

COURSE CODE:	EMT 309
COURSE TITLE:	ENVIRONMENTAL GEOSCIENCES
NUMBER OF UNITS:	3 UNITS
COURSE DURATION:	3 hours per week

COURSE DETAILS:

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COURSE CONTENT:

ENVIRONMENTAL GEOSCIENCES

Planetary System, Composition of the Environment, Interaction between various components of the environment, Earth Planetary System, The Earthcrusts, matter and minerals, Mineral Composition and Rock Forming Minerals, Rock formation and Rock Types, Weathering Phenomenon and Soil Formation, Weathering Phenomenon and Soil Formation, Environmental Impact of Mineral Development, Geological Environments, Metals Concentrations and Diseases, Environmental Geosciences Mapping Techniques(EGMT),

COURSE REQUIREMENTS:

This is a compulsory course for all 400 level students in the Department. It is compulsory that students should participate in all the course activities and have minimum of 75% attendance in order to be qualify to write the final examination.

READING LIST:

LECTURE NOTES

**LECTURE NOTES –
ENVIRONMENTAL GEOSCIENCES (EMT 309)
BY
DR A.M GBADEBO**

PLANETARY SYSTEM

Environment can be defined as the natural world including water, air, plant, land and animal. It can also be a place where people live and work including all physical conditions that affect them. From the above definition, environment can broadly be divided into human and physical environment. The study of the physical, chemical and biological components of the environment in relation to natural and anthropogenic (man made) activities is called environmental science.

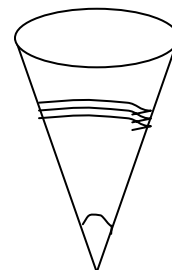
Somebody who engages in the study of the environment in an institution is called environmental scientists. However, whoever engages in the practice of environmental protection is called an environmentalist.

COMPOSITION OF THE ENVIRONMENT

Environmental sciences as an applied science has several components with series of interphase among different parts of earth sphere which includes:

a) Lithosphere: when loosely used, it connotes the solid part of the environment i.e., the earth crust which implies the rocks and the soil. Lithosphere is always represented by rich brown colour. It can be divided into 3 parts:

- The upper surface called Lithosphere
- The middle portion called Asthenosphere
- The lowest portion called Mesosphere



i) Lithosphere is the solid outer shell of the earth and it is about 20-50km thick. It includes the upper part of the earth and the crust. It is divided into six major and many minor slab – like plates that are shifting about on the plastic asthenosphere in the complex interlocking pattern.

- ii) **Asthenosphere:** it is a cyclic zone of soft, hot and plastic material extending roughly between the earth surfaces. This mobile layer separates the lithosphere above and the mesosphere below and on it is the lithosphere plate shifting slowly in a complex interlocking pattern.
- iii) **Mesosphere:** is the solid interior part of the earth, below the hot and plastic asthenosphere. The study of the structure of the lithosphere leads to a discipline called geology while the combination of this with the environment will lead to various disciplines such as environmental geology, environmental geochemistry etc.

(b) Hydrosphere: consists of the liquid water bodies of the environment. It is made up of ponds, streams, rivers, lakes, oceans. It also comprises water bodies beneath the surface of the earth groundwater.

The general process by which water moves from the sea by evaporation to the atmosphere and by precipitation to the land and movement under the influence of gravity back into the sea is called hydrological cycle. Hydrosphere is always represented by colour blue on the map. The study of hydrosphere can lead to specializations called hydrology or hydrogeology. Hydrology studies how surface runoff water forms ponds, rivers, etc. while the influence of gravity involved in the movement of water back into the sea is called Hydrogeology. The study of these disciplines (hydro and hydrogeology) in relation to the environment will lead to disciplines of environmental hydrology or environmental hydrogeology.

(c) Atmosphere: This is the gaseous portion or realm of the planetary system of the environment. It is dominated by white expanses of blanket of cloud. The study of atmosphere as a discipline is called atmospheric sciences while the study of atmosphere in relation to the general ecosystem or environment is called environmental atmospheric sciences.

(d) Biosphere: It implies the realm of all earth life forms consider together usually as an independent system. The word 'Biota' means the 'plants' (floral) and animal (fauna) of a particular time and space. Biosphere deals with all plant and animal classes, kingdom, families, general species etc. Biosphere is always represented by lush greens on the map. The study of biosphere can result in various discipline such as zoology (study of animals), botany (study of plant forms), microbiology, biochemistry, human and animal medicine etc. If those disciplines are combined with environmental sciences, we will have 'environmental' as a prefix to any of these e.g. Environmental Botany or Environmental Biochemistry or Environmental Zoology or Environmental Microbiology.

Interaction between various components of the environment.

Interphases are found between various components of the environment. There is an interphase between the atmosphere and the lithosphere, between the atmosphere and hydrosphere (i.e. the free water surfaces of the ocean- streams, and lakes); between water bodies i.e. hydrosphere and the solid earth surface (lithosphere).

However, interphases of the biosphere are vital because of the exchanges of matter and energy that takes place between the super imposed realms. Organisms whether of one specie or many, whether it belongs to plant kingdom or animal kingdom, interact not only with the physical environment but also with one another.

Study of these interactions in the form of exchange of matter, energy and stimuli of various sorts of life forms and environment is called ecology. It is called paleoecology; if such interaction took place in the past i.e. (before present). The total assemblage of component entering into the interaction of a group of Organism is known as ecological system or ecosystem.

The word 'ECO' is a greek word, which implies that a family lives together and interacts within the functional and physical structures. Ecosystems have inputs of matter and energy used to build biological structures (biomass), to reproduce and to maintain necessary internal energy levels.

An ecosystem tends to achieve a 'balance' of the processes and activities within it. However, since most part of these balances are quite sensitive and can easily be upset or destroyed, destruction of such balance leads back to the destruction of the ecosystem which in turn results into environmental degradation or destruction.

Environmental influences or destruction or degradation includes in the broadest sense forces and restraints that arise from man's accumulated cultural resources contained in its elaborately developed social structure. These structures of society include industrial, political, religion, or may be aesthetic in nature. It is not only enough to degrade environment but there is need to manage degraded environment. The cost of cleaning up the air over cities and polluted waters of rains and streams requires an enormous output of human energy and money and tangible resources which are normally drawn against alternative resource uses. In order to restore the quality of our environment, there is need to put in place environmental quality standard. Other measures include,

- Relinquish of automobiles in favour of mass rapid transit movement.
- Willingness to put a larger share of our income into pollution abatement programme from which we will derive no pleasure or entertainment.
- We as a nation must submit to rigid population control (i.e. population being too high than the available resources)

Earth Planetary System

The study of condensed matter of the solar system including planets, satellites, asteroids, meteorite and interplanetary materials is called planetology. Since the exploration and exploitation of the solar bodies belong to the field of geology, hence we talk of astrogeology. In this study of course, we shall be restricted to study of planets with emphasizes on earth (out of other planets). The entire astronomical system consist of the Earth, Mars, Venus, Mercury, which constitute the inner or terrestrial planet while Jupiter, Saturn, Uranus, Neptune and Pluto constitutes the outer or jovian planets.

The inner planets and the moon from geologic view point, are referred to as 'stony' or 'rocky' because of their high content of solid compounds like Silicon, iron and other heavy elements.

All these inner planets have massive and stratified/layered structure such as would result from the action of gravity settling. Each planet has an inner, dense, metal-rich core: and immediate massive mantle and an outer relatively thin crust. The crust of the earth is 7-49km thick, the mantle is 2870km thick while the core has a radius of 3480km.

The earth planet is different from other terrestrial bodies in number of ways which include;

1. It is the most dense of all the inner planets.
2. It possess a large quantity of surface water (12,500,000,000 cubic metres)
3. The outer brittle shell of the earth (i.e. the lithosphere) is in the state of dynamic motion.
4. there are few signs of ancient crater.
5. The electrical and magnetic fields of the earth are exceptionally strong.

The above characteristics may be one result of a more thorough melting which also produce the molten metallic core and expels large quantity of water. The development of the earth like every other member of the entire solar system is better explained as having condensed from an extensive Nebula of gas and dust that collapsed by gravity (i.e. Big Bang Theory) and from which the various bodies were then segregated by complex, physical and chemical processes. (i.e. theory of continental drifting)

The Earthcrusts, matter and minerals.

From the standpoint of view of environment or life on earth, it is the crust that is really significant because it contains the continents, ocean basins and it also a source of soil and other sediments that are vital to life. It is also the sources of salts of the sea, the gases of the atmosphere and all free matters of the oceans, atmosphere and lands. The crust is the direct source of all elements of the environment . Below is the table of crustal elements (PCE) listed in order of abundance. When compared with table of elemental abundance of the entire earth i.e. the core, mantle and crust as it is shown in table 2, one can observe the striking difference.

From table 1 above, oxygen is so abundant on earth crust followed by Si, Al and Fe. The four metallic base elements i.e. Ca, Na, K and Mg which are almost of the same proportion and vital to plant growth and their abundance in the soil is a measure of soil fertility.

Also in table 2, H, P, Ba, Sr also followed by titanium in order of importance. A number of metallic elements that are widely required in the manufacturing of products e.g. Cu, Pb, Zn, Ni, and Sn are present in extremely low percentage in the earth crust and are also scarce indeed. However, since these scarce metals are concentrated as ore minerals, that is why industrial development has not been brought to a halt otherwise, man would still have remained in the primitive iron age.

From the above, it can be seen that the fundamental building blocks of the rocks of the earthcrust in the environment are the above listed chemical elements and combination of which forms compounds called minerals i.e. minerals themselves contain smaller units called 'atoms' which in turn are made up of smaller units of which (protons, neutrons and electrons) are the most important. These negative and positive charged particles are called matter.

Mineral Composition and Rock Forming Minerals.

Minerals are naturally occurring elements or compounds in the solid state and are inorganic in character. Each mineral has a chemical composition fixed within definite limits and displays a crystalline structure. The composition and structure of a mineral give rise to characteristic physical properties for each mineral type. The physical properties used in mineral identification include;

1. Its crystal form.
2. Hardness
3. Specific gravity
4. Cleavage
5. Fracture
6. Colour
7. Streak
8. Striation.

Although there are as many as 2,500 minerals on earth, only about 20 of them are abundant. Therefore, only a few mineral are rock forming minerals. The minerals that constitute most of the rocks of earth crust can be conveniently classified by their 'chemical' compositions which include:

1. Silicate minerals,
2. Ferromagnesian minerals e.g. Olivine, Hornblend, Augite, Biotite.
3. Non-ferromagnesian minerals which include, Muscovite, Felspars, Quartz

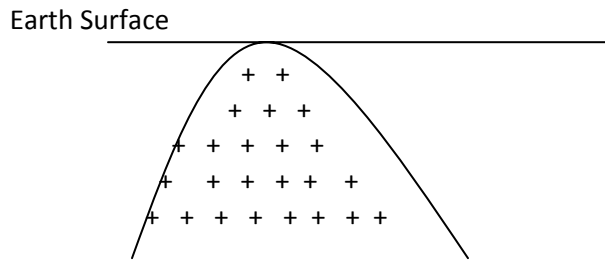
4. Oxide minerals e.g. Corundum, Haematite (Fe_2O_3), Magnetite (Fe_3O_4), Cassiterite (SnO_2)
5. Sulphide minerals e.g. chalcopyrite (CuFeS_2), Galena (PbS), Sphalerite (ZnS).
6. Carbonate and sulphate minerals e.g. Calcite (CaCO_3) – limestone, Dolomite/Marble (MgCO_3) and Anhydrite (CaSO_4)

Rock formation and Rock Types

Rocks are formed as a result of combination or aggregation of two or more of the above rock forming minerals, under certain temperature and pressure (i.e. igneous and metamorphic rocks) or by the dissociation of the already aggregated two or more rock forming minerals under a less or lesser temperature and pressure (Sedimentary rocks).

Types –

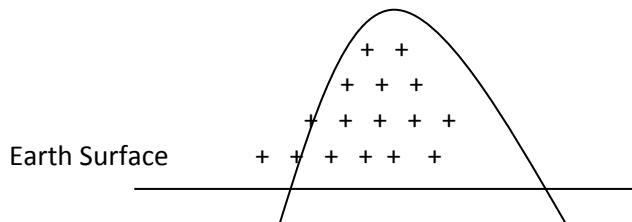
Igneous rock formation - Igneous rocks are formed from magma, which is a hot, molten liquid. When it cools below the earth surface, it is called intrusive rock.



This type of rock includes sills, dykes, laccoliths, batholiths. Sills are in horizontal form, dykes are bigger than sills and are in vertical composition, laccolith and batholiths are of larger dimension.



But when the magma cools above the earth surface, it is called extrusive igneous rock, as a result of volcanic eruption, e.g. tuff, breccia.




The process by which magma gets to the near surface or above the earth surface from the core through the mantle, to within or above the earth crust is called volcanic eruption. Igneous rocks may be light coloured or dark coloured. They may also assume a transition position. It is necessary to note that intrusive plutonic and intermediate rocks (i.e. an intrusive rock that takes place at shallow depth), may be

exposed as volcanic rock after weathering. This explains why chemical analysis of the rocks is necessary in order to be able to ascertain its true origin.

Sedimentary Rocks are formed from the breakdown (i.e. Weathering) of rock forming minerals/existing – igneous rocks, transported and deposited. Sedimentary rocks are therefore derived from previously existing rocks and at the time of their original formation were laid down under water or on land surfaces in most cases in the form of horizontal layers. They are always formed as a result of surface processes (i.e. agents of denudation). Sometimes, they can also be formed by other processes such as organic processes and are hence called biogenic sedimentary rocks.

Note: Sedimentary rocks are always in layers



Actually, there is no entirely satisfactory classification model for sedimentary rocks, however, we have the following 2 major groups:

- a) Clastic or Detrital sedimentary rocks. which include the following subgroup
rudaceous (coarse grain), arenaceous (medium grain) and argillaceous (fine clay grains)
Chemically/organically formed (sedimentary rock. – when calcium (Ca^{+}) reacts with carbonate (CO_3^{-}) to form calcium carbonate called limestone.
- b) Dolomite - when animals die and decay for a long time, they form rocks called oolitic limestone
Evaporite
- c) Siliceous: formed from the flints and cherts.
- d) Ferruginous: has high iron content e.g. laterite
- e) Carbonaceous rocks – formed from carbonaceous material as a result of incomplete oxidation of dead vegetations e.g. peat, coal.

Metamorphic Rock – These are the rocks (igneous and sedimentary) that are formed under the influence of temperature and pressure at a great depth. Often time, it is possible to tell what the original rock was but sometime, the depth of formation can be so great that it becomes impossible to say with certainty the origin of the rocks.

All rocks are capable of being buried at greater depth, however, the ease with which they are changed and the degree of alteration are related to several factors among which are:

1. Resistance of the rock to pressure.
2. Size of the constituent grains of the rocks.
3. Degree of porosity of the rocks.
4. Solubility of the rock constituents.
5. Chemical formations of the minerals in the rocks.
6. Stability of the mineral assemblage that is produced.

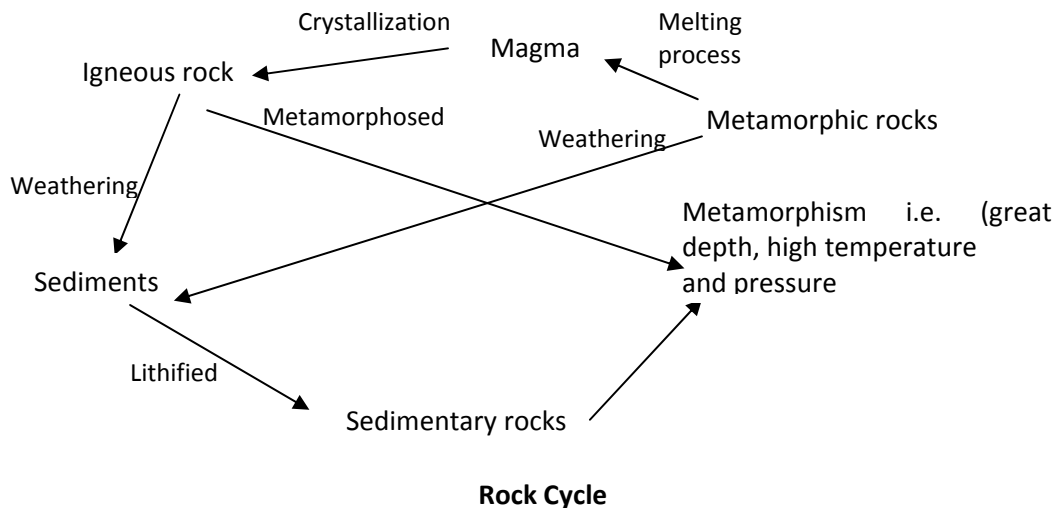
Causes of metamorphic rock formation or metamorphism can be attributed to the followings:

1. Increase in temperature.
2. Increase in pressure
3. Pore fluid pressure.
4. Time factor.

Examples of metamorphic rocks are;

- Hornfels
- Slate
- Marble
- Quartzite (metamorphosed sandstone)
- Phyllite
- Schist
- Gneiss

From the above, igneous, sedimentary and metamorphic rocks are the three types of rocks recognized on the earth crust. Of these, igneous rock is always considered to be the parent rock from which other 2 rocks are eventually derived. We can relate the 3 types of rock to each other by means of rock cycle.



A good knowledge of rock types and their mineral composition (elements or metal composition) is a very good tool in environmental science and ability to identify the rock suite in environment will give an environmental scientist the likely mineral or metal assemblages in the environment. It also provides the knowledge of mineral or metal status in the environment. It enables environmental scientists to know the possible essential and toxic elements in the environment under investigation. Through the sound knowledge of minerals and rocks in the environment, one can predict possible environmental



pathways of toxic substances such as from the rock to soil, to plant to animals and to man. **Rock**

Soil Plant Animals Man.

1. List of Essential Trace Elements

- | | | | |
|---|--|--------------|---------------------------------|
| - Iodine | | - Copper | } Their daily requirements vary |
| - Zinc (needed for plants than animals) | | - Molybdenum | |
| - Selenium (prevents cancer) | | - Chromium | |

2. Trace elements that are probably essential

- | | |
|-------------|------------|
| - Manganese | - Boron |
| - Silicon | - Vanadium |
| - Nickel. | |

3. Potentially toxic elements.

- | | | |
|------------|-----------|------------|
| - Fluoride | - Cadmium | - Aluminum |
| - Lead | - Mercury | - Tin |
| - Arsenic | | |

Weathering Phenomenon and Soil Formation

Weathering is the loosening and breaking down of rocky materials of the earth crust. It results in the formation of rock waste which is sometimes called regolith. Weathering occurs in situ where the rocks are situated. Weathering can encompasses erosion (i.e. sculpturing and modeling of land surface).

Weathering involves by two kinds of processes;

- 1) Disintegration of the rock by mechanical means.
- 2) Decomposition of the rock by chemical means.

These two processes through sometimes can be separated but normally works together with one being dominant under different climatic condition. Sometimes, we have biological weathering which involves both mechanical and chemical weathering.

The physical weathering i.e. breaking down of rocks materials by physical actions may be affected by the following factors.

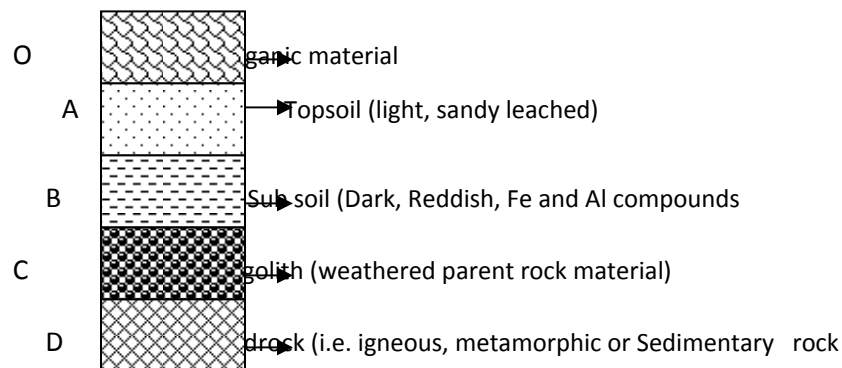
- a) Temperature changes
- b) Frosts action i.e. freezing and expansion of ice
- c) Action of rain (i.e. heavy and torrential rain on soft rocks).

Chemical Weathering includes many chemical processes such as solution, oxidation, reduction, hydration and carbonization. When granite undergoes chemical weathering, its feldspars mineral constituents disintegrate under the influence of water and decompose into soluble clay mineral like kaolin.

Biological Weathering are referred to the prising action of tree roots and the trampling and burrowing action of animals e.g. elephants and other big animals. The activities of bacteria and other organisms are significant in biological weathering. While indeed, they are principally concerned with soil formation, i.e. most especially forms soils.

Soil

Soil is a mixture of inorganic weathered mineral grains and rocks, water, air and at least a small amount of organic materials (plant debris). The inorganic grains in soil are as a result of mechanical & chemical weathering of rock & sediments exposed at the earth surface. Most soils display/exhibit distance layering called soil profile. Typical soil profile in the humid climate (forest soils) like South Western Nigeria is as shown below



The dominant factor in soil formation is climate (i.e temperature and rainfall), besides soils in areas with similar climate tends to be similar in type even through the parent rock materials of the soils are different. However, they can be differentiated using their mineral constituents. Optimum rainfall is required for soil formation while temperature becomes important when it is required to increase the rate of moisture of biological process involved in the formation of soil. Different types of soils are characterized by different sizes and different mineral composition e.g

1. Sandy soils are formed from quartz rich sandstones or its weathered derivatives
2. Clay soils are formed from feldspar rich granite
3. Soils characterized by either the abundance or rarity of a particularly trace element reflects the amount of the elements in the original parent rock materials

- Fluoride

The geology of mineral resources with commercial value can be sub-divided into several categories.

1. Igneous processes which include resources formed based on crystal setting and late magmatic and hydro thermal activities.
2. Metamorphic processes – these are minerals formed due to contact metamorphism.
3. Sedimentary processes – these are resources formed due to accumulation of oceanic, lakes, streams sediments.
4. Weathered processes – these are minerals formed during soil formation or as a result of in *situ* concentration of insoluble minerals in weathered rock debris.

Below is a table of different types of mineral resources deposit from different rock types.

<u>Different Types of Geological Processes</u>	<u>Ore Deposits.</u>
Igneous process:	
Disseminated	Diamond
Crystal settling	Chromite
Late magmatic	Magnetic
Pegmatitic settling	Beryllium & Lithium
Hydrothermal	Copper
Metamorphic process:	
Contact metamorphism	Lead and Silver
Regional metamorphism	Asbestos.
Sedimentary process:	
Evaporite (lake/ocean)	Potassium
Placer deposit (stream)	Gold
Glacia/ice	Sands and Gravel
Deep ocean	Manganese nodules.
Weathering processes:	
Residual soil	Bauxite
Secondary enrichment	Copper

Environmental Impact of Mineral Development

The impact of mineral resources exploration on the environment depends on such factors as:

1. Mining procedures
2. Local hydrological conditions.
3. Climate
4. Rock types encountered.
5. Sizes of operation.
6. Topography
7. Many more interrelated factors.

The impact varies with stages of development of resources e.g. the exploration and the testing stage involves less impact than the mining and processing stages. The exploration activities for mineral deposit varies from collecting and analyzing Remote Sensing Data gathered from air planes and satellites to the field work which involves surface mapping, drilling and gathering of geographical data.

Generally, exploration has a minimal impact on the environment provided that care is taken on sensitive areas. Mining of mineral resources on other hand may have considerable impact on the land, water, air and biological resources. However, the impact on earth and water is part of the price to be paid for the benefit of mineral consumption and it will be unrealistic if we are thinking that mining of our resources can be accomplished without affecting some aspects of our local environment.

Some of these Impacts include:

1. Loss in ecosystem.
2. Land exposure to erosion.
3. Environmental degradation
4. Pollution of area stream and groundwater system by particulate or dissolved sediment from rapidly eroding unprotected waste pipes exposed to soil erosion and migrating groundwater.
5. Possible release of trace elements in hazardous concentration into the environment.

Trace elements such as Ca, Co, Cu, Pb, Mo, when leached from mining waste can concentrate in water, soil or plant, may be toxic and may cause diseases in man and other animals that drink the water or eat the plant or use the soil.

We can only minimize this impact by developing a resource with the minimum adverse impact through good engineering conservation processes

Geological Environments, Metals Concentrations and Diseases

As man continued with exploration of geological cycle from the scale of minute quantities of elements in soil, rocks, and water to regional patterns of climate, geology and topography, one is making startling discoveries of how these factors might influence the incidence of certain disease and death rate. Disease is defined as an imbalance resulting from a poor adjustment between an individual and his environment. It seldom has a one cause, one effect relationship. The contribution of environmental geologist/geoscientist/environmental geoscientist is to help in isolating the aspect of geologic environment that might influence the incidence of disease, hence the emergence of the new field of specialization called Medical Geology.

Industrial societies have almost eliminated diseases such as cholera, typhoid, hookworm and Dysentery. However, they have just began to face serious problem like lung cancer and other disease that are related to air, soil and water pollution.

The soil that we cultivate to provide nutrients for the subsistence, the rock that we use in building our homes and industries, the water we drink and air we breathe all can influence our chances of developing serious ill-health like cancer and heart disease. For us to appreciate the ways geologic environment affects the general health of people, we need to understand the natural distribution of the elements in the earth crust and the ways in which natural or man induced processes can concentrate or disperse elements. These processes may lead to the abundance or deficiency of the elements or metals in the environment.

Trace Elements and Health

Every element has a whole spectrum of possible effect on a particular plant or animal e.g. selenium which is toxic in seleniferous areas, has no observable effects in most conditions and is even beneficial to animal production (i.e. raising of cattle, sheep etc) in some areas. The apparent contradiction is resolved by recognizing that the first case (toxicity) is oversupply of selenium representing a balanced state i.e. no effect and deficiency which in some cases is rectified by supplementation of the elements into the food supplies of animals. (Animal feed).

Below are the representative of elements in geological environment to indicate possible effects of imbalances.

1. Fluoride – Fluoride is fairly abundant in rocks and soils, most of the fluoride in soils is derived from parent rock, but it can be added by volcanic activity which deposits fluorine-rich volcanic ash on the land surface. However, industrial activities and application of fertilizers have also in unlimited basis, contributed locally to an increase in the concentration of fluorine in soils..

Effects – fluorine is an important trace element that forms fluoride compound like calcium fluoride which increases the crystallinity of the apatite $\text{Ca}_3(\text{PO}_4)_2$ crystals in teeth. It helps prevent tooth decay by facilitating the growth of larger, more perfect crystal. The optimum fluoride concentration for the reduction of dental caries is 1.5ppm. Fluoride levels that are 1.5ppm does not decrease issue of dental caries but do increase the occurrence and severity of mottling (i.e. discolouration of teeth).

Regardless of this, fluoride concentration between 4-6ppm greatly reduces prevalence of **osteroporosis** – a disease characterized by reduction in bone mass and collapsed vertebrae.

2. Iodine – it is one of the essential minerals, its deficiency cause legion of diseases called iodine deficiency disorder (IDD) e.g. thyroid disease, caused by deficiency of iodine is probably the best known example of the relationship between geology and disease. The thyroid gland located at the base of the neck, requires iodine for normal function, lack of this iodine in the body causes **Goitre** – a tumorous condition involving an enlargement of the thyroid gland.

The collection of various disease resulting in iodine disease is called Iodine deficiency disorder (IDD), these disorders aside goitre also include cretinism. This goitre may be abated by using iodized salt. e.g. Anapuna

3. Zinc – Zinc is a trace element necessary for plant, animals and man. Although zinc is a heavy metal that in excessive amount has been associated with disease e.g. plant disease that causes low yield, poor seed development and even total crop loss. Zinc is recognized to be essential to all animals and man especially during early stages of development and growth. Although its required concentration is small, however, a slight deficiency of these elements can cause disorders of bones, joints, and skin. Loss of fertility and delayed healing. Zinc deficiency in man is known and may be associated with some chronic arterial disease, lung cancer and other arterial chronic disease.
4. Selenium – In concentrated amount will be most toxic element in the environment. Selenium is required in the diet of animals at a concentration of 0.04ppm. it is beneficial at 0.1ppm and toxic at above 0.04ppm. The source of selenium in the environment is volcanic activities. It has been estimated that throughout the earth, volcanoes have released at least 0.1g of selenium for every square metre of earth surface. Selenium varies from 0.1ppm in deficient areas to as much as 1200ppm in organic rich soils in toxic areas. Similarly, studies have suggested that geochemical environment is indeed a significant factor in the incident of serious health problem such as heart disease and cancer.

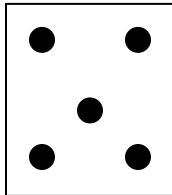
Environmental Geosciences Mapping Techniques(EGMT)

Environmental Geosciences Mapping Techniques can be carried out using the procedure highlighted below viz:

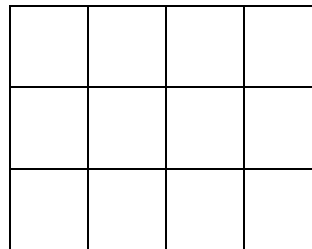
1. Carry out desktop survey – evaluation of existing data e.g. raw or processed (from topo maps published or journal articles, memo or proceeding).
 - Read through the map to have an idea of what the place is all about e.g. mountainous, valleys, forest etc.
 - Go through the topographic map, take note of the relief, population density, geomorphologic feature, climate. It tells us the hilly places through contour spaces.
2. Reconnaissance survey: it is familiarization tour of the study area to get information about the area, gives opportunity of meeting community and relevant people to get relevant information and also to obtain permission to enter their land in order to carry out mapping exercise.
3. Detailed Survey: is the exercise carried out after reconnaissance survey to get data needed for analysis. It involves sampling of different environmental media e.g. soil, water, air, Plant in the study area for laboratory analysis.

Types of Detailed survey may include:

a) Random sampling



Grid pattern/systematic



In detailed survey, the use GPS (Geo positioning System) is required in order to get the location and altitude of the place under investigation. e

4. Laboratory Analysis of Data - e.g. soil, plant collected in the field for various parameters using different analytical technique.
5. Take your sample to the lab (**LAB ANALYSIS**) e.g. water, you shrub check your pit, etc on the field, if you run around doing it in the lab & taking it back to site, it many alter it.
 - a. LAB ANALYSIS: For soil determination of particle size analysis using Sieve or hydrometer test, <0.2mm sieve off i.e. sandy, clay, loamy%

- b. Carry out your metal analysis of cations: using Atomic Absorption Spectrometry (AAS); Inductive couple Plasma Mass Spectrometry (ICPMS)
- c. Sampling: require different equipment and different preservative methods e.g. water sample and land.

Sample to collection

- Rock Sample: It can be broken with hammer or Chisel to collect the samples.
- Soil Sample: Scooping or Pitting with cutlass or Auger is used to collect samples.

N.B Level of depth should be taken with ruler or measuring tape.

- Water: Bailer (Fetcher) is used to collect samples through agitation of water well or stream as the case may be.
- Sediment: It is preferably collected in dry season when the river water is relatively low..
- Plant: The plant is uprooted and the leaf or the stem or the root can be taken for analysis as the case may be

The part of the plant chosen is air/sun/oven dried and pulverized followed by ashing. Pulverization method/ technique is applied to sieve the ashed plant.

Also, Pulverization is applied to soil and rock,

- Air/ Dust: Brush can be used to collect dust

Pre-laboratory Analysis

- Soil sample can be Air dry, Oven dry, Sundry
- In the soil /sediment, particle size distribution could be determined.
- The pH of the samples can be determined

H₂O Analysis

- Total dissolve solid (TDS)
- Alkalinity
- Cation: e.g. Mg, Ca, Na, K
- Anion: Cl, SO₄, HCO₃, NO₃, F

Metal Analysis

We can analyze for Pb, Cr, I, Mn, As etc