MINERALS AND ENERGY RESOURCES

Introduction – Importance of MINERALS

- Minerals are an indispensable part of our lives. Almost everything we use is made of minerals.

Examples:

• tiny pins	• machinery
• towering buildings	• cars
• big ships	• buses
• railway lines	• trains
• paving of roads	• aeroplanes etc.

- Even food contains minerals
- They are used for livelihood, decoration, festivities, religious and ceremonial rites.

WHAT IS A MINERAL?

- Geologists – "homogenous, naturally occurring substance with a definable internal structure".
- Rocks are combinations of minerals (only few out of 2000 minerals are found in them).

↓

- Some rocks (like limestones) contain single mineral, but most rocks consist of several minerals in varying proportions.

- Formation of minerals depends upon physical and chemical ~~cond~~ conditions

Therefore wide range of:
- colours
- hardness
- crystal forms
- lustre
- density

Geologists use these properties to classify minerals ↓

Fig 5.1 (TB)

MODE OF OCCURRENCE OF MINERALS

Where are these minerals found?
↓
In ores (accumulation of minerals + elements)
Only large mineral content inside an ore makes extraction commercially viable.
This structure helps in determining:
- the ease of mining
- the cost of extraction

Occurence

1. Veins and Lodes
   Smaller and larger (respectively) occurrences of minerals in cracks/crevices/faults/joints in igneous and metamorphic rocks

   Liquid (molten) or gaseous forms are forced upwards towards the earth's surface
   ↓
   They cool and solidify as they rise

   Examples - tin, copper, zinc, lead

2. Beds or Layers

»» Formed by
- Deposition
- Accumulation
- Concentration

} of minerals in horizontal strata.

»» Examples:
- Coal
- Iron ore

} [Concentrated due to heat and pressure]

- Gypsum
- potash salt
- Sodium salt

} [formed by evaporation in arid areas]

3. Decomposition

»» Surface rocks are decomposed (mainly by water) Soluble constituents are removed

»» leftover residual mass of weathered material has ores

Example - Bauxite

4. Alluvial deposits

»» Minerals which are not corroded by water occur as alluvial deposits called placer deposits (in sands of valley floors and base of hills)

»» Examples - Gold, Silver, Tin, Platinum

5. Oceans

»» Oceans contain many minerals, but they are widely diffused and do not hold economic Significance. (they aren't worth extracting due to less importance and large costs)

Date

» Exceptions - Common salt, Magnesium, Bromine
(all are derived from oceans)
- Manganese nodules (ocean beds)

UNEVEN DISTRIBUTION

Location	Resources	
Peninsular rocks	• coal • mica	• metallic minerals • non-metallic minera
Sedimentary rocks western and eastern flanks of peninsula (Gujarat and Assam)	Petroleum deposits	
Rajasthan (with peninsular rock systems)	Non-ferrow minerals	
Alluvial Plains	Devoid of economic minerals	

» Reason for variation - Differences in geological structure, processes and time involved in formation

» Factors affecting economic viability of reserve:
- Concentration of mineral in the ore
- ease of extraction
- Closeness to market

» Taking these factors into consideration, to meet the demand, the best reserve is chosen. This 'deposit' or 'reserve' becomes a mine.

FERROUS MINERALS

»» 3/4 th of total metallic minerals
strong base for development of metallurgical industries

Iron Ore

»» basic mineral, backbone of industrial development

»» Magnetite – finest iron ore
- 70% iron content
- excellent magnetic qualities
- valuable in electrical industry

»» Hematite – most important in terms of quantity
- 50-60% iron content

States:
- Odisha
- Chhattisgarh
- Karnataka
- Jharkhand

} 97% production

Major Iron Ore Belts in India

1. Odisha-Jharkhand Belt
»» High-grade hematite ore in:
- Badampahar mines (Mayurbhanj & Kendujhar, Odisha)
- Gua and Naomundi mines (Singbhum, Jharkhand)

2. Durg-Bastar-Chandrapur belt (Chhattisgarh & Maharashtra)
»» High-grade hematites in Bailadila hills (Bastar,

Chhattisgarh) – 14 deposits of hematite
»» Best physical properties for steel-making
»» Iron ore exported to Japan and South Korea via Vishakhapatnam port

3. Ballari–Chitradurga–Chikkamagaluru–Tumakuru (Karnataka)
»» Largest reserves of iron ore
Kudremukh mines:
- Western Ghats
- 100% export unit
- one of the largest deposits in the world

»» Ore transported to Mangaluru port via pipeline

4. Maharashtra-Goa belt (Goa and Ratnagiri, Maharashtra)
»» Medium-quality ores (not very high quality)
↓yet
efficiently EXPLOITED
»» Ore is exported through Marmagao port

Manganese

»» Uses- manufacturing of steel and ferro-manganese alloy
↓
10kg manganese → 1 tonne steel

– manufacturing bleaching powder, paints and insecticides

»» Major States:

• Madhya Pradesh	• Odisha	• Andhra Pradesh
• Maharashtra	• Karnataka	

Date

NON-FERROUS MINERALS

- Reserves and production low
- Important minerals - copper, bauxite, lead, zinc, gold
- Used in metallurgical, engineering and electrical industries

Copper

- India deficient in reserves and production
- Properties → Uses

Properties	Uses
① Malleable	• Electrical cables
② Ductile	• Electronics
③ Good Conductor	• Chemical industries

- Main Producers:
  - Balaghat (Madhya Pradesh)
  - Khetri (Rajasthan)
  - Singbhum (Jharkhand)

Bauxite

- Source of alluminium
- Formed from decomposition of aluminium silicate rocks
- Aluminium - combines strength, lightness, conductivity, malleability
- Main deposits:
  - Amarkantak plateau
  - Maikal Hills
  - Bilaspur-Katni plateau

Date

» Largest producer - Odisha (Panchpatmali, Koraput)

NON-METALLIC MINERALS

Mica

» Made of layered plates / leaves
» Splits easily into thin sheets (malleable)

» Appearance - Clear / Black / Green / Red Yellow / Brown
» Properties:
- di-electric Strength
- low power loss
- insulating
- resistant to high voltage

↓

» Uses: electric and electronic industries
» Major deposits - Chhota Nagpur Plateau (north edge)
» Main producers:
- Koderma - Gaya - Hazaribagh belt (Jharkhand)
- Ajmer (Rajasthan)
- Nellore (Andhra Pradesh)

ROCK MINERALS

Limestone

» Found in calcium carbonate / magnesium carbonate rocks
» In sedimentary rocks of most formations

» Uses - Cement industry raw material
- Smelting iron ore in blast furnace

CONSERVATION OF MINERALS

»» Strong dependence on minerals
↓ yet
Mineral deposits are limited (1% of earth's crust)

»» (↑) Consumption rate > Replenishment rate (↓)
(slow geological processes + rapid consumption)

»» Minerals are finite and non-renewable

»» Problems – Continued extraction :
- increased costs
- decreased quality

»» Solutions :
- Improved tech for low-grade ores (low cost)
- Recycling metals
- Using substitutes (like scrap metals)

ENERGY RESOURCES

»» Needed for all activities (cooking, provision of light and heat, propel vehicles, drive machinery)

Conventional sources	Non-conventiond sources
• Firewood	• Solar
• Cattle dung cake	• Wind
• Coal	• Tidal
• Petroleum	• Geothermal
• Electricity (hydel and thermal)	• Biogas
	• Atomic energy

»» Rural India relies on firewood and dung cake

(70% energy obtained from these two)

↓

» Issues:
- Decreasing forest area
- During cake use → loss of valuable manure for agriculture

CONVENTIONAL SOURCES OF ENERGY

Coal

» Most abundant, fulfills energy needs

» Uses:

Commercial energy
1. Power generation
2. Supplying energy for both industrial and domestic needs

» Formation: Compression of plant material over millions of years

↓

∴ Various forms based on degrees of compressio depth and time of Burial.

I. Peat
- Decaying plants in swamps
- low carbon
- low heating capacity
- high moisture

II. Lignite
- low grade, brown
- high moisture
- soft

Reserves - Neyvali, Tamil Nadu

↓

electricity generation

III. Bituminous
Most popular for commercial use
Buried with high temperatures
Metallurgical coal - high grade
- Smelting iron in blast furnaces

IV. Anthracite
Highest quality hard core

Coal occurs in two geological ages:

1. Gondwana	2. Tertiary
• 200 million years	• 55 million years
• Locations: Damodar valley Jharia Raniganj Bokaro	• Locations: Meghalaya Assam Arunachal Pradesh Nagaland
• River valleys: Godavari Mahanadi Son Wardha	—

>>> Heavy industries and thermal power plants are located near coalfields

↓ Why?

- Coal is bulky
- Loses weight on use as it is reduced to ash.

Petroleum

»» Next major energy source after coal

»» Uses:

1. Fuel for heat and lightning
2. Lubricants for ~~mach~~ machinery
3. Raw material for manufacturing industries
4. Nodal industry for synthetic textile, fertiliser and chemical industries

»» Occurence: Anticlines and fault traps

Anticlines

- Oil is trapped in the crest of the upfold in regions of folding, anticlines or domes
- The oil bearing layer is a porous limestone or sandstone through which oil may flow
- It is prevented from rising or sinking by intervening non-porous layers.

Fault traps

- Found in fault traps between porous and non-porous rocks as well
- Gas is lighter and occurs above the oil.

Major producing areas	OIL FIELDS	Gujarat:	Assam:
Mumbai High Gujarat Assam		◦ Ankeleshwar (most imp.)	◦ Digboi ◦ Naharkatiya ◦ Moran-Hugrijan

Assam is the oldest oil-producing state

Page No.
Date

Natural Gas

- Found with petroleum deposits
- Released when crude oil is brought to the surface

- Uses:
  1. Domestic and industrial fuel
  2. Fuel in power sector to generate electricit
  3. Raw material in chemical, petrochemical and fertilizer industries
  4. Transport fuel (CNG)
  5. Cooking fuel (PNG)
  6. Heating in industries

CNG and PNG are getting popular due to:
1. Expansion of gas infrastructure
2. Local city gas distribution (CGD) networks

Major gas reserves:
- Mumbai High
- Cambay Basin
- Krisha-Godavari basin

Hazira - Vijaipur - Jagdishpur (HVJ) pipeline
- First gas pipeline
- 1700 Km long
- Constructed by GAIL (India)
- Linked Mumbai High and Bassein oil fields with fertilizer, power and industrial complexes in west and north India
- Led to Indian gas market development

Date

» Expansion: 1700 km → 18,500 km (10 times ↑)
cross-country (gas infrastructure)
pipelines

» Projection: 34,000 km soon as Gas Grid by linking gas sources with consuming markets (including North-East states)

Electricity

» Per capita consumption = an index of developmen
Wide range of applications

» Generation:
1. Hydro-electricity (renewable) — running water drives hydro turbines
2. Thermal power (non-renewable) — burning fuels like coal, ~~pet~~ petroleum and natural gas to drive turbines

» Multipurpose hydel projects
- Bhakra Nangal
- Damodar Valley Corporation
- Kopili Hydel Project, etc.

NON-CONVENTIONAL SOURCES OF ENERGY

The Problem: (with conventional sources)
» India's energy consumption is rising and it is heavily dependent on fossil fuels (coal, oil, gas).
» Their prices are increased, and shortages are

observed

The consequences:
- Uncertainties ~~are~~ about energy supply security
- Repercussions on economic growth
- Environmental problems

The Solution:
- Use of non-conventional, renewable energy sources – solar, wind, tide, biomass, waste energy

Nuclear or Atomic Energy

PROCESS
- Structure of atoms is altered
- Energy is released in the form of heat
- Electric power is generated

- Uranium and Thorium are used to generate atomic power
- They are available in:
  - Jharkhand (uranium in Singbhum)
  - Aravalli ranges, Rajasthan
  - Monazite sands, Kerala (LARGELY Thorium-rich)

Solar Energy

- India is tropical, abundant solar energy.
- Enormous possibilities of tapping it.
- Photovoltaic technology – sunlight → electricity
- Fast, popular in rural and remote areas
- Big solar plants are being established to reduce rural dependence on firewood, dung cakes → contribute to environmental conservation and adequate manure supply.

Wind Power

- Largest wind farm cluster: Tamil Nadu (Nagarcoil to Madurai)
- Other wind farms: AndhraP, Karnataka, Gujarat, Kerala, Maharashtra, Lakshadweep
- Effective use of wind energy: Nagarcoil, Jaisalmer

Biogas

- Shrubs, farm waste, animal and human waste produce biogas for domestic consumption in rural areas.
- Decomposition of organic matter
  ↓
  Gas with higher thermal efficiency
  (compared to kerosene, dung cakes, charcoal)
- Plants set up at municipal, cooperative and individual levels
- Plants using cattle dung = 'Gobar gas plants' (rural)
- Twin Benefits:
  - Energy generation
  - Improved quality of manure
- Biogas is the most efficient use of cattle dung:
  - Improves manure quality
  - prevents loss of trees and manure due to burning of fuel wood and cow dung cakes.

Tidal Energy

» Electricity is generated using oceanic tides.

» Floodgate dams are built across inlets
- High tide occurs
- Water flows into the inlet
- The gate gets closed
- Water gets trapped
- This retained water goes back to sea (via pipe) through a power generating turbine

Locations - Gulf of Khambhat } Gujarat (west coast)
- Gulf of Kuchch }
- Gangetic Delta } Sunderbans, West Bengal

Geo Thermal Energy

» Heat and electricity produced using the heat from the interior of the Earth.

» Earth grows progressively hotter with increasing depth
(high geothermal gradient = high temperatures at depths)
- Ground water in such areas absorbs heat from the rocks and becomes hot
- When it rises to earth's surface, it turns into steam
- This steam drives turbines to generate electricity.

» Hot spring projects - Parvati valley (near Manikarn), Himachal Pradesh
- Puga Valley, Ladakh

CONSERVATION OF ENERGY RESOURCES

» Energy is basic requirement for development

» Every sector of economy needs energy inputs.
(agriculture, industry, transport, commercial, domestic, etc.)

Date

Thus, consumption is rising.
Need for sustainable energy development.

Twin approach:
- Promote energy conservation
- Increase the use of renewable energy sources

India is one of the least energy efficient countries; needs a cautious approach.

Ways to contribute:
- Use public transport
- Switch off unnecessary lights
- Use power-saving devices
- Use non-conventional energy sources

"Energy saved is energy produced."