

Mineral Resources Economics and the Environment
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CHAPTER 2 - ORIGIN OF MINERAL DEPOSITS

36 questions (asterisk by correct answer)

Plate tectonics:

- a) is the process by which plates of magma move about the surface of Earth
- b) can account for annual climate changes
- c) have been going on since Earth formed 1 million years ago
- d) all of the above
- e) none of the above*

A rock is:

- a) a consolidated mixture of minerals*
- b) any concentration of minerals that is mineable
- c) always made up of more than one type of mineral
- d) a, b and c
- e) none of the above

Ultramafic rocks:

- a) are rich in Mg and Fe silicates, and probably came from the mantle of Earth*
- b) are rich in Na, K and Ca silicates and came from the mantle of Earth
- c) are commonly associated with deposits of manganese and potash
- d) would be common in bauxite and phosphate deposits
- e) none of the above

A hydrothermal fluid is:

- a) a water-rich, hot solution found only in the ocean
- b) a hot fluid that forms during the smelting of iron ore
- c) a cool solution used to dissolve tungsten ore
- d) a solution found in hot springs
- e) a natural, hot, water-rich solution anywhere in the earth*

A natural concentration of minerals or rocks that can be mined at a profit is:

- a) a laterite
- b) an ore deposit*
- c) a result of sea floor spreading
- d) pentlandite
- e) none of the above

Ore deposits are mineral deposits:

- a) that have been mined
- b) that are measured as resources
- c) that can be extracted at a profit*
- d) that have yet to be cleared for extraction on an environmental basis
- e) none of the above

If the average abundance of zinc in the crust is 50 ppm and the density of the average crust is 3 metric tonnes/cubic meter, how many metric tonnes of zinc are in a cubic kilometer of average crust? (Don't be confused by the spelling of tonnes. That is the way to spell a metric ton.)

- a) 1500
- b) 12500
- c) 150000*
- d) 250000
- e) 500000

The following minerals are known to form placer deposits:

- a) gold
- b) cassiterite
- c) diamond
- d) all of the above*
- e) none of the above

The most abundant elements in Earth's crust are:

- a) oxygen, silicon and aluminum
- b) commonly found in silicate minerals
- c) not usually mined in the form in which they commonly occur in the crust
- d) all of the above*
- e) none of the above

Mineral deposits are defined as naturally formed:

- a) zones that can be mined at a profit
- b) zones where elements or compounds of economic interest have been concentrated by geologic processes*
- c) zones where geologic processes permit mining by either open pit or solution methods
- d) zones where economic considerations permit mining with minimum impact on the environment
- e) zones where subduction allows formation of magmatic solutions to concentrate elements

The cut-off grade of a mineral deposit is:

- a) the maximum concentration of a mineral or element in the deposit that can be extracted without engineering complications
- b) the smallest concentration of mineral or element that can be extracted at a profit*
- c) the largest average concentration of mineral or element present in the deposit
- d) the maximum amount of any mineral or element that can be dispersed from a mineral operation
- e) none of the above

A deposit with a grade of 2% copper, would contain how many pounds of copper per 2000 pound ton?

- a) 10
- b) 25
- c) 40*
- d) 200
- e) 500

Meteoric hydrothermal solutions form when:

- a) magmas release large amounts of brine into lakes
- b) rain water mixes with deeply buried basinal brines
- c) brines are expelled from sedimentary basins
- d) rain water percolates into the crust where it is heated and rises*
- e) none of the above

Mineral deposits form when:

- a) geologic processes form unusual concentrations of some elements and/or minerals*
- b) elements are dissolved and dispersed by hydrothermal solutions passing through the crust
- c) fluid inclusions form during vein deposition
- d) magmas intrude large blocks of rock causing explosive eruptions
- e) kerogen-rich rock is heated to temperatures of 500°C

Placer deposits form when:

- a) flowing water in streams slows down and drops heavy minerals*
- b) gold weathers out of veins
- c) geysers reach relatively high levels in fault zones
- d) all of the above
- e) none of the above

When a magma crystallizes minerals that sink to the bottom of the chamber and accumulate in layers, it is undergoing the process of:

- a) crystal fractionation*
- b) immiscibility
- c) vapor separation
- d) subduction
- e) sublimation

Weathering is:

- a) the process by which rocks and minerals are partly dissolved and new minerals are formed at the surface of Earth
- b) an important geologic process that forms mineral deposits containing aluminum and nickel
- c) the process that forms most soils
- d) all of the above*
- e) none of the above

Chemical weathering:

- a) involves the addition of gold to most rocks to form placer deposits
- b) is not common in areas with warm, humid climates and is found, instead, in polar areas where water is frozen all year
- c) is the most common geologic process in Earth's core
- d) all of the above
- e) none of the above*

The importance of CO₂, SO₂ and other atmospheric gases to chemical weathering is:

- a) the fact that they form compounds that precipitate in minerals, causing them to decompose
- b) their low concentrations, which limit the solubility of iron and copper
- c) their reaction with rain water to form acids that dissolve rocks, minerals and other materials*
- d) all of the above
- e) none of the above

Physical weathering:

- a) involves the decomposition of rocks by dissolution in ocean water
- b) involves the destruction of rocks by natural processes that break them apart*
- c) is important as a source of gases to the atmosphere
- d) all of the above
- e) none of the above

Organic sedimentary processes:

- a) form magmas
- b) include formation of potassium-rich skeletal material for many organisms
- c) form the material from which oil and natural gas form*
- d) are not commonly observed in modern oceans
- e) none of the above

A lacustrine environment is:

- a) a lake*
- b) a river
- c) a lava flow
- d) a volcano
- e) none of the above

Sedimentary basins:

- a) contain several types of fluids including water, brines, oil and natural gas
- b) contain thick sequences of sediments and sedimentary rocks
- c) can form hydrothermal solutions if the waters and brines are heated when the sediments are buried deeply
- d) all of the above*
- e) none of the above

Seawater hydrothermal solutions:

- a) form where seawater is heated by magmas beneath sedimentary basins
- b) consist of magmatic water
- c) are the most common type of groundwater
- d) have been found only in Antarctica
- e) are found at mid-ocean ridges where they sometimes form black smokers*

Magmatic hydrothermal solutions:

- a) form when water and other fluids are released by sedimentary basins
- b) form at the tops of volcanoes where rain is most common
- c) are extremely cool and lack dissolved salt
- d) all of the above
- e) none of the above*

Metamorphic hydrothermal solutions:

- a) are released when rocks undergo metamorphism to form minerals that lack water*
- b) are formed where igneous rocks are heated by lava flows
- c) form placer deposits
- d) usually contain extremely high levels of copper and other elements driven from the minerals
- e) none of the above

The main types of hydrothermal solutions are:

- a) meteoric, magmatic, metamorphic, basinal and seawater*
- b) igneous, metamorphic and sedimentary
- c) quartz, calcite and galena
- d) environmental, engineering and economic
- e) none of the above

Darcy's Law:

- a) describes the movement of fluids through porous, permeable rocks
- b) is used only where the dispersal of elements from minerals is very high
- c) says that more water can be forced through a porous, permeable rock by increasing pressure
- d) a and b
- e) a and c*

Good aquifers:

- a) must have a low enough porosity to keep water from flowing out
- b) are commonly found at deep crustal levels
- c) will store and release large amounts of water*
- d) can be contaminated with lead if the aquifer collapses
- e) none of the above

The Colorado River:

- a) is a major navigational route in the American Southwest
- b) flows into the Gulf of California, where it has a large, active delta
- c) is an overcommitted river, with more water promised to areas in its basin than it usually contains*
- d) used to be the major source of water to the Phoenix area via the Central Arizona Project
- e) has difficulties with salt concentrations that are caused by dissolving evaporite beds in the banks of the river

Salt water encroachment:

- a) occurs most commonly in areas where irrigation has increased the salinity of groundwater
- b) is a hazard in Boston where tornadoes cause seawater to push inward along beaches
- c) occurs when heavier fresh water is removed from an aquifer, thus permitting lighter seawater to take its place
- d) is a problem where waterways connecting the ocean with coastal areas permit saltwater to flow inland and sink into freshwater aquifers*
- e) can be limited by the use of wells to remove freshwater from the aquifer

The Ogallala aquifer:

- a) is recharged by precipitation in the Rockies and carries water eastward into the Great Plains
- b) consists of sands and other porous, permeable sediment that was deposited east of the Rocky Mountains
- c) is being depleted by overproduction of groundwater, principally for irrigation purposes
- d) all of the above*
- e) none of the above

The Los Angeles Metropolitan Water District:

- a) controls the distribution of all water that supplies the Los Angeles metropolitan area, as well as communities as far south as San Diego*
- b) is in danger of having inadequate supplies because of the failure of desalinization efforts attempted on Pacific Ocean water
- c) obtains important amounts of water in pipelines from eastern sources, including the Mississippi and Missouri Rivers
- d) controls water supplies throughout the southwestern part of the U.S., including all water from the Colorado River
- e) has been unable to use runoff from the eastern Sierra Nevada several hundred miles north of Los Angeles, because of environmental problems

Recharge is:

- a) the amount of clay added to pellets to make them stick together
- b) a term used to describe electrical power movement during aluminum production
- c) the most common process by which reserves are enhanced in oil wells
- d) the flow of precipitation into the groundwater system*
- e) an important contribution to magmatic hydrothermal solutions

The vadose zone is:

- a) found just above the water table,
- b) wetted intermittently as water flows downward into the water table
- c) not saturated all the time
- d) all of these*
- e) none of these

Permeability:

- a) refers to effective porosity, or the ability of rocks to transmit fluids through them
- b) is highest for rocks such as sandstone
- c) can be filled if new minerals deposit in pores
- d) is important in the production of oil, water and natural gas
- e) all of the above*

Short Answer

Although mineral deposits are forming today by natural geologic processes, we refer to them as "non-renewable resources." Why?

Gold is found in sea water and copper is found in average rock. Why do we not use these materials as sources of these metals?