, Girida</td>
<td>Occur within Eastern Ghat Mobile Belt, associated with khondalite, quartzite, calc-silicate, granulite, charnockite, basic granulites and quartzofeldspathic gneises cross cut by leptynites and pegmatites.</td>
<td>4.40 million tonnes</td>
<td>Crucible Industry, pencil, brick lining, battery, lubricants and paint</td>
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<tr>
<td>Baragada</td>
<td>Temtrimal, Tentulikhunti, Hardatal, Ranjitpur, Dahigaon, Menaramunda</td>
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<tr>
<td>Balangir</td>
<td>Gerdi, Fulmati, Ganjaudar, Rengali, Sargipalli-Golomunda, Dhandamunda, Godgadbahal, Mahulpati, Banjipali, Dukukamal, Beherapani, Beheramunda, Sapmunda, Mohanilaha, Malisira, Sargibahal</td>
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<tr>
<td>Kalahandi</td>
<td>Sargipada, Gaidar, Singjaran, Lamer, Badibahal</td>
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<tr>
<td>Kandhamal</td>
<td>Madagurha (Tumudibandh), Bargaon, Dhursi, Mahabali</td>
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<tr>
<td>Nuapada</td>
<td>Kirkita, Dharamsagar, Gandabahali</td>
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<tr>
<td>Nayagada</td>
<td>Narajpada</td>
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<tr>
<td>PYRO-PHYLLITE</td>
<td>Kendujhar District</td>
<td>A 90 km long belt extending from Rebna-Palasbahal in the south to Dhabakuchuda-Balabhadrapur in the North. Main deposits are Dhabakuchuda, Baladihi, Balabhadrapur, Amjor, Madrangojodi, Nitigotha, Roduan, Rebna, Palasbahal etc.</td>
<td>Associated with Singhbhum Granite Phase II that is overlain by Dhanjori quartzites</td>
<td>8.35 million tonnes (Al₂O₃ 20-23%, SiO₂ 65-75%, Fe₂O₃ 0.77, LOI 3-4%)</td>
<td>Refractory industry Stone ware/ china ware, Sanitary ware/ porcelain</td>
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<tr>
<td>Mayurbhanj District</td>
<td>Jashipur, Gorumahisani, Bangiriposi and Manada</td>
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<tr>
<td><strong>DIMENSION STONE</strong></td>
<td><strong>Anugul District</strong></td>
<td><strong>Gobinda Pana Sahi, Durgapur Panasahi</strong></td>
<td><strong>Eastern Ghats Super Group of rocks consisting of khondalites, leptynite, charnockite, pyroxene granulite, nepheline syenite, granite etc. can be categorised as dimension stone.</strong></td>
<td><strong>463.53 million cubic metres of all varieties.</strong></td>
<td><strong>As polished blocks &amp; tiles for flooring kitchen Platforms, wall panels, table tops, in commercial complexes, domestic houses, monuments, temples, platforms, tomb stones, landscaping etc. Many coloured varieties are used for flower vases, name plates, pen stands, paper weights, statues &amp; modern sculptures.</strong></td>
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<tr>
<td><strong>Dhenkanal District</strong></td>
<td>Mahapada, Haripur, Radhadeipur</td>
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<tr>
<td><strong>Ganjam District</strong></td>
<td>Gudiapalli area, Dakhinpur, Lanja, Sukunda, Lathi, Bada Dumula, Kandasara, Dasipur, Mathura, Radhamohanpur, Gobinda nagar, Krushnanagar, Nuaparha, Baranga, Dutipur, Gopalpur, Sarahanaipalli, Manikyapur, Hinjlicut, Pathan Punji, Kirtipur, Sahaspur, Butasarsingi, Purusottampur, Khetapalli, Patapur, Gudiala, Mandalpur, Matisahi, Kohibiradi, Nuamundia, Bishnuchakra, Kanteipalli, , Olamba, Chakunda, Baragada, Badangi, Ekatapur, Matisahi etc.</td>
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<tr>
<td><strong>Nawarangpur District</strong></td>
<td>Cheptiamb, Karlapada, Samarcharan, Hatibari, Tohra</td>
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<tr>
<td><strong>Nuapada District</strong></td>
<td>Bhaira, Dalipathara, Damarkhol</td>
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<tr>
<td>QUARTZ &amp; QUARTZITE</td>
<td>Boudh, Baragada, Kandhamal, Kendujhar, Jharsuguda, Kalahandi, Mayurbhanj, Nuapada, Subarnapur, Nabrangpur, Rayagada &amp; Koraput districts</td>
<td>Numerous occurrences of Boudh, Baragada, Kandhamal, Kendujhar, Jharsuguda, Kalahandi, Mayurbhanj, Nuapada, Subarnapur, Nabrangpur, Rayagada &amp; Koraput districts</td>
<td>Quartz occurs in the form of veins and as a constituent of pegmatites. In Orissa, quartz and silica sand deposits are located in the Precambrian terrains. Quartzite occurs as beds interstratified with other meta-sedimentaries</td>
<td>70.30 million tonnes</td>
<td>Ceramic, fertilizers, abrasives, electrical, paint, rubber, chemical and textile industries with different specifications. Transparent varieties of quartz such as rock crystals, amethyst, citrine, rose quartz and smoky quartz are used as semiprecious gems. Quartz is a piezoelectric material and is used in radio circuit, radars, ultrasonic devices, chronometers etc. Quartzites are used in refractory, iron and steel making, ferro-silicon, glass &amp; ceramics etc.</td>
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<table>
<thead>
<tr>
<th>HIGH MAGNESIA ROCKS</th>
<th>Jajpur District</th>
<th>Sukinda area</th>
<th>Dunite, peridotite, serpentinite, pyroxenites mostly associated with Iron Ore Super Group</th>
<th>Not estimated</th>
<th>Used as flux in blast furnace for steel making in place of dolomite</th>
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<tbody>
<tr>
<td>Kendujhar District</td>
<td>Managovindpur. Boula Nuasahi area</td>
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<tr>
<td>Dhenkanal District</td>
<td>Bhuban –Asurbandh-Maulabhanj</td>
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<tr>
<td>Baleswar District</td>
<td>Bhalukasoni near Nilgiri</td>
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<tr>
<td>Sundargada</td>
<td>Rajabera, Jharbeda</td>
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<tr>
<td>Sambalpur District</td>
<td>Thelkobadi of Kuchinda Sub-division</td>
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<tr>
<td>GOLD</td>
<td>Mayurbhanj District</td>
<td>Suriagoda, Jagaguda, Ghutudihi, Maredihi, Janudihi, Jhabukucha, Jharadihi, Amdiha, Joshipur, Surda Dhusurapahar (Suleipat)</td>
<td>Occur within boulder-pebbly-quartz conglomerate associated with metasediments and metabasites of Iron Ore super Group</td>
<td>Not definite</td>
<td>Ornament, metallurgical etc.</td>
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<tr>
<td></td>
<td>Kendujhar District</td>
<td>Gopur, Salaikena, Dimirimunda, Rangadihi, Gajipur, Odal, Kushkala, Kardangi, Kalima, Koillisuta</td>
<td>Occur within quartz vein associated with Iron Ore Super Group of rocks</td>
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<tr>
<td></td>
<td>Sundargada District</td>
<td>Digajharan, Malidihi, Ghoger</td>
<td>On the bank of Ib river</td>
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<td>Koraput District</td>
<td>Dasmantpur-Govindpalli, Kusumghati, Kyang, Kaliaguda</td>
<td>On the bank of Kolab river</td>
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<td></td>
<td>Anugul District</td>
<td></td>
<td>In Tikira river</td>
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</table>

**PRECIOUS AND SEMIPRECIOUS STONES**

<table>
<thead>
<tr>
<th>AQUA-MARINE</th>
<th>Sambalpur District</th>
<th>Charbati, Beldhi</th>
<th>Associated with Eastern Ghats Granulite Belt interbanded with mafic and ultramafic complexes, anorthosites, and alkaline complexes intruded by granites, pegmatites and quartz vein Contact of beryl bearing pegmatite with ultramafic rocks</th>
<th>Not estimated</th>
<th>As semi-precious stone</th>
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<tbody>
<tr>
<td></td>
<td>Balangir District</td>
<td>Saraibahal, Sukulimuri, Guchhepalli, Desand, Chhanchanabhata</td>
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<td></td>
<td>Subarnapur District</td>
<td>Badmal, Mursundi, Bairagipalli, Amarpalli</td>
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<td><strong>CHRYSOBERYL</strong></td>
<td><strong>Sambalpur District</strong></td>
<td><strong>Meghpal (Ranchipada)</strong></td>
<td><strong>Occur within pegmatites in khondalite suit of rocks</strong></td>
<td><strong>Not estimated</strong></td>
<td><strong>As semi-precious stone</strong></td>
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<tr>
<td>Rayagada District</td>
<td>Paikadakalguda, Karlaghati, Karanjguda</td>
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<td>Koraput District</td>
<td>Turia</td>
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<tr>
<td>Kandhamal District</td>
<td>Belghar</td>
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<tr>
<td>Balangir District</td>
<td>Ghumsar</td>
<td>Associated with pegmatite intruding into quartzo-feldspathic gneiss</td>
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<tr>
<td>Kalahandi District</td>
<td>Sirjapalli, Tundla, Muribahal</td>
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<tr>
<th><strong>GARNET</strong></th>
<th><strong>Anugul District</strong></th>
<th><strong>Nuagaon, Parhang, Biribolei, Barkotia</strong></th>
<th><strong>Occur in high grade pelitic schist, amphibolites, calc granulite etc.</strong></th>
<th><strong>Not estimated</strong></th>
<th><strong>As semi-precious stone</strong></th>
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</thead>
<tbody>
<tr>
<td>Dhenkanal District</td>
<td>Ghagarmunda, Katamunda, Asanabahal, Tipeijharan</td>
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<td>Debagada District</td>
<td>Budido, Palsama, Jharposhi</td>
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<tr>
<td>Subarnapur</td>
<td>Sial, Naktamunda, Binika, Subarnapur</td>
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<tr>
<td>Boudh District</td>
<td>Boudh, Ramgarh, Kantamal, Manmunda</td>
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<tr>
<td>Kalahandi District</td>
<td>Banjipadar, Sargidua, Ghatpara</td>
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<tr>
<td>Nuapada District</td>
<td>Sardhapur, Patialpada, Damjhar, Patialpada, Budhapada, Mantritarai</td>
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<tr>
<td>Sambalpur District</td>
<td>Bagdhopa, Tabloi</td>
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<tr>
<td>Balangir District</td>
<td>Khaliapalli, Kesaipalli, Luhuramunda</td>
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<tr>
<th><strong>RUBY</strong></th>
<th><strong>Kalahandi District</strong></th>
<th><strong>Jhillingdhar, Hinjilibahal, Kerumunda</strong></th>
<th><strong>Contact of pegmatite and ultramafic rocks associated with cordierite-sillimanite-garnet schists and para gneisses</strong></th>
<th><strong>Not estimated</strong></th>
<th><strong>As semi-precious stone</strong></th>
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<tr>
<th><strong>SAPPHIRE</strong></th>
<th><strong>Nuapada District</strong></th>
<th><strong>Katamal, Karlakot, Amera</strong></th>
<th><strong>High grade pelitic schist at the contact of alkali syenite and pegmatite</strong></th>
<th><strong>Not estimated</strong></th>
<th><strong>Not estimated</strong></th>
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</thead>
<tbody>
<tr>
<td>DIAMOND</td>
<td>Nuapada District</td>
<td>Kalamidadar valley of Nuapada district Mahanadi river bed particularly from Binika in Subarnapur district to Madhapur in Boudh district.</td>
<td>Diamond occurrences are associated with olivine-lamproite pipes within Bastar cratonic complex or at the interface of Bastar cratonic complex and Proterozoic cover sediments around Kalamidadar of Nuapada district. The secondary diamond occur in association with pebble and gravel of Mahanadi river particularly from Binika in Subarnapur district to Madhapur in Boudh district.</td>
<td>Not estimated</td>
<td>Jewellery, oil drilling, grinding, cutting &amp; polishing.</td>
</tr>
</tbody>
</table>

*Source* : DG, GSI, IBM