Underground Mining of Metalliferous Deposits

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Lecture 03

Present Status of Mineral Deposits

Learning objectives for this lecture

- To understand the current status of mineral deposits with special reference to the metalliferous deposits.
- To learn the current status of metalliferous mining in the country as well as in the world.

Mining is basically defined as the process of obtaining or excavating the minerals or rocks or any other valuable materials either in the form of solid or liquid. liquid specially when we are considering the case of petroleum mining. Mining is in general carried out on the solid and most of the time it is for excavating the stones either it is a mineral or rock. Currently in India around 4000 mines are under operation and mining is carried out is basically for the rocks or minerals or fuels.

Rock is any naturally occurring solid mass or also it is called aggregate of mineral matter. Characteristically a rock comprises a number of minerals either in homogeneous or heterogeneous proportion and these are naturally occurring. These are basically formed because of the different geological activities and based on these geological activities rocks are classified in three groups igneous, metamorphic, and sedimentary rocks.

The complete earth crust is formed in rock and rock mass. The two common material forming the earth crust are rock and soil. Soil is formed by the disintegration of rock by weathering activities of nature. Thus the composition of both rock and soil are the same but physical and mechanical behaviours differ significantly.

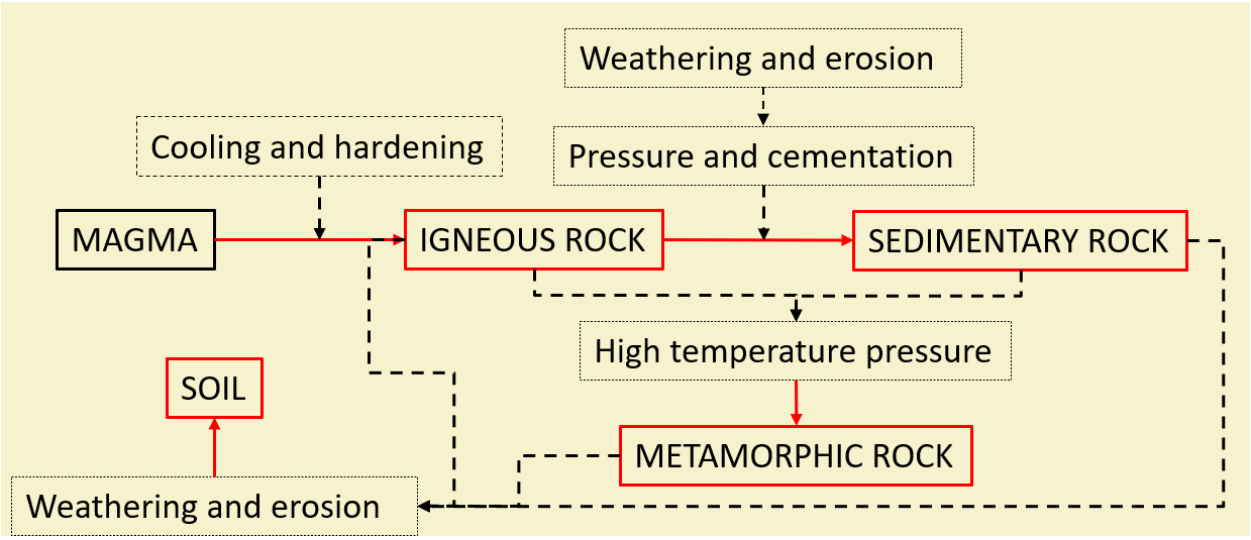


Figure1. General formation of rockmass

And if we are looking at the formation of these three types of rock, igneous, sedimentary and metamorphic rock, we can understand that the earth was initially in hot liquid state, and from there the cooling of this magma first the rock which is formed because of the cooling and hardening of the magma is called igneous rock and when the igneous rock is weathered or either dead or subjected to the pressure or cementation is occurred on them then they are basically formed to the sedimentary rock.

So, what is happening? Igneous rock is basically coming out from the cooling of the magma then because of weathering, erosion et cetera those are in disintegrated sometimes floated also, then again, they became consolidated because of the pressure and cementation and by that way they are formed as the sedimentary rock.

But often what is happened this igneous and sedimentary rock both are further subjected to high temperature or high pressure and in those cases again their textures and formations are changed and those change rocks are called metamorphic rocks. And soil has come out from all these three rocks because of their weathering, erosion and then adding with the biomass et cetera, the soils are formed. So, soils are basically formed from all igneous, sedimentary and metamorphic rock from their erosion and weathering the rocks are disintegrated in the fine pieces and they are becoming soil.

Minerals is a solid chemical compound and it has a fairly defined chemical composition and a specific crystal structure, that occurs naturally in pure form. So, if we are thinking of the rock, rock is basically the aggregate of the mineral, but mineral is one constituent of the rock which is having a definite chemical formula.

- Minerals are very valuable natural resources for any country's growth and development.
- Minerals increases the potential wealth of any country.
- The distribution of minerals across the globe is non uniform and highly varies.

Ore is basically one or more number of minerals, it may be one mineral or a number of minerals together, but ore means they are economic for mining. So it can be defined as a natural rock that contains one or more valuable minerals, typically containing metals, or economic material that can be mined, treated and sold at a profit.

Mineral resources are the rock mass containing one or more minerals, which are potentially valuable but may not be valuable always but it is definite that means the occurrence of that mineral is already established then it is called a resource. It is called resources, because often it may not be valuable for the current mining practice but may be valuable in future, in that condition we consider itself a potentially valuable material. So, mineral resources, resources means the rock mass containing more than one or more minerals and those are potentially valuable but their occurrences are established with suitable scientific studies, so that is called reserves.

Reserve or deposits are the mineral resources that are valuable and legally, economically, and technically feasible to extract.

Status of ore deposits and mining in India: India produces as many as around 87 minerals, which includes 4 fuel mineral, 10 metallic mineral, 47 non-metallic mineral, 3 atomic mineral and 23 minor minerals. The total value of mineral production excluding the atomic and fuel has been estimated at 1 lakh 13 crore rupees. The mining of aggregate which in India is an unorganized sector, it is expected that approximately 4 billion tonnes of sand and aggregates are

being mined in the country every year and altogether the commercial value of this sand and aggregates is coming close to 4 to 5 lakhs crore rupees and that is significantly very high.

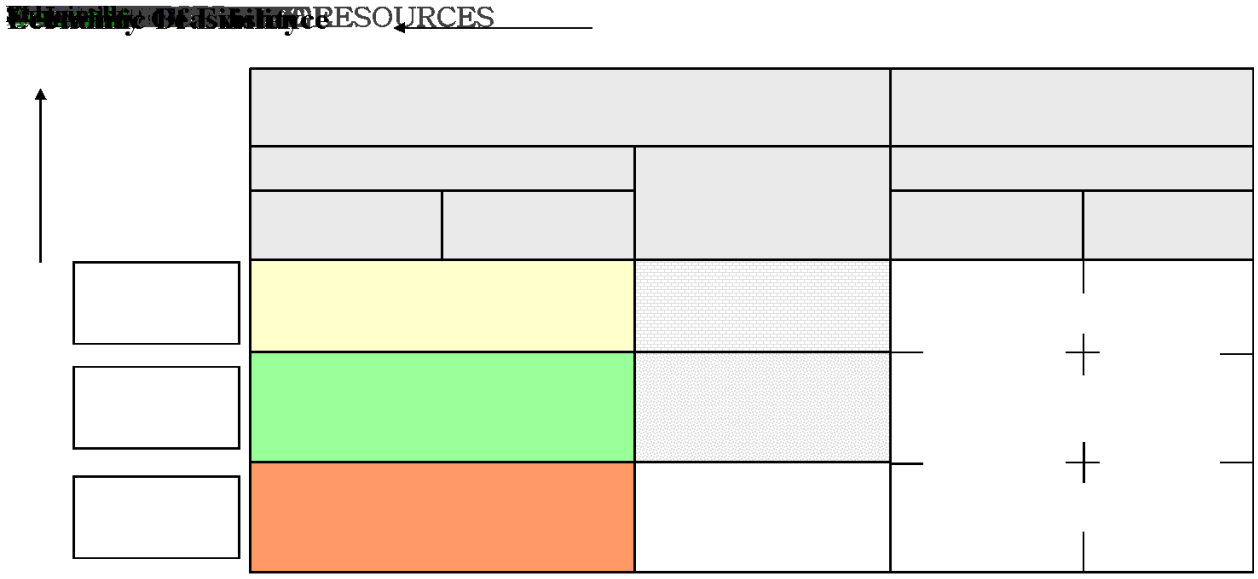


Figure 2. Reserve and types

It can be seen that the minerals are basically considered by this economic table (Figure 2) where some minerals are identified sufficiently whereas some are not identified sufficiently. If the mineral is identified not sufficiently is called inferred and if it is identified sufficiently it is called resources. sometimes these resources are not currently economic, but having a potential to become economic in future is called sub economic, some deposits or reserves are marginal economic and some are very economic.

Mineral classification: Economic basis

1. Metallic Minerals (Ferrous Group)
2. Metallic Minerals (Non-Ferrous Group)
3. Precious and Semi Precious Minerals
4. Strategic Minerals
5. Fertilizer Minerals
6. Refractory Minerals
7. Ceramic Industrial Minerals
8. Minor Minerals
9. Mineral Fuels (Coal, Oil & Gas)
10. Other Industrial Minerals

Classification of minerals in economic basis can be done in a number of types like metallic in ferrous group, metallic non-ferrous group, if we are considering ferrous group is basically iron, manganese, chromium, these are considered as the ferrous group, non-ferrous groups are Antimony, Bauxite, Copper, Lead, Zinc, Platinum group of Metals

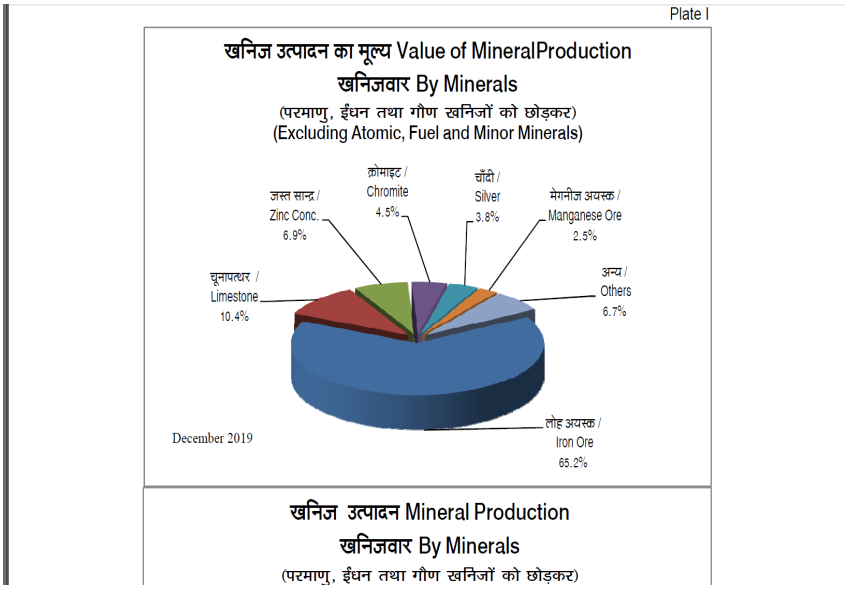
Precious and Semi-Precious Minerals: Corundum, Garnet, Gold, Ruby, Sapphire, Silver

Strategic Minerals: Cobalt, Molybdenum, Nickel, Tin, Titanium, Tungsten, Vanadium

All the atomic minerals are also called strategic minerals. The ceramic industrial minerals, minor minerals are basically sand gravels apart from those other industrial minerals are there like limestone, dolomite, these are considered as the industrial minerals.

Some states like Madhya Pradesh, Bihar, Jharkhand, Odisha, Rajasthan, these are having significant mineral resources and they are having significant earning from these mineral productions.

Status of ore deposits and mining in India



Metals	Ores	Chemical Formula	Process of formation
Iron	Hematite	Fe_2O_3	sedimentary
	Magnetite	Fe_3O_4	Igneous /sedimentary
	Limonite	$HFeO_2$	hydration of hematite and magnetite
	Siderite	$FeCO_3$	Magmatic
Copper	Chalcopyrite	$CuFeS_2$	Hydrothermal circulation
	Chalcocite	Cu_2S	Leaching of copper from the oxidized minerals. It is also often found in sedimentary rocks.
	Cuprite	Cu_2O	Oxidation product of copper sulphides in the upper zones of veins
Aluminium	Bauxite	$Al_2O_3.2H_2O$	Sedimentary
Gold	Calaverite	$AuTe_2$ or native	epithermal and porphyry deposits
Silver	Argentite	Ag_2S	Hydrothermal deposits
	Chlorargyrite	AgCl	Secondary mineral phase in the oxidation of silver deposits
Manganese	Pyrolusite	MnO_2	occurs in various ways: a sedimentary rock, as vein deposit
	Magnesite	$MgCO_3$	as a replacement mineral in carbonate rocks

Metals	Ores	Chemical Formula	Process of formation
Chromium	Chromite	$FeCr_2O_4$	In igneous/ metamorphic/ sedimentary chromite-bearing rocks when rocks are altered by heat or weathering
Tin	Casseterite	$Sn0_2$	Hydrothermal process, and also occurs as veins, alluvial, and placer deposits
Molybdenum	Molybdenite	MoS_2	Hydrothermal
Mica	Muscovite	$KAl_2(AlSi_3O_{10})(F,OH)_2$	Contact metamorphism
	Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(F,OH)_2$	Contact metamorphism

Uranium	Uraninite (pitch blende)	(UO_2)	Hydrothermal
Thorium	Monazite	$(Ce,La,Th)PO_4$	Placer deposits
Lithium	Petalite	$(LiAl(Si_2O_5)_2$	Pegmatite deposits
	Lepidolite	$K(Li,Al)_3(Al,Si,Rb)_4O_{10}(F,OH)_2$	Magmatic crystallization
Zinc	Sphalerite	ZnS	Contact metamorphism
Lead	Galena	PbS	Hydrothermal

So, these are different minerals and their ores. This is not only in India but worldwide these are the common ore. Hematite, magnetite limonite, siderite are the common ore of the iron ore. Copper mainly comes out from the chalcopyrite, chalcocite, cuprite melasite also, aluminium mostly comes out from the bauxite, gold is from Calaverite and as well as native gold is also found, silver is also found in its sulphide form, manganese is mostly found in the oxide form, magnesite is in general used as the refectory mineral but that is also a manganese ore. Other metals such as chromium is called chromite, molybdenum is in general found in the sulphide formation, mica is basically of two types Muscovite and Biotite and these are in general form. Ore of uranium is called pitchblende. Lead, zinc ore is called Galena and sphalerite respectively.