

Lead Minerals

Presentation to East KingCo Rock Club

June 2015

LEAD metal symbol Pb, Z=82, 4 stable isotopes A=204, 206, 207, 208

- Name from Old English word for the metal
- One of the elements known to ancient people, discovered earlier than 6000 BC
- Latin: plumbum (basis of our word plumber)
- Specific gravity: 11.3, m.p. 621° F; silvery bluish-gray, tarnishing to a duller luster, heavy, soft, malleable, castable - makes up about .001% of earth's crust (compare gold about .0000003%) - highest Z of any stable element

Uses include lead-acid batteries, stained glass work, bullets, solder, pewter, weights, radiation shielding - formerly a gasoline additive

Lead toxicity: effects include nerve damage, mental impairment, kidney damage, stomach pain, anemia, miscarriage, decreased fertility; reduced ability to taste salt reported...infants and children are more sensitive than adults are.

1

Minium "red lead" - $2\text{PbO} \cdot \text{PbO}_2$ - name from Minius (Latin) river in Spain, now Miño (PbO alone called litharge [red] or massicot [yellow], being dimorphous)

- Color bright red to orange, specific gravity about 8.3, hardness about 2.5
- Scaly and earthy forms, secondary mineral produced in strong oxidation zones of lead deposits, and by mine fires
- Used as a pigment ("miniature" paintings), batteries, lead glass, glazes
- Occurs in small amounts all over the world
- Samples from Rowley mine, Theba AZ, and Chihuahua Mexico

Plattnerite - PbO_2 - named for K F Plattner, German metallurgist

- Jet black to brown-black, hardness about 5.5, specific gravity about 9
- Tetragonal crystal system; adamantine to metallic luster, tarnishing to dull; no cleavage, dark brown streak, opaque, non-fluorescent
- Prismatic, acicular crystals; aggregates in nodular or botryoidal masses and crusts forms in weathered hydrothermal deposits
- Synthesized for use in lead-acid batteries
- Occurs worldwide in e.g., Scotland, Iran, Russia, Namibia, Australia, Mexico, USA
- Sample from Mapimi Mexico

Murdochite - $\text{PbCu}_6\text{O}_{8-x} (\text{Cl}, \text{Br})_{2x}$, $x \leq 0.5$ - named for American mineralogist Joseph Murdoch

- Black, sometimes with pinkish tinge, hardness 4, specific gravity about 6.4
- Isometric (cubic) crystal system, adamantine luster, good cleavage, black streak, opaque
- Cubic and octahedral crystals, twinning common, often forms thin crusts
- Formed in oxidized Pb-Cu deposits
- Found in e.g., Iran, Chile, Australia, Mexico, and in USA, NM and AZ
- Sample from Mapimi Mexico

Galena - PbS - often contains substantial amounts of Ag, Zn, Sb, As and/or Bi - name from Latin: lead ore, dross from smelting lead

- Dark gray color, specific gravity about 7.4, hardness 2.5 - 2.7
- Isometric (cubic) crystal system, good to perfect cleavage, silvery metallic luster on fresh cleavage faces, tarnishing to dull; dark gray streak, opaque
- Cubic and octahedral crystals, aggregates in tabular, blocky, massive and granular habits
- Primary mineral, deposited in hydrothermal veins and metamorphic rocks
- Most common ore of lead, found in many places including MO, CO, WI, ID (w/ Ag) in USA, as well as e.g., England, Germany, Bulgaria and Australia. Ancient Romans mined large amounts in Spain and Sardinia
- Samples from Bulgaria and MO

2

Bournonite PbCuSbS_3 - named for French mineralogist Jacques, Comte de Bournon

- Steel gray color, hardness 2.5 - 3, specific Gravity About 5.8
- Orthorhombic crystal system, metallic luster, imperfect cleavage, metallic gray streak, opaque
- Short prismatic to tabular crystals, often striated, usually twinned, also platy and massive
- Forms in moderate temperature hydrothermal veins
- Found in many locales including England, France, Canada, China, Mexico, Peru, Bolivia, and in the USA, CA, CO, AZ and Stevens county, WA
- Specimen from Bolivia

Andorite $\text{PbAgSb}_3\text{S}_6$ - named for Andor von Semsey, an amateur Hungarian mineral collector

- dark gray, sometimes tarnishing to yellow or iridescent, hardness 3 - 3.5, specific gravity 5.3 - 5.4
- orthorhombic crystal system, metallic luster, no cleavage, black streak, opaque
- blocky prismatic or thick tabular crystals, often striated, and massive forms
- formed in low-temperature polymetallic hydrothermal veins
- Found in e.g., Bolivia, Romania, Russia and in the USA, NV, CA and WA (Bear Basin, King Co.)
- Specimen from Bolivia

Zinkenite $\text{Pb}_9\text{Sb}_{22}\text{S}_{42}$ - named for discoverer, German mineralogist Johann Zinken

- steel gray, hardness 3 - 3.5, specific gravity 5.2 - 5.3
- hexagonal crystal system, metallic luster, poor cleavage, gray streak, opaque
- thin prismatic and acicular needle-like crystals, often striated; columnar to radial aggregates, massive
- formed in Pb-bearing hydrothermal veins
- found in e.g., Bolivia
- Specimens from Germany, Italy

Anglesite - PbSO_4 - name is from Anglesey, an island off the west coast of Wales

- colorless, white, yellow, greenish to brownish, can be gray to black from residual

3

Galena - specific gravity about 7.5, hardness 2.5 - 3

- orthorhombic crystal system, adamantine to resinous luster (dull when massive), distinct cleavage, white streak, transparent to translucent
- tabular or prismatic crystals, sometimes with pointed terminations, often striated; aggregates in grainy, massive or reniform habits
- a secondary mineral produced by oxidation of e.g., galena - a minor lead ore
- notable specimens from Morocco and Namibia in Africa, Sardinia, Mexico, and New South Wales in Australia - in the U.S., deposits found in PA, MO, AZ, ID
- Sample is from Morocco and fluoresces pale yellow under SW UV

Cerussite - PbCO_3 - named is from Latin cerussa, meaning white lead (note)

- Usually colorless to gray-white, yellowish, hardness 3 to 3.5.
- Specific gravity 6.5 - 6.6
- orthorhombic crystal system; adamantine, vitreous, pearly or earthy luster; good cleavage, white streak, transparent to translucent
- tabular, prismatic and equant crystals, often striated, prone to twinning - aggregates in reticular, massive and granular habits

- a secondary mineral that forms in the oxidized zones of Pb mineral veins; a minor Pb ore
- found in e.g., Morocco, Namibia, UK, Germany, Australia, and in the USA, NM, AZ and ID
- sample is from Morocco, and fluoresces yellow when irradiated by SW UV
- note: "white lead" is hydrocerussite, $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$ - forms in the hexagonal system as platy to bladed crystals, massive aggregates - formerly used in paints, cosmetics, lubricants - specimen from Somerset, England

Crocoite - PbCrO_4 - name from Greek "krokos," meaning saffron, from the usual color

- red to orange, yellow - hardness 2.5 - 3, specific gravity about 6
- monoclinic crystal system, adamantine to vitreous luster, distinct cleavage in one plane, yellow-orange streak, transparent to translucent
- thin prismatic crystals, often striated; aggregates of acicular, reticulated, granular and encrusting habits
- secondary mineral, often formed in oxidation zones of Pb deposits, where Cr-bearing ultramafic rocks are present
- artificially produced as chrome yellow pigment in paint and fireworks
- found in e.g., Tasmania, Russia, Brazil, Philippines, and in the USA in CA and AZ
- specimens from Tasmania, Australia

Wulfenite - PbMoO_4 - named for Austrian mineralogist Franz von Wulfen

- Red-orange to yellow, rarely other colors; hardness 2.7 - 3, specific gravity 6.5-7
- tetragonal crystal system, adamantine to resinous luster, distinct cleavage in one plane, white streak, transparent to opaque
- square tabular or pyramidal crystals; aggregate habits can be platy, granular or earthy
- a secondary lead mineral and a minor molybdenum ore
- found in e.g., Mexico, Slovenia, China and in the USA, AZ, NM and CO
- samples from AZ, Mexico and China

Mimetite - $\text{Pb}_5(\text{AsO}_4)_3\text{Cl}$ - name from Greek mimetes, an imitator or mimic, from its resemblance to pyromorphite

- yellow to orange-brown, green; hardness 3.5 - 4, specific gravity 7.1 - 7.3
- hexagonal crystal system, resinous to vitreous luster, poor cleavage, white streak, transparent to opaque
- prismatic and acicular crystals, rarely tabular; aggregate forms include botryoidal, mammillary, encrusting

- a secondary mineral formed in the oxidation zone of lead deposits in the presence of e.g., Arsenopyrite - a minor lead ore
- found in e.g., Namibia; New South Wales, Australia; Mexico; China; England and in the U.S., AZ and PA
- Specimens from AZ and China

Vanadinite - $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$ - named for the presence of the element vanadium

- color bright red to brownish; hardness 3-4, specific gravity 6.8 - 7.1
- hexagonal crystal system, resinous to adamantine luster, no cleavage
- streak pale yellow to brownish yellow, transparent to opaque
- short hexagonal prismatic and pyramidal crystals, aggregating into nodular, fibrous and encrusting forms
- a secondary mineral formed in the oxidation zone of e.g., galena deposits, esp. in arid climates and where V is present in adjacent silicate rocks
- a significant ore of vanadium and a minor ore of lead
- found in e.g., Morocco, Namibia, Austria, Scotland, Ural Mts. of Russia, Mexico, and in the U.S., AZ, CA, NM and SD
- samples from Morocco

Pyromorphite - $\text{Pb}_5(\text{PO}_4)_3\text{Cl}$ - name from Greek words meaning, "fire formed"

5

- usually green to yellow-green; hardness 3.5-4, specific gravity 7 - 7.2
- hexagonal crystal system, resinous to vitreous luster, imperfect cleavage, white streak, transparent to translucent
- hexagonal prismatic, pyramidal or acicular crystals, may have barrel-like curvature; aggregates in globular, botryoidal or drusy forms
- a secondary mineral formed in the oxidation zone of Pb deposits
- some specimens fluoresce orange to yellow
- found in e.g., Canada, Mexico, England, Spain, China, Australia, and in the USA ID and PA
- Specimen from China

Linarite - $\text{PbCu}^{+2}\text{SO}_4(\text{OH})_2$ - named after the Linares plateau, Spain

- deep blue color, hardness 2.5, specific gravity 5.3 - 5.5
- monoclinic crystal system, adamantine to vitreous luster, perfect cleavage in one direction and imperfect in another, pale blue streak, translucent
- tabular and prismatic crystals, aggregating in acicular and encrusting forms
- a secondary mineral formed in the oxidation zone of Pb/Cu ore deposits
- a minor Cu ore

- found in e.g., England, Sardinia, Spain, Namibia, Morocco, Chile and in the USA, AZ, NM, CA and UT
- Specimen from Utah

Caledonite - $\text{Pb}_5\text{Cu}_2\text{CO}_3(\text{SO}_4)_3(\text{OH})_6$ - name is from the Roman name for Scotland, Caledonia

- dark blue to green-blue, hardness 2.5 - 3, specific gravity 5.6 - 5.8
- orthorhombic crystal system, vitreous to resinous luster, perfect cleavage in one direction and imperfect in two others, streak pale blue to pale blue-green, transparent to translucent
- prismatic and tabular crystals, often striated, aggregating into radial forms and encrustations
- a secondary mineral formed in the weathered oxidation zone of Pb/Cu ore deposits
- found in e.g., Scotland, Chile and in the USA, CA and AZ
- Samples from AZ and CA

Descloizite - $\text{PbZnVO}_4(\text{OH})$ - named for French mineralogist Alfred Des Cloizeaux - Zn-rich end of series with mottramite (Cu)

- deep red to brown-black - hardness 3-3.5 - specific gravity about 6.2 - orthorhombic crystal system, greasy luster, no cleavage - yellow, orange or red-brown streak - transparent to opaque
- prismatic or pyramidal crystal shapes; granular, massive, mammillary or drusy crust aggregates
- a secondary mineral, found in the oxidation zone of hydrothermal replacement deposits - a minor ore of Pb and Zn
- found in Namibia, Argentina, Austria, Mexico - in the U.S., found in AZ and NM
- Sample from Chihuahua Mexico

Mottramite - $\text{PbCuVO}_4(\text{OH})$ - named for Mottram St. Andrews, a place in England, where the mineral was first found

- shades of green to blackish brown - hardness 3-3.5 - specific gravity about 5.9 orthorhombic crystal system, greasy luster, no cleavage, greenish streak, transparent to opaque
- prismatic or pyramidal crystal shapes; granular, massive, mammillary or drusy crust aggregates
- a secondary mineral, found in the oxidation zone of hydrothermal replacement deposits - a minor ore of Pb and Cu
- found in Australia, Morocco, UK, Mexico - in the U.S., found in CA, AZ and MT

- Specimens from Mexico

Plumbojarosite - $\text{PbFe}^{+3}_6(\text{SO}_4)_4(\text{OH})_{12}$ - a Pb-containing form of the mineral jarosite, where in plumbojarosite 2K \rightarrow Pb - type mineral named for the yellow jara flower (type of rockrose) that grows in mountains in Spain

- yellow-brown to dark brown, hardness 1.5 - 2, specific gravity 3.6 - 3.7
- trigonal (hexagonal) crystal system, silky to dull luster, imperfect cleavage
- pale brown streak, translucent to opaque
- small tabular crystals, forming earthy concretions and rounded masses of fine grains
- a secondary mineral formed in the oxidation zone of Pb ore deposits
- found in e.g., Mexico, Turkey and in the USA, AZ, NM, UT and NV
- specimen from Mexico

Diaboleite $\text{Pb}_2\text{Cu}^{+2}\text{Cl}_2(\text{OH})_4$ - name combines "dia" (different from) and boleite, another blue mineral that has the same ionic constituents but also some Ag and a small amount of K

- bright blue, hardness 2.5, specific gravity 5.4 - 5.5
- tetragonal crystal system, adamantine luster, perfect cleavage in one direction, blue streak, transparent to translucent
- tabular crystals, aggregating into massive and granular encrusting forms
- a secondary mineral formed in the low-temperature oxidation zone of Pb/Cu ore deposits
- found in e.g., England, Greece, Iran, Australia, Chile and AZ in the USA
- Specimens from AZ and Greece

Wherryite $\text{Pb}_7\text{Cu}_2(\text{SO}_4)_4(\text{SiO}_4)_2(\text{OH})_2$ - named for American mineralogist Edgar Wherry

- light green to light yellow, specific gravity 6.4 - 6.5
- monoclinic crystal system, vitreous to adamantine luster, transparent to translucent
- prismatic, acicular crystals; granular, massive
- a secondary mineral formed in the oxidation zone of Pb/Cu ore deposits
- found in e.g., France and AZ
- specimen from Tiger mine, AZ

Fornacite $\text{Pb}_2\text{Cu}(\text{CrO}_4)(\text{AsO}_4)(\text{OH})$ - named for a former governor of French Congo, Lucien Forneau

- olive green to yellow, hardness 2-3, specific gravity about 6.3
- monoclinic crystal system, resinous or greasy luster, olive green streak, transparent to translucent
- prismatic aggregates of steep pyramidal to bladed crystals, massive
- a secondary mineral formed in the oxidation zones of polymetallic deposits
- found in many locales in Africa, North America, Australia and Europe
- specimen from Tiger mine, AZ

Tsumebite $\text{Pb}_2\text{Cu}(\text{PO}_4)(\text{SO}_4)(\text{OH})$ - named for Tsumeb mine, Namibia

- green to blue-green, hardness 3.5, specific gravity about 6.1
- monoclinic crystal system, adamantine to vitreous luster, no cleavage, green to whitish streak, transparent
- prismatic, crusts of intergrown crystals, usually twinned
- a secondary mineral formed in the oxidation zone of Pb/Cu ore deposits
- found in e.g., Namibia, Australia, and in the USA, AZ and CA
- specimen from Tiger mine, AZ

Curite $\text{Pb}_3(\text{UO}_2)_8\text{O}_8(\text{OH})_6 \cdot 3\text{H}_2\text{O}$ - named for scientists Marie and Pierre Curie

- orange to orange-red, yellow; hardness 4 - 5, specific gravity 7 - 7.4
- orthorhombic crystal system, adamantine luster, imperfect cleavage, orange streak, transparent to translucent
- prismatic and acicular crystals, often striated, massive aggregates of very fine crystals, earthy
- radioactive, secondary mineral forming as an alteration product of uraninite, source of uranium - fluorescent?
- sample from Dem. Republic of Congo (Zaire), Africa