But earth’s crust. chief among these are the

But even in the transformed state in which they are used, they are not lost to the planet and so are ideally available for reuse.

Terrestrial Mineral Resources:

For his industrial, technological and cultural growth man has required and still needs a great variety of inorganic materials, all of which come from the earth’s crust. Chief among these are the ores which are used on a large scale to yield metals like iron, aluminium, copper, silver, gold, platinum, etc. To them must be added elements which may not be needed in large quantities but which are indispensable in many modern industrial processes, as for example catalysts and hardners such as vanadium, tungsten, and molybdenum. Finally there are non-metallic materials which are vital to industrialized nations such as sand and gravel, cement, fluxes, clay, salt, sulphur, phosphorus, diamonds, and the chemical by-products of petroleum refining. The distribution of minerals in the earth’s crust is characterized by discontinuity. There is spatial discontinuity in which deposits rarely coincide with the boundaries of nation states that wish to use them. North America is well supplied with the ore of molybdenum, for example, where Asia is not; by way of compensation Asia is rich with tin, tungsten, and manganese.

Between them, Cuba and New Caledonia have half the world’s reserve of nickel, and industrial diamonds are dominated by Zaire. Such discontinuity are also emphasized by temporal patterns of use—the older industrial coun-tries such as UK are running out of their ore reserves and coming to depend upon imports, and heavy users like the USA face similar problems; in both cases iron ore stands as a good example. Another type of discontinuity is exemplified by the richness of an ore. A few metals show a more or less continuous grading from the richest ores to the poorest, e. g.

, iron and porphyry copper. On the other hand some ores are either very rich or very poor or both.

Marine Mineral Resources:

The sea’s mineral resources can be divided into three categories: those which are dissolved in water itself; sediments present on the sea-bed at various depths; and those present at some depths below the sea-floor, beyond the sediments of relatively recent origin.

At present the utility of the dissolved elements is in direct proportion to their abundance and to the relative cost from terrestrial sources. Cloud (1969) has enlisted certain commonest elements in sea water which could be extracted (Table 26’1). Common salt is one of the resources that have been utilized since prehistoric times for its value in flavouring and meat preservation. At present only salt, magnesium and bromine are being extracted in commercial quantities and sea seems to remain inexhaustible for these elements. Except a few other elements, economically feasible recovery pro-cesses of most other elements from sea are very low. However, it may be possible to lower feasibility thresholds by investigating the capacity of marine organisms to concentrate desired elements (this is done in facto for nitrogen used in the form of fish-meal fertilizer and sea-bird guano), and in the possible exploitation of zones along the sea-bed where fractures allow the escape of unusually high concentrations of mineral ions (Simmons, 1974). Table 261.

Concentration and value of the elements in sea water (source Simmons, 1974). The elements are listed in order of abundance those in the italic type have concentrations valued at $ 1. 00 or more per million gallons of sea water. All others are <0. 02 1b/106 gal: ElementConcentration 1b/106 gal. AsValue $/106 gal.

1. Chlorite166, 000NaCl9242. Sodium92, 000Na2CO33783. Magnesium11, 800Mg4, 1304. Sulphur7, 750S1015. Calcium3, 500CaCI31506.

Potassium3, 300K3O917. Bromine570Br31908. Carbon250Graphite8? 10-09. Strontium70SrCO3210. Boron40H3BO3311. Silicon26——12. Fluorine11CaF20. 3513.

Argon5——14. Nitrogen4NH4NO3115. Lithium1.

5Li2CO33616. Rubidium1. 0Rb12. 517. Phosphorus0.

6CaHPO40. 0818. Iodine0. 5I2119.

Barium0. 3BaSO40. 0120.

Indium0. 2In421. Zinc0. 09Zn0.

01322. Iron0. 09Fe2O30. 00123.

Aluminium0. 09A10. 0424. Molybdenum0. 09Mo0.

00425. Selenium0. 04Se0. 226. Tin0. 03Sn0.

227. Copper0. 03Cu0. 0128. Arsenic0. 03As2O30.

00229. Uranium0. 03U3O80. 330. Nickel0. 02Ni0. 0231.

Vanadium0. 02V2O50. 0432. Manganese0. 02Mn0. 006Sediments and sedimentary rocks on the continental shelves are sources of certain materials.

Placer deposits contain workable quantities of gold, tin, and diamonds, and the other sediments which may be amenable to exploitation include sand, gravel and shells. However, land-use problems by their extraction from the land would largely be obviated by the use of the sea as a source, provided that the ecosystems of the oceans were not too greatly damaged by the recovery processes, which create great quantities of silt and also eventuate imbalance in the sedimentary systems of the sea-floor. Phosphates are found as nodules and in crust. A further resource of the continental shelves is fresh-water: large quantities of artesian water may be found in certain aquifers. Finally there are petroleum and natural gas. The deep sea basins are found to contain enormous quantities of minerals such as manganese, nickel, cobalt and copper, but their extraction is not economically feasible (Cloud, 1969). Marine mineral resources of India: The deep sea basins and continental shelf of Indian sea (Arabian Sea, Bay of Bengal and Indian Ocean, are found to have rich mineral resources of the following three types: 1.

Terrigenous minerals. Recently: Geological Survey of India (GSI) and National Institute of Oceno- graphy (NIO) have discovered huge deposits of ilmnite, monazite and calcareous sands along the cost of Maharashtra, Kerala, Tamil Nadu, Andhra Pradesh and Orissa. Ilmnite is used in the manufacture of titanium (used in supersonic aircrafts) and titanium dioxide (TiO2) that is used in paint industry.

Monazite is used for obtaining thorium. 2. Biogenous deposits: Biogenous deposits along the ocean floor consist of shell pieces and skeletal debris of marine organisms and they contain mainly calcium carbonate. Such deposits are common in Kerala's Vembanad Lake, in Gulf of Kuteh, Gulf of manar, Palk straits, and along the coasts of Andman and Nicobar and Lakshadweep islands. 3. Chemogenous diposits: The most important chemogenous deposits are manganese nodules.

Manganese nodules in the shape of potatoes contain manganese (19%) and iron (12%) They also contain nickle, cobalt and copper in recoverable quantities. These deposits are very important resource for manganese, as terrestrial source of manganese (i. e., Indian reserve of manganese ore is 68 million tonnes) is fastly depleting (Joshi, 1978).

Conservation of Terrestrial Mineral Resources:

Until recently little attention was paid to conservation of terrestrial mineral resources because it was assumed that there were plenty for centuries to come and that nothing could be done to save them any way. But quite recently Cloud (1969) made it evident that both assumption are dead wrong.

During his assessment of the situation, he has formulated following two situations about the exploitation of terrestrial mineral resources— The first is the demographic quotient or Q: Q = total resources available / population density ? per capita consumption As this quotient goes down, so does the quality of modern life; it is going down at a frightening rate because available supplies can only go down as consumption goes up. (2) The other concept introduced by Clovd is the graphic model of depletion curve, as shown in figure 26. 1. With the present procedure of " mine, use and throw away", a huge boom and bust is projected, as shown in curve A. The time scale is uncertain because lack of data, but the " bust" could begin within this century since certain key metals and fuels such as zinc, tin, lead, copper, uranium-235, natural gas could be mined or extracted out within 20 years in so far as the readily exploitable reserves are concerned.

If a programme of mineral conservation, substitutions (using less scarce minerals wherever possible), and partial recycle were to be started now, the depletion curve could be flattened as shown in curve B. Efficient recycling combined with stringent conservation and a reduction in per capita use could prolong depletion for a long time, as shown in curve C. It should be noted that even with perfect recycle depletion would still occur, because small amounts of most metals lose by friction, rust, etc. Consequently, terrestrial mineral conservationists have suggested following measures for terrestrial mineral conservation: 1. Technological advancement for extraction of minerals from sea which is unlimited supply depot. 2. Extraction of metals from lean ores with the use of vast quantities of cheap atomic energy. Granite is suggested as a source for the extraction of many metals.

3. Recovery of mineral elements from scrap and waste (recycling).

Ecological Aspects of Mining:

Most kinds of mining processes of man have side-effects of an ecological nature. Underground mining may include whole new towns among its surface installations (e. g., the Khateri Copper Project, JhunJhnu, and Rajasthan, India). Timber is cut in forested areas, often leading to soil erosion and the tailings and mine-waste have to be discarded.

Large-size solid wastes can be used as backfill or sold for aggregates, but tailings usually yield silt particles to wind and water and are often chemically unstable; the only suitable treatment appeares to be “ fix” them with vegetation. Mine waters are often heavily contaminated and have to be treated chemically and physically, or injected into “ safe” rock strata. Further, in most countries open-pit mining is more widespread than extraction by shaft.

In such mining waste disposal becomes a major problem to which back fill is the obvious solution; if the topsoil is saved then restoration of agriculture or recreational use is often possible. The processes of concentration, beneficiation and refining may all create biological changes if various products are released into nearby ecosystems, i. e., they may create environmental pollution which affect adversely the Ecosystems.