Wulfenite in Arizona

by Jan C. Rasmussen, R.G.

Glove Mine, Santa Rita Mts, donor Lyda Hill

Sources of photos and information

- Former Arizona Mining & Mineral Museum (467 wulfenite specimens)
- [www.mindat.org](http://www.mindat.org) (approximately 275 localities, 1585 photos)
- Inventoried 150 localities from MRDS in 1980
- Flagg Mineral Foundation samples
- Based on 1980 compilation at Arizona Geological Survey for a USGS grant
Map of Arizona Wulfenite Localities

275 wulfenite localities in Arizona in www.mindat.org

Maps from www.mindat.org
Mineralogy:

- Chemical & Physical Characteristics
- Mineralogical Associations

Geologic Setting: (age of primary deposit – wulfenite later)

- Alkali-calcic – lead-zinc-silver districts (Stage 3 and 4)
  - Jurassic – 170-160 Ma – Defiance, Silver Bill
  - Laramide – 85 - 65 Ma - Glove
  - mid-Tertiary – 30-20 Ma – Red Cloud

- Calc-alkalic – in later, outer Pb-Zn-Ag zones (Stage 4)
  - Laramide porphyry copper - 75-60 Ma – 79 Mine

- Quartz alkalic – in Pb-Zn-Ag zones with stage 4 rhyolites
  - Jurassic - Bisbee
  - Laramide - Old Yuma
  - mid-Tertiary - Tiger, Rowley

- Peraluminous calcic
  - Laramide – Gold Basin

- Peraluminous calc-alkalic
  - Precambrian

Paragenesis - Oxidized zones , water courses
**Wulfenite Mineralogy**

- PbMoO$_4$
  - Lead Molybdate (molybdenum and oxygen)

- Colors
  - Orange-yellow, yellow, honey-yellow, reddish-orange, rarely colorless, grey, brown, olive-green and black

- Subadamantine to greasy luster

Defiance Mine, Gleeson (Turquoise) district, Cochise Co., AZ Mining & Mineral Museum, MM-M900, 18 cm, donor Les Presmyk

Common impurities: W, Ca, V, As, Cr (red), W, Ti

Jan C. Rasmussen Ph.D., R.G.  
AEG Mar. 29, 2017  
www.JanRasmussen.com
Wulfenite Crystallography

- Tetragonal
  - usually tabular (flat square), thin plates
  - rare dipyramidal
  - rare pseudo-cubic

Glove Mine, Tyndall district, Santa Cruz Co.
AZ Mining & Mineral Museum MM-T554  14 cm

H = 2 ½-3
Streak white, brittle, cleavage on {011}, density 6.5-7.5
Truncated dipyramid, San Diego mine, Tombstone district, Cochise Co., 3 mm FOV, Rolf Luetcke photo, specimen, www.mindat.org
Unusual crystal forms - dipyramid

Wulfenite, dipyramid, Melissa Mine, Silver District, La Paz Co., AZ, FOV 3 mm, Trevor Boyd photo, specimen, mindat.org
Unusual crystal forms –
elongated dipyramid - acicular

Needle-like dipyramid, Heavy Weight Mine, Helvetia-Rosemont district, Santa Rita Mts., Pima Co., FOV 4 mm, Rolf Luetcke photo, specimen, mindat.org
Unusual crystal forms - elongated dipyramid

Wulfenite, tall dipyramid. Indiana-Arizona Mine, Waterman district, Pima Co., FOV 0.75 mm, Bob Rothenberg photo & specimen, mindat.org
Unusual crystal forms – pseudo cube = very thick plates

Wulfenite, pseudo cube, Gleeson Mine, Turquoise district, Dragoon Mts., Cochise Co., FOV 1.46 mm, Matteo Chinellato photo & specimen, mindat.org
Wulfenite dipyramids on relict galena with pseudocubic wulfenite about 1 inch away from galena.

Gorilla Mine, Mineral Mountain, Pinal County, AZ

Collected by Ken Algier, Stan Keith specimen & photo
Whole rock geochemistry of associated plutonic rock (granite or quartz monzonite)
- Silver Bill, Defiance, Mystery, Tom Scott mines – Gleeson district (formerly part of Turquoise district) (on Gleeson Ridge), Cochise County
Defiance & Silver Bill Mines, Turquoise district, Dragoon Mts., Cochise County - Jurassic

Wulfenite, Defiance Mine, ~2 in., owner Mark Hay

Jan C. Rasmussen Ph.D., R.G.
AEG Mar. 29, 2017
www.JanRasmussen.com
Silver Bill Mine, Gleeson Ridge (Turquoise district)

- Alkali-calcic, Jurassic
- Lead-Zinc-Silver
- Irregular small stringers, pockets, and replacement bodies of oxidized base metal sulfides in Pennsylvanian-Permian Naco Group limestones
- Adjacent to a quartz monzonite porphyry contact
- Shaft workings connected to the Mystery mine
- Large tonnage mined during late 1800s; 6570 tons produced during 1922-30, 1938-41

Jan C. Rasmussen Ph.D., R.G.
AEG Mar. 29, 2017
Defiance Mine, Gleesons dist.

- Alkali-calcic, Jurassic
- Cerussite, anglesite, malachite, smithsonite, cerargyrite, and pyrolusite
- Large amounts of magnificent wulfenite specimens lining solution cavities and in oxidized lead, manganese, and iron deposits
- Ore bodies are in Pennsylvanian-Permian Naco Group limestones where fractures intersect or change dip or are parallel to bedding
- Aplite dikes are related to Sugarloaf Quartz Latite Porphyry of Jurassic age

AZ Mining & Mineral Museum MM-M900, Donor Les Presmyk, 18 cm
• Glove mine – Tyndall district - Santa Rita Mountains

• Emerald-Silver Plume, Toughnut mines – Tombstone district

• Total Wreck mine – Empire district - Empire Mts.
Laramide (80-75 Ma) Alkali-Calcic Lead-Zinc-Silver

- Tombstone
- Glove Mine
- Total Wreck

(Empire Mts.)

From Keith & Wilt, 1986
Glove Mine, Tyndall district, Santa Rita Mts.

AZ Mining & Mineral Museum MM-8564, 9 cm, Arthur Bloyd donor
Glove Mine, Santa Rita Mts.

- Alkali-calcic, Lead-Zinc-Silver, Laramide
- Argentiferous galena, sphalerite, small amounts of pyrite, chalcopyrite & quartz
- Deposited in permeable zones at the intersection of a bedding plane fault and favorable beds in Permian Naco Limestone
- Extensive solution of the limestone and deep oxidation concentrated cerussite, anglesite, wulfenite, & smithsonite in the leached caverns as sand carbonate ore
- Worked various times 1911-1972
- Produced 29,260 tons of ore averaging about 22% Pb, 9% Zn, 7 oz Ag/T, 0.3% Cu, minor Au

AZ Mining & Mineral Museum
MM-T554 14 cm

diagram = Olson, 1966, Glove mine, Economic Geology, v. 61, p. 731-743.

Jan C. Rasmussen Ph.D., R.G.
AEG Mar. 29, 2017

www.JanRasmussen.com
Flagg Mineral Foundation 3258 on loan to AZ Mining & Mineral Museum in 2010, 12 cm
Tombstone district,
Tombstone Hills, Cochise County
• Tombstone district
• Alkali-calcic - Laramide
• Lead-Zinc-Silver
• Oxidized, base metal sulfides in replacement ore bodies in lower Cretaceous Bisbee Group
• Along anticlinal rolls and in pipes where rolls are cut by faults
• In NE fissures
• Shaft workings
• Several thousand tons
• Produced Ag ore in late 1800s and early 1900s

Toughnut Mine, AZ
Mining & Mineral Museum MM-T056, donor John Weber, 4 cm


Jan C. Rasmussen Ph.D., R.G.  
AEG Mar. 29, 2017  
www.JanRasmussen.com
Total Wreck Mine, Empire district, Empire Mts., Pima County

Wulfenite, Total Wreck Mine, Empire Mts., 2 in., Les Presmyk sample, Flagg show 2017

Wulfenite, mimetite, Total Wreck Mine, Empire Mts., Pima Co., FOV 7 mm, Michael Cline photo, specimen, www.mindat.org
Alkali-calcic Laramide

Lead-Zinc-Silver

Cerussite, wulfenite, vanadinite, cerargyrite, malachite, azurite, chrysocolla & minor copper & lead sulfides

In irregular replacement ore bodies in badly faulted Permian limestone beds intruded by Laramide diorite stringers & dikes

Shafts & tunnels

Worked from 1880s to 1940, producing some 14,000 tons of ore averaging 8% Pb, 6 oz Ag/T, & minor Au & Cu

Shipped 8 tons of Mo concentrates in 1918.


Wulfenite, Total Wreck Mine, Empire Mts., Pima Co., 2.5 cm, Dennis Tryon collection, www.mindat.org
Alkali-calcic Lead-Zinc-Silver – mid-Tertiary 25-15 Ma

- Red Cloud Mine
- Aravaipa district
- Hilltop mine, Chiricahua Mts.
Red Cloud wulfenite, ~ 2 inches; collected by Rose from Edson-Rose pocket ~ 1972, photo and specimen in collection of Stan Keith

Red Cloud Mine

- Alkali-calcic, mid-Tertiary
- 25-15 Ma, Yuma Co.
- Irregular masses and vug linings of argentiferous lead and zinc carbonates with pyrolusite, vanadinite, wulfenite & minor malachite, nodules of partly altered argentiferous galena, & disseminated masses of silver chloride & bromide in a gangue of iron oxides, quartz, fluorite, calcite, gouge & brecciated wall rock
- Vein occurs in an irregular fault zone between Tertiary andesite breccia, dacite porphyry, rhyolite to dacitic tuffs & lapilli tuffs & Laramide granodiorite to quartz diorite intrusive
- Average grade 5-6% Pb, 10 oz Ag/T
- Shaft operations, 1880s
- total est. prod 21,000 tons ore ave. 18 oz Ag/T and 5.5% Pb and minor Au

AZ Mining & Mineral Museum, MM-T565, 7 cm
Red Cloud Mine, Silver district

AZ Mining & Mineral Museum MM-T274, 9.3 cm, Donors Les & Paula Presmyk

Red Cloud normal fault zone, vertical channels containing wulfenite

Photo by Dick Bideaux

Vanadinite, North Geronimo Mine, AZ Mining & Mineral Museum MM-T567, 9 cm

Vanadinite

$\text{Pb}_5(\text{VO}_4)_3\text{Cl}$

- barrel shaped
- Soft, H=2.75-3
- hexagonal prisms
- Heavy, SG=6.8-7.1
- No cleavage

Table 1. Red Cloud mine wulfenite trace element semiquantitative analysis*

<table>
<thead>
<tr>
<th>Element</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>0.028</td>
</tr>
<tr>
<td>As</td>
<td>ND 0.05</td>
</tr>
<tr>
<td>Mg</td>
<td>0.0052</td>
</tr>
<tr>
<td>Fe</td>
<td>0.0028</td>
</tr>
<tr>
<td>W</td>
<td>0.20</td>
</tr>
<tr>
<td>Ca</td>
<td>0.0031</td>
</tr>
<tr>
<td>Cr</td>
<td>0.0030</td>
</tr>
<tr>
<td>Sr</td>
<td>ND 0.001</td>
</tr>
<tr>
<td>V</td>
<td>ND 0.002</td>
</tr>
<tr>
<td>Other elements</td>
<td>nil</td>
</tr>
</tbody>
</table>

Hilltop Mine, California district, Chiricahua Mts., Cochise County


Jan C. Rasmussen Ph.D., R.G.
Hilltop Mine, Chiricahua Mts.

- Alkali-calcic
- Pb-Zn
- mid-Tertiary
  - Galena, cerussite, sphalerite, wulfenite, & spotty copper oxides and scheelite
  - In fissure veins and in irregular replacement lenses and bodies in banded and tilted, silicified Mississippian to Permian limestones and quartzites
- Extensive workings from several tunnels
- Total of 30,000 tons of base metal sulfide ore produced intermittently from early 1910s to 1954

Jan C. Rasmussen Ph.D., R.G.
AZ Mining & Mineral Museum MM-T549, 11.5 cm
Old Yuma Mine
- ~ 72 Ma
- Amole pluton
- Amole district
- Tucson Mts.

Quartz Alkaline - Laramide

Old Yuma Mine, Amole district, Jim & Gail Spann
Old Yuma Mine, Amole district, Tucson Mts.

- Quartz Alkaline
- Laramide
- Au, Pb, Zn

Wulfenite, owners John & Karen Cesar

Vanadinite, owner Dick Morris
Quartz Alkalic - Mid-Tertiary

- 20-12 Ma
  - Tiger (Mammoth-St. Anthony Mine, Mammoth district, Pinal County)
  - Rowley Mine, Painted Rock district, Maricopa County
  - Red Picacho district (Purple Passion mine) – (date, etc. uncertain)

- Mammoth St. Anthony Mine (Tiger)
- Rowley Mine
- Purple Passion Mine, Red Picacho district
Quartz alkalic –
Pb-Zn-Ag zones
mid-Tertiary

Mohawk shaft, Tiger, Arizona

Collins Cut, Tiger, AZ
Wulfenite, vanadinite, gold in quartz, galena, sphalerite, anglesite, cerussite, and many oxidized minerals.

In west-northwest shear zones intruded by mid-Tertiary (22 Ma) rhyolite, with widest fissure veins occurring in quartz monzonite (Precambrian) that was most intensely shattered and brecciated.

Deposit was oxidized and faulted, then wulfenite and vanadinite were deposited with later oxidation.


Jan C. Rasmussen Ph.D., R.G.
AEG Mar. 29, 2017
Mammoth-St. Anthony Mine (Tiger)

AZ Mining & Mineral Museum, MM-T553, 7 cm, Schultz Cut circa 1880s
Rowley Mine, Painted Rock district, Maricopa County

- Quartz alkalic
- Pb-Zn-Ag zones
- mid-Tertiary 25-13 Ma

Red dot wulfenite, 2.58 mm crystal, Domenico Priete collection, photo Matteo Chinellato, www.mindat.org
• Barite, wulfenite, cerussite, base-metal sulfides, with secondary minerals of cerussite-anglesite suite, wulfenite suite, caledonite suite, and vanadinite suite.

• In northwest fissure veins in mid-Tertiary andesite and rhyolite flows and dikes

• Shipped 130 tons of wulfenite concentrate to California (18.26 % MoO$_3$),

AZ Mining & Mineral Museum, MM-S201, 12.5 cm, Donor James Horner

Wulfenite spicules, 2 mm long, Purple Passion mine, Red Picacho district; Steve Stuart, 2004, www.mindat.org
Calc-alkalic – Later Pb-Zn zones

- Porphyry Copper deposits
  - Chilito, Christmas mine
  - 79 mine
  - Finch mine (S of 79 mine)
  - Grayhorse (Ray area)
  - Silver Bell
  - Twin Buttes
  - Mineral Park

From Keith, 2003, MagmaChem model book

Stage 4 Oxidized Pb-Zn zones of Porphyry Copper deposits

Chilito Mine, Christmas Mine, 79 Mine, Banner district

Owner Stan Keith, 1-2 in.

From Keith & Wilt, 1986, AGS digest

Banner district - Calc-alkalic - "outer"/ later (Stage 4) Pb-Zn zones

Owner Stan Keith,
1-2 in.

• Galena, sphalerite, pyrite, cerussite, with a large variety of secondary minerals

• In permeable zones such as breccias, fractures, and shear zones

• Especially as bedded and vein replacements, in favorable rock types, such as contact metamorphosed Pennsylvanian Naco limestone and silicified rhyolite porphyry dikes of probable Tertiary 62 Ma age

AZ Mining & Mineral Museum, MM-S698, 10.8 cm
Wulfenite, 79 mine, 4\textsuperscript{th} level on main fault, large crystal 1.2 in. on edge, collected by Stan Espenshade, mid 1970s, photo and specimen by Stan Keith.
Finch Mine (Banner district)

- Galena, anglesite, cerussite, with vanadinite, descloizite, and copper carbonates

- In east-northeast striking fissure veins that juxtapose Williamson Canyon volcanics with Pennsylvanian Horquilla Formation

- 3 lots less than 1 ton of Molybdenum-vanadium concentrates produced in 1934

AZ Mining & Mineral Museum, MM-T305, 8.2 cm, Donors Robert & Catherine Sanders
• Good cabinet-sized specimens from the porphyry copper districts are not spectacular specimens that are attractive to most collectors

Wulfenite, Queen Creek/Belmont Mine, Pioneer/Superior district, Pinal Co., 3 in.
Silver Bell Mine, Pima County

Wulfenite under calcite, Silver Bell district, Silver Bell Mts., Pima Co., 7 mm, ex Ray Grant Collection, Chris Whitney-Smith collection & photo, www.mindat.org

Jan C. Rasmussen Ph.D., R.G.

AEG Mar. 29, 2017

www.JanRasmussen.com
Jurassic or Laramide

- Mildren mine, Cababi district
- Vulture Mine
- Gold Basin district
  - Shelby Mine
  - Junction Mine
- Herradura, Mexico
  - Wulfenite is guide to gold

Dipyramidal wulfenite, Shelby Mine, Gold Basin District, Mohave Co., FOV 3 mm, former Phil Partington collection, Rolf Luetcke specimen & photo, www.mindat.org
Wulfenite Formation

- Oxidized zones – supergene zones of Lead-Zinc deposits
- Largest, best specimens are formed in water courses
- Wulfenite is deposited away from the primary ores
  - Examples with thick tabular plates
    - Glove mine,
    - 79 mine,
    - Red Cloud mine
    - Defiance etc. Gleeson Ridge

79 Mine, Banner district

Wulfenite in open space watercourse near main fault, 79 mine, John Callahan photo

Callahan, modified from Keith, 1972, Mineralogy and paragenesis of the 79 Mine lead-zinc-copper deposit: Mineralogical Record, v. 3, no. 4, p. 247-264.
Main fault exposure in wulfenite room, 79 mine, Stan Keith photo

Olson, 1962, Glove mine
Wulfenite Colors

Colors

- Colorless (no impurities)
- Red (Chromate)
- Orange-yellow (Arsenate)
- Yellow (Arsenate)
- Brown (iron?)
- Grey/black (Manganese?)
- Greenish (arsenic-manganese?)

Jan C. Rasmussen Ph.D., R.G.
AEG Mar. 29, 2017
www.JanRasmussen.com
Mineral Associations

- anglesite \( \text{PbSO}_4 \)
- cerussite \( \text{PbCO}_3 \)
- mimetite \( \text{Pb}_5(\text{AsO}_4)_3\text{Cl} \)
- vanadinite \( \text{Pb}_5(\text{VO}_4)_3\text{Cl} \)
- pyromorphite \( \text{Pb}_5(\text{PO}_4)_3\text{Cl} \)
- descloizite \( \text{PbZnVO}_4(\text{OH}) \)
- limonite \( \text{FeO} \cdot (\text{OH}) \cdot n\text{H}_2\text{O} \)
- fornacite \( \text{Pb}_2\text{Cu}(\text{AsO}_4)(\text{CrO}_4)(\text{OH}) \)
- hemimorphite \( \text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot n\text{H}_2\text{O} \)
- smithsonite \( \text{ZnCO}_3 \)
- aurichalcite \( (\text{Zn,Cu})_5(\text{CO}_3)_2(\text{OH})_6 \)
- willemite \( \text{Zn}_2\text{SiO}_4 \)
- dioptase \( \text{Cu}_6(\text{Si}_6\text{O}_{18}) \cdot 6\text{H}_2\text{O} \)
- rosasite \( (\text{Cu,Zn})_2(\text{CO}_3)(\text{OH})_2 \)
- chrysocolla \( (\text{Cu,Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O} \)
- fluorite \( \text{CaF}_2 \)

Cerussite, Mammoth-St. Anthony Mine (Tiger), Pinal County
On loan to AZ Mining & Mineral Museum in 2010 from AMMMF (Flagg Mineral Foundation)

- calcite \( \text{CaCO}_3 \)
- quartz \( \text{SiO}_2 \)
- nevers on molybdenite \( \text{MoS}_2 \)

**Table V: Oxidation of Transported Ions**

Paragenesis in the 79 Breccia System (3rd, 4th and 470 Levels)

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Oxide Deposition</th>
<th>Carbonate Deposition (Zinc Predominant)</th>
<th>Silicate Deposition</th>
<th>Molybdate, etc. Deposition</th>
<th>Carbonate Deposition (Lead Predominant)</th>
<th>Oxide Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MnOxides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melaconite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aurichalcite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malachite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smithsonite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemimorphite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chrysocolla</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hetacrolite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrozincite?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerussite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azurite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosasite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descloizite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wulfenite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyromorphite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murdochite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plattnerite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mimetite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Present</td>
</tr>
</tbody>
</table>

Paragenesis in the Main Fault (4th Level)

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Oxide Deposition</th>
<th>Silicate Deposition</th>
<th>Arsenate, Phosphate, Molybdate, Vanadate Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MnOxides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melaconite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wulfenite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mimetite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanadinite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descloizite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerussite</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
275 wulfenite occurrences in Arizona in www.mindat.org

Nearly all wulfenite occurrences were oxidation products of deposits with primary galena.

No wulfenite found in any primary deposits that contained primary molybdenite (porphyry copper and porphyry molybdenum deposits).

Color is related to impurities installed during early colloidal element/ion diffusion under meteoric conditions.

Best wulfenite specimens are in water courses/large open fillings in Alkali-Calcic and Quartz Alkalic districts away from immediate lead source.

Enough Mo is present as a chemical component of meteoric waters to stabilize wulfenite after oxidation of the lead source (typically after cerussite formation).
Mineralogy:
- Chemical & Physical Characteristics
- Mineralogical Associations

**Geologic Setting:** (age of primary deposit – wulfenite later)
- Alkali-calcic – lead-zinc-silver districts (Stage 3 and 4)
  - **Jurassic** – 170-160 Ma – Defiance, Silver Bill
  - **Laramide** – 85 - 65 Ma - Glove
  - **mid-Tertiary** – 30-20 Ma – Red Cloud
- Calc-alkalic – in later, outer Pb-Zn-Ag zones (Stage 4)
  - Laramide porphyry copper - 75-60 Ma – 79 Mine
- Quartz alkalic – in Pb-Zn-Ag zones with stage 4 rhyolites
  - **Jurassic** - Bisbee
  - **Laramide** - **Old Yuma**
  - **mid-Tertiary** - **Tiger, Rowley**
- Peraluminous calcic
  - Laramide – Gold Basin
- Peraluminous calc-alkalic
  - Precambrian

**Paragenesis** - Oxidized zones, water courses