Chapter - 6 Geology of Maharashtra

Highlights :

- An account of physiography and stratigraphy of Maharashtra
- Geographic and geological distribution of economic mineral deposits of Maharashtra.

Introduction :

After gaining sufficient knowledge on the fundamental aspects of geology, it is necessary to understand the geology of our own state. Geology of Maharashtra occupies special status globally due to Deccan volcanism and the Lonar meteorite crater. The state is also gifted with economic minerals and hydrocarbons. Maharashtra is the third largest state in area after Rajasthan and Madhya Pradesh. Maharashtra covers a large part of west-central India between North latitudes 15°45' and 22°00', and East longitudes 73°00' and 80°59'. The total area of Maharashtra is 3,07,713 sq. km. exposing a wide range of geological features and mineral resources. Rock formations from Archaean to Holocene age are exposed in Maharashtra.

6.1 Physiographic subdivisions of Maharashtra :

Maharashtra can be divided into three physiographic regions (Fig. 6.1), namely-

1) Maharashtra Plateau
2) Western Ghats (Sahyadri)
3) Coastal Region (Konkan)

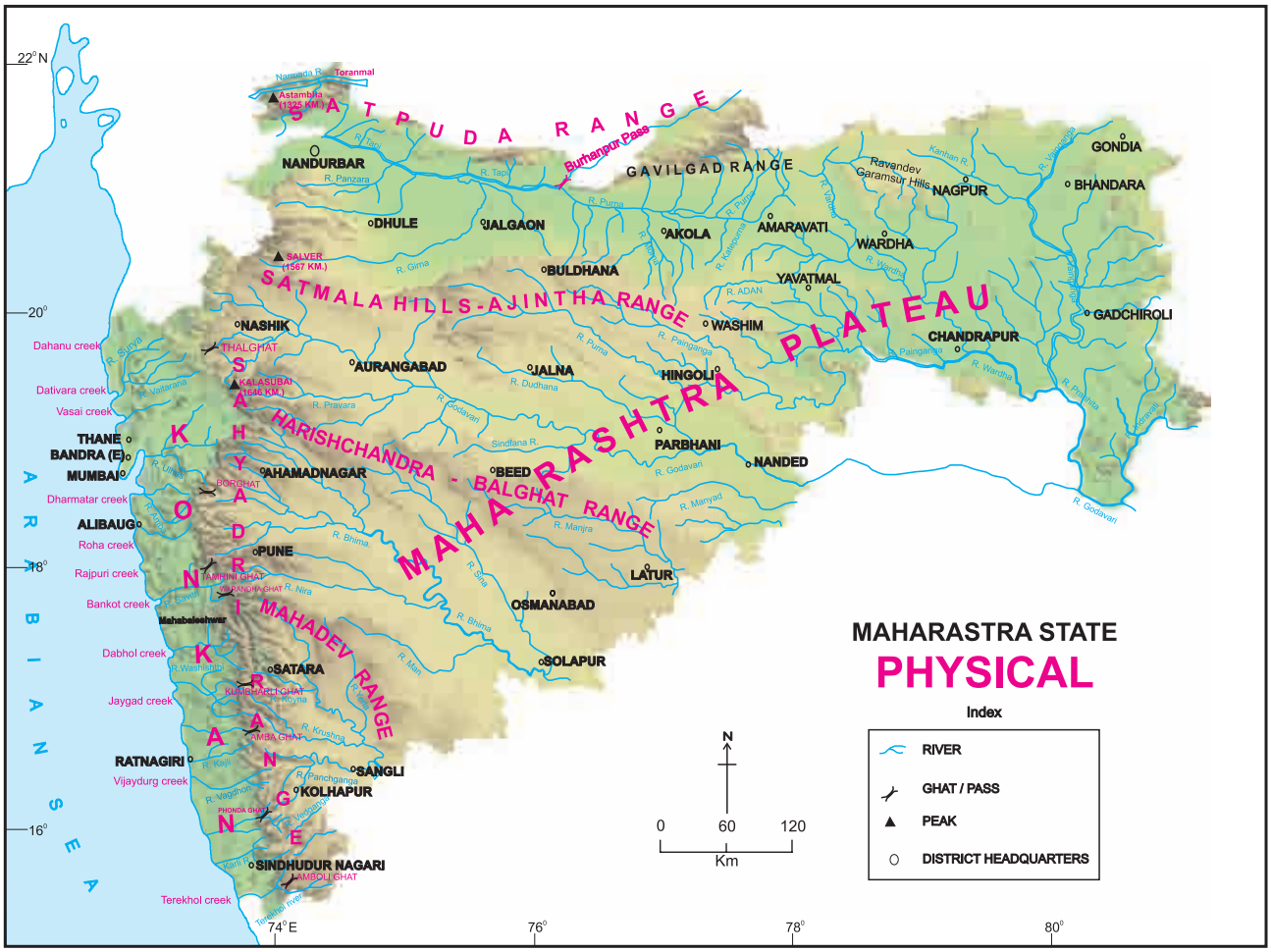

Fig. 6.1 : Map showing the physiographic features of the state of Maharashtra.

1) **Maharashtra plateau :** Maharashtra Plateau is a major part of Deccan plateau of Peninsular region of India. It is formed by basaltic lava erupted through fissures. These basaltic lava flows are horizontal to sub-horizontal and are found to spread practically all over the state. The landscape is more or less uniform with flat-topped hill ranges. They occupy about 81% area of the state and mainly covers Vidarbha, Khandesh, Marathwada and some Western Maharashtra divisions. The region is traversed by eastwest and northwest to southeast trending river valleys, and hill ranges with more or less similar trends. The altitude of Maharashtra Plateau varies from 400 to 600 msl with gentle eastward gradient. It has been exposed to denudation for several millions years.

The Satmala, Ajantha, Harishchandra-Balaghat range and Mahadev hills stretch across the Maharashtra plateau. Their altitude ranges between 600m and 900m above msl. Melghat range which is a branch of Satpura hill trends east-west, almost parallel to northern border of the State. Satmala-Ajantha hills trend in east-west direction and separate Tapi basin from Godavari basin. Harishchandra-Balaghat hills trending northwest-southeast separate Godavari basin and Bhima basin. Mahadev hills run northwest-southeast, dividing Bhima and Krishna basins.

2) **Western Ghats :** The Western Ghats are also known as Sahyadris. They are situated to the west of Maharashtra Plateau and extends north-south. They are parallel to the west coast of India. The average elevation is between 1000 and 1300 msl and decreases from south to north. Many hills are places of pilgrimage, hill stations and forts.

The topography is formed by differential weathering and erosion of rock masses. The rock masses are composed of series of near horizontal lava flows of basalt. The thickness of the lava flows varies from less than a meter to more than 35m. Due to differential weathering and erosion, harder lava flows form steep scarps whereas the softer lava flows form gentler slopes, resulting in a step-like topography. Because of this step-like or terraced appearance the hills are called 'Traps'. These hills are generally flat-topped or table-topped. The Sahyadris have a gentler slope towards the Deccan plateau and steep slope towards west. Major rivers in Maharashtra flow in an easterly to southeasterly direction with their sources in Sahyadri, whereas some of their tributaries originate in the east-west trending ranges. The major easterly flowing rivers are Godavari and Krishna which originate at Trimbakeshwar and Mahabaleshwar respectively, in the Western Ghats. Godavari basin is the largest basin of the Indian Peninsular region next to Ganga basin. Wardha, Penganga, Wainganga, Manjra, Pranhita, Indravati and Shabari are the main tributaries of Godavari. Koyna and Bhima are the major tributaries of Krishna. The major westerly flowing rivers are Narmada and Tapi. The Narmada river originates at Amarkantak in Madhya Pradesh and flows along the northern boundary of Maharashtra. Where as the Tapi river originates near Multai in Betul district of Madhya Pradesh and flows nearly parallel to the Narmada river before meeting the Arabian sea.

Do you know?

The highest peak in the Sahyadris is Kalsubai at 1646m (5400ft) which is located in the Harishchandragad-Kalsubai sanctuary. Kalsubai is also known as the Everest of Maharashtra.

3) **Coastal region :** A narrow coastal plain between Western Ghat and Arabian Sea is known as Konkan coast. In Maharashtra

state, the coastal lowland is called 'Konkan' and the vast plateau region east of the Ghats is known as 'Desh'. The Konkan coastal belt is about 720 km long and its width varies from about 50 - 105 km. The formation of coastal lowland mainly depends on the length of rivers, volume of water (perennial or seasonal) flowing through rivers, the alluvium brought by rivers, extent of catchment areas and slope of land.

The Konkan belt consists of number of east-west trending ridges. There are some small and narrow plateaus. The average height of these plateaus is about 60 to 100m above msl. These plateaus are covered by laterite in South Konkan. Several short and swift rivers originate in Sahyadri and flow westwards finally to enter the Arabian Sea. Due to limited length and heavy rainfall, the velocity of water flow is high. Many of the coastal streams carry out severe erosion in their source region and have caused diversion of some of the plateau rivers, towards west. This has resulted in development of waterfalls all along the western slope of Sahyadri. The major rivers are Ulhas, Vashishthi, Shastri, Vaitarna, Savitri, Patalganga, Kundalika and Terekhol.

6.2 Stratigraphy :

Various rock formations are exposed in the state of Maharashtra along with their varied lithology. The distribution of different rock formations is shown in (Fig. 6.2) and their stratigraphic succession is given in Table 6.1.

i) **Paleo-archean (3600 - 3200 Ma) :** The oldest rocks exposed in the state are biotite gneisses belonging to Amgaon gneissic complex, Tirodi gneisses and Peninsular gneisses, that formed the basement.

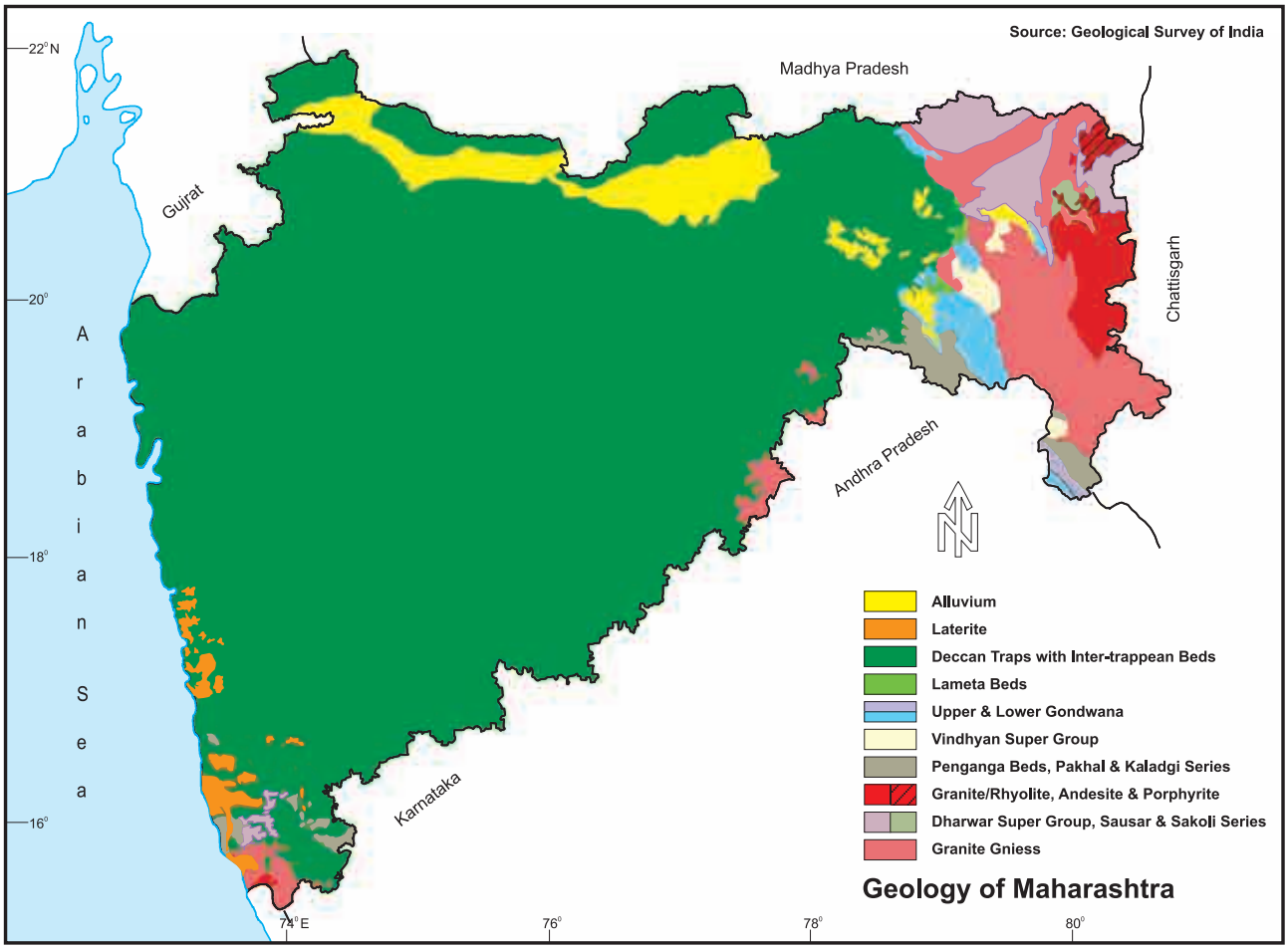

Fig. 6.2 : The generalized Geological map of Maharashtra

ii) **Neo-archean (2800 - 2500 Ma) :** The basement gneisses are overlain by volcanics and metasediments belonging to Amgaon, Sakoli and Dongargarh groups. They are represented by different types of schists, gneisses, quartzites, marbles, amphibolites, hornblende schists with intercalated bands of iron and manganese ores. These rocks were involved in several orogenic cycles and hence are intensely deformed and mixed up. They are intruded by Dongargarh granite, a batholith in Gondia and Gadchiroli districts.

iii) **Paleo-to-Meso proterozoic (2500 - 1000 Ma) :** After the intrusive activity there was a long period of non-deposition during which these rocks were subjected to weathering. This resulted in the development of Eparchaean unconformity. Bhandara, Nagpur and Gondia regions are represented by Khairagarh and Sausar groups. The Sausar group hosts one of the richest manganese ore deposits.

iv) **Neo-proterozoic (1000 - 541 Ma) :** Denuded topography formed during Eparchean unconformity became the sites of deposotion for the Neo-proterozoic sedimentation. They are represented by sediments of Kaladgi Group in the Ratnagiri district and sediments of Pakhal Group, Vindhyan Supergroup and Penganga Group in the Gadchiroli, Chandrapur and Yavatmal districts.

During the period between Cambrian and upper Carboniferous there is no lithological record in Maharashtra. During this period India was part of Gondwanaland and was covered by thick sheet of ice.

v) **Upper carboniferous (323 - 299 Ma) :** During Carboniferous period glacial to fluvio-glacial sediments were deposited in the linear rift basins, that are exposed in Nagpur, Chandrapur and Yavatmal districts represented by 'Boulder Bed' or tillites at the base (Talchir Formation).

vi) **Permian (299 - 252 Ma) :** Talchirs are followed upward by deposition of fluvial sediments during warmer period now represented by coal-bearing sandstones and shales of Barakar and Kamthi formations.

vii) **Triassic (252 - 201 Ma) :** The sedimentary sequence viz., Mangli, Pachmari and Maleri. formations are represented by sandstone and shale.

viii) **Jurassic (201 - 145 Ma) :** This period is represented by the Kota and Chikiala formations comprising of limestone.

Do you know?

The strata ranging in age from Upper Carboniferous to Jurassic is called as Gondwana Supergroup.

ix) **Upper Cretaceous (100 - 66 Ma) :** After the cessation of sedimentation in the Gondwana basin around 100 Ma, there was a marine incursion marked by deposition of Bagh beds in Dhule district and contemporaneous fluvial and lacustrine Lameta beds were deposited in parts of Nagpur, Chandrapur, Amravati and Yavatmal districts.

x) **Lower Paleocene to Upper Cretaceous (~ 69 - 61 Ma):** This time is represented by voluminous outpouring of lava through extensive fissures resulting in the formation of Deccan basalt, which is one of the well-known flood basalt provinces of the world. The Deccan traps cover an area > 500,000 sq. km. The eruption was mostly non explosive and the lava spread over extensive areas in the form of nearly horizontal flows of varying thickness (Fig. 6.3). Number of such flows are found piled one above the other and some individual flows can be traced for several hundred kilometers. The flows occupy almost the entire area of Maharashtra except some parts of Nagpur, Bhandara, Gondia, Chandrapur, Gadchiroli and Yavatmal

districts in Vidarbha region and Ratnagiri and Sindhudurg districts in coastal Konkan. Two types of lava flows are recognized. They are the pahoehoe or ropy lava and the 'aa' or blocky lava. Pahoehoe lava flows predominate in Dhule, Aurangabad, Pune and Nasik districts, whereas in rest of Maharashtra, 'aa' lava flows are dominantly exposed. In Maharashtra between some flows intertrappean beds of lacustrine origin are found. Red bole beds commonly occur in between two lava flows. The flows are intruded by number of dolerite dykes trending nearly N-S, parallel to the west coast. East-west trending dykes are commonly exposed in northern part of Maharashtra around Nandurbar, Dhule and Jalgaon districts.

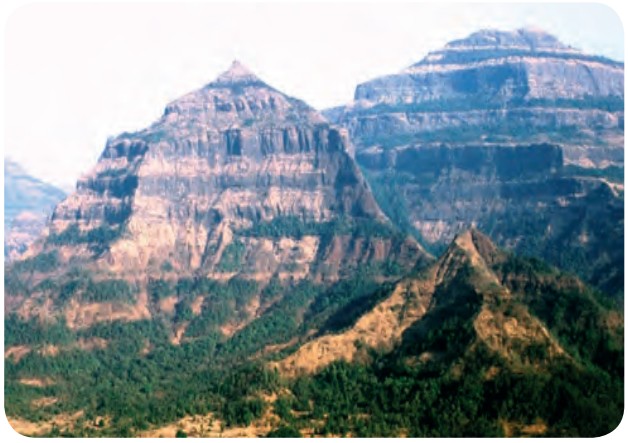

Fig. 6.3 : Stratigraphic exposures of lava flows in Malshej Ghat area of Maharashtra

Do you know?

The term 'Deccan trap' was first coined by W. W. Sykes in 1833 after the Swedish word 'trapp / trappa' meaning stair to describe the step-like or terrace-like topography peculiar to Deccan trap terrain. The name Deccan is an anglicised form of the Prakrit word 'Dakkhini', itself derived from the Sankrit word 'Dakhina' meaning south.

Deccan basalts have uniform mineralogical and chemical characters. It is essentially composed of plagioclase and augite with accessory amount of biotite and hornblende. Olivine may or may not be present. It shows compact, vesicular, amygdaloidal, pipe amygdaloidal, pillow and columnar structure. The cavities in vesicular basalts are filled with secondary minerals like heulandite stilbite, apophyllite, quartz, amethyst, chalcedony, agate, jasper, opal, calcite etc. Ropy lava structure, columnar joints are commonly observed in basalts (Fig.6.4 and 6.5).

Fig. 6.4 : Ropy Lava

Fig. 6.5 : Columnar joints, Tumzai Hills, Panhala

Do you know?

The rock cut caves of Ajanta, Ellora and Elephanta are the UNESCO world heritage sites.

The Ajanta caves located in Aurangabad are 30 rock cut Buddhist cave monuments in Deccan Basalt.

The Kailash Temple or cave 16 as it is known at Ellora is a huge monolithic temple dedicated to Lord Shiva.

Table 6.2 : Lithostratigraphy of Deccan traps

(M1 - M4 are marker horizons)

Super Group	Group	Sub Group	Formation
DECCAN TRAPS	SAHYADRI	Mahabaleshwar	Mahabaleshwar
			M4
		Diveghat	Purandargad
			Diveghat
			Elephanta
		Lonavala	Karla
			Indrayani
		Kalsubai	M3
			Upper Ratangad
			M2
			Lower Ratangad
			M1
			Salher

xi) Paleocene-Oligocene (66 - 23 Ma) : This period is mainly represented by lateralisation in western Maharashtra.

xii) Miocene-Pliocene (23 - 2.58 Ma) : This period represents episodes of sedimentation and lateralisation.

xiii) Pleistocene-Recent (<2.58 Ma) : This period is represented by Quaternary alluvium, soils and laterites. Important archaeological sites and the Toba volcanic ash occurrence are unique to the Quaternary sequence of Maharashtra.

6.3 Distribution of major economic minerals of Maharashtra :

Though most of the mineral deposits of Maharashtra state are concentrated in eastern Maharashtra, the major mineral deposits of bauxite occurs in western Maharashtra. The minerals which are being economically exploited are manganese ore, iron ore, coal, bauxite, limestone, sillimanite, kyanite and clays. Deposits of copper, gold, tungsten, barite, magnetite, ilmenite and chromite are also worth mentioning. Other minerals like andalusite, antimony, asbestos, lead and zinc, platinum, silver, diamond, corundum and radioactive minerals are occurrences that have not been proved to be economically viable so far.

6.3.1 Manganese ore :

Manganese ore deposits of Maharashtra are the part of world famous manganese ore producing Nagpur-Bhandara-Balaghat belt of India. Manganese is mainly used in the manufacture of steel. It is also used in the manufacture of ferro-alloys, dry batteries, manganese chemicals and paints.

6.3.2 Iron ore :

Iron ore deposits of Maharashtra occur in Chandrapur, Gadchiroli, Gondia and Sindhudurg districts. They are mostly concentrated in the Vidarbha region. The iron ore minerals are hematite and magnetite.

6.3.3 Coal :

Coal is a compact, stratified rock formed by accumulation and preservation of plant matter. It is combustible and considered a fossil fuel. Plants when buried in marshy land get decayed and carbonization process gives rise to coal. These coal bearing areas are present only in the Vidarbha region. Coal is being mined from

several underground and opencast mines in Nagpur, Chandrapur and Yavatmal districts. Major portion of coal produced is used for power generation, while part of coal produced is utilized in cement plants, textile mills, paper mills, brick and lime kilns and railways. Coal deposits in Vidarbha have the potential of meeting the requirements of increasing thermal power generation and other industries in western Maharashtra.

Lignite (low rank brown coal) also occurs in association with Tertiary sediments in Ratnagiri and Sindhudurg districts of Maharashtra. It is brown in colour and contains abundant non-combustible matter.

6.3.4 Bauxite :

Bauxite is a mixture of various minerals of aluminium hydroxide. It is a porous clay-like rock sometimes having pisolitic structure, and different colours depending upon its composition. The colours generally vary between earthy white to brownish yellow. Bauxite occurs as blanket deposits, lenses and pockets and intercalated beds within sedimentary strata or as detrital deposits. It also occurs as a layer below laterite cap developed on basalts of Sahyadri. Bauxite is principally used as a source of aluminium, but it is also used in refractory, chemical, abrasive, iron and steel, cement and other industries.

Bauxite deposits in Maharashtra are reported from Kolhapur, Raigad, Satara, Sangli, Sindhudurg, Ratnagiri and Thane districts.

6.3.5 Limestone and dolomite :

Limestone is a fine grained sedimentary rock predominantly composed of calcium carbonate. In Maharashtra limestone occurs in rock formations of different ages, which includes, Kaladgi, Pakhal, Vindhyan, Penganga, Gondwana, Lameta, Bagh beds and intertrappean beds. However, economically important limestones occur in Neoproterozoic Vindhyan Supergroup and Penganga Group of Yavatmal and Chandrapur districts. In these districts, considerable reserves of cement and flux grade limestones are available. A good quality limestone is mainly used in cement industry. It is also used in paper, sugar, rubber, metallurgical and other industries.

Extensive deposits of dolomite associated with metamorphic rocks of Sausar Group occur in Nagpur district. Dolomite is also associated with limestones of Penganga Group in Chandrapur and Yavatmal districts.

6.3.6 Kyanite and sillimanite :

These are aluminium silicate minerals commonly found in metamorphic rocks like gneisses and schists. In Maharashtra kyanite and sillimanite are used as refractory material in refractory industries because of their high degree of melting point and alumina content. They are also used for the manufacture of porcelain used in spark plugs. Kyanite and sillimanite deposits in Maharashtra are present in Bhandara and Gadchiroli districts.

6.3.7 Fluorite :

Occurrence of fluorite is reported mostly from Dongargaon area of Chandrapur district. Fluorite along with barite occur as cavity filling deposits. It is being economically exploited by Maharashtra State Mining Corporation. It is use in metallurgy, glass and ceramic industries.

6.3.8 Barite :

Significant occurrences of barite have been reported from Mul area of Chandrapur district. Some minor occurrences are also noticed in Gadchiroli, Yavatmal and Sindhudurg districts. Barite occurs as cavity filling mineral in quartz veins in granite gneiss. It is used in drilling mud, filler in paper and rubber industries.

6.3.9 Chromite :

Chromite is the ore of chromium. In Maharashtra, chromite occurs in Bhandara, Chandrapur, Nagpur and Sindhudurg districts. Chromite occurs as pockets, veins, lenses and as discontinuous bodies. It is used in steel, refractory and metallurgical industries.

6.3.10 Copper :

Copper mineralisation occurs in shear zones traversing the Sakoli Group of rocks from Nagpur, Bhandara, Chandrapur and Gadchiroli districts. The deposits in Chandrapur, Gadchiroli and Nagpur districts are of economic importance.

6.3.11 Tungsten :

Tungsten in the form of wolframite and sheelite mineralization occurs in Nagpur district. Minor occurrences are reported from other parts of Nagpur and Bhandara districts.

6.3.12 Silica sand :

Silica sand is available from the sandstones and decomposed quartzites belonging to Kaladgi Supergroup occur in south Konkan. The sand deposits mainly occur in Sindhudurg, Ratnagiri and Kolhapur districts at number of places. These reserves are used in foundry, chemical and glass industries.

6.3.13 Secondary minerals :

Zeolites and associated secondary minerals including varieties of silica, occur as cavity filling minerals in Deccan Trap. They include heulandite, stilbite, apophyllite, natrolite, mesolite, cavanzite, chabazite, prehnite etc. Silica minerals include rock crystal, amethyst, agate, opal etc.

6.3.14 Oil and natural gas :

The off-shore area along the west coast of Maharashtra has assumed importance because of the occurrence of oil and natural gas. The off-shore area includes the giant Bombay High Field which is surrounded by several small fields. The Bombay High, which is the largest known oil field in India, is located about 160 km west-north-west of Mumbai in the Arabian Sea. In Maharashtra potential areas for Coal Bed Methane (CBM) have been identified in Wardha Valley coal field areas.

Summary :

- Physiographically Maharashtra state is divided in three regions :

  a) Maharashtra Plateau, b) Western Ghats and c) Coastal region.

- Rock formations from Archean to Holocene age are exposed in Maharashtra.
- Archean rocks belonging to Amgaon gneissic complex, Tirodi gneisses, peninsular gneisses form the basement. Basement gneisses are overlain by volcanics and meta-sediments. These formations have been later intruded by dolerite dykes at many places. After the Eparchaean unconformity, rocks of Neoproterozoic period were deposited. These are overlain by basaltic rocks which erupted during Cretaceous period and cover about 81% of the state.
- Coal deposits are found in Vidharbha region. Commercial deposits of non-metallic minerals like limestone and dolomite, kyanite, sillimanite, fluorite, barite, etc. are found in southern and eastern regions of Maharashtra. Off shore areas of Maharashtra state have the commercial deposits of oil and natural gas. These are being exploited from 'Bombay High'.

Table 6.1 : Stratigraphic sequence in Maharashtra state.

Stratigraphic Sequence	Age in Million Yrs.	Representative Rock Formations	Geographic Distribution
xiii) Holocene-Pleistocene (Quaternary)	< 2.58	Alluvium, laterite, sand, soils, volcanic ashe	Younger and older alluvium in Nagpur, Bhandara, Gondia, Chandrapur, Wardha, Yavatmal, Akola, Amravati, Jalgaon, Dhule and Nandurbar districts. Laterite in Kolhapur, Satara, Sangli, Raigad, Ratnagiri, Sindhudurg and Thane districts. River terraces of Wainganga, Wardha and Penganga rivers; raised beaches along west coast
xii) Miocene-Pliocene	2.58 - 23.0	Sediments, lignite, shales and laterites	Ratnagiri and Sindhudurg districts
xi) Paleocene-Miocene	< 66	Laterites, saprolites, ferricretes, bauxites, lateritic soils	Laterites occur in majority of coastal stretches. Few occurrences are their in central eastern Maharashtra
x) Paleocene-Upper Cretaceous	~ 69 - 61	Deccan Trap basalt flows with intertrappean beds	Basalt flows cover most of the state from west of Nagpur and Chandrapur, up to the Arabian sea coast excepting in the eastern parts of Nagpur, Bhandara, Gondia, Chandrapur, Gadchiroli and Ratnagiri districts. Intertrappeans occur in Nagpur, Yavatmal, Chandrapur districts and Mumbai.
ix) Upper Cretaceous	100 - 66	Infratrappeans (Lameta and Bagh beds)	Lameta Formation in Nagpur, Chandrapur and Yavatmal districts. Bagh Beds in Dhule district.
viii) Jurassic	201 - 145	Limestone of Chikiala and Kota formations	Gadchiroli district
vii) Triassic	252 - 201	Clays and sandstone of Maleri and Pachmari formations	Sironcha Tahsil of Gadchiroli district and Achalpur Tahsil of Amravati district
vi) Permian	299 - 252	Sandstone and shale (Mangli Formation) Sandstone and shale (Kamthi Formation) Sandstone, shale and coal (Barakar Formation)	Nagpur, Chandrapur, Yavatmal and Gadchiroli districts
v) Upper Carboniferous	323 - 299	Talchir Formation	Nagpur, Chandrapur and Yavatmal districts
iv) Neo-proterozoic	1000 - 541	Limestone, shale and sandstone (Vindhyan Supergroup) Limestone and shale (Penganga Formation)	Nagpur, Chandrapur and Yavatmal districts
		Limestone and shale (Pakhal Group)	Chandrapur district
		Conglomerate, sandstone and shale (Kaladgi Group)	Ratnagiri and Sindhudurg districts
iii) Palaeo - Mesoproterozoic	2500 - 1000	Khairagarh Group, Sausar Group	Nagpur, Bhandara and Gondia districts
ii) Neo-archean	2800 - 2500	Dongargarh Granite, Nandgaon Group, Sakoli Group, Bailadila Group, Amgaon Group	Nagpur, Bhandara, Gondia, Chandrapur and Gadchiroli districts
i) Paleo-archean	3600 - 3200	Tirodi and Amgaon Gneissic Complex, Peninsular Gneissic Complex	Nagpur, Bhandara, Chandrapur, Gadchiroli, Ratnagiri and Sindhudurg districts.

EXERCISE

Q. 1. Fill in the blanks :

1) Bagh beds occur in ..... districts.
   a) Dhule b) Ratnagiri
   c) Satara d) Hingoli

2) Lameta beds occur in parts of ..... districts.
   a) Yavatmal b) Kolhapur
   c) Solapur d) Raigad

Q. 2. True or false :

1) During the period between Cambrian and Upper Carboniferous there is no lithological record in Maharashtra.
2) A narrow coastal plain between Western Ghat and Arabian Sea is known as Konkan coast.
3) Sahyadris are also known as Western Ghat.

Q. 3. Choose the correct alternative :

1) The pahoe-hoe lava flows predominate in
   a) Dhule - Aurangabad- Pune- Nasik
   b) Osmanabad- Sangli- Satara- Latur
   c) Nagpur - Buldhana- Amravati- Akola
   d) Parbhani - Beed- Nanded- Akola

Q. 4. Match the following :

River	Origin
a) Narmada	i) Betul
b) Godavari	ii) Amarkantak
c) Krishna	iii) Trimbakeshwar
d) Tapi	iv) Mahabaleshwar

1) a-ii, b-iii, c- iv, d-i
2) a-iii, b-ii, c-i, d- iv
3) a- iv, b-i, c-ii, d-iii
4) a-ii, b- iv, c-iii, d-i

Q.5. Arrange the following Geological formations of Maharashtra in the correct stratigraphic sequence (oldest to youngest) :

a) Lameta beds - Talchir formation - Kaladgi group
b) Talchir formation- Kaladgi group- Lameta beds
c) Kaladgi group - Talchir formation- Lameta beds
d) Lameta beds -Kaladgi group - Talchir formation

Q. 6. Give geological reasons :

a) Iron mining is economically suitable in Maharashtra.
b) Bauxite mining is feasible in Maharashtra.
c) Secondary minerals like zeolite occur in Deccan traps.
d) Thermal power plants in Maharashtra have their coal source in Vidarbha region.

Q. 7. Write Short notes on :

1) Building stones of Maharashtra.
2) Energy resources in Maharashtra.
3) Secondary minerals found in Deccan Traps.
4) Uses of kyanite and sillimanite.
5) Occurrence of following economic deposit.
   a) Manganese b) Iron one c) Coal
   d) Bauxite e) Chromite f) Copper

Q. 8. Answer in detail :

1) Describe lithostratigraphy of the Deccan traps.
2) Give the genesis of Laterite and Bauxite.
3) Explain why thickness of Basalt is variable in the Deccan Volcanic Province .
4) Give an account of major economic minerals of Maharashtra.
5) Describe general succession of stratigraphy of Maharashtra.

Q. 9. Read the following passage and answer the questions :

The Singhbhum Shear Zone hosts mineral deposits of great economic value. The sulphide deposits were formed in this shear zone before the third-phase deformation. The original copper mineralization is attributed to hydrothermal activity. The passage of hydrothermal fluids was controlled by faults of the rift zone. Along the shear zone, the deposits of chalcopyrite, pyrite and pyrrhotite are syngenetic with respect to volcano - sedimentary phase, predating the main tectonothermal event. The total reserve in the Singhbhum Shear Zone is of the order of 217 million tonnes with 1.36 % Cu. In the Gangpur Basin, the lead and copper deposits of the Sargipali belt are estimated to be 206 million tonnes with 6.73 % Pb and 0.33 % Cu.

Ref : K S Valdiya, The making of India 2016.

1) What kind of deposit is characteristic of the Singhbhum Shear Zone.
2) How is the copper mineralization associated in the shear zone.
3) Calculate the total estimated Cu and Pb content in the Singhbhum Shear Zone.
4) If the Sargipali deposits are dated 1660 Ma, find the period referring the geological time scale.

Calendar of Important Earth Events

Sr. No.	Important Earth Events	Day
1)	World Wetlands Day	February 2
2)	World Water Day	March 22
3)	World Meteorological Day	March 23
4)	International Geologists Day	First Sunday of April
5)	International Day for Mine Awareness	April 5
6)	World Heritage Day	April 18
7)	Earth Day	April 22
8)	Coal Miners Day	May 4
9)	International Museum Day	May 18
10)	World Environment Day	June 5
11)	World Ocean Day	June 8
12)	Indian Geologist Day (Birth Anniversary of M. S. Krishnan)	August 24
13)	World Ozone Day	September 14
14)	International Day for Preservation	September 16
15)	World Tourism Day	September 27
16)	World River Day	Last Saturday of September
17)	UN International Day for Natural Disaster Reduction.	October 13
18)	Earth Science Week.	October 14 to 20
19)	World Tsunami Day	November 5
20)	National Pollution control	December 2
21)	World Soil Day	December 5
22)	International Mountain Day	December 11
23)	World Energy Conservation Day	December 14

Activity : Celebrate the event with some relevant activities.