

# 10<sup>th</sup> - Minerals and Energy Resources



In our daily life, we use different things which are made from metals. Metals are extracted from various minerals found deep inside the rocks. Almost everything we use, from a tiny pin to a towering building or a big ship, all are made from metals.

**Minerals:** A homogeneous, naturally occurring substance with a definable internal structure is called mineral. Minerals are found in various forms in nature, ranging from the hardest diamond to the softest talc. Rocks are the combinations of minerals. Some rocks consist of single mineral, but most of them consist of several minerals in different quantity. Although over 2000 minerals have been identified, only a few are abundantly found in most of the rocks. The formation of minerals depend upon physical and chemical conditions that in turn, results in a wide range of colours, hardness, crystal forms, lustre and density of a particular mineral.

**Use of Minerals in Daily Life:** Minerals have a great importance in our daily life. For example, the toothpaste that cleanse our teeth consists of coarse minerals like silica, limestone, aluminium oxide and various phosphate minerals which do the cleaning. Fluoride which is used to reduce cavities, comes from a mineral fluorite. Most of the toothpastes are made white with titanium oxide, which comes from minerals called rutile, ilmenite and anatase. Sparkle is used in some toothpastes that comes from mica. The toothbrush and tube containing the paste are made of plastics from petroleum.

**All Living Things Need Minerals:** Life processes cannot occur without minerals. Our mineral intake represents only about 0.3% of our total intake of nutrients, but they are very important.

**Study of Minerals by Geographers and Geologists:** For better understanding of Earth's landforms, Geographers study minerals as part of earth's crust. They are also interested in studying the distribution of mineral resources and the economic activities related to these. Geologists study the formation, age and composition (Physical and Chemicals minerals).

**Mode of Occurrence of Minerals:** Minerals are usually found in ores. An ore is a naturally occurring material having one or more minerals in sufficient concentration mixed with other elements. Mineral generally occur in these forms

- **Veins and Lodes:** In igneous and metamorphic rocks, minerals occur in cracks, crevices, faults or joints. The smaller occurrences are called veins and the larger are called lodes. They are usually formed when minerals in liquid/molten and gaseous forms are forced upwards through cavities towards the Earth's surface. They cool and solidify as they rise. Major metallic minerals like tin, copper, zinc and lead are obtained from veins and lodes.

- **Beds and Layers:** In sedimentary rocks, minerals occur in the form of beds and layers. They have been formed as a result of deposition, accumulation and concentration in horizontal layers of the rock. Coal and some forms of iron ore have been concentrated here due to great heat and pressure, for long periods. Other minerals like gypsum, potash salt and sodium salts are also found in sedimentary rocks. They have been formed as a result of evaporation especially in arid regions.

- **Decomposition of Surface Rocks:** If decomposition of surface rocks occurs with the removal of soluble constituents, the residual mass of weathered material left behind contains mineral ores. Bauxite is formed in this way.

- **Alluvial Deposits:** Some minerals are found in sands of valley floors and at the base of hills. These are known as placer deposits. These placer deposits consist of minerals which are not corroded by water e.g. gold, silver, Platinum and tin.

- **Ocean Waters:** These contain many minerals. Common salt, magnesium and bromine are derived from ocean waters, whereas manganese nodules occur in ocean beds.

**Distribution of Minerals in India:** India is fortunate to have fairly rich and varied mineral resources, but these resources are unevenly distributed. The distribution of minerals in India is discussed below-

- **Peninsular Plateau:** Peninsular rocks contain most of the reserves of coal, metallic minerals, mica and many other non-



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metallic minerals. It also has reserves of non-ferrous minerals.

- **Gujarat and Assam:** Sedimentary rocks on the Western and Eastern flanks of the peninsula, in Gujarat and Assam have most of the petroleum deposits.
- **Rajasthan:** It has reserves of many non-ferrous minerals.
- **Northern Plains:** There are very little or no economic minerals in vast alluvial plains of North India. These variations exist largely because of the differences in the geological structure, processes and time involved in the formation of minerals.

**Mining of Minerals:** The economic activity of extraction of minerals from below the Earth's surface is called mining. Most of fossil fuels are extracted by this method. Various factors affect the economic viability of the reserve i.e. concentration of mineral in the ore, the ease of extraction and closeness to the market, etc before mining of the mineral starts. To extract minerals from a shallow depth by removing the overlying materials is called open cast mining.

**Rat-Hole Mining:** Most of the minerals in India are nationalised and their extraction is possible only after obtaining due permission from the government. But in most of the tribal areas of the North-East India, minerals are owned by individuals or communities. In Meghalaya, there are large deposits of coal, iron ore, limestone and dolomite, etc. Coal mining in Jowai and Cherapunjee is done by family member in the form of a long narrow tunnel, known as rat-hole mining.

**Classification of minerals:** Minerals are mainly classified as metallic, non-metallic and energy minerals.

**Metallic Minerals:** Minerals containing metals are called metallic minerals, like gold, silver, tungsten, etc.

1. These are further classified as
2. ferrous minerals
3. non-ferrous minerals.

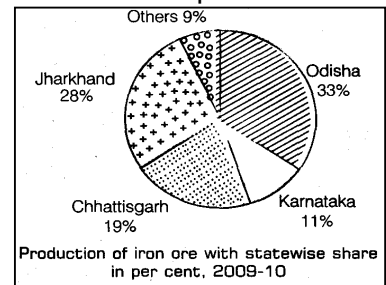
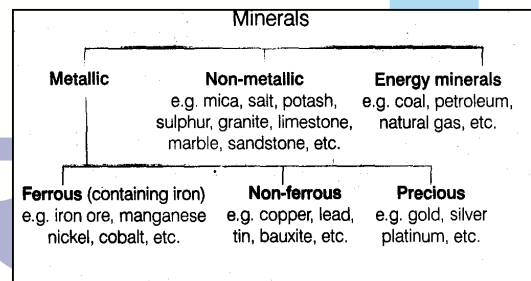
**1. Ferrous Minerals:** Metallic minerals having iron content are called ferrous minerals. A ferro-alloy is an alloy of iron with some other metals. These minerals account for about three-fourths of the total value of the production of metallic minerals. After meeting the internal demands, India exports a fairly large amount of ferrous minerals. These minerals have much importance as they provide a strong base for the development of metallurgical industries. The distribution of ferrous minerals – Iron ore and manganese is discussed below:

**a) Iron Ore:** It is the basic mineral and the backbone of industrial development. India has abundant resources of good quality iron ore. The finest iron ore is magnetite, with a very high content of iron upto 70%. Magnetite has excellent magnetic qualities, especially valuable in the electrical industry. Haematite ore has a content of iron up to 50-60%. It most important industrial iron ore in terms of the quantity used, but has slightly lower iron content than magnetite.

**Iron Ore Belts in India:**

- **Odisha-Jharkhand Belt:** In Odisha, high grade haematite ore is found in Badampahar mines in the Mayurbhanj and Kendujhar districts. In the adjoining Singbhum district of Jharkhand haematite iron ore is mined in Gua and Noamundi.

- **Durg-Bastar-Chandrapur Belt:** It lies in Chhattisgarh and Maharashtra. Very high grade haematites are found in the famous Bailadila range of hills in the Bastar district of Chhattisgarh. The range of hills comprises of 14 deposits of super high grade haematite iron ore. It has the best physical properties needed for making steel. Iron ore from these mines is exported to Japan and South Korea via Vishakhapatnam port.



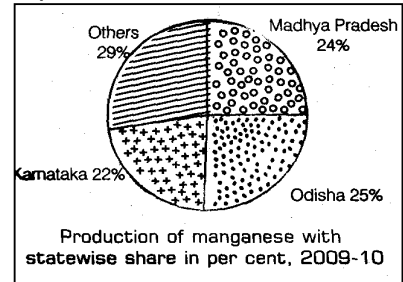
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• **Ballari-Chitradurga-Chikkamagaluru Tumakuru Belt:** Karnataka has large reserves of iron ore. The Kudremukh mines are located in the Western Ghats of Karnataka are a 100% export unit and are known to be one of the largest in the world. The ore from this belt is transported as slurry through a pipeline to a port near Mangaluru.

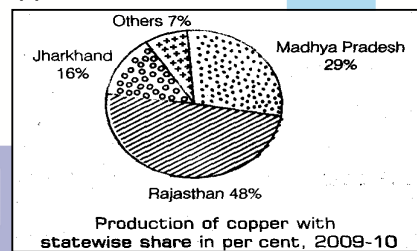
• **Maharashtra-Goa Belt:** It includes the state of Goa and Ratnagiri district of Maharashtra. Though, the ores are not of very high quality, yet they can be efficiently used. From this belt, iron ore is exported through Marmagao port.

b) **Manganese:** Manganese is a metallic element used in manufacturing of steel and ferro-manganese alloys. Nearly 10 kg of manganese is required to manufacture 1 tonne of steel. Manganese is also used in manufacturing insecticides, bleaching powder and paints. The states that produce maximum manganese in India are Odisha, Madhya Pradesh and Karnataka. India ranks fifth in the world in production of manganese and Odisha is the largest producer of manganese ores in India.



2. **Non-Ferrous Minerals:** India has only a few reserves of non-ferrous minerals that are not very adequate. However, these minerals which include (e.g. copper, zinc, bauxite and gold) play a vital role in various industries, i.e. metallurgical, engineering and electrical industries. The distribution of non-ferrous minerals i.e. copper and bauxite are:

a) **Copper:** Copper is an important mineral due to its excellent electrical conductivity. It is used in manufacturing of electrical cables and in electronics and chemical industries. The leading producers of copper in India are Khetri mines in Rajasthan, Balaghat mines in Madhya Pradesh and Singhbhum district of Jharkhand



b) **Bauxite:** Bauxite used for obtaining aluminium is formed by decomposition of rocks rich in aluminium silicates. Bauxite is a clay-like substance from which alumina is extracted firstly and later alumina becomes aluminium. Aluminium is known for its strength and lightness. It is widely used in manufacturing of utensils, electrical goods, etc. Aluminium is an important metal because it combines the strength of metals such as iron with extreme lightness, good conductivity and great malleability. Amarkantak plateau, Maikal hills and the plateau region of Bilaspur-Katni are the main areas of bauxite deposits. Odisha is the largest bauxite producing state in India with 34.97% of the country's total production in 2009-10. Panchpatmali deposits in Koraput district is the most important centres of bauxite deposits in Odisha.

**Interesting Fact about Aluminium:** After the discovery of aluminium, Emperor Napoleon III wore buttons and hooks on his clothes made of aluminium. He served food to his more important guests in aluminium utensils and the less honourable ones were served in gold and silver utensils. Thirty years after this incident, aluminium bowls were most common with the beggars in Paris.

**Non-Metallic Minerals:** The basic characteristic of non-metallic minerals is that they do not yield new products on melting. These are generally associated with sedimentary rocks. E.g. granite, sandstone, etc.

**Mica:** It is an important non-metallic, mineral. It is used in electrical and electronics industries due to its di-electric strength, insulating properties and resistance to high voltage. Mica occurs in the form of plates or leaves, which can be split into thin sheets. Mica can be clear, black, green, red, yellow or brown. Its deposits are mainly found in the Northern edge of the Chota Nagpur plateau. Koderma-Gaya- Hazaribagh belt of Jharkhand is the leading producer of mica. In Rajasthan, the major mica producing area is around Ajmer. Nellore mica belt of Andhra Pradesh is also an important producer in the country.

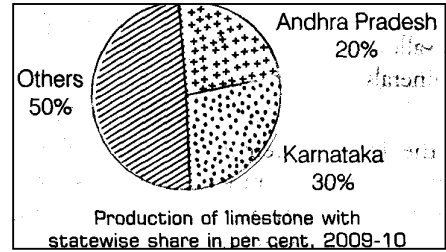


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**Rock Minerals:** Rock mineral like limestone is found, in sedimentary rocks and is composed of calcium carbonates or calcium and magnesium carbonates. Limestone is used for smelting iron ore in blast furnaces of steel plants and is the basic raw material for manufacturing of cement.

**Hazards of Mining:** Mining is a hazardous industry, both for the workers and for the residents. The miners have to work under tough conditions where no natural light is available. There is always a risk of collapse of mine roofs, overflow of water and fire in the mines. The areas around mines face the problem of too much dust from the mines. Slurry from mines damage the roads and the farmland. Houses and clothes become dirty more often than in other areas. Miners are at great risk of getting affected with pulmonary disorders. Cases of respiratory tract diseases are very high in mining areas. Government should impose strict safety regulations and environmental laws to prevent mining from becoming a Killer industry.



## Conservation Of Minerals:

Minerals require millions of years to form and now-a-days, we are consuming minerals at a much faster rate than the rate at which they are formed. The mineral resources are finite and non-renewable. Continuous extraction of minerals raises the cost of extraction as they have to be dug from greater depths. Minerals may also be low in quality. So, there is need to conserve our mineral resources judiciously in the following ways

- Mineral resources should be used in planned and sustainable manner.
- Technologies should be developed to use lower grade minerals at lower costs.
- Metals should be recycled and alternative materials should be used so that minerals can be conserved.

**Energy Resources:** Energy is required for all activities. Resources which are used as power to run industries are called energy resources. Fuel minerals like coal, petroleum, natural gas, uranium and electricity can generate energy. Energy resources can be either conventional or non-conventional.

- Conventional sources: like coal and petroleum have been used for a long time. They take millions of years to form again. Thus, they are finite and non-renewable.
- Non-conventional sources of energy: have come into use recently. These include wind power, solar energy, tidal energy, geothermal energy, atomic energy and biogas energy. They are freely available, usually inexhaustible and renewable.



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**NOTE:** Firewood and cattle dung cake are most common in rural India. According to one estimate, more than 70% energy requirement in rural households is met by these two. Use of dung cake is discouraged because it consumes valuable manure which can be used in agriculture and produces lot of smoke.

**Conventional Sources of Energy:** prominent conventional sources of energy are:

**a) Coal:** India is highly dependent on coal for meeting its commercial energy requirements. Coal is a raw material for heavy industries and thermal power stations. It is bulky due to which these industries are located near coalfields. Depending on the degrees of compression, the depth and time of burial during its formation, there are following varieties of coal:

- **Peat** it is an organic soil or deposit of dense vegetable matter only partially decomposed. It has a low carbon content and low heating capacity.
- **Lignite** It is a low grade brown coal. It is soft and has high moisture content. Neyveli in Tamil Nadu has the main reserves of lignite coal. This type of coal is used for electricity generation.
- **Bituminous** Coal which was formed because of increased temperature and was buried very deep is called bituminous coal. This is the most popular coal for commercial use. High grade bituminous coal is ideal for use in metallurgy.
- **Anthracite** This is the highest quality hard coal.

**Occurrence of Coal in India:** In India, coal occurs in rock series of following two main geological ages

- **Gondwana coal** This was formed over 200 million years ago. The major sources of Gondwana coal are located in the Damodar valley (West Bengal-Jharkhand). In this belt, Jharia, Raniganj and Bokaro are important coal fields. Coal deposits are also present in the Godavari, Mahanadi, Son and Wardha valleys.
- **Tertiary coal** This was formed 55 million years ago and is found in the North-Eastern states of Meghalaya, Assam, Arunachal Pradesh and Nagaland.

**b) Petroleum:** Petroleum is also known as mineral oil. It is the second highest energy source (after refining into various products like furnace oil, diesel, petrol, kerosene, etc) used in India after coal. Petroleum is known as 'liquid gold'. First oil field in India was discovered at Makun (in Assam) in 1867. Petroleum refineries act as a 'nodal industry' for synthetic textile, fertiliser and chemical industries.

**Occurrence of Petroleum in India:** Natural occurrence of petroleum in India is associated with anticlines and fault traps of tertiary rocks. In anticline, folding or dome region, oil is trapped in the crest of the upfold. The oil bearing layer is a porous limestone or sandstone through which oil may flow. The non-porous layers come in between and prevent the oil from rising or sinking. 'Whereas in fault traps; it is found in between porous and non-porous rocks. Mumbai High produces about 63% of India's petroleum. Gujarat produces 18% and Assam 16%. Ankeleshwar is the most important oil field in Gujarat. Assam is the oldest oil producing state of India. Important oil fields of Assam are Digboi, Naharkatiya and Moran-Hugrijan.

**c) Natural Gas:** Natural gas is a clean energy resource. It is usually found along with petroleum, but sometimes separately also. Compared to coal and petroleum products, it burns with a very low emission of harmful gases and other pollutants. It provides energy for running of petrochemical industry besides being used as fuel for cooking and automobiles. The offshore region of the Krishna-Godavari basin has the largest amount of natural gas currently available in India. To fulfil its natural gas needs, India imports some gas and feeds it to various industries through pipelines. The 1700 km long Hazira-Vijaipur-Jagdishpur (HVJ) pipeline links Mumbai High and Bassein with the fertiliser, power and industrial complexes in Western and Northern India. Natural gas is mainly used by the fertiliser and power industries. Use of Compressed Natural Gas (CNG) for vehicles to replace liquid fuel is gaining wide popularity in the country.

**Electricity:** Electricity has a wide range of applications in

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today's world. That's why its Per Capita Consumption is considered as a sign of development. There are two ways through which electricity is generated. These are

1. Conventionally, electricity (or thermal power) has been generated by burning fossil fuels that supplies energy (coal, petroleum, natural gas etc) to drive turbines. It is known as thermal electricity. There are over 310 thermal power plants in India. Due to depletion of fossil fuels on the Earth, other methods of generating electricity are becoming popular.
2. Electricity generated by flowing water is called hydro electricity. It is pollution free and commonly used all over India, as it is a renewable resource. A number of multi-purpose projects have been set-up to harness the power of river water like Bhakra Nangal, Damodar valley Krishnarajasagara.

**Non-Conventional Sources of Energy:** India is a tropical country that's why is blessed with an abundance of renewable energy resources. The excessive use of non-renewable resources causes several environmental problems. Hence a shift towards renewable resources is necessary. Some, prominent non-conventional sources of energy are:

**a) Nuclear or Atomic Energy:** It is generated by transforming the structure of atoms. Due to this alteration heat (energy) generates, which is used to generate electric power. Uranium and thorium are used for generating atomic power. These minerals are available in Aravalli ranges of Rajasthan and Jharkhand. The monazite sands of Kerala is also rich in thorium.

**b) Solar Energy:** India is a tropical country. It has enormous possibilities tapping solar energy. Solar energy is a freely available resource. It is used for a variety of purposes like electric power generation (using photovoltaic panels) and for heating purposes. Increase use of solar energy contributes to environmental conservation and adequate manure supply in agriculture as it minimises dependence on fire wood and cow dung cakes. India's largest solar power plant is located in Madhapur near Bhuj in Rajasthan.

**c) Wind Power:** Wind energy is utilised to turn huge windmills to generate electric power. These have been set-up in the windy areas of the country like the belt between Nagercoil and Madurai in Tamil Nadu as well as in Jaisalmer, Rajasthan. Apart from these, Andhra Pradesh, Karnataka, Gujarat, Kerala, Maharashtra and Lakshadweep have important wind farms.

**d) Biogas:** It can be produced from shrubs, farm waste, animal and human wastes. Biogas is used as a fuel in rural areas because it has a higher thermal efficiency as compared to kerosene, charcoal or dung cake. It is generated by decomposition of organic matter in biogas plants. Biogas plants can be set-up at municipal, cooperative and individual levels. These provide benefits to the farmer in the form of energy and improved quality of manure. Biogas is by far the most efficient use of cattle dung. It improves the quality of manure and also prevents the loss of trees and manure.

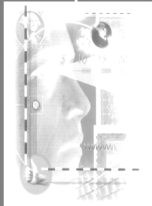
**e) Tidal Energy:** Tidal energy is the energy generated by movement of oceanic tides, which can be harnessed to generate electricity. Floodgate dams are built across inlets. During high tide, water flows into the inlet and gets trapped when the gate is closed. After the tide falls outside the floodgate the water inside it flows back to the sea via a pipe that carries it through power generating turbine. In India, the Gulf of Khambhat, the Gulf of Kutch in Gujarat on the Western coast and Gangetic delta in Sunderban regions of West Bengal provide ideal conditions for utilising tidal energy.

**f) Geo-thermal Energy:** Geo-thermal energy refers to the heat and electricity produced by using the heat from the interior of the Earth. Wherever the concentration of geo-thermal energy is high, higher temperatures are found at shallow depths, leading to the existence of hot springs. To harness energy from hot springs, experimental projects have been set up in India in Parvati valley near in Manikarn Himachal Pradesh and Puga valley in Ladakh.

**Conservation of Energy Resources:** Since, energy is a basic requirement for economic development, we need to conserve it. To have sustainable development, we need to promote energy conservation by using public transport systems instead of individual vehicles, switching off electrical

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appliances when not in use, using power-saving. After all, “energy saved is energy produced”.



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