I. Mineral deposits
   A. ore
      1. metallic mineral
      2. can be profitably mined and processed
      3. definition of an ore changes with
         a) price of the metal
         b) technology (mining cost goes down)
   B. in addition to ores, we also extract
      1. industrial minerals
         a) used in industrial or chemical processing
      2. gems
         a) sapphire, diamond, etc.
         b) some minerals are both gem and industrial
            (1) diamond, sapphire
            (2) depends on usage, quality, size
      3. building materials
         a) sand and gravel
         b) stone
   C. distribution of elements on earth
      1. 98% of the crust is composed of about 8 elements
         a) O, Si, Al, Fe, Ca, Mg, Na, K
      2. concentration of the rest is pretty small
   D. for an ore to exist
      1. a geologic process must concentrate desired minerals
      2. some possible processes
         a) magmatic separation
         b) hydrothermal alteration
         c) weathering
         d) precipitation
         e) placer

II. magmatic segregation
   A. occurs during cooling of an intrusive igneous body
   B. requires a large intrusive, cools very slowly
      1. heavy minerals crystallize early
         a) chromium
         b) platinum
      2. settle to the bottom of the melt
      3. lighter minerals float to the top
         a) can form large crystals called pegmatites
(1) muscovite  
(2) feldspar  
(3) gem minerals  
(4) rare earth minerals  

b) pegmatite crystals can be huge  
   (1) North Carolina  
   (2) feldspar crystals size of telephone poles  
   (3) used in ceramics industry  

III. hydrothermal deposits  
A. occurs in the final stages in cooling an igneous intrusion  
B. fluid at the top of the chamber contains light elements  
   1. significant water and volatile gasses  
   2. silicon, oxygen, and metallic ions  
C. fluids may be driven out of the magma  
   1. move through pores, fractures  
   2. can travel long distances, 10’s of miles  
D. in fractures  
   1. forms vein deposits  
      a) silver, copper, gold, or mercury  
      b) Keewenaw, Tri-state districts  
   2. metal is often big enough to be seen with the naked eye  
   3. usually mined with underground techniques  
E. in small pores  
   1. alters the host rock  
   2. leaves minute traces of the metal  
   3. called disseminated deposits  
      a) Comstock Lode and central Nevada  
   4. amenable to surface mining  
F. in limestone  
   1. metamorphoses the rock  
   2. leaving ores of lead, copper, zinc, or iron  
   3. Tri-state district  

IV. weathering deposits  
A. weathering can concentrate minor amounts of ore minerals  
B. undesirable minerals are preferentially weathered  
   1. removed  
   2. leaving behind the desirable minerals  
C. aluminum  
   1. was once more expensive than gold  
   2. is found everywhere  
   3. strongly bound to other elements  
   4. economically viable concentrations are relatively rare
5. aluminum in silicate minerals has a high extraction cost
6. in rainy tropical environments,
   a) other minerals are leached from the soil
   b) aluminum does not leach out easily
   c) weathering can leave
      (1) hydrated aluminum oxide (bauxite)
      (2) bauxite yields pure aluminum
         (a) Reynolds process
         (b) lots of electricity

V. precipitation deposits
   A. desirable minerals may also be precipitated
   B. copper and silver
      1. hydrothermal fluids deposit
         a) copper, silver
         b) also deposit pyrite
      2. weathering of pyrite forms sulfuric acid
      3. sulfuric acid mobilizes copper and silver
      4. move downward with the groundwater
      5. groundwater dilutes acid
      6. metals are precipitated at groundwater table
      7. porphyry copper deposits
         a) Arizona
         b) Utah
   C. Uranium
      1. mobilizes in an oxidizing environment
         a) groundwater containing O, CO2
      2. precipitates in a reducing environment
         a) oxygen decreases
         b) chemical or biologic activity
   D. Utah and Wyoming
      1. uranium laden groundwater in buried stream channels
      2. dead logs created local reducing environments
      3. uranium compounds precipitated in the dead logs

VI. placer deposits
   A. streams transport the products of erosion and weathering
   B. some minerals are especially resistant to weathering
      1. gold, platinum, diamonds, tin
   C. these minerals are denser than rest of transported load
      1. silicate minerals are lighter
      2. sand, gravel
   D. particles settle out by weight
      1. placer minerals will settle with larger silicates
E. placer deposits are mined on the basis of density differences
F. placer deposits have to have a source
   1. it may be possible to trace the placer upstream
   2. find the original source rock (California’s Mother Lode)

VII. Building materials
A. commonly available in most locales
   1. low intrinsic value
   2. value is added by processing
   3. price is often determined by the haulage distance
B. aggregate
   1. crushed stone
      a) different rocks fit different needs
      b) granite for railroad ballast
         (1) stable
         (2) heavy
   2. sand
      a) stream deposits
      b) glacial outwash
   3. gravel
C. gypsum
   1. plaster
   2. drywall
   3. deposited as an evaporite
   4. mined by surface excavation or solution
D. clay
   1. bricks
   2. steel manufacture
   3. waste disposal
   4. kitty litter
E. concrete
   1. shale
   2. limestone
   3. aggregate

VIII. Industrial minerals
A. minerals used in agricultural or industrial processes
B. fertilizer
   1. potassium
      a) a common evaporite
      b) mined by surface excavation or solution
      c) western US and Michigan basin
   2. phosphate
      a) aviary deposits
b) calcium phosphate (Florida)

C. halite
   1. evaporite mineral
      a) mined by underground or solution
      b) evaporation of sea water
         (1) arid regions
         (2) California
   2. used for
      a) table salt
      b) road salt
      c) industrial processing
      d) food processing

D. pegmatites
   1. mined for feldspar (ceramics)
   2. mica (electrical manufacturing)