Block 2

Mineral Exploration

Lesson 3

Economic Mineral Deposits and Host Rocks

Mineral exploration

Earth Sciences & Petroleum, 2nd

Dr. Awaz K. Rasul 2022-2023

Economic Mineral Deposits and Host Rocks

(Classification)

C. Structural Control:

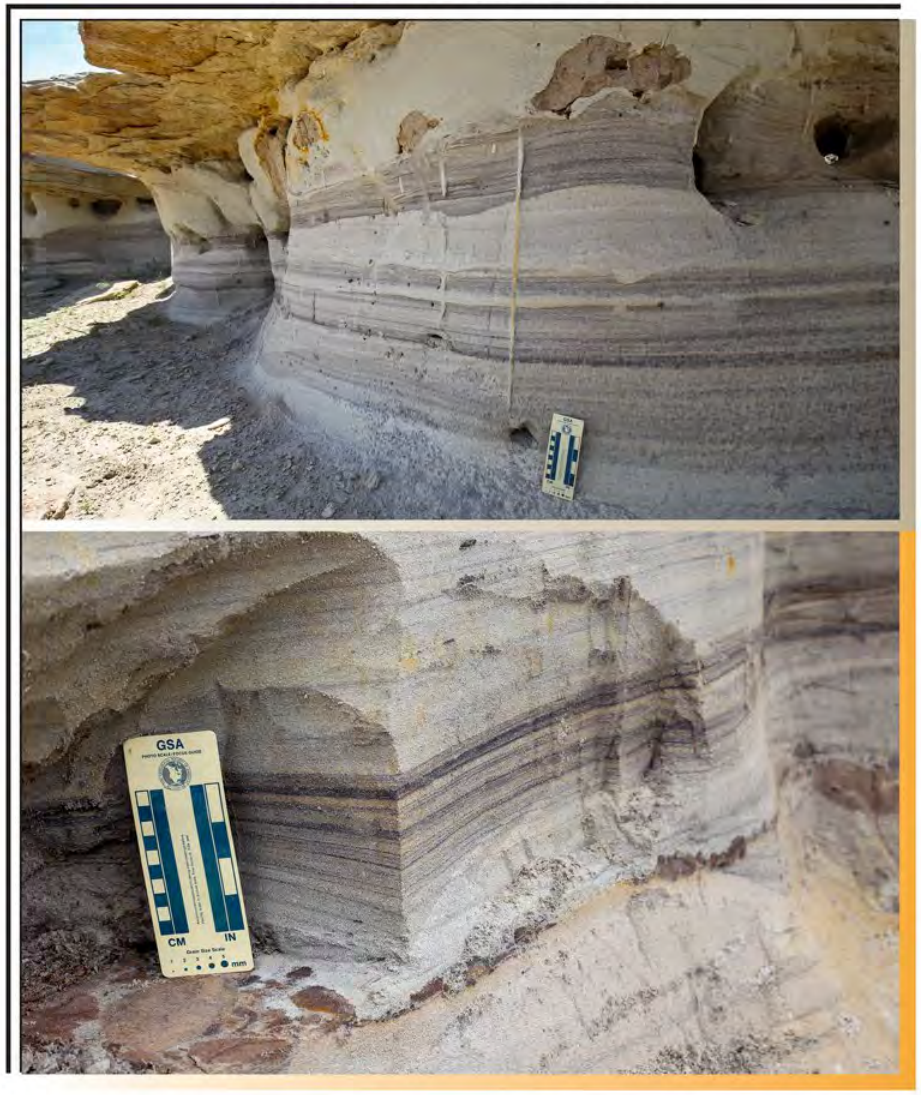
Structure, tectonics, and surface weathering play a significant role over geological time in the passage of hydrothermal flow of mineralized fluids, accumulation and concentration at suitable locations, and remobilization and reorientation of postgenetic activity. The features related to mineralization control are deformation, weathering, joints, fractures, folds, faults, breccia, and plate tectonics.

1. Undeformed

Most of the residual and placer deposits are of undeformed type such as East Coast Bauxite deposit, India.

Beach Placer Mineral Deposits along Localized Paleoshorelines of the Western Interior Seaway, Upper Cretaceous Fox Hills Sandstone, Eastern Denver Basin, Colorado

By
Michael K. O'Keeffe, Marieke Dechesne, Matthew L. Morgan, Stephen M. Keller, Katharina Pfaff, Asha Mahatma, and Alexander I. Peretyatko

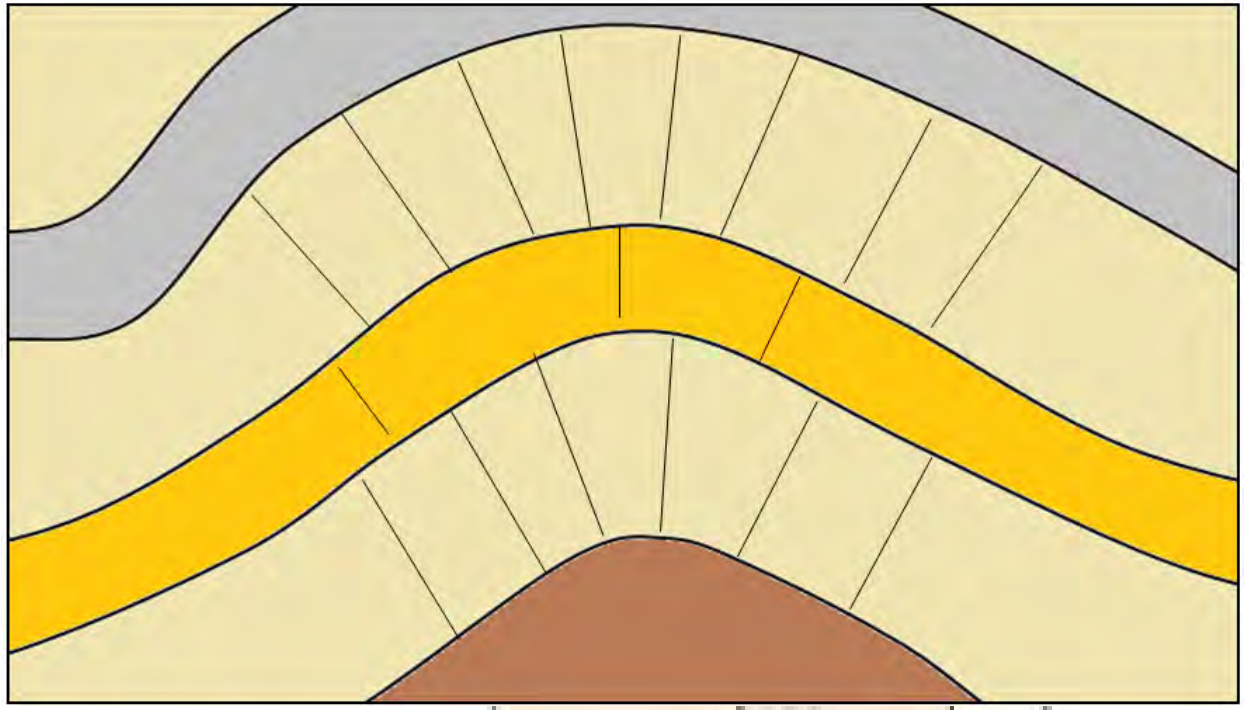


Resource Series 48

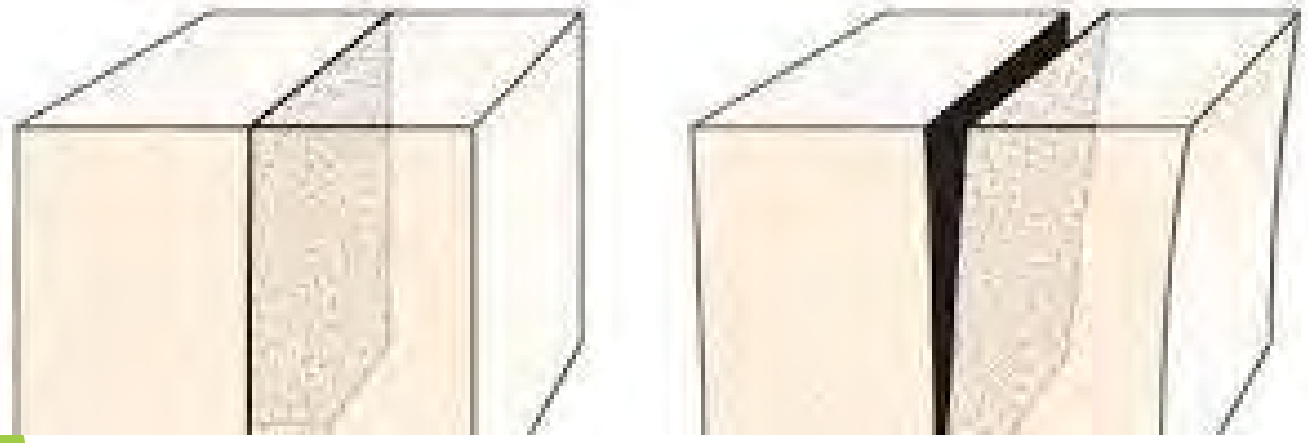
Colorado Geological Survey - 2020

2. Joints and Fractures

Many deposits show varied degrees of deformation, contemporaneous with formation or as an after-effect. Joints and fractures caused by regional stress break in the rocks along which little or no movement has occurred. Mineralization often concentrates along these regular and irregular planes. Magnesite accumulation can be seen along road cuttings near Salem Town, Tamil Nadu, India. The Lennared Shelf zinc-lead deposit, Western Australia, is an example of a cavity filled along a major fault zone.



Shear fracture



3. Fold

Directed compression of the crust, resulting in a semi plastic deformation, creates folding of strata (fold). The fold closure, limb in-flex zone, and axial planes are suitable for mineral localization. These mineral deposits are often folded during or after formation, e.g., Sukinda chromite belt, India.

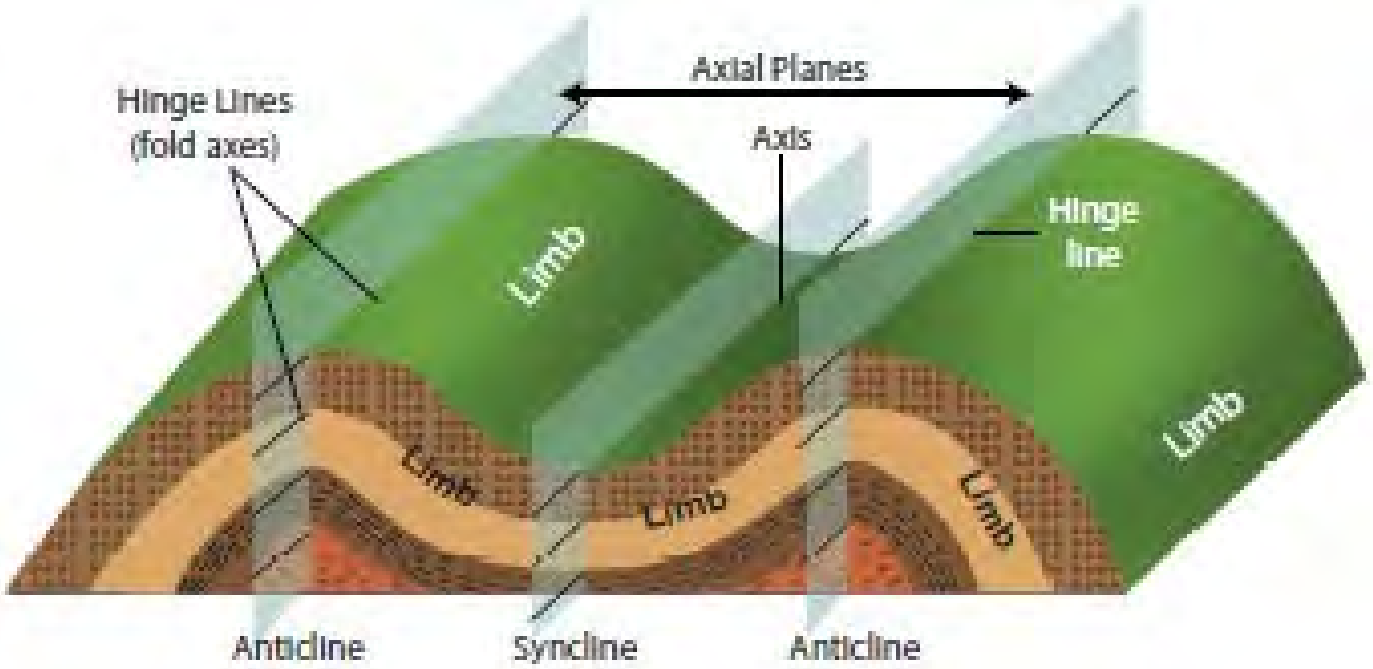
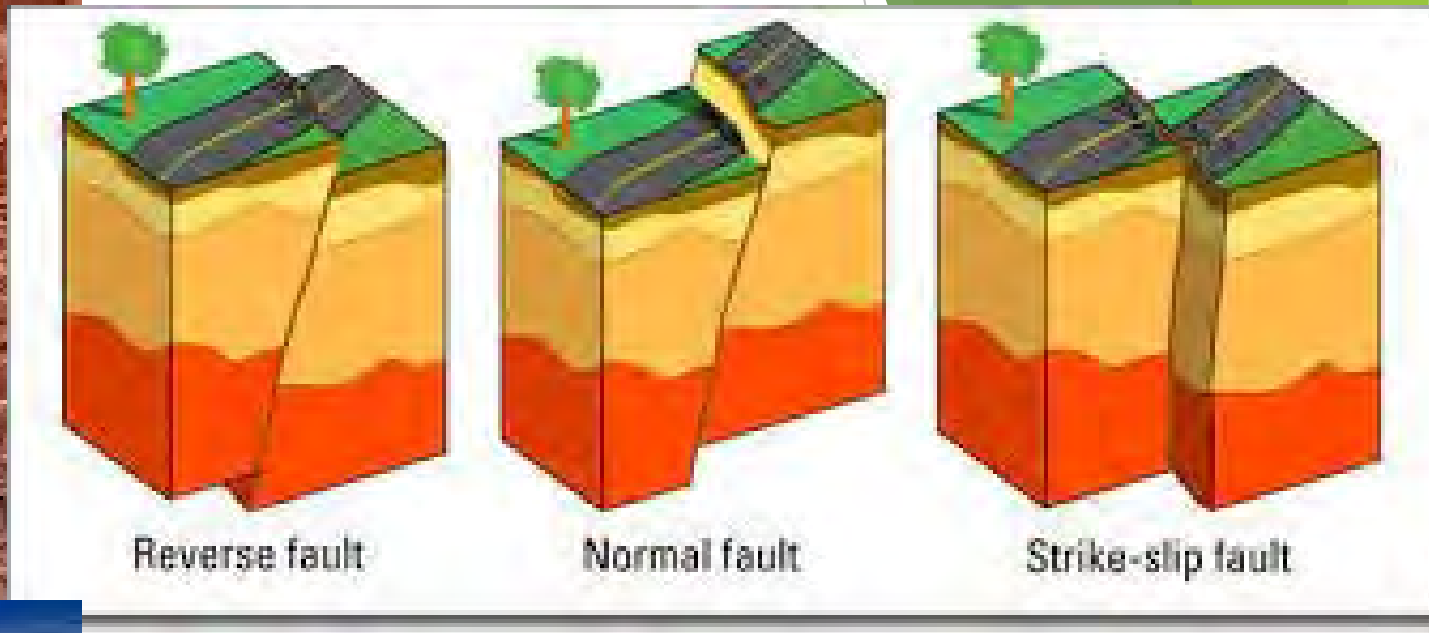


Figure 3.14 Parts of the Fold

chromite reserve in India

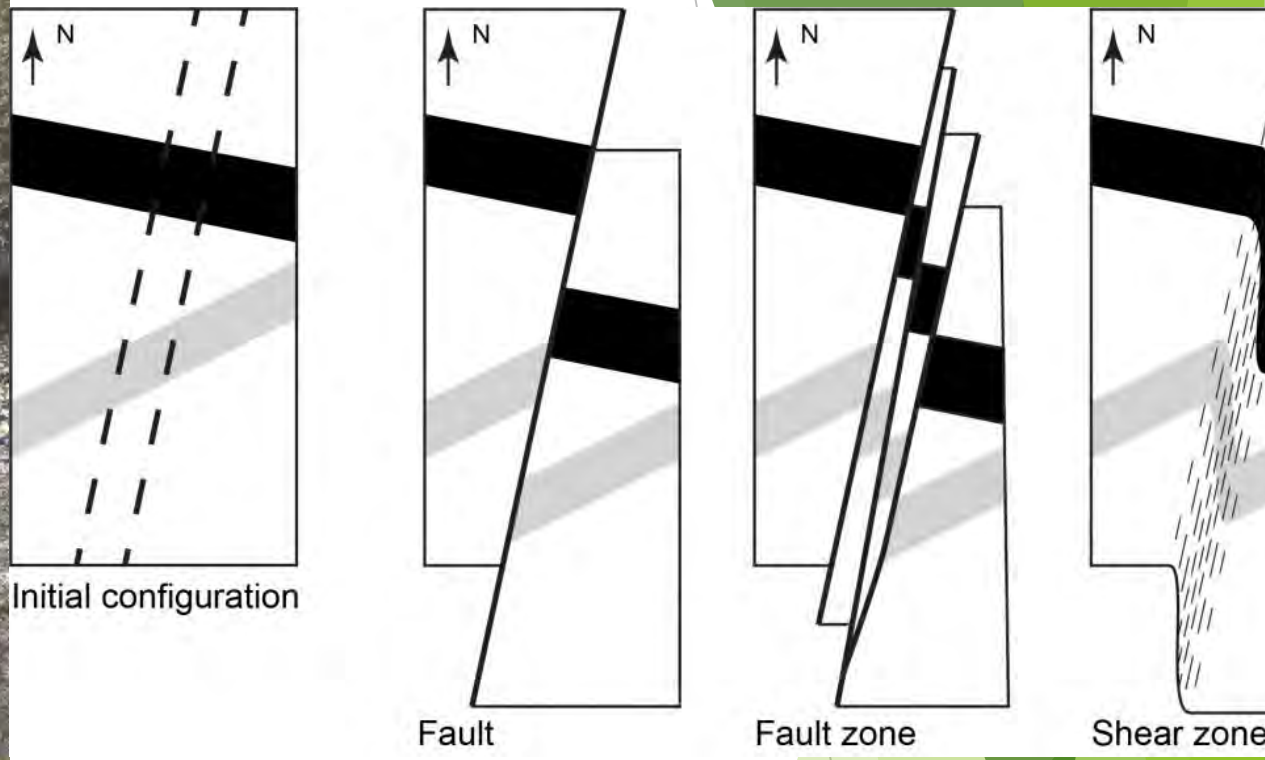
4. Fault

The joints and fractures along which noticeable movements have occurred are called faults. Deposits can be faulted with displacement from millimeters to kilometers, thus creating challenges for exploration. Fault zones are favorable settings, and localization of mineralized solution for movement and concentration. Mantoverde copper in Chile and many of the coal deposits are faulted.


Reverse fault
Normal fault
Strike-slip fault

5. Shear Zone

Shear is the outcome of rock deformation generating particular textures like intense foliation, deformation, and micro folding due to compressive stress. A shear zone is a wide region of distributed shearing in crushed rock mass with widths varying between a few centimeters and several kilometers. The interconnected openings of the shear zone serve as excellent channel ways for mineral bearing solutions and subsequent formation of deposits. Many shear zones in orogenic belts host ore deposits. The Um El Tuyor gold deposit in Eastern Desert, Egypt, is a shear zone-related mineralization.


N
Initial configuration
N
Fault
N
Fault zone
N
Shear zone

6. Breccia:

Breccia is commonly used for clastic sedimentary rocks composed of large sharp-angled fragments embedded in a fine-grained matrix of smaller particles or mineral cement. The breccia generated by folding, faulting, magmatic intrusions, and similar forces is called tectonic breccia. The tectonic breccia zones are represented by crush, rubble, crackle, and shatter rock mass. Breccia and conglomerate are similar rocks but with a difference in the shape of larger particles due to the transportation mechanism. Igneous, flow, or pyroclastic breccias are rocks composed of angular fragments of preexisting igneous rocks of pyroclastic debris ejected by volcanic blast or pyroclastic flow. For example, zinc-copper-gold deposits of Saudi Arabia are hosted in volcaniclastic breccia.

tectonic breccia.

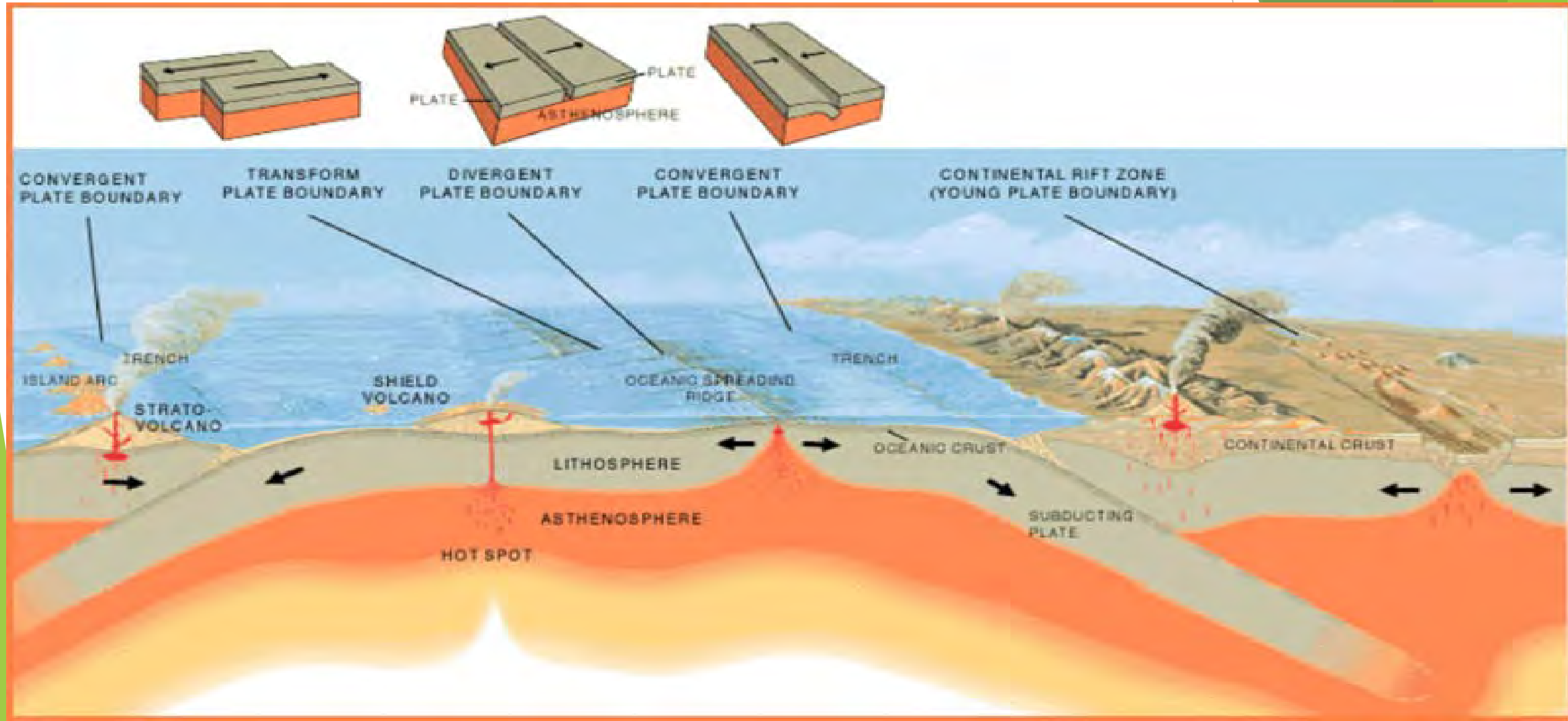
pyroclastic breccias

7. Subduction:

Subduction is the process of two converging tectonic plate movements. The plates of continental margin arcs, oceanic lithosphere, and volcanic island arcs collide and one slides under the other. In the process the heavier oceanic crust stoops under the lighter continental crust or the volcanic island arc forming a subduction zone. Formation of the subduction zone is closely associated with multidimensional tectonic activities like shallow and deep focuses, earthquakes, melting of mantle, volcanism, rising magma resulting in volcanic arc, plutonic rocks of ophiolite suites, platinum-chromium-bearing peridotite-dunite-gabbro-norite, movement of metal-bearing hydrothermal solution, and metamorphic dewatering of crust.

The great belt of porphyry copper-gold that extends north from central Chile into Peru is a good example associated with the subduction of the Pacific Ocean floor beneath the South American plate. The main Chilean porphyry copper belt hosts some of the largest open-cut copper mines in the world.

There are three kinds of plate tectonic boundaries: divergent, convergent, and transform plate boundaries.



D. Nature of Mineralization

The nature of mineralization is the expression of mineral formation as a natural process that includes disseminated, massive veins and stringers, ladder veins, stock work, morphology, and many more.

1. Dissemination

Disseminated types of mineralization are formed by crystallization of deep-seated magma. The early formed in situ valuable metallic and nonmetallic minerals are sparsely disseminated or scattered as fine grains throughout or as part of the host rock. Good example is diamonds in kimberlite pipes in South Africa.

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Disseminated Ore Type

Dissemination

"Disseminated" types of mineralization are formed by crystallization of deep-seated magma. The geological body in which the ore minerals "usually metallic" are disseminated or scattered, usually are not visible to the naked eye, in low concentration as fine grains throughout or part of the host rock. It can be mined profitably under the current market conditions, the deposits are high tonged and low grade. Good examples are Gold Sukari mine Egypt, Copper, Molybdenum, diamonds in kimberlite pipes in South Africa, porphyry copper deposits at El Salvador, Chile, porphyry tungsten-molybdenum deposit at Yukon, and Sargipalli lead-copper deposit, India.

The ore consists of silicified rock that often was originally some sort of limy shale. In some places the silicification is sufficient that the rock is known as jasperied.

Molybdenite occurs as disseminated coarse grains throughout the deposit.

This is a piece of gold ore from the famous Witwatersrand gold deposits of South Africa. The ore consists of conglomerate pebbles mostly of quartz, in a sandy matrix, with abundant pyrite in the cement.

Visible gold in rhyolite from Arizona.

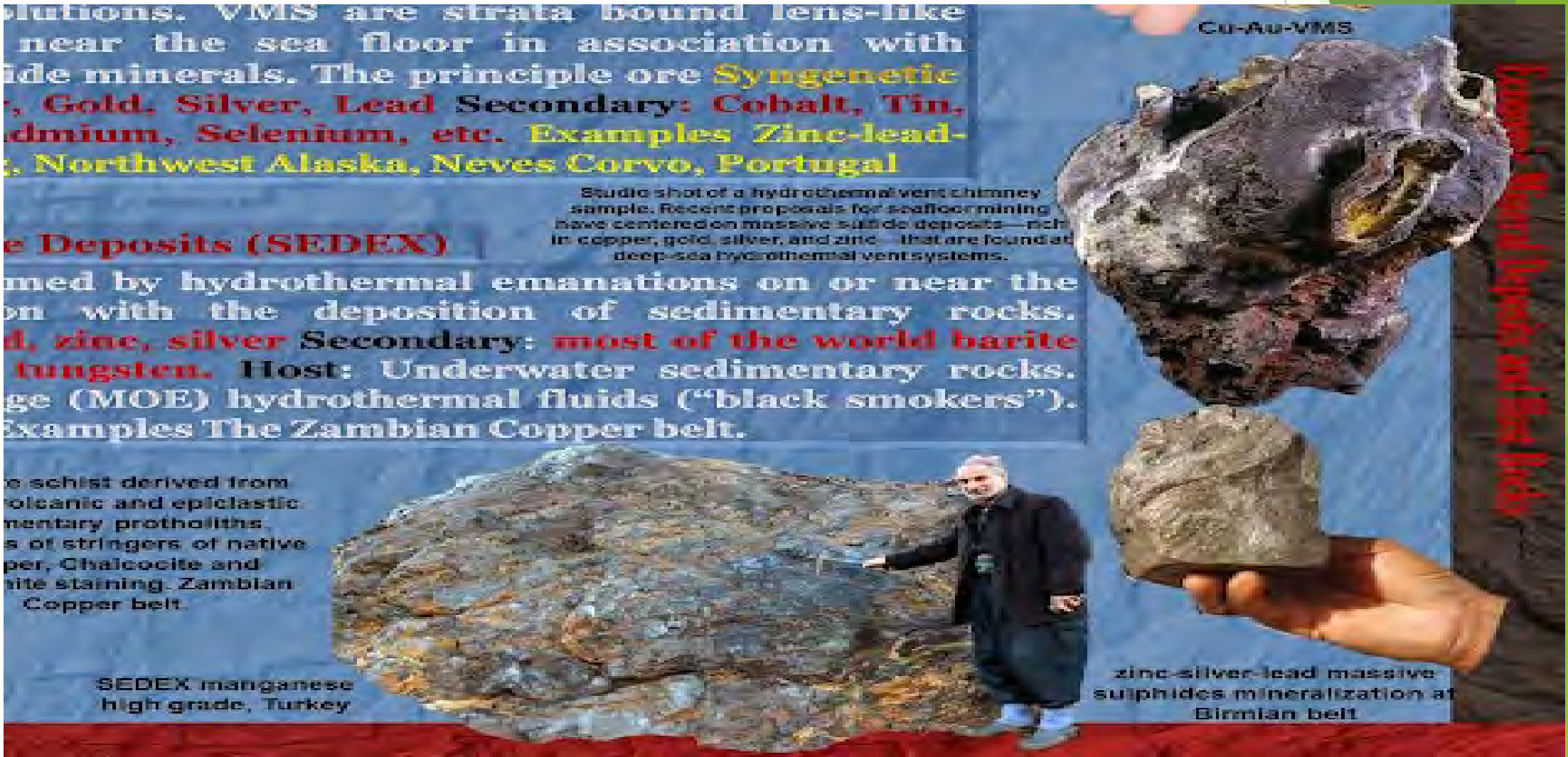
Diamond in Kimberlite from Fuxian, Liaoning Province, China

Disseminated copper sulphide (bornite) in andesite

2. Massive

Massive deposits with more than 60% sulfides (volcanogenic massive sulfide [VMS], volcanic-hosted massive sulfide [VHMS] are formed due to accumulations on or near the sea floor in association with volcanic activity or hydrothermal emanations along with sedimentary deposition. An example is the zinc-lead-silver deposit of Red Dog, Northwest Alaska, Neves Corvo, Portugal.

SedEx, or sedimentary exhalative deposits, are ore deposits formed when hydrothermal fluids enter a water reservoir, such as an ocean, and precipitate minerals. SedEx deposits are a major source of minerals including **copper, silver , gold and tungsten** - and the single most important source of lead and zinc



3. Veins and Stringers

Veins, fissure veins, and lodes are tabular deposits usually formed by deposition of ore and gangue minerals in open spaces within fault, shear, and fracture zones. Veins often have great lateral and/or depth extents but are usually of narrow width that portrays veins and stringers. Veins frequently pinch and swell in all directions. The pinch and swell structure type of deposits pose problems during both exploration and mining. Proper delineation of the ore body, dilution control, and planning for large-scale mining are difficult

A good example is the sheeted veins in the underground mine of Zawar zinc-lead-silver, Kolihan copper deposit, India. The mineralized vein or clusters of veins are exposed to the surface in many places, and are a good indicator of mineral exploration. Stringers are large numbers of thin, tiny, and closely spaced mineralized veins originating from the main orebody and often described as the stringer zone.

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Veins and Stringers Ore Type

Veins and Stringers

"Veins", "fissure-veins" and "lodes" are tabular deposit usually formed by deposition of ore and gangue minerals in open spaces within a fault, shear and fracture zones.

Veins often have great lateral and/or depth extent but which are usually of narrow width that portray veins and stringers. There are two distinct types Fissure veins and ladder veins. Veins "lodes" are of prime importance to mineral deposits "ores related to hydrothermal mineralization" . A large portion of the world's economic deposits of Gold, Silver, Copper and Lead-Zinc are found in vein "lode" deposits. "Stringers" are large numbers of thin, tiny and closely spaced mineralized veins originating from the main orebody and often described as "Stringer Zone".

The Road Gold vein. The lode deposits are classified as epithermal veins that precipitated from hot hydrothermal fluids and hot springs rich in silica and carbonate.

Exposed gold vein at the Vulture mine

Stratification and stringers of sphalerite, galena and pyrite hosted by carbonaceous calc-silicate rock at Sindesar Khurd orebody, India.

Gold-bearing quartz veins, Blue Ribbon Mine, Alaska

Economic Mineral Deposits and Their Forms

4. Ladder Veins

Ladder veins are regularly spaced, short, and transverse fractures confined wall to wall within dikes or compact rock mass. The fractures are nearly parallel to each other and occur for considerable distances along the host dike or rock. The fractures are generally formed by contraction joints and filled with auriferous quartz or valuable mineral matter to form an economic deposit. An example is copper ladder veins in Norway.

5. Stock Work

Stock work styles of metalliferous deposits are characterized by a large mass of rock impregnated with a dense interlacing network of variously oriented irregular ore bearing veins and grouped veinlets. The stock works are formed by a group of hydrothermal systems of metal bearing fluids from hot mineralized solutions circulating through the fissured rocks and deposited in the basin. The veins contain metallic minerals.

The stock work style of mineralization occurs in porphyritic plutonic igneous intrusions. These deposits are especially common with platinum-bearing sulfides, zinc, lead, copper, gold, silver, molybdenum, tin, tungsten, beryllium, uranium, mercury, and other metal ores. Stock work mineralization may occur as a separate body or in association with other styles. A system of working in the ore body, when it lies neither in strata nor in veins but in solid masses, can be done in chambers or stories. Examples of stock work are disseminated gold-bearing Trinity Mine, Nevada, USA, copper and tin-rich stock work at Neves Corvo mine, Portugal, and platinum-palladium-chromite mines at Boula-Nausahi and Sindesar-Khurd zinc-lead-silver mine, India.

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Stock-work Ore Type

Stock Work

The "stock work" styles of metalliferous deposits are characterized by a large mass of rock impregnated by dense interlacing network of variously oriented irregular ore-bearing veins and grouped veinlets. **Stock works** are formed by group of hydrothermal systems of metal-bearing substance from hot mineralized solutions circulating through the fissured rock or deposited in the basin. The veins contain metallic minerals. **The stock work style of mineralization** commonly occurs in porphyritic plutonic igneous intrusions.

These kinds of deposits are especially common with **platinum-bearing sulfides, copper, gold, molybdenum, tin, tungsten, beryllium, uranium, mercury and other metal ore.**

The stock work mineralization may occur as separate body or in association with other style, **The ore is mined** as chambers or stories when the stock work style of mineralization occurs exclusively as solid massive form outside the host strata or veins. **The examples** of stock work are disseminated **gold-bearing Trinity Mine**, Nevada, **copper- and tin-rich stock work at Neves Corvo mine**, Portugal, **platinum-palladium-chromite mines** at Boula-Nausali, India.

gold vein stockwork

Indium-bearing stockwork of quartz veins with greisen alteration zones in fine-grained granite from the Fire Tower Zone, Mount Pleasant deposit, New Brunswick, Canada. The deposit was partly mined for tungsten and molybdenum but there is potential to extract high grades of tin and indium

Stockwork of the Volcanic Hosted Massive Sulfide (VHMS) San Miguel in the Riotinto Belt, Spain.

The green coloration is a chlorite-montmorillonite-celadonite clay assemblage that formed by chemical interaction of boiling hot springs water and the rock.

Sample of gold ore from the Red Lake Mine consisting of a stockwork of gold filled veinlets

E. Morphology

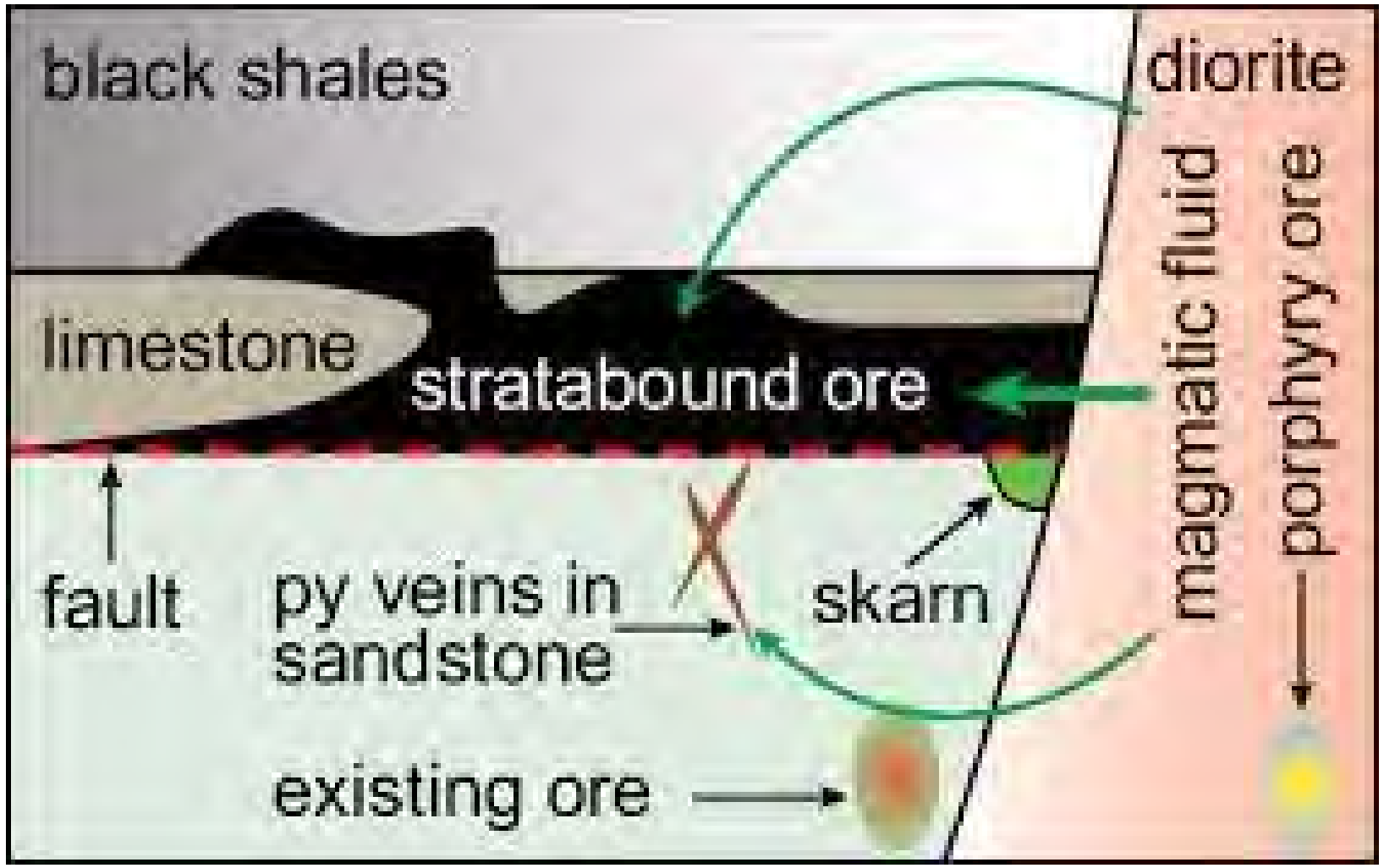
1. Stratiform

Hydrothermal, volcanogenic, and SEDEX-type mineralization closely resembles stratification of sedimentary metal-bearing hydrothermal solution through a porous aquifer and deposits ore minerals in the overlying pile of sedimentary strata of shale and dolomite. These deposits may contain a significant amount of organic matter and fine pyrite. Some of the world's largest and most famous stratiform base metal deposits are copper deposits at White Pine, Michigan, copper deposits of Zambia, lead-zinc-copper deposits at Sullivan in British Columbia, and zinc-lead-silver deposits at Rajpura-Dariba in India.

2. Stratabound

Ore minerals in stratabound deposits are exclusively confined within a single specific stratigraphic unit. Stratabound deposits include various orientations of mineralization representing layers, rhythmic, stratiform, veinlets stringers, and disseminated and alteration zones, strictly contained within the stratigraphic unit, but which may or may not be conformable with bedding.

There are several world-class stratabound zinc-lead-silver deposits: they are Proterozoic Mt. Isa-McArthur Basin System of NT, Australia (Mt. Isa, George Fisher, Hilton, Lady Loretta, Century, and McArthur River), and the Proterozoic Middle Arravalli System in India (Zawar, Rajpura-Dariba, and Rampura-Agucha).


black shales
diorite
limestone
stratabound ore
magmatic fluid
porphyry ore
fault
py veins in sandstone
skarn
existing ore

3. Layered, Rhythmic, and Bedded

Layered, rhythmic, and bedded types of deposits are formed generally by deposition and consolidation of sediments that may or may not be metamorphosed. The type of ore deposit will depend on the composition of the transported sediments. The deposits showing these features are iron ore, lignite, and coal seam. Layered and rhythmic features are also developed during the differential crystallization and segregation of mafic and ultramafic magma in a huge chamber over a prolonged time. The early crystallization, settling, and consolidation of heavy metal-rich layers are composed of Cr-Ni-Cu-Pt-Pd and disseminated sulfides- Au and Ag forming economic mineral deposits.

The late crystallization and solidification of residual magma form alternate layers of dunite, peridotite, gabbro, and anorthosite. The process repeats with addition of fresh magmatic cycles. An example is Bushveld platinum-chromite deposits, South Africa.

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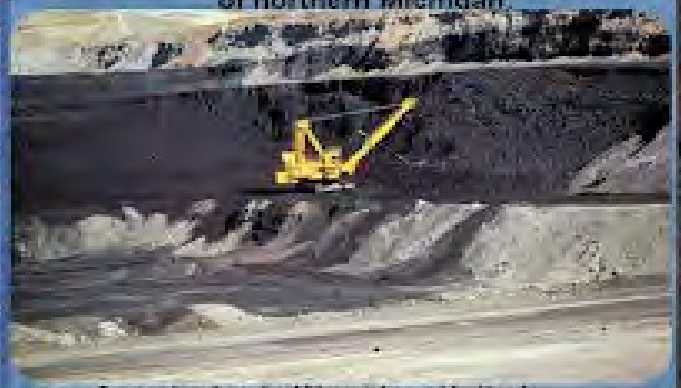
Layered Rhythmic Bedded

Layered, Rhythmic and Bedded

"**Layered**", "**rhythmic**" and "**bedded**" types of deposits are formed generally by deposition and consolidation of sediments that may or may not be metamorphosed. The type of ore deposit will depend on the composition of the transported sediments. The deposits showing these features are iron ore (**BIIQ/BIF**), **lignite**, and **coal**. The **layered** and **rhythmic** features are also developed during the differential crystallization and segregation of the **mafic** and **ultramafic magma** in a huge chamber over a prolonged time. The early crystallization, settling and consolidation of heavy metal-rich layers are composed of **Cr-Ni-Cu-Pt-Pd** and disseminated **sulfides** +,- **Au** and **Ag** forming economic mineral deposits. The late crystallization and solidification of residual magma form alternate layers of **dunite**, **peridotite**, **gabbro** and **anorthosite**. The process repeats with addition of fresh magmatic cycles. **The examples** are **Bushveld platinum-chromite deposits**, South Africa, **Sittampundi Cr-Pt-Pd**, **Sukinda Cr-Ni**, India.

Sedimentary layers with bands of hematite, magnetite (gray/black), and jasper (red) in Precambrian banded iron formations (BIFs) of northern Michigan.



A coal mine in Wyoming, United States. The United States has the world's largest coal reserves.

Outcrop showing alternation of dunite(-wehrlite), clinopyroxenite and gabbro (whitish band).

Chromitite seams in the Bushveld Igneous Complex.

Economic Mineral Deposits and Rocks

4. Porphyry

Porphyry is a diversity of igneous rock consisting of large grained crystals such as quartz and feldspar scattered in a fine-grained groundmass. The groundmass is composed of indistinguishable crystals (aphanites as in basalt) or easily distinguishable crystals (phanerites as in granite). Porphyry refers to the texture of the igneous racks, and used as suffix after granite-, rhyolite-, and basalt-porphyry. The porphyry deposits are formed by differentiation and cooling of a column of rising magma in stages. The different stages of cooling create porphyritic textures in intrusive as well as in subvolcanic rocks. The process leads to a separation of dissolved metals into distinct zones responsible for forming rich deposits of copper, molybdenum, gold, tin, zinc, and lead in the intrusive rock itself. There are several large porphyry copper deposits in the world such as Malanjkhand (145 Mt, 1.35% Cu), India.

Porphyry Ore Deposit

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Brassy-yellow Chalcopyrite is the primary copper-bearing mineral in Porphyry deposits.

Porphyry

"**Porphyry**" is a diversity of **igneous rock** consisting of large-grained crystal such as quartz and feldspar scattered in a fine-grained groundmass. The groundmass is composed of indistinguishable crystals (aphanites as in basalt) or easily distinguishable crystals (phanerites as in granite).

Porphyritic refers to the texture of the rocks and suffix as **granite-**, **rhyolite-**, and **basalt-porphyry**. **The porphyry deposits** are formed by differentiation and cooling of a column of rising magma in stages. In the process it leads to a separation of dissolved metals into distinct zones and responsible for forming rich deposits of **copper**, **molybdenum**, **gold**, **tin**, **zinc** and **lead** in the intrusive rock itself. There are several large **porphyry copper deposits** in the world:

Examples Chuquicamata (690 Mt at 2.58% Cu), **Dexing Cu-Au-Ag Distirct**, South China, **Escondida and El Salvador**, Chile, Toquepala, Peru, **Lavender pit, Arizona** and Malanjkhand, India.

Erdenet Cu-Mo Porphory mining

The Bingham Canyon Porphory copper mine in Utah has been in production for more than a century.

Summary

Porphyry Deposits Epigenetic and Syngenetic
Primary: Copper
Secondary: Molybdenum and Gold
Other: Chalcopyrite, Bornite, Chalcocite **Host**: magmatic rocks, stockwork (veins and breccias).
Process: Intrusion of heavy mineral rich fluids in subduction zones (leading to hydrothermal alterations). Stockwork texture, veins and breccia are typical types of rocks. If the formation is caused due to hydrothermal alternation, then the ore is classified as an epigenetic formation.
Examples: El Teniente, Chile.

Porphyry Mineral Deposits and Their Origin

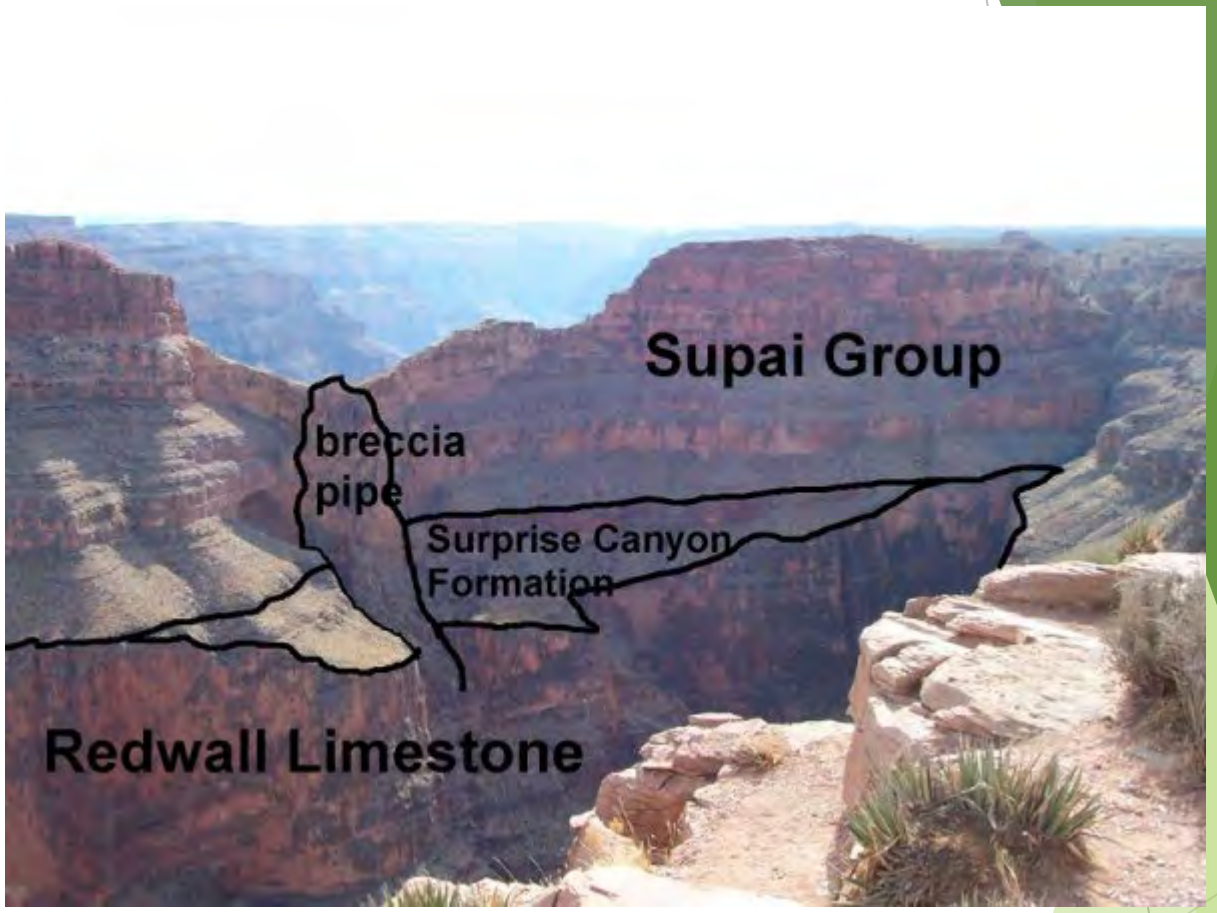
5. Lenticular

The magmatic segregation deposits are formed by fracture filling within the host rock, and are generally irregular, roughly spherical, and more often "tabular" or "lenticular" in shape. The width/thickness ranges between a few centimeters and a few meters. The length may exceed 1 km. An example is Sukinda chromite deposits in dunite peridotites, India.

6. Pipe

Pipe-like deposits are relatively small in the horizontal dimension and extensively large in the vertical direction. These pipes and chimneys are orientated in vertical to subvertical positions. Pipes may be formed by infillings of mineralized breccias in volcanic pipes, e.g., copper-bearing breccia pipes of Messina, South Africa.

Another common type of volcanic pipe is a deep narrow cone of solidified intrusive magma characteristically represented by kimberlite or lamproite. Kimberlite is high in magnesium, carbon dioxide, and water. Kimberlite is the primary source of diamond, precious gemstone, and semiprecious stones. The best example is the diamond pipe at Kimberley, South Africa, and Panna, India.


Supai Group
breccia
pipe
Surprise Canyon
Formation
Redwall Limestone

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Lenticular and Pipe

Lenticular

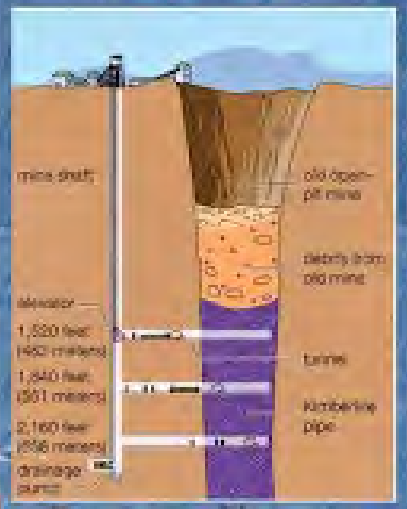
Magmatic segregation deposits are formed by fracture filling within the host rock or contained within them. They are generally irregular, roughly spherical, more often "tabular" or "lenticular" in shape. The **width** and **thickness** ranges between few centimeters and few meters. The **length** may exceed kilometers. **Examples** are **Sukinda chromite deposits** in **dunite-peridotites** and **Balaria zinc-lead-silver deposit** in **dolomite**, India.

Sharp base of tidal channel deposits above sediments with (closed) lenticular bedding

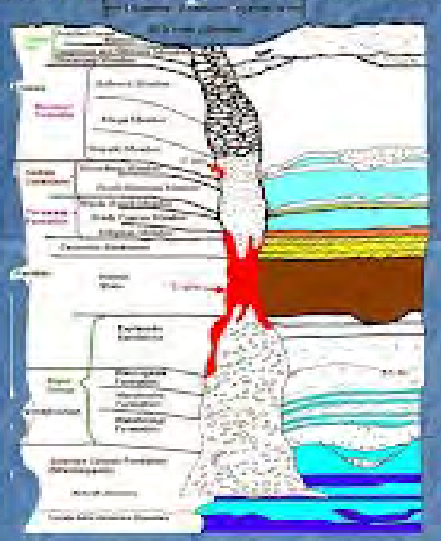
Pipe

Pipes may be formed by infillings of mineralized breccias in volcanic pipes e.g. **copper-bearing breccia pipes** of Messina, South Africa. Another common type of volcanic pipes is a deep narrow cone of solidified intrusive magma characteristically represented by Kimberlite or lamproite. **Kimberlite Deposits** Epigenetic **Primary:** Diamond **Other:** Kimberlite Indicator Minerals (KIM) **Host:** Kimberlite **Process:** Formed in depths over 100 km under the temperature of 900 – 1200 C and high pressure. Ideal conditions are in the old, cold, thick Archean (>2.5 Ga). Rapid igneous intrusions known as Kimberlite pipes.
best example is diamond pipe at Kimberly, South Africa, and Canada,Russia.

World's top diamond producing



Breccia pipe Diamond deposits



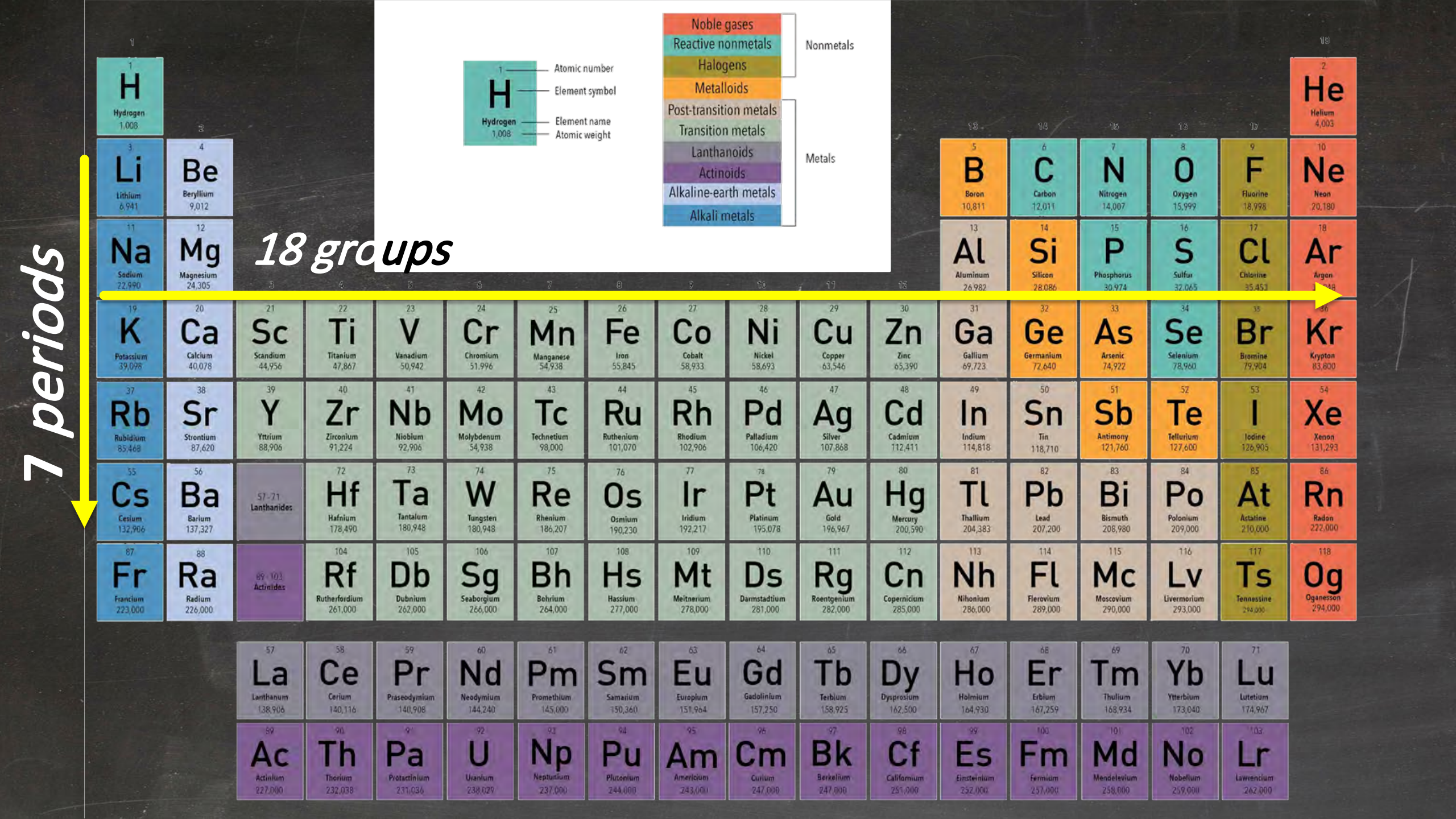
Breccia pipe uranium deposits

Breccia Pipe and Diatreme

Thank You

A residual placer is, in effect, **a concentration of gold (or other heavy mineral) at or near its point of release from the parent rock**. In this type of placer the enrichment results from the elimination of valueless material rather than from concentration of values brought in from an outside source

Megatonne, abbreviated as Mt, is a metric unit equivalent to 1 million (10^6) tonnes, or 1 billion ($10^{9)}$ kilograms.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H
Hydrogen
1.008
Atomic number
Element symbol
Element name
Atomic weight
Noble gases
Reactive nonmetals
Halogens
Metalloids
Post-transition metals
Transition metals
Lanthanoids
Actinoids
Alkaline-earth metals
Alkali metals
Nonmetals
Metals
7 periods
18 groups
He Helium 4.003
Li Lithium 6.941
Be Beryllium 9.012
B Boron 10.811
C Carbon 12.011
N Nitrogen 14.007
O Oxygen 15.999
F Fluorine 18.998
Ne Neon 20.180
Na Sodium 22.990
Mg Magnesium 24.305
Al Aluminum 26.982
Si Silicon 28.086
P Phosphorus 30.974
S Sulfur 32.065
Cl Chlorine 35.453
Ar Argon
K Potassium 39.098
Ca Calcium 40.078
Sc Scandium 44.956
Ti Titanium 47.867
V Vanadium 50.942
Cr Chromium 51.996
Mn Manganese 54.938
Fe Iron 55.845
Co Cobalt 58.933
Ni Nickel 58.693
Cu Copper 63.546
Zn Zinc 65.390
Ga Gallium 69.723
Ge Germanium 72.640
As Arsenic 74.922
Se Selenium 78.960
Br Bromine 79.904
Kr Krypton 83.800
Rb Rubidium 85.468
Sr Strontium 87.620
Y Yttrium 88.906
Zr Zirconium 91.224
Nb Niobium 92.906
Mo Molybdenum 54.938
Tc Technetium 98.000
Ru Ruthenium 101.070
Rh Rhodium 102.906
Pd Palladium 106.420
Ag Silver 107.868
Cd Cadmium 112.411
In Indium 114.818
Sn Tin 118.710
Sb Antimony 121.760
Te Tellurium 127.600
I Iodine 126.905
Xe Xenon 131.293
Cs Cesium 132.906
Ba Barium 137.327
57-71 Lanthanides
Hf Hafnium 178.490
Ta Tantalum 180.948
W Tungsten 180.948
Re Rhenium 186.207
Os Osmium 190.230
Ir Iridium 192.217
Pt Platinum 195.078
Au Gold 196.967
Hg Mercury 200.590
Tl Thallium 204.383
Pb Lead 207.200
Bi Bismuth 208.980
Po Polonium 209.000
At Astatine 210.000
Rn Radon 222.000
Fr Francium 223.000
Ra Radium 226.000
89-103 Actinides
Rf Rutherfordium 261.000
Db Dubnium 262.000
Sg Seaborgium 266.000
Bh Bohrium 264.000
Hs Hassium 277.000
Mt Meitnerium 278.000
Ds Darmstadtium 281.000
Rg Roentgenium 282.000
Cn Copernicium 285.000
Nh Nihonium 286.000
Fl Flerovium 289.000
Mc Moscovium 290.000
Lv Livermorium 293.000
Ts Tennessine 294.000
Og Oganesson 294.000
La Lanthanum 138.906
Ce Cerium 140.116
Pr Praseodymium 140.908
Nd Neodymium 144.240
Pm Promethium 145.000
Sm Samarium 150.360
Eu Europium 151.964
Gd Gadolinium 157.250
Tb Terbium 158.925
Dy Dysprosium 162.500
Ho Holmium 164.930
Er Erbium 167.259
Tm Thulium 168.934
Yb Ytterbium 173.040
Lu Lutetium 174.967
Ac Actinium 227.000
Th Thorium 232.038
Pa Protactinium 231.036
U Uranium 238.029
Np Neptunium 237.000
Pu Plutonium 244.000
Am Americium 243.000
Cm Curium 247.000
Bk Berkelium 247.000
Cf Californium 251.000
Es Einsteinium 252.000
Fm Fermium 257.000
Md Mendelevium 258.000
No Nobelium 259.000
Lr Lawrencium 262.000

What are the 3 types of rock?
Extrusive, or volcanic, igneous rocks are formed when molten hot material cools and solidifies. There are three main types of rocks: **sedimentary, igneous, and metamorphic**.

Three Types of Rock

•Igneous rocks are formed from melted rock deep inside the Earth.

•Sedimentary rocks are formed from layers of sand, silt, dead plants, and animal skeletons.

•Metamorphic rocks formed from other rocks that are changed by heat and pressure underground.

What are the 3 main types of igneous rocks?

Igneous Rocks Examples

•Granite. Granite is a hard igneous rock made of clearly visible crystals of various minerals. ...

•Basalt. Basalt is a dark-coloured, fine-grained igneous rock. ...

•Pumice. Pumice is a light igneous rock with thousands of tiny bubbles in them.

Extrusive, or volcanic, igneous rock is produced when magma exits and cools above (or very near) the Earth's surface. These are the rocks that form at erupting volcanoes and oozing fissures.

Disseminated" types of mineralization are formed by crystallization of deep-seated magma. The geological body in which the ore minerals "usually metallic" are disseminated or scattered, usually are not visible to the naked eye, in low concentration as fine grains throughout or part of the host rock.

Volcanogenic massive sulfide (VMS)

Or VHMS Volcanic-hosted massive sulfide they are formed in tectonic settings collisional environments during period of extension and rifting . They are related to precipitation of metals from hydrothermal solutions. VMS are strata bound lens-like accumulations on or near the sea floor in association with volcanic activity of sulfide minerals.

Veins", "fissure-veins" and "lodes" are tabular deposit usually formed by deposition of ore and gangue minerals in open spaces within a fault, shear and fracture zones.

Veins often have great lateral and/or depth extent but which are usually of narrow width that portray veins and stringers. There are two distinct types Fissure veins and ladder veins. Veins "lodes" are of prime importance to mineral deposits "ores related to hydrothermal mineralization" . A large portion of the world's economic deposits of Gold, Silver, Copper and Lead-Zinc are found in vein "lode" deposits. "Stringers" are large numbers of thin, tiny and closely spaced mineralized veins originating from the main orebody and often described as "Stringer Zone".

Ladder veins" are regularly spaced, short and transverse fractures confined wall to wall within dikes or compact rock mass. The fractures are nearly parallel to each other and occur for considerable distance along the host dike or rock.

Stock-work

The “stock work” styles of metalliferous deposits are characterized by a large mass of rock impregnated by dense interlacing network of variously

oriented irregular ore-bearing veins and grouped vein-lets. Stock works are formed by group of hydrothermal systems of metal-bearing substance
from hot mineralized solutions circulating through the fissured rock or deposited in the basin. The veins contain metallic minerals. The stock work style
of mineralization commonly occurs in porphyritic plutonic igneous intrusions.
These kinds of deposits are especially common with platinum-bearing sulfides, copper, gold, molybdenum, tin, tungsten, beryllium, uranium, mercury and
other metal ore.
The stock work mineralization may occur as separate body or in association with other style. The ore is mined as chambers or stories when the stock
work style of mineralization occurs exclusively as solid massive form outside the host strata or veins. The examples of stock work are disseminated gold-bearing Trinity Mine,
Nevada, copper- and tin-rich stock work at Neves Corvo mine, Portugal, platinum-palladium-chromite mines at Boula-Nausali, India.

Veins are **mineral deposits which form when a preexisting fracture or fissure within a host rock is filled with new mineral material**

Ladder veins are **short, rather regularly spaced, roughly parallel fractures that traverse dikes (tabular bodies of igneous rocks) from wall to wall**. Their width is restricted to the width of the dike, but they may extend great distances along it.

a system of working in ore when it lies not in strata or veins but in solid masses so as to be worked in chambers or stories. : a body or tract of rock so charged with veinlets, nests, or impregnations of ore and especially tin ore that it can be profitably mined.

Kimberlites & lamproites are **unusual igneous bodies having overall pipe-shaped geometries**. Their mode of formation is only moderately understood because they have not been observed forming. Kimberlites & lamproites are known from scattered localities throughout the world - only some are significantly diamondiferous.

A final class of hydrothermal deposit is called stratiform because the ore minerals are always confined within specific strata and are distributed in a manner that resembles particles in a sedimentary rock.

Rhythmic bedding consists of **a repeated sequence of beds**. Varves are a simple example of rhythmic bedding. Turbidites are a more complex example of rhythmic bedding. Rhythmic beds are sometimes called "rhythmites."