Benha university | **Fourth level (Credit hours system)**
Faculty of Science | **Special Geology**
Geology Dept. | **Medical geology and Volcanology (G 436)**
1/6/2013 | **Two hours**

Examination of the Medical geology and Volcanology (G 436) for the students of Fourth level (Special Geology) May 2013.

1. **Discuss the following:**
   a) What is asbestos?
   b) What happens to asbestos when it enters the environment?
   c) How can asbestos enter and leave human body?
   d) How can asbestos affect human health?
   e) Is there a medical test to determine whether someone has been exposed to asbestos?
2. **Answer the following questions**
   a) What is "Medical geology"? Illustrate the cycle that shows the relation between geology and human health?
   b) Discuss the Geological relation of the following mineral elements and nutrients?
      i. Calcium
      ii. Zinc
      iii. Potassium
      iv. Copper
      v. Manganese
3. **Fluorides are found in over 150 minerals. Discuss in brief**:-
   a. Where is fluoride located in?
   b. How fluorides enter the surface and ground water?
   c. How fluorides affect the human health?
4. **Explain the following:**
   a) Volcano and its parts
   b) Different types of volcanic cones
   c) Volcanic products
   d) Characteristics of volcanic lava

Good Luck
Dr. M. M. Mogahed

Model Answer

1. **Discuss the following:**

a) What is asbestos?

a) Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment. One of these, namely chrysotile, belongs to the serpentine family of minerals, while all of the others belong to the amphibole family. All forms of asbestos are hazardous, and all can cause cancer, but amphibole forms of asbestos are considered to be somewhat more hazardous to health than chrysotile.

b) What happens to asbestos when it enters the environment?

b) Asbestos fibers do not evaporate into air or dissolve in water. However, pieces of fibers can enter the air and water from the weathering of natural deposits and the wearing down of manufactured asbestos products. Small diameter fibers and fiber-containing particles may remain suspended in the air for a long time and be carried long distances by wind or water currents before settling. Larger diameter fibers and particles tend to settle more quickly. Asbestos fibers are not able to move through soil. They are generally not broken down to other compounds in the environment and will remain virtually unchanged over long periods.

c) How can asbestos enter and leave human body?

c) If you breathe asbestos fibers into your lungs, some of the fibers will be deposited in the air passages and on the cells that make up your lungs. Most fibers are removed from your lungs by being carried away or coughed up in a layer of mucus to the throat, where they are swallowed into the stomach. This usually takes place within a few hours. Fibers that are deposited in the deepest parts of the lung are removed more slowly. In fact, some fibers may move through your lungs and can remain in place for many years and may never be removed from your body. Amphibole asbestos fibers are retained in the lung longer than chrysotile asbestos fibers. If you swallow asbestos fibers (either those present in water or those that are moved to your throat from your lungs), nearly all of the fibers pass along your intestines within a few days and are excreted in the feces. A small number of fibers may penetrate into cells that line your stomach or intestines, and a few penetrate all the way through and get into your blood. Some of these become trapped in other tissues, and some are removed in your urine.

d) How can asbestos affect human health?

d) Information on the health effects of asbestos in people comes mostly from studies of people who were exposed in the past to levels of asbestos fibers (greater than or equal to 5 μm in length) in workplace air that were as high as 5 million fibers/m^3 (5 fibers/mL). Workers who repeatedly breathe in asbestos fibers with lengths greater than or equal to 5 μm may develop a slow buildup of scar-like tissue (fibrosis) in the lungs and in the membrane that surrounds the lungs. This scar-like tissue does not expand and contract like normal lung tissue and so breathing becomes difficult.

e) Is there a medical test to determine whether someone has been exposed to asbestos?

e) The most common test used to determine if you have received sustained exposure to asbestos is a chest x-ray. A chest x-ray is recommended for detecting exposure to asbestos only in persons who have sustained relatively heavy exposure. A chest x-ray is of no value for detecting evidence of asbestos exposure in a person whose exposure to asbestos has been only brief or transient. The x-ray cannot detect the asbestos fibers themselves, but it can detect early signs of lung disease caused by asbestos.

2. Answer the following questions

a) What is "Medical geology"? Illustrate the cycle that shows the relation between geology and human health?

- "Medical Geology" is defined as the science dealing with the relation ship between natural geological factors and health in man and animals, and understanding the influence of ordinary environmental factors on the geographical distribution of such health problems.
- Medical Geology is therefore abroad and complicated subject which requires interdisciplinary contributions from different scientific fields if the problems are to be understood, mitigated or resolved.
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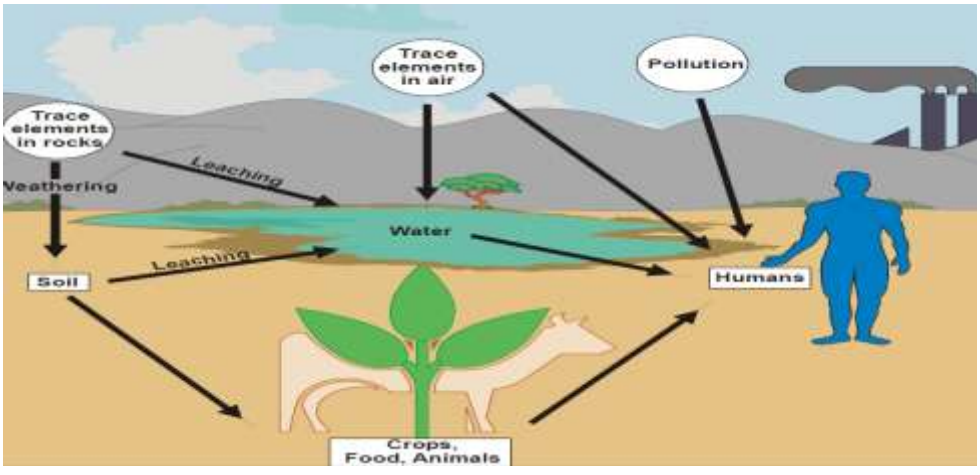


b) Discuss the Geological relation of the following mineral elements and nutrients?

i. Calcium
ii. Zinc
iii. Potassium
iv. Copper
v. Manganese

- Calcium: Calcium is fifth in abundance in the earth's crust, occurs as Limestone ($CaCO_3$), Gypsum($CaSO_4.2H_2O$), and Fluorite (CaF_2) and Apatite (Calcium Fluorophosphate) (Berry et al. 1985; Mason, 1991). Calcium is essential for all life as it forms part of cell walls and bones and is also for blood clotting. Calcium deficiency may results in Osteoporosis and impaired nervous conduction or muscular contraction. And excessive calcium intake may lead to renal stone formation, hypocalcaemia and imbalance utilization of iron, zinc, magnesium, and phosphorus.
- Zinc: Source of Zinc element are ores like Sphalerite (ZnS), Smithsonite ($ZnCO_3$), Zincspar ($ZnCO_3$) and Marmatite (ZnS with Iron sulphide) (Tiwari, 2010). Zinc is essential in the diets of plants and animals and key component of many enzymes. Zinc plays a role in reproduction and also sexual maturation. Zinc deficiency is characterized by poor growth and dwarfism, anorexia, Parakeratotic skin lesions, diarrhea, impaired testicular development, impaired immune function (including wound healing), and impaired cognitive function. Low zinc status is also thought to increase risk to osteoporosis and susceptibility to oxidative stress. Very high intakes of zinc, which have occurred due to inappropriate use of zinc supplements, can interfere with copper metabolism and deplete the body of copper.
- Potassium: Potassium is found extensively in minerals like Sylvite (KCl), Carnallite, and Langbeinite, Potash (KOH) and in the sea water (Tiwari, 2010). Potassium salts are essential for both animals and plants. It is essential for nerve and heart function. Potassium deficiency (hypokalemia) can be caused by insufficient intake and/or excessive excretion (e.g., due to diarrhea, bulimia) of the element. This is characterized by skeletal muscular weakness; smooth muscle paralysis resulting in anorexia, nausea, vomiting, and constipation; cardiac arrhythmias; carbohydrate intolerance due to diminished insulin secretion; impaired renal function due to reduced blood flow; and altered water balance involving increased water consumption.
- Copper: Copper is an essential for all life, it is the key component of redox enzymes and of haemocyanin. The most important copper ores are Chalcopyrite ($CuFeS_2$), Chalcocite (Cu_2S), Covellite (CuS), Bornite ($2Cu_2S \cdot CuS \cdot FeS$), Malachite ($CuCO_3 \bullet Cu(OH)_2$), Cuprite ($Cu_2O$) and Chrysocolla ($CuO \cdot SiO_2 \cdot 2H_2O$). Copper deficiency is manifested as hypochromic, normocytic or macrocytic anemia; bone abnormalities resembling osteoporosis or scurvy; increased susceptibility to infection; and poor growth. The ingestion of high

amounts of copper can cause nausea. Chronic high copper intake can lead to the hepatic accumulation of copper, which has been suspected in juvenile cases of hepatic cirrhosis in India.

- Manganese: Manganese bearing minerals like Pyrolusite (MnO_2), Braunite, $(Mn^{2+}Mn^{3+}_6)(SiO_{12})$, Psilomelane $(Ba,H_2O)_2Mn_5O_{10}$) and Rhodochrosite ($MnCO_3$) are source Mn for plants and animals. Manganese compounds are essential to life normal for skeletal development, deficiency of manganese may results into shortened limbs, twisted legs, lameness, ataxia, glucose tolerance, and hepatic steatosis and infertility in mammals.

3. **Fluorides are found in over 150 minerals. Discuss in brief**:-
   a. Where is fluoride located in?
   b. How fluorides enter the surface and ground water?
   c. How fluorides affect the human health?

a. Fluoride is located in

- Fluoride rich minerals such as fluoro-apatite
- Replacement of OH-and O_2-in muscovite (mean 0.1-0.3 %)
- Solid and fluid inclusions: micas, feldspars, quartz
- Rock glasses –obsidian and pitchstones

b. Fluorides in the surface and groundwater are derived from:

- Leaching of rocks rich in F (eg. Granite: 700 mg/kg)
- Dissolution of fluorides from volcanic gases
- Rainwater F from marine aerosols and dusts
- Industrial emissions: freons, organo-fluorides, cryolite dust etc.
- Industrial effluents
- Run off from farms: phosphate fertilizers

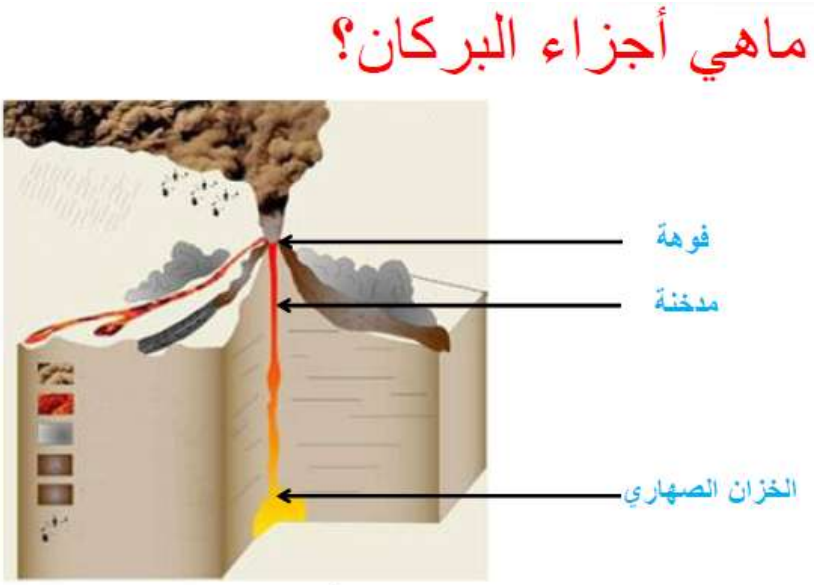
c. How fluorides affect the human health?

Concentration of fluoride	Impact on health
Nil	Limited growth and fertility
0.0-0.5 mg/l	Dental caries
0.5-1.5 mg/l	Promotes dental health resulting in healthy teeth. Prevents tooth decay
1.5-4.0 mg/l	Dental fluorosis (mottling of teeth)
4.0-10.0 mg/l	Dental fluorosis, Skeletal fluorosis
> 10.0 mg/l	(pain in back and neck bones) Crippling fluorosis

4. Explain the following:

a) Volcano and its parts

When pressure from the molten rock beneath the earth's surface becomes too great, the rock, usually accompanied by lava or gases, escapes through a fissure or vent in the crust of the earth. "Volcano" is the term given to both the vent and the conical mountain left by the overflow of the erupted lava, rock and ash.



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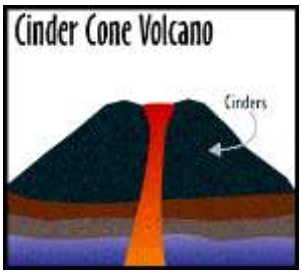
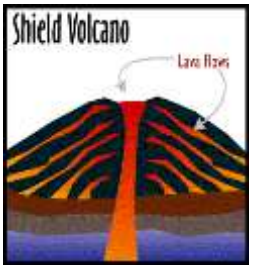
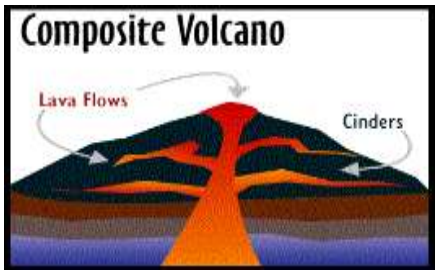
b) Different types of volcanic cones

Shapes of volcanoes include composite cones, or stratovolcanoes, with steep concave sides such as Mt. St. Helens in the W United States; shield cones have gentle slopes and can be relatively large such as the Hawaiian Islands; and cinder cones as Parícutin in Mexico, with steep slopes made of cinderlike materials. Explosive eruptions build up steep-sided cones, while the nonexplosive ones usually form broad, low lava cones. Cones range in height from a few feet to nearly 30,000 ft (9 km) above their base. Usually the cone has as its apex a cavity, or crater, which contains the mouth of the vent. Such craters are typically less than 1 mi (1.6 km) across, but larger craters, called calderas, ranging in diameter from 3 mi to-in a few instances-50 mi (5-80 km), are formed by particularly large eruptions.







c) Volcanic products

Volcanic products

Magma erupted onto the Earth's surface is called lava. If the lava is chilled and solidifies quickly, it forms volcanic glass; slower rates of chilling result in greater crystallization before complete solidification. Lava may accrete near the vent to form various minor structures or may pour out in streams called lava flows, which may travel many tens of miles from the vents. During more violent eruption, lava torn into fragments and hurled into the air is called pyroclastic (fire-broken materials). See also Crystallization; Lava; Magma; Pyroclastic rocks; Volcanic glass.

d) Characteristics of volcanic lava

Lava texture

Two types of lava are named according to the surface texture: ʻAʻa (pronounced [ˈʔaʔa]) and pāhoehoe ([paːˈho.eˈho.e]), both Hawaiian words. ʻAʻa is characterized by a rough, clinkery surface and is the typical texture of viscous lava flows. However, even basaltic or mafic flows can be erupted as ʻaʻa flows, particularly if the eruption rate is high and the slope is steep.

Pāhoehoe is characterized by its smooth and often ropey or wrinkly surface and is generally formed from more fluid lava flows. Usually, only mafic flows will erupt as pāhoehoe, since they often erupt at higher temperatures or have the proper chemical make-up to allow them to flow with greater fluidity.