

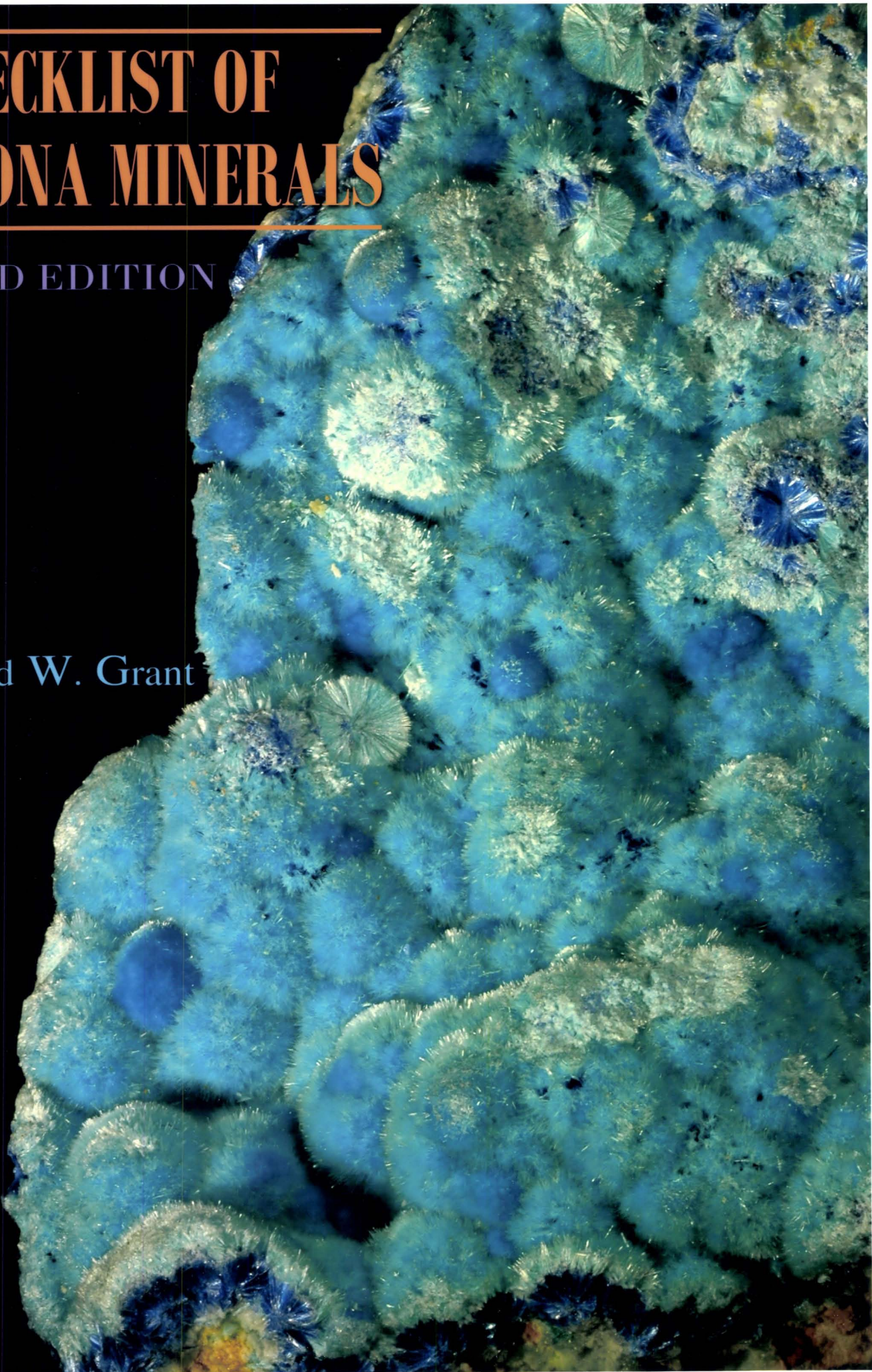
---

☑ **CHECKLIST OF  
ARIZONA MINERALS**

---

SECOND EDITION

Raymond W. Grant





## Introduction

The third edition of *Mineralogy of Arizona* was published in 1995 (Anthony et al., 1995). It had descriptions of about 808 minerals found in Arizona. In the twelve years since then 61 more minerals have been reported from Arizona, a number of minerals have been discredited, and some minerals have had a name change.

This checklist is an effort to bring the Arizona mineral list up to date. Of the 61 minerals added to the list, six are new minerals with the type locality being in Arizona. They are: bechererite from the Tonopah-Belmont mine, Maricopa County; calcioaravaipate from the Grand Reef mine, Graham County; carmichaelite from Garnet Ridge, Apache County; shannonite from the Grand Reef mine, Graham County; wupatkiite from near Gray Mountain, Coconino County, and grandviewite from the Grandview mine, Coconino County. A few of the additional minerals were cited in references before 1995, but were missed in the previous literature search. They include annabergite, meionite, molybdate, pyrochlore, soddyite, straczekite, and wagnerite. The remainder of the minerals added to this list is the result of scientific studies and of collectors having new material identified.

The format used here is similar to that used in Anthony et al., 1995:

**ACANTHITE**---Names in bold capital letters indicate mineral species found in Arizona. The species list was compiled from Mandarino and Back - *Fleischer's Glossary of Mineral Species* (2004), Burke (2007), the International Mineralogical Association website ([www.geo.vu.nl/~ima-cnmmn/MINERALlist.pdf](http://www.geo.vu.nl/~ima-cnmmn/MINERALlist.pdf)), and other recent publications. The IMA has a mineral category "grandfathered" for which the original description preceded the establishment of the nomenclature committee, but they are generally regarded as valid species. Fleischer's glossary lists many of the grandfathered minerals but not all of them. The grandfathered minerals have been included in this list. The formula for the mineral and the page number in the third edition of *Mineralogy of Arizona* are given for each entry.

The first edition of the checklist included the physical properties of the minerals; they have not been included here and the reader is referred to the many references and Internet sites available. The chemistry has been included, as it is useful to see the relationship among different minerals and can be useful in understanding the occurrence of the minerals. A description of additional localities for some minerals previously found at only one locality in Arizona is also given. Some species were added that were included in groups in the third edition, such as albite. In some cases there is not enough data about the chemistry of the mineral to give the exact species. For example there is Jahnsite-(CaMnFe), Jahnsite-(CaMnMg) and Jahnsite-(CaMnMn). Since we don't know which species was found in Arizona, Jahnsite is listed as the mineral. Table 1 is a list of the species from Arizona where the exact species is not known at present.

Table 1. Arizona minerals for which the exact species is not known.

Erionite	Gadolinite	Parisite
Chabazite	Gmelinite	Phillipsite
Clinoptilite	Heulandite	Pumpellyite
Domeykite	Jahnsite	Stilbite
Fergusonite	Levyne	Tantalite
Ferrierite	Monazite	

The chemical formula for the minerals in table 1 is given as a general formula or a possible formula.

When there has been a name change, the old name is given in lower case letters and the new name follows in capital letters. The page number given with the new name is that for the description in the third edition under the old name.

Jeromite ---Names in lower case indicate that the mineral (or substance) is not a distinct species. It may have been discredited since 1995, had a name change, or may be a variety. Also included are some obsolete and generally discarded varietal names (e.g., ripidolite) that were included in the third edition to assist the interested reader in interpreting older literature. Other examples of obsolete names are among the apatite, amphibole, chlorite, and kaolinite-serpentine groups. Some names such as bisbeeite that have not been accepted as distinct species are listed because of historical interest.

\***GRANDREEFITE**---Names in bold capital letters and preceded by an \* are minerals added to the Arizona mineral list since the revised third edition of *Mineralogy of Arizona* was published in 1995. The descriptions used for the additional minerals follows that used in the third edition. If there is no reference given for the locality information both in this checklist and in the third edition, then the information was supplied by one of the authors of the third edition.

This list contains 863 valid species reported from Arizona.

### **Acknowledgements**

Thanks to the many people who have contributed to this project. The following have contributed to this list: John Reeve suggested the format used. Richard Bideaux, Robert Downs, Kyle Eastman, M.S. Enders, Richard Graeme, Pat Haynes, Bill Hunt, Robert Jenkins, Joe Marty, Jim McGlasson, Tony Nikishire, Joe Ruiz, Mike Shannon, Dick Thomssen, Shirley Wetmore, Peter Williams, and Sid Williams contributed information about minerals and localities. Harvey Jong did the cover photograph. George Godas reviewed the manuscript.

It is hoped that more information can be added to this list in the future. Please send corrections and additions of mineral and locality information to Ray Grant at email-[raycyn@cox.net](mailto:raycyn@cox.net) or to 530 E. Hunt hwy, Ste. 103, PMB 425, Queen Creek, AZ 85243.

## Mineral Species Found in Arizona

### \*ABERNATHYITE

Potassium uranyl arsenate hydrate,  $K_2(UO_2)_2(AsO_4)_2 \cdot 8H_2O$ . A secondary mineral found in sandstone uranium deposits on the Colorado Plateau.

*Coconino County*: near Tuba City (Anthony et al., 2000).

<b>ACANTHITE</b> $Ag_2S$	p. 100
Acmite see AEGIRINE	
<b>ACTINOLITE</b> $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	p. 101
<b>ADAMITE</b> $Zn_2(AsO_4)(OH)$	p. 102
Adularia a variety of ORTHOCLASE	
<b>AEGIRINE</b> $NaFeSi_2O_6$	p. 102
<b>AENIGMATITE</b> $Na_2(Fe_5Ti)Si_6O_{20}$	p. 102
Agate see QUARTZ	
<b>AIKINITE</b> $PbCuBiS_3$	p. 102
<b>AJOITE</b> $(K,Na)Cu_7AlSi_9O_{24}(OH)_6 \cdot 3H_2O$	p. 103
<b>AKAGANÉITE</b> $\beta-Fe_8(OH,O,Cl)_{17}$	p. 103
<b>ALABANDITE</b> $MnS$	p. 103
<b>ALAMOSITE</b> $PbSiO_3$	p. 104
<b>ALBITE</b> $NaAlSi_3O_8$ : listed under plagioclase in 3 <sup>rd</sup> edition	p. 329
<b>ALLANITE-(Ce)</b> $(Ca,Ce,La)_2(Al,Fe)_3(SiO_4)_3(OH)$	p. 104
<b>ALLOCLASITE</b> $(Co,Fe)AsS$	p. 105
<b>ALLOPHANE</b> $Al_2SiO_5 \cdot H_2O$	p. 105
<b>ALMANDINE</b> $Fe_3Al_2(SiO_4)_3$	p. 105
<b>ALTAITE</b> $PbTe$	p. 106
<b>ALUNITE</b> $KAl_3(SO_4)_2(OH)_6$	p. 106
<b>ALUNOGEN</b> $Al_2(SO_4)_3 \cdot 17H_2O$	p. 107
<b>AMBLYGONITE</b> $(Li,Na)Al(PO_4)(F,OH)$	p. 108
<b>AMESITE</b> $(Mg,Al)_3(Si,Al)O_5(OH)_4$	p. 108
Amethyst see QUARTZ	
Amphibole is a group name	
<b>ANALCIME</b> $NaAlSi_2O_6 \cdot H_2O$	p. 108
<b>ANATASE</b> $TiO_2$	p. 109
<b>ANDALUSITE</b> $Al_2SiO_5$	p. 109
<b>ANDERSONITE</b> $Na_2Ca(UO_2)(CO_3)_3 \cdot 6H_2O$	p. 110
<b>ANDRADITE</b> $Ca_3Fe_2(SiO_4)_3$	p. 111
<b>ANGLESITE</b> $PbSO_4$	p. 112
<b>ANHYDRITE</b> $CaSO_4$	p. 113



**\* ANILITE**

Copper sulfide,  $\text{Cu}_7\text{S}_4$ . A primary or supergene copper sulfide found with other copper sulfides.

*Greenlee County*: found in the supergene alteration zone at Morenci with pyrite and chalcopyrite (M.S. Enders, Phelps Dodge Corp., pers. commun., 2001).

**ANKERITE**  $\text{Ca}(\text{Fe},\text{Mg},\text{Mn})(\text{CO}_3)_2$  p. 113

**\* ANNABERGITE**

Nickel arsenate hydrate,  $\text{Ni}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$ . A rare secondary nickel mineral formed from primary nickel arsenide minerals in hydrothermal deposits.

*Yavapai County*: Monte Cristo mine, as an alteration of nickeline and skutterudite (Bastin, 1922).

**ANORTHITE**  $\text{CaAl}_2\text{Si}_2\text{O}_8$  listed under plagioclase in 3<sup>rd</sup> edition p. 329

**ANORTHOCLASE**  $(\text{Na},\text{K})\text{AlSi}_3\text{O}_8$  p. 114

**ANTHONYITE**  $\text{Cu}(\text{OH},\text{Cl})_2 \cdot 3\text{H}_2\text{O}$  p. 114

**ANTHOPHYLLITE**  $\text{Mg}_7\text{Si}_8\text{O}_{22}(\text{OH})_2$  p. 114

**ANTIGORITE**  $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$  listed under serpentine p. 367

**ANTLERITE**  $\text{Cu}_3(\text{SO}_4)(\text{OH})_4$  p. 115

**APACHITE**  $\text{Cu}_9\text{Si}_{10}\text{O}_{29} \cdot 11\text{H}_2\text{O}$  p. 116

Apatite see FLUORAPATITE, HYDROXYLAPATITE

Apophyllite see FLUORAPOPHYLLITE, HYDROXYAPOPHYLLITE,  
CHLORAPATITE

**ARAGONITE**  $\text{CaCO}_3$  p. 118

**ARAVAIPATE**  $\text{Pb}_3\text{AlF}_9 \cdot \text{H}_2\text{O}$  p. 118

Argentite see ACANTHITE

**ARGENTOJAROSITE**  $\text{AgFe}_3(\text{SO}_4)_2(\text{OH})_6$  p. 119

Arizonite not considered a valid species (see appendix 3) p. 119

**ARSENIC** As p. 119

**ARSENIOSIDERITE**  $\text{CaFe}_3(\text{AsO}_4)_3\text{O}_2 \cdot 3\text{H}_2\text{O}$  p. 119

**ARSENOLITE**  $\text{As}_2\text{O}_3$  p. 120

**ARSENOPYRITE**  $\text{FeAsS}$  p. 120

Arsenosulvanite see COLUSITE p. 120

**ARTROEITE**  $\text{PbAlF}_3(\text{OH})_2$  p. 120

Asbestos see ANTIGORITE, LIZARDITE, CHRYSOTILE

Attapulgitite see PALYGORSKITE

**ATACAMITE**  $\text{Cu}_2\text{Cl}(\text{OH})_3$  p. 121

**AUGELITE**  $\text{Al}_2(\text{PO}_4)(\text{OH})_3$  p. 122

**AUGITE**  $(\text{Ca},\text{Na})(\text{Mg},\text{Fe},\text{Al},\text{Ti})(\text{Si},\text{Al})_2\text{O}_6$  p. 122

**AURICHALCITE**  $(\text{Zn},\text{Cu})_5(\text{CO}_3)_2(\text{OH})_6$  p. 122

**AURORITE** (Mn,Ag,Ca)Mn<sub>3</sub>O<sub>7</sub>·3H<sub>2</sub>O p. 123

**AUSTINITE** CaZn(AsO<sub>4</sub>)(OH)

*Cochise County*: Warren district, Southwest mine, 7<sup>th</sup> level; A small open cut on the surface near the Hendricks Gulch portal to this level contained a few specimens that had a crust of 0.1 mm tan to colorless crystals on silica breccia fragments. These crystals were partially overgrown by 0.25 mm gray-green to deep green crystals of cuprian-austinite. Pyrolusite was associated with this occurrence (R.W. Graeme, pers. commun., 2007). p. 124

**AUTUNITE** Ca(UO<sub>2</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>·10-12H<sub>2</sub>O p. 124

Axinite see MANGANAXINITE AND TINZENITE

**AZURITE** Cu<sub>3</sub>(CO<sub>3</sub>)<sub>2</sub>(OH)<sub>2</sub> p. 125

**BARITE** BaSO<sub>4</sub> p. 127

**BARRINGERITE** (Fe,Ni)<sub>2</sub>P p. 129

Basaluminite see FELSOBANYAITE p. 129

**BASSANITE** 2CaSO<sub>4</sub>·H<sub>2</sub>O p. 130

**BASSETITE** Fe(UO<sub>2</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>·8H<sub>2</sub>O p. 130

**BAYLDONITE** PbCu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>(OH)<sub>2</sub> p. 130

**BAYLEYITE** Mg<sub>2</sub>(UO<sub>2</sub>)(CO<sub>3</sub>)<sub>3</sub>·18H<sub>2</sub>O p. 130

**BEAVERITE** Pb(Fe,Cu)<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>(OH,H<sub>2</sub>O)<sub>6</sub> p. 131

**\* BECHERERITE**

Zinc copper hydroxide sulfate silicate, Zn<sub>7</sub>Cu(OH)<sub>13</sub>[SiO(OH)<sub>3</sub>SO<sub>4</sub>]. A secondary mineral from the oxidized zone of a basemetal deposit. The Arizona occurrence is the type locality.

*Maricopa County*: found on the dumps of the Tonopah-Belmont mine with willemite, rosasite, smithsonite, paratacamite and boleite (Giester and Rieck, 1996).

**BECQUERELITE** Ca(UO<sub>2</sub>)<sub>6</sub>O<sub>4</sub>(OH)<sub>6</sub>·8H<sub>2</sub>O p. 131

**BEIDELLITE** (Na,Ca<sub>0.5</sub>)<sub>0.3</sub>Al<sub>2</sub>(Si,Al)<sub>4</sub>O<sub>10</sub>(OH)<sub>2</sub>·nH<sub>2</sub>O p. 131

**BEMENTITE** Mn<sub>7</sub>Si<sub>6</sub>O<sub>15</sub>(OH)<sub>8</sub> p. 132

**BERLINITE** AlPO<sub>4</sub> p. 132

**BERMANITE** MnMn<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>(OH)<sub>2</sub>·4H<sub>2</sub>O p. 132

**BERTRANDITE** Be<sub>4</sub>Si<sub>2</sub>O<sub>7</sub>(OH)<sub>2</sub> p. 133

**BERYL** Be<sub>3</sub>Al<sub>2</sub>Si<sub>6</sub>O<sub>18</sub> p. 133

**BEUDANTITE** PbFe<sub>3</sub>[(As,S)O<sub>4</sub>]<sub>2</sub>(OH,H<sub>2</sub>O)<sub>6</sub> p. 134

**BEYERITE** (Ca,Pb)Bi<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>O<sub>2</sub> p. 135

**BIANCHITE** Zn(SO<sub>4</sub>)·6H<sub>2</sub>O p. 135

**BIDEAUXITE** Pb<sub>2</sub>AgCl<sub>3</sub>F(OH) p. 135

**BIEBERITE** CoSO<sub>4</sub>·7H<sub>2</sub>O p. 136



<b>BILINITE</b> $\text{Fe}_3(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$	p. 136
<b>BINDHEIMITE</b> $\text{Pb}_2\text{Sb}_2\text{O}_6(\text{O},\text{OH})$	p. 136
<b>BIOTITE</b> $\text{K}(\text{Mg},\text{Fe})_3(\text{Al},\text{Fe})\text{Si}_3\text{O}_{10}(\text{OH},\text{F})_2$	p. 136
<b>BIRNESSITE</b> $(\text{Na},\text{Ca})_{0.5}\text{Mn}_2\text{O}_4 \cdot 1.5\text{H}_2\text{O}$	p. 137
Bisbeeite not considered to be a valid species (see appendix 3)	p. 137
<b>BISMITE</b> $\text{Bi}_2\text{O}_3$	p. 138
<b>BISMUTH</b> Bi	p. 138
<b>BISMUTHINITE</b> $\text{Bi}_2\text{S}_3$	p. 139
<b>BISMUTITE</b> $(\text{BiO})_2\text{CO}_3$	p. 139
<b>BIXBYITE</b> $(\text{Mn},\text{Fe})_2\text{O}_3$	p. 140
<b>BLÖDITE</b> $\text{Na}_2\text{Mg}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$	p. 140
<b>BOGDANOVITE</b> $(\text{Au},\text{Te},\text{Pb})_3(\text{Cu},\text{Fe})$	p. 140
<b>BÖHMITE</b> $\text{AlO}(\text{OH})$	p. 140
<b>BOKITE</b> $\text{KAl}_3\text{Fe}_6\text{V}_6\text{V}_{20}\text{O}_{76} \cdot 15\text{H}_2\text{O}$	p. 140
<b>BOLÉITE</b> $\text{KPb}_{26}\text{Cu}_{24}\text{Ag}_9\text{Cl}_{62}(\text{OH})_{48}$	p. 141
<b>BOLTWOODITE</b> $\text{HK}(\text{UO}_2)\text{SiO}_4 \cdot 1.5\text{H}_2\text{O}$	p. 141

**\*BONATTITE**

Copper sulfate hydrate,  $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$ . A post-mining mineral formed from the decomposition of copper-bearing minerals.

*Graham County*: Grand Reef mine as coatings on a wall in the underground workings. (R.T. Downs, pers. commun., 2005).

**\* BOOTHITE**

Copper sulfate hydrate,  $\text{CuSO}_4 \cdot 7\text{H}_2\text{O}$ . An uncommon post-mining mineral formed as the result of the decomposition of copper-bearing minerals in a humid environment.

*Cochise County*: Warren district, Southwest mine, 7th level where it is found as centimeter-wide clusters of light blue radiating acicular crystals. It also occurs as small granular masses composed of 1 to 2 mm crystals (R.W. Graeme, pers. commun., 2004).

<b>BORNITE</b> $\text{Cu}_5\text{FeS}_4$	p. 141
<b>BOTALLACKITE</b> $\text{Cu}_2\text{Cl}(\text{OH})_3$	p. 143
<b>BOTRYOGEN</b> $\text{MgFe}(\text{SO}_4)_2(\text{OH}) \cdot 7\text{H}_2\text{O}$	p. 143
<b>BOULANGERITE</b> $\text{Pb}_5\text{Sb}_4\text{S}_{11}$	p. 143
<b>BOURNONITE</b> $\text{PbCuSbS}_3$	p. 143
<b>BRACKEBUSCHITE</b> $\text{Pb}_2\text{Mn}(\text{VO}_4)_2(\text{OH})$	p. 144
<b>BRANNERITE</b> $(\text{U},\text{Ca},\text{Y},\text{Ce})(\text{Ti},\text{Fe})_2\text{O}_6$	p. 144
<b>BRAUNITE</b> $\text{MnMn}_6\text{SiO}_{12}$	p. 144
Braunite II not considered a valid species	p. 145
<b>BRAZILIANITE</b> $\text{NaAl}_3(\text{PO}_4)_2(\text{OH})_4$	p. 145

<b>BREZINAITE</b> $\text{Cr}_3\text{S}_4$	p. 145
<b>BROCHANTHITE</b> $\text{Cu}_4\text{SO}_4(\text{OH})_6$	p. 146
<b>BROCKITE</b> $(\text{Ca,Th,Ce})(\text{PO}_4)\cdot\text{H}_2\text{O}$	p. 147
<b>BROMARGYRITE</b> $\text{AgBr}$	p. 147
Bronzite see ENSTATITE	
<b>BROOKITE</b> $\text{TiO}_2$	p. 148
<b>BRUCITE</b> $\text{Mg}(\text{OH})_2$	p. 148

**\* BRUSHITE**

Calcium hydrogen phosphate hydrate,  $\text{CaHPO}_4\cdot 2\text{H}_2\text{O}$ . Found as a cave mineral forming from organic material such as bat guano.

*Cochise County*: found at Kartchner Caverns southwest of Benson. In the Big Room it forms large masses over 2 m long, 0.3 m wide, and 6 cm thick. It is forming from solutions beneath a fresh bat guano pile (Hill, 1999).

Bursaite is a mixture of two minerals p. 148

**\*BUSTAMITE**

Calcium manganese silicate,  $(\text{Ca,Mn})_3\text{Si}_3\text{O}_9$ . Formed by the metamorphism of rocks rich in manganese.

*Yavapai County*: found near Tower Mountain, near Crown King. It occurs as white balls of radiating crystals up to 3 mm in size as inclusions in Quartz crystals (Kyle Eastman, pers. commun., 2007).

<b>BUTLERITE</b> $\text{Fe}(\text{SO}_4)(\text{OH})\cdot 2\text{H}_2\text{O}$	p. 149
<b>BÜTSCHLIITE</b> $\text{K}_2\text{Ca}(\text{CO}_3)_2$	p. 149

**BUTTGENBACHITE**  $\text{Cu}_{19}(\text{NO}_3)_2\text{Cl}_4(\text{OH})_{32}\cdot 2\text{H}_2\text{O}$

*Cochise County*: Warren district, Cole mine, Buttgenbachite was identified in a sample from this mine, which had previously been identified as connellite (Hibbs, et al. 2002, 2003). Czar mine; a single specimen of massive cuprite from an undocumented level in this mine contained buttgenbachite in very small amounts as tight clusters of radiating crystals.

Lowell mine; several specimens labeled as connellite have been shown to be buttgenbachite. It occurs as radiating, bright blue masses in massive cuprite with brochantite, and malachite (R.W. Graeme, pers. commun., 2007). p. 149

<b>CACOXINITE</b> $\text{AlFe}_{24}(\text{PO}_4)_{17}\text{O}_6(\text{OH})_{12}\cdot n\text{H}_2\text{O}$ ( $n\sim 75$ )	p. 150
<b>CALAVERITE</b> $\text{AuTe}_2$	p. 150

**\* CALCIOARAVAIPAITE**



Lead calcium aluminum fluoride hydroxide,  $\text{PbCa}_2\text{Al}(\text{F},\text{OH})_9$ . A secondary mineral found with other lead and aluminum fluorides, sulfates, and hydroxides. The Arizona occurrence is the type locality.

*Graham County*: found at the Grand Reef mine on a single specimen in a quartz vug with artroeite and anglesite (Kampf and Foord, 1996).

Calciovolborthite see TANGEITE	p. 150
<b>CALCITE</b> $\text{CaCO}_3$	p. 151
<b>CALEDONITE</b> $\text{Pb}_5\text{Cu}_2(\text{CO}_3)(\text{SO}_4)_3(\text{OH})_6$	p. 153
<b>CALOMEL</b> $\text{Hg}_2\text{Cl}_2$	p. 153
<b>CANFIELDITE</b> $\text{Ag}_8\text{SnS}_6$	p. 153
<b>CANNIZZARITE</b> $\text{Pb}_{46}\text{Bi}_{54}\text{S}_{127}$	p. 154

**CARBONATE-CYANOTRICHITE**  $\text{Cu}_4\text{Al}_2(\text{CO}_3,\text{SO}_4)(\text{OH})_{12}\cdot 2\text{H}_2\text{O}$ .

*Coconino County*: Grandview mine, Grand Canyon National Park (Peter Williams, pers. commun., 2006).

p. 154

**CARBONATE-FLUORAPATITE**  $\text{Ca}_5(\text{PO}_4,\text{CO}_3)_3(\text{F},\text{OH})$  p. 154

**CARLSBERGITE**  $\text{CrN}$  p. 154

#### \* **CARMICHAELITE**

Titanium chromium oxide hydroxide,  $(\text{Ti},\text{Cr})\text{O}_{1.5}(\text{OH})_{0.5}$ . Found as inclusions in pyrope from an ultramafic diatreme. Garnet Ridge, Arizona is the type locality.

*Apache County*: from an ultramafic diatreme at Garnet Ridge on the Navajo Reservation. It occurs as inclusions in pyrope crystals in concentrates collected from the surface. These pyropes also contain rutile, srilankite, spinel, minerals of the crichtonite group, and olivine (Wang et al., 2000).

**CARNALLITE**  $\text{KMgCl}_3\cdot 6\text{H}_2\text{O}$  p. 154

**CARNOTITE**  $\text{K}_2(\text{UO}_2)_2(\text{VO}_4)_2\cdot 3\text{H}_2\text{O}$  p. 155

**CASSITERITE**  $\text{SnO}_2$  p. 155

**CELADONITE**  $\text{KFe}(\text{Mg},\text{Fe})\text{Si}_4\text{O}_{10}(\text{OH})_2$  p. 156

**CELESTINE**  $\text{SrSO}_4$  p. 156

**CELSIAN**  $\text{BaAl}_2\text{Si}_2\text{O}_8$  p. 157

Cerargyrite see CHLORARGYRITE

**CERUSSITE**  $\text{PbCO}_3$  p. 157

**CERVANTITE**  $\text{Sb}_2\text{O}_4$  p. 159

**CESÀROLITE**  $\text{PbH}_2\text{Mn}_3\text{O}_8$  p. 159

**CESBRONITE**  $\text{Cu}_3\text{TeO}_6\cdot 2\text{H}_2\text{O}$  p. 159

**CHABAZITE**  $\text{Ca}_2(\text{Al}_4\text{Si}_8\text{O}_{24})\cdot 13\text{H}_2\text{O}$  p. 159

**CHALCANTHITE**  $\text{CuSO}_4\cdot 5\text{H}_2\text{O}$  p. 160

Chalcedony see QUARTZ

<b>CHALCOALUMITE</b> $\text{CuAl}_4(\text{SO}_4)(\text{OH})_{12}\cdot 3\text{H}_2\text{O}$	p. 161
<b>CHALCOCITE</b> $\text{Cu}_2\text{S}$	p. 162
<b>CHALCOMENITE</b> $\text{CuSeO}_3\cdot 2\text{H}_2\text{O}$	p. 164
<b>CHALCOPHANITE</b> $(\text{Zn,Fe,Mn})\text{Mn}_3\text{O}_7\cdot 3\text{H}_2\text{O}$	p. 164
<b>CHALCOPHYLLITE</b> $\text{Cu}_9\text{Al}[(\text{AsO}_4)_2(\text{SO}_4)_{1.5}(\text{OH})_{12}]\cdot 18\text{H}_2\text{O}$	p. 165
<b>CHALCOPYRITE</b> $\text{CuFeS}_2$	p. 165
<b>CHALCOSIDERITE</b> $\text{CuFe}_6(\text{PO}_4)_4(\text{OH})_8\cdot 4\text{H}_2\text{O}$	p. 167
<b>CHAMOSITE</b> $(\text{Fe,Al,Mg})_6(\text{Si,Al})_4\text{O}_{10}(\text{OH})_8$	p. 167
<b>CHENEVIXITE</b> $\text{Cu}_2\text{Fe}_2(\text{AsO}_4)_2(\text{OH})_4\cdot \text{H}_2\text{O}$	p. 168
Chert see QUARTZ	
<b>CHEVKINITE-(Ce)</b> $(\text{Ce,La,Ca,Na,Th})_4(\text{Fe,Mg})_2(\text{Ti,Fe})_3\text{Si}_4\text{O}_{22}$	p. 168
<b>CHLORAPATITE</b> $\text{Ca}_5(\text{PO}_4)_3\text{Cl}$	p. 168
<b>CHLORARGYRITE</b> $\text{AgCl}$	p. 169
Chlorite is a group name	
<b>CHLORITOID</b> $(\text{Fe,Mg,Mn})_2\text{Al}_4\text{Si}_2\text{O}_{10}(\text{OH})_4$	p. 171
<b>CHOLOALITE</b> $\text{CuPb}(\text{TeO}_3)_2$	p. 171
<b>CHONDRODITE</b> $(\text{Mg,Fe})_5(\text{SiO}_4)_2(\text{F,OH})_2$	p. 171
<b>CHROMITE</b> $\text{FeCr}_2\text{O}_4$	p. 171
<b>CHRYSOBERYL</b> $\text{BeAl}_2\text{O}_4$	p. 172
<b>CHRYSOCOLLA</b> $(\text{Cu,Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4\cdot n\text{H}_2\text{O}$	p. 172

**CHRYSOTILE**  $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$  listed under Clinochrysotile and Serpentine  
p. 177, p. 367

<b>CINNABAR</b> $\text{HgS}$	p. 174
<b>CLARINGBULLITE</b> $\text{Cu}_4\text{Cl}[(\text{OH}),\text{Cl}](\text{OH})_6$	p. 175
<b>CLAUDETITE</b> $\text{As}_2\text{O}_3$	p. 175
<b>CLAUSTHALITE</b> $\text{PbSe}$	p. 176

Cliftonite is a variety of GRAPHITE

**\*CLINOATACAMITE** – Copper chloride hydroxide,  $\text{Cu}_2\text{Cl}(\text{OH})_3$ .

A mineral formed with other secondary minerals in the oxide zone of copper deposits. All four copper chloride hydroxide polymorphs, atacamite, botallackite, clinoparatacamite, and paratacamite, are found in Arizona.

*Cochise County*: Warren district, Southwest mine, 14 stope, 5<sup>th</sup> level, a number of 2mm, prismatic and orthorhombic appearing crystals were found in vugs in massive cuprite from this locality. They were associated with superb claringbullite and connellite as well as atacamite and what appears to be larger crystals of paratacamite (R. W. Graeme, pers. commun., 2007).

<b>CLINOBIENVANITE</b> $\text{BiVO}_4$	p. 176
<b>CLINOCHLORE</b> $(\text{Mg,Al})_6(\text{Si,Al})_4\text{O}_{10}(\text{OH})_8$	p. 176
Clinochrysotile see CHRYSOTILE	p. 177



<b>CLINOCLASE</b> $\text{Cu}_3(\text{AsO}_4)(\text{OH})_3$	p. 177
<b>CLINOHEDRITE</b> $\text{CaZnSiO}_4 \cdot \text{H}_2\text{O}$	p. 177
<b>CLINOHUMITE</b> $(\text{Mg,Fe})_9(\text{SiO}_4)_4(\text{F,OH})_2$	p. 177
<b>CLINOPTILOLITE</b> $(\text{Na,K,Ca})_{2-3}\text{Al}_3(\text{Al,Si})_2\text{Si}_{13}\text{O}_{36} \cdot 12\text{H}_2\text{O}$	p. 178
<b>CLINOZOISITE</b> $\text{Ca}_2\text{Al}_3\text{Si}_3\text{O}_{12}(\text{OH})$	p. 179
<b>CLINTONITE</b> $\text{CaMg}_2\text{Al}_4\text{SiO}_{10}(\text{OH})_2$	p. 179
<b>COBALTITE</b> $\text{CoAsS}$	p. 179
<b>COCONINOITE</b> $\text{Fe}_2\text{Al}_2(\text{UO}_2)_2(\text{PO}_4)_4(\text{SO}_4)(\text{OH})_2 \cdot 20\text{H}_2\text{O}$	p. 180
<b>COESITE</b> $\text{SiO}_2$	p. 180
<b>COFFINITE</b> $\text{U}(\text{SiO}_4)_{1-x}(\text{OH})_{4x}$	p. 181
<b>COHENITE</b> $(\text{Fe,Ni,Co})_3\text{C}$	p. 181
<b>COLEMANITE</b> $\text{CaB}_3\text{O}_4(\text{OH})_3 \cdot \text{H}_2\text{O}$	p. 181
Columbite see FERROCOLUMBITE	
<b>COLUSITE</b> $\text{Cu}_{26}\text{V}_2(\text{As,Sn,Sb})_6\text{S}_{32}$	p. 182, p. 120
<b>CONICALCITE</b> $\text{CaCu}(\text{AsO}_4)(\text{OH})$	p. 182
<b>CONNELLITE</b> $\text{Cu}_{19}(\text{SO}_4)\text{Cl}_4(\text{OH})_{32} \cdot 3\text{H}_2\text{O}$	p. 183
<b>COOKEITE</b> $\text{LiAl}_4(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$	p. 184
<b>COPIAPITE</b> $\text{FeFe}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$	p. 184
<b>COPPER</b> $\text{Cu}$	p. 184
<b>COQUIMBITE</b> $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$	p. 186
<b>CORDIERITE</b> $\text{Mg}_2\text{Al}_4\text{Si}_5\text{O}_{18}$	p. 186
<b>CORKITE</b> $\text{PbFe}_3[(\text{P,S})\text{O}_4]_2(\text{OH,H}_2\text{O})_6$	p. 187
<b>CORNETITE</b> $\text{Cu}_3(\text{PO}_4)(\text{OH})_3$	p. 187
<b>CORNUBITE</b> $\text{Cu}_5(\text{AsO}_4)_2(\text{OH})_4$	p. 187
Cornuite not a valid species	p. 187
<b>CORNWALLITE</b> $\text{Cu}_5(\text{AsO}_4)_2(\text{OH})_4$	p. 188
<b>CORONADITE</b> $\text{Pb}(\text{Mn})_8\text{O}_{16}$	p. 188
<b>CORRENSITE</b> interstratification of chlorite and vermiculite	p. 189
<b>CORUNDUM</b> $\text{Al}_2\text{O}_3$	p. 189
<b>CORVUSITE</b> $(\text{Na,Ca,K})(\text{V,V,Fe})_8\text{O}_{20} \cdot 4\text{H}_2\text{O}$	p. 189
<b>COSALITE</b> $\text{Pb}_2\text{Bi}_2\text{S}_5$	p. 189
<b>COTUNNITE</b> $\text{PbCl}_2$	p. 190
<b>COVELLITE</b> $\text{CuS}$	p. 190
<b>COWLESITE</b> $\text{Ca}(\text{Al}_2\text{Si}_3\text{O}_{10}) \cdot 5.3\text{H}_2\text{O}$	p. 191
<b>CRANDALLITE</b> $\text{CaAl}_3(\text{PO}_4)_2(\text{OH,H}_2\text{O})_6$	p. 191
<b>CREASEYITE</b> $\text{Cu}_2\text{Pb}_2\text{Fe}_2\text{Si}_5\text{O}_{17} \cdot 6\text{H}_2\text{O}$	p. 191
<b>CREDNERITE</b> $\text{CuMnO}_2$	p. 192

**CREEDITE** –  $\text{Ca}_3\text{Al}_2(\text{SO}_4)(\text{OH})_2\text{F}_8 \cdot 2\text{H}_2\text{O}$ . *Graham County*: Iron Cap mine, near Landsman Camp as small clear crystal groups up to 3 mm. on johannsenite (Mike Shannon, pers. commun., 2006).

p. 192

### \*CRICHTONITE

Strontium rare earth titanium oxide,  $(\text{Sr}, \text{La}, \text{Ce}, \text{Y})(\text{Ti}, \text{Fe}, \text{Mn})_{21}\text{O}_{38}$ . Usually found in Alpine fissure veins.

*Apache County*: found in an ultramafic diatreme at Garnet Ridge on the Navajo Reservation as inclusions in pyrope with srilankite, carichaelite, rutile, and a number of other minerals (Wang et al. 1999).

<b>CRISTOBALITE</b> $\text{SiO}_2$	p. 192
Crocidolite see RIEBECKITE	
<b>CROCOITE</b> $\text{PbCrO}_4$	p. 193
<b>CRONSTEDTITE</b> $\text{Fe}_2\text{Fe}(\text{Si}, \text{Fe})\text{O}_5(\text{OH})_4$	p. 194
<b>CRYPTOMELANE</b> $\text{K}(\text{Mn}, \text{Mn})_8\text{O}_{16}$	p. 194
<b>CUBANITE</b> $\text{CuFe}_2\text{S}_3$	p. 195
<b>CUMMINGTONITE</b> $\text{Mg}_7\text{Si}_8\text{O}_{22}(\text{OH})_2$	p. 195
<b>CUPRITE</b> $\text{Cu}_2\text{O}$	p. 195

### \* CUPROCOPIAPITE

Copper iron sulfate hydroxide hydrate,  $\text{CuFe}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$ . A secondary mineral formed from the oxidation of sulfides.

*Cochise County*: Warren district, 1800 level of the Junction mine, where it was found as a minor constituent of post-mining crusts with rhomboclase, copiapite, and other sulfates (R. W. Graeme, pers. commun., 1999).

<b>CUPROPAVONITE</b> $\text{AgPbCu}_2\text{Bi}_5\text{S}_{10}$	p. 197
<b>CUPROTUNGSTITE</b> $\text{Cu}_2(\text{WO}_4)_2(\text{OH})_2$	p. 197
<b>CYANOTRICHITE</b> $\text{Cu}_4\text{Al}_2(\text{SO}_4)(\text{OH})_{12} \cdot 2\text{H}_2\text{O}$	p. 198
Danaite see ARSENOPIRITE	
<b>DANALITE</b> $\text{Fe}_8(\text{Be}_6\text{Si}_6\text{O}_{24})\text{S}_2$	p. 198
<b>DANBURITE</b> $\text{CaB}_2(\text{SiO}_4)_2$	p. 199
<b>DARAPSKITE</b> $\text{Na}_3(\text{SO}_4)(\text{NO}_3) \cdot \text{H}_2\text{O}$	p. 199
<b>DATOLITE</b> $\text{CaBSiO}_4(\text{OH})$	p. 199
<b>DAUBRÉELITE</b> $\text{FeCr}_2\text{S}_4$	p. 199
<b>DAVIDITE-(La)</b> $(\text{La}, \text{Ce})(\text{Y}, \text{U}, \text{Fe})(\text{Ti}, \text{Fe})_{20}(\text{O}, \text{OH})_{38}$	p. 199
<b>DELAFOSSITE</b> $\text{CuFeO}_2$	p. 200
<b>DESCLOIZITE</b> $\text{PbZnVO}_4(\text{OH})$	p. 200
<b>DEVILLINE</b> $\text{CaCu}_4(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$	p. 201
<b>DIABOLÉITE</b> $\text{Pb}_2\text{CuCl}_2(\text{OH})_4$	p. 202
<b>DIADOCHITE</b> $\text{Fe}_2(\text{PO}_4)(\text{SO}_4)(\text{OH}) \cdot 6\text{H}_2\text{O}$	p. 202
<b>DIAMOND</b> C	p. 203
<b>DIASPORE</b> $\text{AlO}(\text{OH})$	p. 203
<b>DICKINSONITE</b> $\text{KNa}_4\text{CaMn}_{14}\text{Al}(\text{PO}_4)_{12}(\text{OH})_2$	p. 203
<b>DICKITE</b> $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$	p. 203



<b>DIGENITE</b> $\text{Cu}_9\text{S}_5$	p. 204
<b>DIOPSIDE</b> $\text{CaMgSi}_2\text{O}_6$	p. 204
<b>DIOPTASE</b> $\text{Cu}_6\text{Si}_6\text{O}_{18}\cdot 6\text{H}_2\text{O}$	p. 205
<b>DJURLEITE</b> $\text{Cu}_{31}\text{S}_{16}$	p. 206
<b>DOLOMITE</b> $\text{CaMg}(\text{CO}_3)_2$	p. 206
<b>DOLORESITE</b> $\text{H}_8\text{V}_6\text{O}_{16}$	p. 207
<b>DOMEYKITE</b> $\text{Cu}_3\text{As}$	p. 207
<b>DRAVITE</b> $\text{NaMg}_3\text{Al}_6(\text{BO}_3)_3(\text{Si}_6\text{O}_{18})(\text{OH})_4$	p. 208
<b>DUFRENOYSITE</b> $\text{Pb}_2\text{As}_2\text{S}_5$	p. 208
<b>DUFTITE</b> $\text{PbCu}(\text{AsO}_4)(\text{OH})$	p. 208
<b>DUGGANITE</b> $\text{Pb}_3\text{Zn}_3(\text{TeO}_6)(\text{AsO}_4)_2$	p. 208
Duhamelite see MIMETITE (see appendix 3)	p. 209
<b>DUMONTITE</b> $\text{Pb}_2(\text{UO}_2)_3(\text{PO}_4)_2\text{O}_2\cdot 5\text{H}_2\text{O}$	p. 209
<b>DUMORTIERITE</b> $\text{Al}_7(\text{BO}_3)(\text{SiO}_4)_3\text{O}_3$	p. 209
Dunhamite not a valid species	p. 210
<b>DYSCRASITE</b> $\text{Ag}_3\text{Sb}$	p. 210
<b>ECLARITE</b> $\text{Pb}_9(\text{Cu},\text{Fe})\text{Bi}_{12}\text{S}_{28}$	p. 210
<b>EDENITE</b> $\text{NaCa}_2\text{Mg}_5(\text{Si}_7\text{Al})\text{O}_{22}(\text{OH})_2$	p. 211
<b>EGLESTONITE</b> $\text{Hg}_4\text{OCl}_2$	p. 211
<b>ELBAITE</b> $\text{Na}(\text{Al}_{1.5}\text{Li}_{1.5})\text{Al}_6(\text{BO}_3)_3(\text{Si}_6\text{O}_{18})(\text{OH})_4$	p. 211
Electrum is a GOLD-SILVER alloy	p. 211
<b>EMMONSITE</b> $\text{Fe}_2\text{Te}_3\text{O}_9\cdot 2\text{H}_2\text{O}$	p. 212
<b>EMPLECTITE</b> $\text{CuBiS}_2$	p. 212
<b>EMPRESSITE</b> $\text{AgTe}$	p. 212
<b>ENARGITE</b> $\text{Cu}_3\text{AsS}_4$	p. 213
Endellite see HALLOYSITE	p. 213
<b>ENSTATITE</b> $\text{Mg}_2\text{Si}_2\text{O}_6$	p. 214
<b>EOSPHORITE</b> $\text{MnAl}(\text{PO}_4)(\text{OH})_2\cdot \text{H}_2\text{O}$	p. 214
<b>EPIDOTE</b> $\text{Ca}_2\text{Al}_2(\text{Al},\text{Fe})_3\text{Si}_3\text{O}_{12}(\text{OH})$	p. 214
<b>EPSOMITE</b> $\text{MgSO}_4\cdot 7\text{H}_2\text{O}$	p. 216

### \*ERIOCHALCITE

Copper chloride hydrate,  $\text{CuCl}_2\cdot 2\text{H}_2\text{O}$ . A rare water soluble mineral found around volcanic fumaroles and as a product of weathering of copper sulfides in an arid climate.

*Pinal County*: found at Asarco's Sacaton mine as light blue-green crusts with brochantite on pyrite partially altered to chalcocite (P. A. Williams, pers. commun., 2005).

<b>ERIONITE</b> $\text{Ca}_4\text{K}_2\text{Al}_{10}\text{Si}_{26}\text{O}_{72}\cdot 32\text{H}_2\text{O}$	p. 216
<b>ERYTHRITE</b> $\text{Co}_3(\text{AsO}_4)_2\cdot 8\text{H}_2\text{O}$	p. 216

<b>ETTRINGITE</b> $\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12}\cdot 26\text{H}_2\text{O}$	p. 217
<b>EUCRYPTITE</b> $\text{LiAlSiO}_4$	p. 217
<b>EUGENITE</b> $\text{Ag}_{11}\text{Hg}_2$	p. 217
<b>EUXENITE-(Y)</b> $(\text{Y}, \text{Ca}, \text{Ce}, \text{U}, \text{Th})(\text{Nb}, \text{Ta}, \text{Ti})_2\text{O}_6$	p. 217
<b>FAIRBANKITE</b> $\text{PbTeO}_3$	p. 218
<b>FAIRCHILDITE</b> $\text{K}_2\text{Ca}(\text{CO}_3)_2$	p. 218
<b>FAIRFIELDITE</b> $\text{Ca}_2(\text{Mn}, \text{Fe})(\text{PO}_4)_2\cdot 2\text{H}_2\text{O}$	p. 218
<b>FAMATINITE</b> $\text{Cu}_3\text{SbS}_4$	p. 219
<b>FAYALITE</b> $\text{Fe}_2\text{SiO}_4$	p. 219
<b>FELSÖBÁNYAITE</b> $\text{Al}_4\text{SO}_4(\text{OH})_{10}\cdot 4\text{H}_2\text{O}$ was Basaluminite	p. 129
<b>FERBERITE</b> $\text{FeWO}_4$	p. 422
<b>FERGUSONITE</b> $\text{YNbO}_4$	p. 219
<b>FERNANDINITE</b> $(\text{Ca}, \text{Na}, \text{K})_x(\text{V}, \text{Fe})_8\text{O}_{20}\cdot 4\text{H}_2\text{O}$	p. 219
<b>FERRICOPIAPITE</b> $\text{Fe}_{2/3}\text{Fe}_4(\text{SO}_4)_6(\text{OH})_2\cdot 20\text{H}_2\text{O}$	p. 220
<b>FERRIERITE</b> $(\text{Na}, \text{K})_2\text{Mg}(\text{Al}_5\text{Si}_{31}\text{O}_{72}\cdot n\text{H}_2\text{O})$	p. 220
<b>FERRIMOLYBDITE</b> $\text{Fe}_2(\text{MoO}_4)_3\cdot 8\text{H}_2\text{O}$	p. 220
<b>FERRO-ACTINOLITE</b> $\text{Ca}_2\text{Fe}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$	p. 221
<b>FERROCOLUMBITE</b> $\text{FeNb}_2\text{O}_6$	p. 221

**\*FERROHEXAHYDRITE**

Iron sulfate hydrate,  $\text{FeSO}_4\cdot 6\text{H}_2\text{O}$ . A rare mineral formed at volcanic fumaroles. *Coconino County*: found at Sunset Crater as a fumarolic deposit. It occurs as a white powder with pickeringite, locally coating the cinders (Hanson et al., 2000).

**\*FERROHORNBLLENDE**

Calcium, iron, aluminum silicate hydroxide,  $\text{Ca}_2[\text{Fe}_4(\text{Fe}, \text{Al})](\text{Si}_7 \text{Al})\text{O}_{22}(\text{OH})_2$ . A member of the amphibole group found in metamorphic rocks.

*Yavapai County*: Wabayuma Peak Wilderness Study Area, southeast of Wabayuma Peak, where a black rather than more common dark-green amphibole occurs. Some of the hornblende occurs in rocks with magnetite. This suggests ferrohornblende rather than the more common magnesiohornblende (Conway, et al., 1990).

<b>FERROKAERSUTITE</b> $\text{NaCa}_2\text{Fe}_4\text{TiSi}_6\text{Al}_2\text{O}_{23}(\text{OH})$	p. 221
---	--------

**\*FERROSELITE**

Iron selenide,  $\text{FeSe}_2$ . Occurs in sedimentary uranium deposits in the Colorado Plateau.

*Navajo County*: found at the Mitten #2 mine in Monument Valley.

<b>FERROTAPIOLITE</b> $\text{FeTa}_2\text{O}_6$	p. 221
<b>FERVANITE</b> $\text{Fe}_4(\text{VO}_4)_4\cdot 5\text{H}_2\text{O}$	p. 222
<b>FIBROFERRITE</b> $\text{Fe}(\text{SO}_4)(\text{OH})\cdot 5\text{H}_2\text{O}$	p. 222

<b>FILLOWITE</b> $\text{Na}_2\text{Ca}(\text{Mn},\text{Fe}^{2+})_7(\text{PO}_4)_6$	p. 222
<b>FLAGSTAFFITE</b> $\text{C}_{10}\text{H}_{22}\text{O}_3$	p. 222
<b>FLUORAPATITE</b> $\text{Ca}_5(\text{PO}_4)_3\text{F}$	p. 116
<b>FLUORAPOPHYLLITE</b> $\text{KCa}_4\text{Si}_8\text{O}_{20}(\text{F},\text{OH}) \cdot 8\text{H}_2\text{O}$	P. 117
<b>FLUORITE</b> $\text{CaF}_2$	p. 223
<b>FORNACITE</b> $\text{Pb}_2\text{Cu}(\text{CrO}_4)(\text{AsO}_4)(\text{OH})$	p. 225
<b>FORSTERITE</b> $\text{Mg}_2\text{SiO}_4$	p. 225
<b>FOURMARIERITE</b> $\text{PbU}_4\text{O}_{13} \cdot 4\text{H}_2\text{O}$	p. 226
<b>FRAIPONTITE</b> $(\text{Zn},\text{Cu},\text{Al})_3(\text{Si},\text{Al})_2\text{O}_5(\text{OH})_4$	p. 226
<b>FREIBERGITE</b> $\text{Ag}_6\text{Cu}_4(\text{Fe},\text{Zn})_2\text{Sb}_4\text{S}_{13}$	p. 226
<b>FREIESLEBENITE</b> $\text{gPbSbS}_3$ A	p. 226
<b>FROHBERGITE</b> $\text{FeTe}_2$	p. 227
Fuchsite see MUSCOVITE	
<b>GADOLINITE</b> $(\text{Ce},\text{La},\text{Nd},\text{Y})_2\text{FeBe}_2\text{Si}_2\text{O}_{10}$	p. 227
<b>GAHNITE</b> $\text{ZnAl}_2\text{O}_4$	p. 227
<b>GALENA</b> $\text{PbS}$	p. 227
<b>GARRONITE</b> $\text{NaCa}_{2.5}(\text{Al}_6\text{Si}_{10})\text{O}_{32} \cdot 14\text{H}_2\text{O}$	p. 229
<b>GEARKSUTITE</b> $\text{CaAl}(\text{OH})\text{F}_4 \cdot \text{H}_2\text{O}$	p. 230
<b>GEDRITE</b> $\text{Mg}_5\text{Al}_2\text{Al}_2\text{Si}_6\text{O}_{22}(\text{OH})_2$	p. 230
<b>GEIKIELITE</b> $\text{MgTiO}_3$	p. 230
<b>GERHARDITE</b> $\text{Cu}_2(\text{NO}_3)(\text{OH})_3$	p. 230
<b>GERSDORFFITE</b> $\text{NiAsS}$	p. 231
<b>GIBBSITE</b> $\text{Al}(\text{OH})_3$	p. 231
<b>GILALITE</b> $\text{Cu}_5\text{Si}_6\text{O}_{17} \cdot 7\text{H}_2\text{O}$	p. 231
<b>GIRDITE</b> $\text{H}_2\text{Pb}_3(\text{TeO}_3)(\text{TeO}_6)$	p. 231
<b>GISMONDINE</b> $\text{Ca}_4\text{Al}_8\text{Si}_8\text{O}_{32} \cdot 16\text{H}_2\text{O}$	p. 232
<b>GLADITE</b> $\text{PbCuBi}_5\text{S}_9$	p. 232
<b>GLAUBERITE</b> $\text{Na}_2\text{Ca}(\text{SO}_4)_2$	p. 232

**\*GLAUCOCERINITE**

Zinc copper aluminum sulfate hydroxide hydrate,

$(\text{Zn},\text{Cu})_{10}\text{Al}_6(\text{SO}_4)_3(\text{OH})_{32} \cdot 18\text{H}_2\text{O}$ . A rare secondary mineral from oxidized copper deposits.

*Cochise County*: Maid of Sunshine mine as fibrous masses (Frost et al., 2004).

**\*GLAUCODOT**

Cobalt, iron arsenic sulfide,  $(\text{Co},\text{Fe})\text{AsS}$ . Forms in hydrothermal veins.

*Graham County*: Blue Bird mine, near Mount Trumbull with cobaltite (MRDS database ID# 10067567).

<b>GLAUCONITE</b> $(\text{K},\text{Na})(\text{Al},\text{Fe},\text{Mg})_2(\text{Al},\text{Si})_4\text{O}_{10}(\text{OH})_2$	p. 232
--	--------



**\*GLUSHINSKITE**

Magnesium oxalate hydrate,  $\text{Mg}(\text{C}_2\text{O}_4) \cdot 2\text{H}_2\text{O}$ . Found associated with decaying organic material.

*Maricopa County*: formed from the weathering of weddellite in decaying saguaro cacti in the Gila Bend Mountains (Garvie, 2003).

<b>GMELINITE</b> $(\text{K}, \text{Na}, \text{Ca})_6\text{Al}_7\text{Si}_{17}\text{O}_{48} \cdot 22\text{H}_2\text{O}$	p. 233
<b>GOETHITE</b> $\text{FeO}(\text{OH})$	p. 233
<b>GOLD</b> Au	p. 234
<b>GOLDFIELDITE</b> $\text{Cu}_6\text{Cu}_4\text{Te}_2(\text{Sb}, \text{As})_4\text{S}_{13}$	p. 237
<b>GONNARDITE</b> $(\text{Na}, \text{Ca})_{6-8}[(\text{Al}, \text{Si})_{20}\text{O}_{40}] \cdot 12\text{H}_2\text{O}$	p. 237

**\*GORDAITE**

Sodium zinc sulfate hydroxide chloride hydrate,  $\text{NaZn}_4(\text{SO}_4)(\text{OH})_6\text{Cl} \cdot 6\text{H}_2\text{O}$ .

Found in the oxidized zone of hydrothermal deposits. The Arizona locality is the second in the world.

*Yavapai County*: found at an unspecified locality in San Miguel Wash. It forms a white crust with thenardite in a calcite matrix (Vajdak, 2002).

<b>GORMANITE</b> $\text{Fe}_3\text{Al}_4(\text{PO}_4)_4(\text{OH})_6 \cdot 2\text{H}_2\text{O}$	p. 237
<b>GOSLARITE</b> $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	p. 238
<b>GRAEMITE</b> $\text{CuTeO}_3 \cdot \text{H}_2\text{O}$	p. 238
<b>GRANDREEFITE</b> $\text{Pb}_2(\text{SO}_4)\text{F}_2$	p. 238

**\*GRANDVIEWITE**

Copper Aluminum sulfate hydroxide,  $\text{Cu}_3\text{Al}_9(\text{SO}_4)_2(\text{OH})_{29}$ . A secondary copper mineral found with other oxidized copper minerals. The Arizona locality is the type locality.

*Coconino County*: from the Grandview mine (also known as the Last Chance mine), Horseshoe Mesa, Grand Canyon National Park in goethite-rich gossan with chalcoalumite and cyanotrichite (Williams, P.A., 2007).

<b>GRAPHITE</b> C	p. 239
<b>GREENOCKITE</b> CdS	p. 239
<b>GROSSULAR</b> $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_3$	p. 239
<b>GROUTITE</b> $\text{MnO}(\text{OH})$	p. 240
<b>GRUNERITE</b> $\text{Fe}_7\text{Si}_8\text{O}_{22}(\text{OH})_2$	p. 240
<b>GUILDITE</b> $\text{CuFe}(\text{SO}_4)_2(\text{OH}) \cdot 4\text{H}_2\text{O}$	p. 240
Gummite not a valid species	p. 241
<b>GYPSUM</b> $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	p. 241
<b>GYROLITE</b> $(\text{NaCa}_2)\text{Ca}_{14}(\text{Si}_{23}\text{Al})\text{O}_{60}(\text{OH})_8 \cdot (14+x)\text{H}_2\text{O}$	p. 242
<b>HALITE</b> NaCl	p. 242

<b>HALLOYSITE</b> $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ listed as Endellite	p. 213
<b>HALOTRICHITE</b> $\text{FeAl}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$	p. 243
<b>HARMOTOME</b> $\text{Ba}_2(\text{NaKCa}_{0.5})(\text{Al}_5\text{Si}_{11}\text{O}_{32}) \cdot 12\text{H}_2\text{O}$	p. 244
<b>HAUSMANNITE</b> $\text{Mn}_3\text{O}_4$	p. 244
<b>HAWLEYITE</b> $\text{CdS}$	p. 244
<b>HAXONITE</b> $(\text{Fe}, \text{Ni})_{23}\text{C}_6$	p. 244
<b>HECTORITE</b> $\text{Na}_{0.3}(\text{Mg}, \text{Li})_3\text{Si}_4\text{O}_{10}(\text{F}, \text{OH})_2$	p. 244
<b>HEDENBERGITE</b> $\text{CaFeSi}_2\text{O}_6$	p. 245
<b>HELVITE</b> $\text{Mn}_4\text{Be}_3(\text{SiO}_4)_3\text{S}$	p. 245
<b>HEMATITE</b> $\text{Fe}_2\text{O}_3$	p. 245
<b>HEMIHEDRITE</b> $\text{Pb}_{10}\text{Zn}(\text{CrO}_4)_6(\text{SiO}_4)_2\text{F}_2$	p. 247
<b>HEMIMORPHITE</b> $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$	p. 247
<b>HENRYITE</b> $\text{Cu}_4\text{Ag}_3\text{Te}_4$	p. 248
<b>HERCYNITE</b> $\text{FeAl}_2\text{O}_4$	p. 249
<b>HERSCHELITE</b> discredited	p. 249
<b>HESSITE</b> $\text{Ag}_2\text{Te}$	p. 249
<b>HETAEROLITE</b> $\text{ZnMn}_2\text{O}_4$	p. 249
<b>HEULANDITE</b> $(\text{Na}, \text{Ca}_{0.5}, \text{K})_9[\text{Al}_9\text{Si}_{27}\text{O}_{72}] \cdot \sim 24\text{H}_2\text{O}$	p. 250
<b>HEWETTITE</b> $\text{CaV}_6\text{O}_{16} \cdot 9\text{H}_2\text{O}$	p. 250
<b>HEXAHYDRITE</b> $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	p. 250
<b>HIDALGOITE</b> $\text{PbAl}_3(\text{S}, \text{As})\text{O}_4(\text{OH}, \text{H}_2\text{O})_6$	p. 251
<b>HILLEBRANDITE</b> $\text{Ca}_2\text{SiO}_3(\text{OH})_2$	p. 251
<b>HINSDALITE</b> $\text{PbAl}_3[(\text{P}, \text{S})\text{O}_4]_2(\text{OH}, \text{H}_2\text{O})_6$	p. 251
<b>HISINGERITE</b> $\text{FeSi}_2\text{O}_5(\text{OH})_4 \cdot 2\text{H}_2\text{O}$	p. 251
<b>HOCARTITE</b> $\text{Ag}_2\text{FeSnS}_4$	p. 252
<b>HODRUSHITE</b> $\text{Cu}_8\text{Bi}_{12}\text{S}_{22}$	p. 252
<b>HOLLANDITE</b> $\text{Ba}(\text{Mn})_8\text{O}_{16}$	p. 252

**\*HOPEITE**

Zinc phosphate hydrate  $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ . A secondary mineral found in hydrothermal zinc deposits.

*Graham Count* : found at the Iron Cap mine as white botryoidal masses with manganaxinite, hedenbergite, and clinochrysotile (Vajdak, 1995).

Hornblende see FERROHORNBLLENDE and MAGNESIOHORNBLLENDE

<b>HÖRNESITE</b> $\text{Mg}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$	p. 253
<b>HÜBNERITE</b> $\text{MnWO}_4$	p. 422
<b>HUMMERITE</b> $\text{K}_2\text{Mg}_2\text{V}_{10}\text{O}_{28} \cdot 16\text{H}_2\text{O}$	p. 253
<b>HUNTITE</b> $\text{CaMg}_3(\text{CO}_3)_4$	p. 253
<b>HURÉAULITE</b> $\text{Mn}_5(\text{PO}_4)_2[\text{PO}_3(\text{OH})]_2 \cdot 4\text{H}_2\text{O}$	p. 253
<b>HYDROBASALUMINITE</b> $\text{Al}_4(\text{SO}_4)(\text{OH})_{10} \cdot 12\text{H}_2\text{O}$	p. 254
<b>HYDROBIOTITE</b> 1:1 interstratification of biotite and vermiculite	p. 254

**HYDROCERUSSITE**  $\text{Pb}_3(\text{CO}_3)_2(\text{OH})_2$ 

p. 254

**\*HYDROGLAUBERITE**

Sodium calcium sulfate hydrate,  $\text{Na}_{10}\text{Ca}_3(\text{SO}_4)_8 \cdot 6\text{H}_2\text{O}$ . Found as a weathering product of glauberite.

*Yavapai County*: found at the Verde Salt mine near Camp Verde. Crystals of glauberite are found altering to hydroglauberite in the walls of the pit (T. Nikischer, pers. commun., 2006). Pseudomorphs of aragonite, calcite, gypsum, and hydroglauberite after glauberite are found in the area.

**HYDROHETAEROLITE**  $\text{Zn}_2\text{Mn}_4\text{O}_8 \cdot \text{H}_2\text{O}$ 

*Cochise County*: Warren district, Campbell Mine, 1900 level, 105 stope; a large number of fine hydrohetaerolite specimens with a gray botryoidal to stalactitic surface were recovered from here during the late 1930s to mid-1940s. Minor calcite was associated with this occurrence. Some of this material was plumbous as well. Along the fringes of the oxidized copper/lead ores there were patches of friable, brownish-black hydrohetaerolite on altered limestone. Minor hetaerolite, goethite, and later calcite were directly associated with the hydrohetaerolite, while malachite, azurite, cerussite, and hematite were in the adjacent ores (R.W. Graeme, pers. commun., 2007).

p. 254

**\*HYDROHONESSITE**

Nickel iron sulfate hydroxide hydrate,  $\text{Ni}_6\text{Fe}_2(\text{SO}_4)(\text{OH})_{16} \cdot 7\text{H}_2\text{O}$ . Occurs as a secondary incrustation on primary nickel ores.

*Coconino County*: from a shallow open cut eight miles ESE of Gray Mountain. It is found as a post-mine incrustation on the walls of a uranium prospect (Williams and Cesbron, 1995).

**HYDROMAGNESITE**  $\text{Mg}_5(\text{CO}_3)_4(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ 

p. 255

Hydromuscovite see ILLITE

**HYDRONIUM JAROSITE**  $(\text{H}_3\text{O})\text{Fe}_3(\text{SO}_4)_2(\text{OH})_6$ 

p. 255

**HYDROXYAPOPHYLLITE**  $\text{KCa}_4\text{Si}_8\text{O}_{20}(\text{OH},\text{F}) \cdot 8\text{H}_2\text{O}$ 

p. 255

**HYDROXYLAPATITE**  $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$ 

p. 255

**HYDROZINCITE**  $\text{Zn}_5(\text{CO}_3)_2(\text{OH})_6$ 

p. 255

**HYPERSTHENE** not a valid species

p. 256

**"ILLITE"** (a series)  $\text{K}_{0.65}\text{Al}_{2.0}\text{Si}_{3.35}\text{O}_{10}(\text{OH})_2$ 

p. 256

**ILMENITE**  $\text{FeTiO}_3$ 

p. 257

**ILSEMANNITE**  $\text{Mo}_3\text{O}_8 \cdot \text{H}_2\text{O}(?)$ 

p. 258

**ILVAITE**  $\text{CaFe}_3\text{Si}_2\text{O}_7\text{O}(\text{OH})$ 

p. 258

**INGODITE**  $\text{Bi}_2(\text{TeS})$ 

p. 259

**IODARGYRITE**  $\text{AgI}$ 

p. 259

**IRANITE**  $\text{Pb}_{10}\text{Cu}(\text{CrO}_4)_6(\text{SiO}_4)_2(\text{OH})_2$ 

p. 259



**IRIGINITE**  $(\text{UO}_2)\text{Mo}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$  p. 260  
**IRON** Fe see Kamacite - p.265, Taenite - p. 388

**\*JACOBSITE**

Manganese iron magnesium oxide,  $(\text{Mn,Fe,Mg})(\text{Fe,Mn})_2\text{O}_4$ . A rare hypogene mineral found with other manganese oxides.

*Cochise County*: Warren district, Number 4 claim. Found in a small manganese deposit that was largely braunite with cryptomelane veins in the surrounding limestone. The jacobsite is included as 5 mm blebs in the cryptomelane (R.W. Graeme, pers. commun., 1999).

**JADEITE**  $\text{Na}(\text{Al,Fe})\text{Si}_2\text{O}_6$  p. 260

**JAHSITE**  $\text{CaMn}(\text{Fe,Mg})_2\text{Fe}_2(\text{PO}_4)_4(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  p. 260

**JALPAITE**  $\text{Ag}_3\text{CuS}_2$  p. 260

**JAMESONITE**  $\text{Pb}_4\text{FeSb}_6\text{S}_{14}$  p. 260

**JAROSITE**  $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$  p. 261

Jeromite not considered a valid species (see appendix 3) p. 262

**JOHANNITE**  $\text{Cu}(\text{UO}_2)_2(\text{SO}_4)_2(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ .

*Cochise County*: Warren district, Cole mine, this species has been recognized on only a small number of specimens collected in the late 1940s from an unspecified level in this mine. On these, it was found as an efflorescence on decomposing sulfides as a green to blue-green crust with gypsum and minor zippeite as well as uranopilite (R.W. Graeme, pers. commun., 2007). p. 263

**JOHANNSENITE**  $\text{CaMnSi}_2\text{O}_6$  p. 263

**\*JÔKOKUITE**

Manganese sulfate hydrate,  $\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$ . A post-mining manganese mineral.

*Cochise County*: Warren district, Junction mine, 2300 level; minor amounts of post-mining jokokuite were found in broken alabandite left in the stope during mining. It occurs as a soft, granular, pink to white material to 5 mm thick filling fractures (R.W. Graeme, pers. commun., 2007).

**JORDISITE**  $\text{MoS}_2$  p. 263

**JUNITOITE**  $\text{CaZn}_2\text{Si}_2\text{O}_7 \cdot \text{H}_2\text{O}$  p. 263

**JURBANITE**  $\text{Al}(\text{SO}_4)(\text{OH}) \cdot 5\text{H}_2\text{O}$  p. 264

**KAERSUTITE**  $\text{Ca}_2\text{Na}(\text{Mg}_4\text{Ti})(\text{Si}_6\text{Al}_2)\text{O}_{23}(\text{OH})$  p. 264

Kamacite see IRON p. 265

**\*KAMITUGAITE**

Lead aluminum uranyl phosphate arsenate hydroxide hydrate,

$\text{PbAl}(\text{UO}_2)_5[(\text{P,As})\text{O}_4]_2(\text{OH})_9 \cdot 9.5\text{H}_2\text{O}$ . A very rare secondary uranium mineral. The Arizona locality is the second in the world.

*Maricopa County*: from the Tiger Wash area of the Buckhorn Mountains, associated with wickenburgite, mimetite, and quartz (Vajdak, 2002).

<b>KANONAITE</b> $(\text{Mn,Al})\text{AlSiO}_5$	p. 265
<b>KAOLINITE</b> $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$	p. 265
<b>KASOLITE</b> $\text{Pb}(\text{UO}_2)\text{SiO}_4 \cdot \text{H}_2\text{O}$	p. 266
<b>KÄSTERITE</b> $\text{Cu}_2(\text{Zn,Fe})\text{SnS}_4$	p. 267
<b>KETTNERITE</b> $\text{CaBi}(\text{CO}_3)\text{OF}$	p. 267
<b>KHINITE</b> $\text{Cu}_3\text{PbTeO}_6(\text{OH})_2$	p. 267
<b>KIDDCREEKITE</b> $\text{Cu}_6\text{SnWS}_8$	p. 268

**\*KIESERITE**

Magnesium sulfate hydrate,  $\text{MgSO}_4 \cdot \text{H}_2\text{O}$ . Found commonly in evaporite deposits.

*Coconino County*: found as an efflorescent mineral in the Grand Canyon (Quick et al., 1989).

<b>KINOITE</b> $\text{Ca}_2\text{Cu}_2\text{Si}_3\text{O}_8(\text{OH})_4$	p. 268
---	--------

**\*KINOSHITALITE**

Barium potassium magnesium manganese aluminum silicate hydroxide,  $\text{BaMg}_3\text{Si}_2\text{Al}_2\text{O}_{10}(\text{OH})_2$ . Found in manganese rocks.

*Apache County*: found in an ultramafic diatreme at Garnet Ridge on the Navajo Reservation as inclusions in pyrope with srilankite, carichaelite, rutile, and a number of other minerals (Wang et al. 1999).

<b>KOECHLINITE</b> $\text{Bi}_2\text{MoO}_6$	p. 268
<b>KORNELITE</b> $\text{Fe}_2(\text{SO}_4)_3 \cdot 7\text{H}_2\text{O}$	p. 268
<b>KOSMOCHLOR</b> $\text{NaCrSi}_2\text{O}_6$	p. 269
<b>KOSTOVITE</b> $\text{CuAuTe}_4$	p. 269
<b>KRENNERITE</b> $(\text{Au,Ag})\text{Te}_2$	p. 269
<b>KRINOVITE</b> $\text{Na}_2\text{Mg}_4\text{Cr}_2\text{Si}_6\text{O}_{120}$	p. 269
<b>KTENASITE</b> $(\text{Cu,Zn})_5(\text{SO}_4)_2(\text{OH})_6 \cdot 6\text{H}_2\text{O}$	p. 269
<b>KULANITE</b> $\text{BaFe}_2\text{Al}_2(\text{PO}_4)_3(\text{OH})_3$	p. 270
<b>KURAMITE</b> $\text{Cu}_3\text{SnS}_4$	p. 270
<b>KUTNOHORITE</b> $\text{Ca}(\text{Mn,Mg,Fe})(\text{CO}_3)_2$	p. 270
<b>KYANITE</b> $\text{Al}_2\text{SiO}_5$	p. 270
<b>LANARKITE</b> $\text{Pb}_2\text{O}(\text{SO}_4)$	p. 271
<b>LANGITE</b> $\text{Cu}_4(\text{SO}_4)(\text{OH})_6 \cdot 2\text{H}_2\text{O}$	p. 271

### \*LANSFORDITE

Magnesium carbonate hydrate,  $\text{MgCO}_3 \cdot 5\text{H}_2\text{O}$ . An alteration mineral usually formed in coal mines and in serpentine masses.

*Maricopa County*: formed from the weathering of weddellite in decaying saguaro cacti in the Gila Bend Mountains (Garvie, 2003).

<b>LAUMONTITE</b> $\text{Ca}_4[\text{Al}_8\text{Si}_{16}\text{O}_{48}] \cdot 18\text{H}_2\text{O}$	p. 271
<b>LAURELITE</b> $\text{Pb}_7\text{F}_{12}\text{Cl}_2$	p. 272
<b>LAUSENITE</b> $\text{Fe}_2(\text{SO}_4)_3 \cdot 6\text{H}_2\text{O}$	p. 272
<b>LAUTITE</b> $\text{CuAsS}$	p. 272
<b>LAWRENCITE</b> $(\text{FeNi})\text{Cl}_2$	p. 273
<b>LAWSONITE</b> $\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$	p. 273
<b>LAZULITE</b> $\text{MgAl}_2(\text{PO}_4)_2(\text{OH})_2$	p. 273
<b>LEAD</b> $\text{Pb}$	p. 273
<b>LEADHILLITE</b> $\text{Pb}_4(\text{SO}_4)(\text{CO}_3)_2(\text{OH})_2$	p. 273
<b>LEPIDOCROCITE</b> $\gamma\text{-FeO}(\text{OH})$	p. 275
<b>LEPIDOLITE</b> $\text{K}(\text{Li},\text{Al})_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{F},\text{OH})_2$	p. 275
<b>LEUCITE</b> $\text{KAlSi}_2\text{O}_6$	p. 275
<b>LEUCOPHOSPHITE</b> $\text{KFe}_2(\text{PO}_4)_2(\text{OH}) \cdot 2\text{H}_2\text{O}$	p. 275
<b>LEUCOSPHEENITE</b> $\text{BaNa}_4\text{Ti}_2\text{B}_2\text{Si}_{10}\text{O}_{30}$	p. 276
<b>LEVYNE</b> $(\text{Ca}_{0.5}\text{Na},\text{K})_6\{\text{Al}_6\text{Si}_{12}\text{O}_{36}\} \cdot \sim 17\text{H}_2\text{O}$	p. 276
Lewisite see ROMEITE	p. 276
<b>LIBETHENITE</b> $\text{Cu}_2(\text{PO}_4)(\text{OH})$	p. 276
<b>LIEBIGITE</b> $\text{Ca}_2(\text{UO}_2)(\text{CO}_3)_3 \cdot 11\text{H}_2\text{O}$	p. 277
<b>LIME</b> $\text{CaO}$	p. 277
Limonite not a valid species	
<b>LINARITE</b> $\text{PbCu}(\text{SO}_4)(\text{OH})_2$	p. 278
<b>LINDGRENITE</b> $\text{Cu}_3(\text{MoO}_4)_2(\text{OH})_2$	p. 278
<b>LINNAEITE</b> $\text{Co}_3\text{S}_4$	p. 279

### \*LIROCONITE

Copper aluminum arsenate hydroxide hydrate,  $\text{Cu}_2\text{Al}(\text{AsO}_4)(\text{OH})_4 \cdot 4\text{H}_2\text{O}$ . A rare secondary mineral found in the oxide zone of copper deposits.

*Cochise County*: Lavender pit, Holbrook Extension, Warren district. Found as tabular bright blue crystals up to 2.2 mm on chrysocolla (R.W. Graeme, pers. commun., 1999).

<b>LITHARGE</b> $\text{PbO}$	p. 279
<b>LITHIOPHILITE</b> $\text{LiMnPO}_4$	p. 279
<b>LITHIOPHORITE</b> $(\text{Al},\text{Li})\text{MnO}_2(\text{OH})_2$	p. 279
<b>LIZARDITE</b> $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$	p. 280
<b>LÖLLINGITE</b> $\text{FeAs}_2$	p. 280

**\*LOVERINGITE**

Calcium Cerium titanium iron chromium magnesium oxide,  
 $(Ca,Ce)(Ti,Fe,Cr,Mg)_{21}O_{38}$ . Occurs as a late-stage mineral in mafic igneous rocks.

*Apache County*: found in an ultramafic diatreme at Garnet Ridge on the Navajo Reservation as inclusions in pyrope with srilankite, carmichaelite, rutile, and a number of other minerals (Wang et al. 1999).

<b>LUDDENITE</b> $Cu_2Pb_2Si_5O_{14} \cdot 14H_2O$	p. 280
<b>LUDWIGITE</b> $(Mg,Fe)_2FeO_2(BO_5)$	p. 281
<b>LUETHEITE</b> $Cu_2Al_2(AsO_4)_2(OH)_4 \cdot H_2O$	p. 281
<b>LUZONITE</b> $Cu_3AsS_4$	p. 281
<b>MACKAYITE</b> $FeTe_2O_5(OH)$	p. 281
<b>MACKINAWITE</b> $FeS$	p. 282
<b>MACPHERSONITE</b> $Pb_4(SO_4)(CO_3)_2(OH)_2$	p. 282
<b>MACQUARTITE</b> $Pb_3Cu(CrO_4)(SiO_3)(OH)_4 \cdot 2H_2O$	p. 282
<b>MAGHEMITE</b> $\gamma-Fe_2O_3$	p. 282
<b>MAGNESIOCHROMITE</b> $MgCr_2O_4$	p. 282
<b>MAGNESIOCOPIAPITE</b> $MgFe_4(SO_4)_6(OH)_2 \cdot 20H_2O$	p. 283
<b>MAGNESIOHORNBLLENDE</b> $Ca_2[Mg_4(Fe,Al)](AlSi_7)O_{22}(OH)_2$	p. 283
<b>MAGNESITE</b> $MgCO_3$	p. 283
<b>MAGNETITE</b> $Fe_3O_4$	p. 284
<b>MALACHITE</b> $Cu_2(CO_3)(OH)_2$	p. 285
<b>MAMMOTHITE</b> $Pb_6Cu_4AlSbO_2(OH)_{16}Cl_4(SO_4)_2$	p. 287
<b>MANANDONITE</b> $Li_2Al_4((Si_2AlB)O_{10})(OH)_8$	p. 287
<b>MANGANAXINITE</b> $Ca_2MnAl_2BO(OH)(Si_2O_7)_2$	p. 287
<b>MANGANBABINGTONITE</b> $Ca_2(Mn,Fe)FeSi_5O_{14}(OH)$	p. 288
<b>MANGANITE</b> $MnO(OH)$	p. 288
<b>MANJIROITE</b> $(Na,K)Mn_8O_{16} \cdot nH_2O$	p. 289
<b>MARCASITE</b> $FeS_2$	p. 289
<b>MARIALITE</b> $Na_4Al_3(Al,Si)_3Si_9O_{24}Cl$	p. 362
<b>MARICOPAITE</b> $(Pb_7Ca_2)[Al_{12}Si_{36}(O,OH)_{100}] \cdot n(H_2O,OH) \quad n \sim 32$	p. 290
<b>MASSICOT</b> $PbO$	p. 290
<b>MATILDITE</b> $AgBiS_2$	p. 291
<b>MATLOCKITE</b> $PbFCl$	p. 291
<b>MAWSONITE</b> $Cu_6Fe_2SnS_8$	p. 290
<b>MCKINSTRYITE</b> $(Ag,Cu)_2S$	p. 290

**\*MEIONITE**

Calcium aluminum silicate carbonate,  $Ca_4Al_6Si_6O_{24}CO_3$ . A member of the scapolite group found mainly in metamorphic rocks.



*Cochise County*: 500 level of the Holbrook mine, Warren district. Found in altered Abrigo Limestone with tremolite and wollastonite (Tenny, 1913). It is almost certain that the species noted is meionite (R.W. Graeme, pers. commun., 1999).

<b>MELANOTEKITE</b> $Pb_2Fe_2Si_2O_9$	p. 292
<b>MELANOVANADITE</b> $CaV_4O_{10} \cdot 5H_2O$	p. 292
<b>MELANTERITE</b> $FeSO_4 \cdot 7H_2O$	p. 292
<b>MELILITE</b> $(Na,Ca)_2(Al,Mg)(Al,Si)_2O_7$	p. 293
<b>MELONITE</b> $NiTe_2$	p. 293
<b>MERCURY</b> Hg	p. 293
<b>MESOLITE</b> $Na_2Ca_2(Al_6Si_9O_{30}) \cdot 8H_2O$	p. 293
<b>META-ALUNOGEN</b> $Al_4(SO_4)_6 \cdot 27H_2O$	p. 294
<b>META-AUTUNITE</b> $Ca(UO_2)_2(PO_4)_2 \cdot 2-6H_2O$	p. 294
<b>METACINNABAR</b> HgS	p. 294
<b>METAHEWETTITE</b> $CaV_6O_{16} \cdot 3H_2O$	p. 294
<b>METANOVÁČEKITE</b> $Mg(UO_2)_2(AsO_4)_2 \cdot 4-8H_2O$	p. 295
<b>METAROSSITE</b> $CaV_2O_6 \cdot 2H_2O$	p. 295
<b>METASIDERONATRITE</b> $Na_2Fe(SO_4)_2(OH) \cdot 1.5H_2O$	p. 295
<b>METATORBERNITE</b> $Cu(UO_2)_2(PO_4)_2 \cdot 8H_2O$	p. 295
<b>METATYUYAMUNITE</b> $Ca(UO_2)_2(VO_4)_2 \cdot 3H_2O$	p. 296
<b>META-URANOCIRCITE</b> $Ba(UO_2)_2(PO_4)_2 \cdot 8H_2O$	p. 296
<b>METAVOLTINE</b> $(K,Na)_8Fe_7(SO_4)_{12}O_2 \cdot 18H_2O$	p. 297
<b>METAZEUNERITE</b> $Cu(UO_2)_2(AsO_4)_2 \cdot 8H_2O$	p. 297
<b>MIARGYRITE</b> $AgSbS_2$	p. 297
<b>MICROCLINE</b> $KAlSi_3O_8$	p. 297
<b>MICROLITE</b> $NaCaTa_2O_6(OH)$	p. 298
<b>MIERSITE</b> $(Ag,Cu)I$	p. 298
<b>MILLERITE</b> NiS	p. 298
<b>MIMETITE</b> $Pb_5(AsO_4)_3Cl$	p. 298
<b>MINIUM</b> $Pb_3O_4$	p. 300
<b>MIRABILITE</b> $Na_2SO_4 \cdot 10H_2O$	p. 300
<b>MIXITE</b> $BiCu_6(AsO_4)_3(OH)_6 \cdot 3H_2O$	p. 300
<b>MOISSANITE</b> SiC	p. 301
<b>MOLYBDENITE</b> $MoS_2$	p. 301

**\*MOLYBDITE**

Molybdenum oxide,  $MoO_3$ . Found rarely as an alteration of molybdenite.

*Gila County*: Castle Dome mine, Pinto Valley with other secondary minerals (MRDS database ID# 10027321).

*Yavapai County*: Picacho View mine, east half of sec.10, T. 7 N., R. 3 W. in fractures in quartz in the pegmatite (Jahns, 1952).

**MOLYBDOFORNACITE**  $\text{Pb}_2\text{CuAsO}_4\text{MoO}_4(\text{OH})$  p. 302  
**MONAZITE**  $(\text{Ce},\text{La},\text{Nd})\text{PO}_4$  p. 303

**\*MONOHYDROCALCITE**

Calcium carbonate hydrate,  $\text{CaCO}_3 \cdot \text{H}_2\text{O}$ . An unstable mineral formed in sediments and from decaying vegetation.

*Maricopa County*: formed from the weathering of weddellite in decaying saguaro cacti in the Gila Bend Mountains (Garvie, 2003).

**\*MONTANITE**

Bismuth tellurium oxide hydrate,  $\text{Bi}_2\text{TeO}_6 \cdot 2\text{H}_2\text{O}$ . Formed from the alteration of earlier telluride minerals.

*Cochise County*: Little Joe shaft, Tombstone district. Present as brown massive fine-grained material that appears to be pseudomorphs after a prismatic mineral. Occurs with mixite in altered rhyodacite.

**MONTEBRASITE**  $(\text{Li},\text{Na})\text{AlPO}_4(\text{OH},\text{F})$  p. 303

**MONTICELLITE**  $\text{CaMgSiO}_4$  p. 304

**MONTMORILLONITE**  $(\text{Na},\text{Ca})_{0.3}(\text{Al},\text{Mg})_2\text{Si}_4\text{O}_{10}(\text{OH})_2 \cdot n\text{H}_2\text{O}$  p. 304

**MONTROSEITE**  $(\text{V},\text{Fe})\text{O}(\text{OH})$  p. 305

**\*MONTROYDITE**

Mercury oxide,  $\text{HgO}$ . A hydrothermal mercury mineral.

*Yavapai County*: found as small bright red patches at the Tres Amigos prospect (Lone Star?) near Copperopolis (R. Jenkins, pers. commun., 2007).

**MOORHOUSEITE**  $\text{CoSO}_4 \cdot 6\text{H}_2\text{O}$  p. 305

**MORDENITE**  $(\text{Ca},\text{Na}_2,\text{K}_2)_4\text{Al}_8\text{Si}_{40}\text{O}_{96} \cdot 28\text{H}_2\text{O}$  p. 305

**MORENOSITE**  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$  p. 306

**MOTTRAMITE**  $\text{PbCu}(\text{VO}_4)(\text{OH})$  p. 306

**MROSEITE**  $\text{CaTe}(\text{CO}_3)\text{O}_2$  p. 307

**MURDOCHITE**  $\text{PbCu}_6\text{O}_{6.5}\text{Cl}$  p. 308

**MUSCOVITE**  $\text{KAl}_2(\text{AlSi}_3)\text{O}_{10}(\text{OH})_2$  p. 308

**NACRITE**  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$  p. 309

**\*NAMIBITE**

Copper bismuth oxide vanadate hydroxide,  $\text{Cu}(\text{BiO})_2(\text{VO}_4)(\text{OH})$ . A rare secondary mineral in hydrothermal deposits.

*Yavapai County*: found at a small prospect near Copperopolis with beyerite and mottramite.

**NANTOKITE**  $\text{CuCl}$  p. 310

**NATROALUNITE**  $\text{NaAl}_3(\text{SO}_4)_2(\text{OH})_6$  p. 310

**\*NATRODUFRENITE**

Sodium iron aluminum phosphate hydroxide hydrate,  
 $\text{NaFe}(\text{Fe,Al})_5(\text{PO}_4)_4(\text{OH})_6 \cdot 2\text{H}_2\text{O}$ . A rare secondary mineral.

*Graham County*: Lone Star deposit, Safford district. Found in drill core as warty deep green to black crusts on open fracture surfaces with apatite, calcite, and stilbite.

**NATROJAROSITE**  $\text{NaFe}_3(\text{SO}_4)_2(\text{OH})_6$  p. 310

**NATROLITE**  $\text{Na}_2\text{Al}_2\text{Si}_3\text{O}_{10} \cdot 2\text{H}_2\text{O}$  p. 310

**NAUMANNITE**  $\text{Ag}_2\text{Se}$  p. 311

**NAVAJOITE**  $(\text{V,Fe})_{10}\text{O}_{24} \cdot 12\text{H}_2\text{O}$  p. 311

**NEKOITE**  $\text{Ca}_3\text{Si}_6\text{O}_{15} \cdot 7\text{H}_2\text{O}$  p. 311

**NEKRASOVITE**  $\text{Cu}_{26}\text{V}_2(\text{Sn,As,Sb})_6\text{S}_{32}$  p. 312

**NELTNERITE**  $\text{CaMn}_6\text{SiO}_{12}$  p. 312

**NEOTOCITE**  $(\text{Mn,Fe})\text{SiO}_3 \cdot \text{H}_2\text{O}(?)$  p. 312

**NEPHELINE**  $(\text{Na,K})\text{AlSiO}_4$  p. 312

**\*NESQUEHONITE**

Magnesium bicarbonate hydroxide hydrate,  $\text{Mg}(\text{HCO}_3)(\text{OH}) \cdot 2\text{H}_2\text{O}$ . An alteration mineral usually formed in coal mines and in serpentine masses.

*Maricopa County*: formed from the weathering of weddellite in decaying saguaro cacti in the Gila Bend Mountains (Garvie, 2003).

**NEYITE**  $\text{Pb}_7(\text{Cu,Ag})_2\text{Bi}_6\text{S}_{17}$  p. 312

**\*NICKEL-BOUSSINGAULTITE**

Ammonium nickel magnesium sulfate hydrate,  $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ . A rare secondary nickel mineral.

*Coconino County*: from a shallow open cut eight miles ESE of Gray Mountain. It is found as a post-mine incrustation with hydrohonesite (Williams and Cesbron, 1995).

**NICKELINE**  $\text{NiAs}$  p. 313

**NICKEL-SKUTTERUDITE**  $(\text{Ni,Co,Fe})\text{As}_{2-3}$  p. 313

**NICKEL-ZIPPEITE**  $\text{Ni}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$  p. 313

**NITER**  $\text{KNO}_3$  p. 313

**NITRATINE**  $\text{NaNO}_3$  p. 314

**NITROCALCITE**  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  p. 314

**NOLANITE**  $(\text{V,Fe,Ti})_{10}\text{O}_{14}(\text{OH})_2$  p. 314

<b>NONTRONITE</b> $\text{Na}_{0.3}\text{Fe}_2(\text{Al},\text{Si})_4\text{O}_{10}(\text{OH})_2 \cdot n\text{H}_2\text{O}$	p. 314
<b>NORDSTRÖMITE</b> $\text{Pb}_3\text{CuBi}_7(\text{S}_{10}\text{Se}_4)$	p. 315
<b>NSUTITE</b> $\text{Mn}_x\text{Mn}_{1-x}\text{O}_{2-2x}(\text{OH})_{2x}$	p. 315
<b>NUKUNDAMITE</b> $(\text{Cu},\text{Fe})_4\text{S}_4$	p. 315
<b>OBOYERITE</b> $\text{H}_6\text{Pb}_6(\text{TeO}_3)_3(\text{TeO}_6)_2 \cdot 2\text{H}_2\text{O}$	p. 315
<b>OFFRÉTITE</b> $\text{KCaMg}[\text{Al}_5\text{Si}_{13}\text{O}_{36}] \cdot 16\text{H}_2\text{O}$	p. 316
<b>OKENITE</b> $\text{Ca}_5\text{Si}_9\text{O}_{23} \cdot 9\text{H}_2\text{O}$	p. 316
<b>OLIVENITE</b> $\text{Cu}_2(\text{AsO}_4)(\text{OH})$	p. 316
Olivine is a group name	
<b>OMPHACITE</b> $(\text{Ca},\text{Na})(\text{Mg},\text{Fe},\text{Al})\text{Si}_2\text{O}_6$	p. 318
<b>OPAL</b> $\text{SiO}_2 \cdot n\text{H}_2\text{O}$ listed under Cristobalite	p. 192
<b>ORPIMENT</b> $\text{As}_2\text{S}_3$	p. 318
<b>ORTHOCLASE</b> $\text{KAlSi}_3\text{O}_8$	p. 318

**\*ORTHOSEPIERITE**

Calcium copper zinc sulfate hydroxide hydrate,  $\text{Ca}(\text{Cu},\text{Zn})_4(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$ .

Forms as a post-mining mineral.

*Pinal County*: formed from a surface seep about 50 meters from the adit of the Childs-Aldwinkle mine, Copper Creek district (Shannon, 1996). Mammoth district, Tiger as blue laths with cerussite (P. Haynes, pers. commun., 2003).

<b>OSARIZAWAITE</b> $\text{Pb}(\text{CuAl})_3(\text{SO}_4)_2(\text{OH})_6$	p. 319
<b>PALYGORSKITE</b> $(\text{Mg},\text{Al})_2\text{Si}_4\text{O}_{10}(\text{OH}) \cdot 4\text{H}_2\text{O}$	p. 319
<b>PAPAGOITE</b> $\text{CaCuAlSi}_2\text{O}_6(\text{OH})_3$	p. 319

**\*PARACOQUIMBITE**

Iron sulfate hydrate,  $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ . Found as a rare post-mining mineral.

*Cochise County*: Warren district, in the Campbell mine, as small bright pale violet crystals with coquimbite, voltaite, rhomboclase, and copiapite and from the Higgins mine, 100 level, as violet scepter growths to 0.5 mm in size with coquimbite and halotrichite (R.W. Graeme, pers. commun., 1999).

<b>PARAGONITE</b> $\text{NaAl}_2(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$	p. 320
<b>PARAKHINITE</b> $\text{Cu}_3\text{PbTeO}_6(\text{OH})_2$	p. 320
<b>PARALAURIONITE</b> $\text{PbCl}(\text{OH})$	p. 320
<b>PARAMELACONITE</b> $\text{Cu}_4\text{O}_3$	p. 320
<b>PARAMONTROSEITE</b> $\text{VO}_2$	p. 321
<b>PARAMMELSBERGITE</b> $\text{NiAs}_2$	p. 321
<b>PARATACAMITE</b> $\text{Cu}_2\text{Cl}(\text{OH})_3$	p. 321
<b>PARATELLURITE</b> $\text{TeO}_2$	p. 321
<b>PARGASITE</b> $\text{NaCa}_2(\text{Mg}_4\text{Al})\text{Si}_6\text{Al}_2\text{O}_{22}(\text{OH})_2$	p. 322
<b>PARISITE</b> $\text{Ca}(\text{Ce},\text{La})_2(\text{CO}_3)_3\text{F}_2$	p. 322



<b>PARNAUITE</b> $\text{Cu}_9(\text{AsO}_4)_2(\text{SO}_4)(\text{OH})_{10} \cdot 7\text{H}_2\text{O}$	p. 322
<b>PARSONSITE</b> $\text{Pb}_2(\text{UO}_2)(\text{PO}_4)_2$	p. 322
<b>PARTZITE</b> $\text{Cu}_2\text{Sb}(\text{O},\text{OH})_7$	p. 322
<b>PASCOITE</b> $\text{Ca}_3\text{V}_{10}\text{O}_{28} \cdot 17\text{H}_2\text{O}$	p. 323
<b>PAULKERRITE</b> $(\text{H}_2\text{O},\text{K})_2\text{Ti}(\text{Mg},\text{Mn})_2(\text{Fe},\text{Al})_2(\text{PO}_4)_4(\text{OH})_3 \cdot 14\text{H}_2\text{O}$	p. 323
<b>PEARCEITE</b> $(\text{Ag},\text{Cu})_{16}\text{As}_2\text{S}_{11}$	p. 323
<b>PECORAITE</b> $\text{Ni}_3\text{Si}_2\text{O}_5(\text{OH})_4$	p. 323

**PECTOLITE**  $\text{NaCa}_2\text{Si}_3\text{O}_8(\text{OH})$

*Cochise County*: Warren district, Lowell mine, 1200 level, 3 drift; pectolite was found here as radiating needle-like crystals to 4 mm with wollastonite, epidote, chlorite, quartz, and pyrite (Tenney, 1913). p. 324

**PEKOITE**  $\text{PbCuBi}_{11}\text{S}_{18}$  p. 324

**\*PENTAHYDRITE**

Magnesium sulfate hydrate,  $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$ . Occurs with efflorescent salts.

*Coconino County*: found as an efflorescent mineral in the Grand Canyon (Quick et al., 1989).

**PENTLANDITE**  $(\text{Fe},\text{Ni})_9\text{S}_8$  p. 324

**PERICLASE**  $\text{MgO}$  p. 325

**PERITE**  $\text{PbBiO}_2\text{Cl}$  p. 325

**PEROVSKITE**  $\text{CaTiO}_3$  p. 325

**PETZITE**  $\text{Ag}_3\text{AuTe}_2$  p. 325

**PHARMACOSIDERITE**  $\text{KFe}_4(\text{AsO}_4)_3(\text{OH})_4 \cdot 6-7\text{H}_2\text{O}$  p. 325

**PHILLIPSITE**  $(\text{K},\text{Na},\text{Ca}_{0.5})_9\text{Al}_9\text{Si}_{27}\text{O}_{72} \cdot \sim 24\text{H}_2\text{O}$  p. 326

**PHLOGOPITE**  $\text{KMg}_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$  p. 326

**PHOENICOCHROITE**  $\text{Pb}_2\text{O}(\text{CrO}_4)$  p. 327

**PHOSGENITE**  $\text{Pb}_2(\text{CO}_3)\text{Cl}_2$

*Cochise County*: Warren district, Cole Mine, 1100 level; Phosgenite was recognized on specimens from here as 5 mm colorless prismatic crystals on calcite with copper. The phosgenite from here could easily be confused with calcite, however, the calcite from this locality is highly fluorescent, while the phosgenite is not (R.W. Graeme, pers. commun., 2007). p. 327

**\*PHOSPHOHEDYPHANE**

Calcium lead phosphate chloride,  $\text{Ca}_2\text{Pb}_3(\text{PO}_4)_3\text{Cl}$ . A new mineral found at the Capitana mine, Copiapo, Atacama Province, Chile. It occurs in the oxidized zone of lead bearing deposits. It was found at sixteen additional localities including four in Arizona (Kampf et al., 2006).

*Cochise County*: found at the Great Eastern mine as colorless steep pyramids.  
*Maricopa County*: from the Tonopah-Belmont mine as colorless tapering prisms.  
*Pinal County*: Mammoth-St. Anthony mine, Tiger as yellow acicular crystals.  
*Santa Cruz County*: found at the Hardshell mine as clear yellow stout prisms.

<b>PHOSPHOSIDERITE</b> $\text{FePO}_4 \cdot 2\text{H}_2\text{O}$	p. 327
<b>PHOSPHURANYLITE</b> $\text{KCa}(\text{H}_3\text{O})_3(\text{UO}_2)_7(\text{PO}_4)_4\text{O}_4 \cdot 8\text{H}_2\text{O}$	p. 328
<b>PICKERINGITE</b> $\text{MgAl}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$	p. 328
<b>PIEMONTITE</b> $\text{Ca}_2(\text{Al,Mn,Fe})_3(\text{SiO}_4)_3(\text{OH})$	p. 328
<b>PIGEONITE</b> $(\text{Mg,Fe,Ca})(\text{Mg,Fe})\text{Si}_2\text{O}_6$	p. 328
<b>PINALITE</b> $\text{Pb}_3\text{WO}_5\text{Cl}_2$	p. 329
<b>PINTADOITE</b> $\text{Ca}_2\text{V}_2\text{O}_7 \cdot 9\text{H}_2\text{O}$	p. 329
Plagioclase see ALBITE and ANORTHITE	
<b>PLANCHÉITE</b> $\text{Cu}_8\text{Si}_8\text{O}_{22}(\text{OH})_4 \cdot \text{H}_2\text{O}$	p. 330
<b>PLATINUM</b> Pt	p. 330
<b>PLATTNERITE</b> $\text{PbO}_2$	p. 331
<b>PLUMBOGUMMITE</b> $\text{PbAl}_3(\text{PO}_4)_2(\text{OH,H}_2\text{O})_6$	p. 331
<b>PLUMBOJAROSITE</b> $\text{PbFe}_6(\text{SO}_4)_4(\text{OH})_{12}$	p. 331
<b>PLUMBONACRITE</b> $\text{Pb}_5(\text{CO}_3)_3\text{O}(\text{OH})_2$	p. 332
<b>PLUMBOTSUMITE</b> $\text{Pb}_5\text{Si}_4\text{O}_8(\text{OH})_{10}$	p. 332
<b>POLLUCITE</b> $(\text{Cs,Na})[\text{AlSi}_2\text{O}_6] \cdot n\text{H}_2\text{O}$	p. 332
<b>POLYBASITE</b> $(\text{Ag,Cu})_{16}\text{Sb}_2\text{S}_{11}$	p. 332
<b>POLYCRASE-(Y)</b> $(\text{Y,Ca,Ce,U,Th})(\text{Ti,Nb,Ta})_2\text{O}_6$	p. 333
<b>POLYHALITE</b> $\text{K}_2\text{Ca}_2\text{Mg}(\text{SO}_4)_4 \cdot 2\text{H}_2\text{O}$	p. 333
<b>POLYLITHIONITE</b> $\text{KLi}_2\text{AlSi}_4\text{O}_{10}\text{F}_2$	p. 333
<b>POSNJAKITE</b> $\text{Cu}_4(\text{SO}_4)(\text{OH})_6 \cdot \text{H}_2\text{O}$	p. 333
<b>POWELLITE</b> $\text{CaMoO}_4$	p. 334
<b>PREHNITE</b> $\text{Ca}_2\text{Al}_2\text{Si}_3\text{O}_{10}(\text{OH})_2$	p. 334
<b>PROSOPITE</b> $\text{CaAl}_2(\text{F,OH})_8$	p. 335
<b>PROUSTITE</b> $\text{Ag}_3\text{AsS}_3$	p. 335
<b>PSEUDOBOLÉITE</b> $\text{Pb}_{31}\text{Cu}_{24}\text{Cl}_{62}(\text{OH})_{48}$	p. 335
<b>PSEUDOBROOKITE</b> $\text{Fe}_2\text{TiO}_5$	p. 336
<b>PSEUDOGRANDREEFITE</b> $\text{Pb}_6(\text{SO}_4)\text{F}_{10}$	p. 336
<b>PSEUDOMALACHITE</b> $\text{Cu}_5(\text{PO}_4)_2(\text{OH})_4$	p. 336
<b>PUMPELLYITE</b> $\text{Ca}_2(\text{Fe,Mg})(\text{Al,Fe})_2\text{Si}_3(\text{O,OH})_{14}$	p. 339
<b>PURPURITE</b> $\text{MnPO}_4$	p. 340
<b>PYRARGYRITE</b> $\text{Ag}_3\text{SbS}_3$	p. 340
<b>PYRITE</b> $\text{FeS}_2$	p. 340

**\*PYROCHLORE**

Calcium sodium niobium oxide fluoride,  $(\text{Ca,Na})_2\text{Nb}_2\text{O}_6\text{F}$ . Formed in granite pegmatites.

*Yavapai County*: Outpost, Midnight Owl, and Picacho View mines, where it is found in the intermediate quartz and perthite zones (Jahns, 1952).

<b>PYROLUSITE</b> $MnO_2$	p. 342
<b>PYROMORPHITE</b> $Pb_5(PO_4)_3Cl$	p. 343
<b>PYROPE</b> $Mg_3Al_2(SiO_4)_3$	p. 344
<b>PYROPHYLLITE</b> $Al_2Si_4O_{10}(OH)_2$	p. 345
Pyroxene is a group name	
<b>PYRRHOTITE</b> $Fe_{1-x}S$	p. 345
<b>QUARTZ</b> $SiO_2$	p. 346
<b>QUEITITE</b> $Pb_4Zn_2(SiO_4)(Si_2O_7)(SO_4)$	p. 350
<b>QUETZALCOATLITE</b> $Cu_3Zn_6(TeO_3)_2O_6(Ag_xPb_y)Cl_{x+2y}$	p. 350
<b>RALSTONITE</b> $Na_xMg_xAl_{2-x}(F,OH)_6 \cdot H_2O$	p. 350
<b>RAMEAUITE</b> $K_2CaU_6O_{20} \cdot 9H_2O$	p. 351
<b>RAMMELSBERGITE</b> $NiAs_2$	p. 351

**\*RAMSBECKITE**

Copper zinc sulfate hydroxide hydrate,  $(Cu,Zn)_{15}(SO_4)_4(OH)_{22} \cdot 6H_2O$ . Forms from the recent weathering of copper and zinc minerals.

*Gila County*: found in the 79 mine (R. Downs, pers. commun., 2006).

<b>RAMSDELLITE</b> $MnO_2$	p. 351
<b>RANCIÉITE</b> $(Ca,Mn)Mn_4O_9 \cdot 3H_2O$	p. 351
<b>RANSOMITE</b> $CuFe_2(SO_4)_4 \cdot 6H_2O$	p. 352
<b>RAUVITE</b> $Ca(UO_2)_2V_{10}O_{28} \cdot 16H_2O$	p. 352
<b>REALGAR</b> $As_4S_4$	p. 352

**\*RECTORITE**

A clay mineral, 1:1 regular interstratification of a dioctahedral mica and a trioctahedral smectite. Forms as a low-temperature alteration mineral.

*Cochise County*: from Kartchner Caverns southwest of Benson (Hill, 1999).

<b>REEVESITE</b> $Ni_6Fe_2(CO_3)(OH)_{16} \cdot 4H_2O$	p. 353
--	--------

**\*REICHENBACHITE**

Copper phosphate hydroxide,  $Cu_5(PO_4)_2(OH)_4$ . Found as a rare secondary copper mineral in oxide zones.

*Yavapai County*: from the Binghampton mine with libethenite (R. Thomssen, pers. commun., 2000).

<b>RHODOCHROSITE</b> $MnCO_3$	p. 353
<b>RHODONITE</b> $CaMn_4Si_5O_{15}$	p. 354

<b>RHODOSTANNITE</b> $\text{Cu}_2\text{FeSn}_3\text{S}_8$	p. 354
<b>RHOMBOCLASE</b> $\text{HFe}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$	p. 354
<b>RICHTERITE</b> $\text{Na}(\text{CaNa})\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$	p. 354
<b>RICKARDITE</b> $\text{Cu}_{3-x}\text{Te}_2$	p. 355
<b>RIEBECKITE</b> $\text{Na}_2\text{Fe}_3\text{Fe}_2\text{Si}_8\text{O}_{22}(\text{OH})_2$	p. 355
<b>ROALDITE</b> $\text{Fe}_4\text{N}$	p. 355
<b>ROBERTSITE</b> $\text{Ca}_2\text{Mn}_3(\text{PO}_4)_3\text{O}_2 \cdot 3\text{H}_2\text{O}$	p. 355
<b>RODALQUILARITE</b> $\text{H}_3\text{Fe}_2(\text{TeO}_3)_4\text{Cl}$	p. 355
<b>ROEDDERITE</b> $\text{NaK}(\text{Mg},\text{Fe})_5\text{Si}_{12}\text{O}_{30}$	p. 356
<b>ROMANÈCHITE</b> $(\text{Ba},\text{H}_2\text{O})_2(\text{Mn})_5\text{O}_{10}$	p. 337
<b>ROMÉITE</b> $(\text{Ca},\text{Fe},\text{Mn},\text{Na})_2(\text{Sb},\text{Ti})_2\text{O}_6$ (O,OH,F) listed as lewisite	p. 276
<b>RÖMERITE</b> $\text{Fe}_3(\text{SO}_4)_4 \cdot 14\text{H}_2\text{O}$	p. 356
<b>ROSASITE</b> $(\text{Cu},\text{Zn})_2(\text{CO}_3)(\text{OH})_2$	p. 356
<b>ROSCOELITE</b> $\text{KV}_2\text{AlSi}_3\text{O}_{10}(\text{OH})_2$	p. 357
<b>ROSSITE</b> $\text{CaV}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$	p. 357
<b>ROZENITE</b> $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$	p. 357
<b>RUCKLIDGEITE</b> $(\text{Bi},\text{Pb})_3\text{Te}_4$	p. 358
<b>RUIZITE</b> $\text{Ca}_2\text{Mn}_2\text{Si}_4\text{O}_{11}(\text{OH})_4 \cdot 2\text{H}_2\text{O}$	p. 358
<b>RUTILE</b> $\text{TiO}_2$	p. 358
<b>SABUGALITE</b> $\text{H}_{0.5}\text{Al}_{0.5}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$	p. 359
<b>SALÉEITE</b> $\text{Mg}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 10\text{H}_2\text{O}$	p. 360
<b>SAMARSKITE-(Y)</b> $(\text{Y},\text{Ce},\text{Fe},\text{U},\text{Th},\text{Ca})(\text{Nb},\text{Ta},\text{Ti})\text{O}_4$	p. 360
<b>SANADINE</b> $(\text{K},\text{Na})\text{AlSi}_3\text{O}_8$	p. 360
<b>SANTAFEITE</b> $\text{Na}_3\text{Mn}_4(\text{VO}_4)_4(\text{OH})_3 \cdot 2\text{H}_2\text{O}$	p. 361
<b>SAPONITE</b> $(\text{Ca}/2,\text{Na})_{0.3}(\text{Mg},\text{Fe})_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$	p. 361
<b>SAPPHIRINE</b> $(\text{Mg},\text{Al})_8(\text{Al},\text{Si})_6\text{O}_{20}$	p. 361
<b>SAUCONITE</b> $\text{Na}_{0.3}\text{Zn}_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$	p. 361
<b>SCAWTITE</b> $\text{Ca}_7\text{Si}_6\text{O}_{18}(\text{CO}_3) \cdot 2\text{H}_2\text{O}$	p. 362
<b>SCHEELITE</b> $\text{CaWO}_4$	p. 362
<b>SCHIEFFELINITE</b> $\text{Pb}(\text{Te},\text{S})\text{O}_4 \cdot \text{H}_2\text{O}$	p. 364

**\*SCHMIEDERITE**

Lead copper selenite selenate hydroxide,  $\text{Pb}_2\text{Cu}_2(\text{SeO}_3)(\text{SeO}_4)(\text{OH})_4$ . A rare secondary mineral.

*Maricopa County*: collected from the main vein at the Tonopah-Belmont mine (R. Thomssen and J. Marty, pers. commun., 2001).

<b>SCHOEPITE</b> $(\text{UO}_2)_8\text{O}_2(\text{OH})_{12} \cdot 12\text{H}_2\text{O}$	p. 364
<b>SCHORL</b> $\text{NaFe}_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$	p. 364
<b>SCHREIBERSITE</b> $(\text{Fe},\text{Ni})_3\text{P}$	p. 364
<b>SCHRÖCKINGERITE</b> $\text{NaCa}_3(\text{UO}_2)(\text{CO}_3)_3(\text{SO}_4)\text{F} \cdot 10\text{H}_2\text{O}$	p. 364
<b>SCHUBNELITE</b> $\text{FeVO}_4 \cdot \text{H}_2\text{O}$	p. 365

**SCOLECITE**  $\text{CaAl}_2\text{Si}_3\text{O}_{10}\cdot 3\text{H}_2\text{O}$  p. 365  
**SCORODITE**  $\text{FeAsO}_4\cdot 2\text{H}_2\text{O}$  p. 365

**SCORZALITE**  $(\text{Fe},\text{Mg})\text{Al}_2(\text{PO}_4)_2(\text{OH})_2$   
Lavender Pit mine Holbrook extension; tiny amounts of pale blue scorzalite were noted in massive variscite in specimens from this area of the pit (Rob Bowell, personal communication 2004). Minor pickeringite was associated with this material as well (R.W. Graeme, pers. commun., 2007). p. 365

**SELENIUM** Se p. 366  
**SENGIERITE**  $\text{Cu}(\text{UO}_2)_2(\text{VO}_4)_2\cdot 6\text{H}_2\text{O}$  p. 366  
**SEPIOLITE**  $\text{Mg}_4\text{Si}_6\text{O}_{15}(\text{OH})_2\cdot 6\text{H}_2\text{O}$  p. 366  
**SERPIERITE**  $\text{Ca}(\text{Cu},\text{Zn})_4(\text{SO}_4)_2(\text{OH})_6\cdot 3\text{H}_2\text{O}$  p. 368

**\*SHANNONITE**

Lead oxide carbonate,  $\text{Pb}_2\text{OCO}_3$ . A secondary mineral formed by the heating of cerussite. The Grand Reef mine is the type locality.

*Graham County*: found at the Grand Reef mine as white porcellaneous masses with plumbojarosite, hematite, quartz, litharge, massicot, hydrocerussite and minium (Roberts, et al., 1995).

*Maricopa County*: found in the main entrance to the Tonopah-Belmont mine as the result of a mine fire.

*Pinal County*: Pioneer district, Black Prince (Olsen) mine from a fire (W. Hunt, pers. commun., 1990).

**SHATTUCKITE**  $\text{Cu}_5(\text{Si}_2\text{O}_6)_2(\text{OH})_2$  p. 369  
**SHERWOODITE**  $\text{Ca}_9\text{Al}_2\text{V}_{28}\text{O}_{80}\cdot 56\text{H}_2\text{O}$  p. 370  
**SICKLERITE**  $\text{Li}(\text{Mn},\text{Fe})\text{PO}_4$  p. 370  
**SIDERITE**  $\text{FeCO}_3$  p. 370  
**SIDEROTIL**  $\text{Fe}(\text{SO}_4)\cdot 5\text{H}_2\text{O}$  p. 371  
**SIEGENITE**  $\text{CoNi}_2\text{S}_4$  p. 371  
**SILLIMANITE**  $\text{Al}_2\text{SiO}_5$  p. 371  
**SILVER** Ag p. 372  
**SKUTTERUDITE**  $\text{CoAs}_3$  p. 373  
**SMITHSONITE**  $\text{ZnCO}_3$  p. 374

**\*SODDYITE**

Uranyl silicate hydrate,  $(\text{UO}_2)_2\text{SiO}_4\cdot 2\text{H}_2\text{O}$ . A secondary mineral formed from the alteration of uraninite.

*Yavapai County*: from the Steel City mine with kasolite and uranium rich thorite (Fron del, 1958).



<b>SODIUM-ZIPPEITE</b> $\text{Na}_4(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10}\cdot 4\text{H}_2\text{O}$	p. 375
<b>SONORAITE</b> $\text{FeTeO}_3(\text{OH})\cdot \text{H}_2\text{O}$	p. 375
<b>SPANGOLITE</b> $\text{Cu}_6\text{Al}(\text{SO}_4)(\text{OH})_{12}\text{Cl}\cdot 3\text{H}_2\text{O}$	p. 375
<b>SPERTINIITE</b> $\text{Cu}(\text{OH})_2$	p. 376
<b>SPESSARTINE</b> $\text{Mn}_3\text{Al}_2(\text{SiO}_4)_3$	p. 376
<b>SPHAEROCOBALTITE</b> $\text{CoCO}_3$	p. 376
<b>SPHALERITE</b> $\text{ZnS}$	p. 376
<b>SPINEL</b> $\text{MgAl}_2\text{O}_4$	p. 378
<b>SPIONKOPITE</b> $\text{Cu}_{39}\text{S}_{28}$	p. 379
<b>SPIROFFITE</b> $(\text{Mn},\text{Zn})\text{Te}_3\text{O}_8$	p. 379
<b>SPODUMENE</b> $\text{LiAlSi}_2\text{O}_6$	p. 379

**\*SRILANKITE**

Titanium zirconium oxide,  $(\text{Ti},\text{Zr})\text{O}_2$ . Found as inclusions in other zirconium minerals and pyrope garnets.

*Apache County*: found in an ultramafic diatreme at Garnet Ridge on the Navajo Reservation. It occurs as inclusions in pyrope crystals collected from surface concentrates. These pyropes also contain carmichaelite, rutile, spinel, minerals of the crichtonite group, and olivine (Wang et al., 2000).

<b>STANNITE</b> $\text{Cu}_2\text{FeSnS}_4$	p. 379
<b>STANNOIDITE</b> $\text{Cu}_8(\text{Fe},\text{Zn})_3\text{Sn}_2\text{S}_{12}$	p. 379
<b>STARKEYITE</b> $\text{MgSO}_4\cdot 4\text{H}_2\text{O}$	p. 380
<b>STAUROLITE</b> $(\text{Fe},\text{Mg},\text{Zn})_{3-4}(\text{Al},\text{Fe})_{18}(\text{Si},\text{Al})_8\text{O}_{48}\text{H}_{2-4}$	p. 380
<b>STEIGERITE</b> $\text{AlVO}_4\cdot 3\text{H}_2\text{O}$	p. 380
<b>STELLERITE</b> $\text{Ca}_4\text{Al}_8\text{Si}_{28}\text{O}_{72}\cdot 28\text{H}_2\text{O}$	p. 380
<b>STEPHANITE</b> $\text{Ag}_5\text{SbS}_4$	p. 380
<b>STERNBERGITE</b> $\text{AgFe}_2\text{S}_3$	p. 381
<b>STETEFELDTITE</b> $\text{Ag}_2\text{Sb}_2\text{O}_5(\text{OH})_2$	p. 381
<b>STEVENSITE</b> $(\text{Ca}/2)_{0.3}\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$	p. 381
<b>STEWARTITE</b> $\text{MnFe}_2(\text{PO}_4)_2(\text{OH})_2\cdot 8\text{H}_2\text{O}$	p. 381
<b>STIBICONITE</b> $\text{Sb}_3\text{O}_6(\text{OH})$	p. 381
<b>STIBNITE</b> $\text{Sb}_2\text{S}_3$	p. 382
<b>STILBITE</b> $(\text{Na},\text{K},\text{Ca}_{0.5})_9[\text{Al}_9\text{Si}_{27}\text{O}_{72}]\cdot 28\text{H}_2\text{O}$	p. 382
<b>STILPNOMELANE</b> $\text{K}(\text{Fe},\text{Mg})_8(\text{Si},\text{Al})_{12}(\text{O},\text{OH})_{27}$	p. 383
<b>STISHOVITE</b> $\text{SiO}_2$	p. 383
<b>STOLZITE</b> $\text{PbWO}_4$	p. 383

**\*STRACZEKITE**

Calcium potassium barium vanadium oxide hydrate,  $(\text{Ca},\text{K},\text{Ba})_2\text{V}_8\text{O}_{20}\cdot 3\text{H}_2\text{O}$ . A secondary mineral found in oxidized portions of vanadium or uranium-vanadium deposits.

*Apache County*: Monument No. 2 mine, found on Harvard Mineralogical Museum specimen 105103, (Evans and Hughes, 1990).

<b>STRENGITE</b> $\text{FePO}_4 \cdot 2\text{H}_2\text{O}$	p. 384
<b>STRINGHAMITE</b> $\text{CaCuSiO}_4 \cdot \text{H}_2\text{O}$	p. 384
<b>STROMEYERITE</b> $\text{AgCuS}$	p. 385
<b>STRONTIANITE</b> $\text{SrCO}_3$	p. 385
<b>STÜTZITE</b> $\text{Ag}_{5-x}\text{Te}_3$	p. 385
<b>SULFUR</b> S	p. 386

**\*SURITE**

Lead calcium aluminum iron magnesium silicate hydroxide carbonate,  
 $\text{Pb}(\text{Pb},\text{Ca})(\text{Al},\text{Fe},\text{Mg})_2(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2(\text{CO}_3)_2$ .

A very rare secondary mineral found in oxidized lead-zinc deposits.

*Pinal County*: Mammoth district, Mammoth-St. Anthony mine (J. Ruiz, pers. commun., 2005).

<b>SVANBERGITE</b> $\text{SrAl}_3[(\text{P},\text{S})\text{O}_4]_2(\text{OH},\text{H}_2\text{O})_6$	p. 386
<b>SWARTZITE</b> $\text{CaMg}(\text{UO}_2)(\text{CO}_3)_3 \cdot 12\text{H}_2\text{O}$	p. 387
<b>SWITZERITE</b> $(\text{Mn}^{2+},\text{Fe}^{2+})_3(\text{PO}_4)_2 \cdot 7\text{H}_2\text{O}$	p. 387
<b>SYLVANITE</b> $\text{Au},\text{AgTe}_4$	p. 387
<b>SYLVITE</b> KCl	p. 387
<b>SZOMOLNOKITE</b> $\text{FeSO}_4 \cdot \text{H}_2\text{O}$	p. 388
Taenite see IRON	p. 388
<b>TALC</b> $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$	p. 388
<b>TALMESSITE</b> $\text{Ca}_2\text{Mg}(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$	p. 389
<b>TANGEITE</b> $\text{CaCu}(\text{VO}_4)(\text{OH})$ listed as calciovolborthite	p. 150
<b>TANTALITE</b> $(\text{Fe},\text{Mn})(\text{Ta},\text{Nb})_2\text{O}_6$	p. 389
<b>TEINEITE</b> $\text{CuTeO}_3 \cdot 2\text{H}_2\text{O}$	p. 389
<b>TELLURITE</b> $\text{TeO}_2$	p. 389
<b>TELLURIUM</b> Te	p. 389
<b>TELLUROBISMUTHINITE</b> $\text{Bi}_2\text{Te}_3$	p. 390
<b>TENNANTITE</b> $\text{Cu}_{10}(\text{Fe},\text{Zn})_2(\text{As},\text{Sb})_4\text{S}_{13}$	p. 390
<b>TENORITE</b> $\text{CuO}$	p. 391
<b>TEPHROITE</b> $\text{Mn}_2\text{SiO}_4$	p. 392
<b>TETRADYMITE</b> $\text{Bi}_2\text{Te}_2\text{S}$	p. 392
<b>TETRAHEDRITE</b> $\text{Cu}_{10}(\text{Fe},\text{Zn})_2(\text{Sb},\text{As})_4\text{S}_{13}$	p. 392
<b>TETRATAENITE</b> $\text{FeNi}$	p. 394
<b>THALÉNITE-(Y)</b> $\text{Y}_3\text{Si}_3\text{O}_{10}(\text{OH})$	p. 394
<b>THAUMASITE</b> $\text{Ca}_6\text{Si}_2(\text{CO}_3)_2(\text{SO}_4)_2(\text{OH})_{12} \cdot 24\text{H}_2\text{O}$	p. 394
<b>THENARDITE</b> $\text{Na}_2\text{SO}_4$	p. 394
<b>THOMSONITE</b> $\text{NaCa}_2\text{Al}_5\text{Si}_5\text{O}_{20} \cdot 6\text{H}_2\text{O}$	p. 395

<b>THORITE</b> (Th,U)SiO <sub>4</sub>	p. 395
<b>TILASITE</b> CaMg(AsO <sub>4</sub> )F	p. 396
<b>TINZENITE</b> CaMn <sub>2</sub> Al <sub>2</sub> BO(Si <sub>2</sub> O <sub>7</sub> ) <sub>2</sub> (OH)	p. 396
<b>TITANITE</b> CaTiOSiO <sub>4</sub>	p. 396
<b>TLAPALLITE</b> H <sub>6</sub> (Ca,Pb) <sub>2</sub> (Cu,Zn) <sub>3</sub> (SO <sub>4</sub> )(TeO <sub>3</sub> ) <sub>4</sub> (TeO <sub>6</sub> )	p. 397
<b>TOBERMORITE</b> Ca <sub>4-5</sub> Si <sub>6</sub> O <sub>15</sub> (O,OH) <sub>2</sub> ·5H <sub>2</sub> O	p. 397
Tocornallite (Ag,Hg)I(?) a questionable species	p. 397
<b>TODOROKITE</b> (Mn,Ca,Mg)Mn <sub>3</sub> O <sub>7</sub> ·H <sub>2</sub> O	p. 398
<b>TOLBACHITE</b> CuCl <sub>2</sub>	p. 398
<b>TOPAZ</b> Al <sub>2</sub> SiO <sub>4</sub> (F,OH) <sub>2</sub>	p. 398
<b>TORBERNITE</b> Cu(UO <sub>2</sub> ) <sub>2</sub> (PO <sub>4</sub> ) <sub>2</sub> ·8-12H <sub>2</sub> O	p. 399
Tourmaline is a group name	
<b>TREMOLITE</b> Ca <sub>2</sub> Mg <sub>5</sub> Si <sub>8</sub> O <sub>22</sub> (OH) <sub>2</sub>	p. 401
<b>TRIDYMITE</b> SiO <sub>2</sub>	p. 402
<b>TRIPHYLITE</b> LiFePO <sub>4</sub>	p. 402
<b>TRIPLITE</b> (Mn,Fe) <sub>2</sub> (PO <sub>4</sub> )F	p. 402
<b>TRIPLOIDITE</b> Mn <sub>2</sub> (PO <sub>4</sub> )(OH)	p. 403
<b>TROILITE</b> FeS	p. 403
<b>TSCHERMAKITE</b> Ca <sub>2</sub> (Mg <sub>3</sub> AlFe)(Si <sub>6</sub> Al <sub>2</sub> )O <sub>22</sub> (OH) <sub>2</sub>	p. 403
<b>TSUMEBITE</b> Pb <sub>2</sub> Cu(PO <sub>4</sub> )(SO <sub>4</sub> )(OH)	p. 403
<b>TUNGSTITE</b> WO <sub>3</sub> ·H <sub>2</sub> O	p. 404
<b>TURQUOISE</b> CuAl <sub>6</sub> (PO <sub>4</sub> ) <sub>4</sub> (OH) <sub>8</sub> ·4H <sub>2</sub> O	p. 404

**TYROLITE** CaCu<sub>5</sub>(AsO<sub>4</sub>)<sub>2</sub>(CO<sub>3</sub>)(OH)<sub>4</sub>·6H<sub>2</sub>O:

*Cochise County:* Tyrolite was confirmed on a single specimen by Anthony J. Nikischer (personal communication, 2005) as sprays of 3 mm crystals on goethite with azurite and malachite. No information on the exact location at Bisbee was available (R.W. Graeme, pers. commun., 2007).

p. 405

**TYUYAMUNITE** Ca(UO<sub>2</sub>)<sub>2</sub>V<sub>2</sub>O<sub>8</sub>·5-8H<sub>2</sub>O p. 405

**ULVÖSPINEL** TiFe<sub>2</sub>O<sub>4</sub> p. 406

**UMOHOITE** [(UO<sub>2</sub>)MoO<sub>4</sub>(H<sub>2</sub>O)](H<sub>2</sub>O) p. 406

**URANINITE** UO<sub>2</sub> p. 406

**URANOCIRCITE** Ba(UO<sub>2</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>·12H<sub>2</sub>O p. 407

**URANOPHANE** Ca(UO<sub>2</sub>)<sub>2</sub>[SiO<sub>3</sub>(OH)]<sub>2</sub>·5H<sub>2</sub>O p. 407

**URANOPHANE-BETA** Ca(UO<sub>2</sub>)<sub>2</sub>[SiO<sub>3</sub>(OH)]<sub>2</sub>·5H<sub>2</sub>O p. 408

**\*URANOPILITE**

Uranium oxide sulfate hydroxide hydrate, (UO<sub>2</sub>)<sub>6</sub>(SO<sub>4</sub>)(OH)<sub>10</sub>·12H<sub>2</sub>O. A rare secondary uranium mineral.

*Cochise County:* Cole mine, Warren district. It was found as a post-mining efflorescence with gypsum and minor zippeite and johannite (R.W. Graeme, pers.

commun., 1999).

*Navajo County*: Big Chief mine, Monument Valley (Shirley Wetmore, pers. commun., 1999).

<b>URANOSPINITE</b> $\text{Ca}(\text{UO}_2)_2(\text{AsO}_4)_2 \cdot 10\text{H}_2\text{O}$	p. 408
<b>UVANITE</b> $\text{U}_2\text{V}_6\text{O}_{21} \cdot 15\text{H}_2\text{O} (?)$	p. 408
<b>UVAROVITE</b> $\text{Ca}_3\text{Cr}_2(\text{SiO}_4)_3$	p. 409
<b>UYTENBOGAARDTITE</b> $\text{Ag}_3\text{AuS}_2$	p. 409
<b>VAESITE</b> $\text{NiS}_2$	p. 409
<b>VALLERIITE</b> $4(\text{Fe,Cu})\text{S} \cdot 3(\text{Mg,Al})(\text{OH})_2$	p. 409
<b>VANADINITE</b> $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$	p. 409
<b>VANDENDRIESSCHEITE</b> $\text{Pb}_{1.5}(\text{UO}_2)_{10}\text{O}_6(\text{OH})_{11} \cdot 11\text{H}_2\text{O}$	p. 411
<b>VANMEERSSCHEITE</b> $\text{U}(\text{UO}_2)_3(\text{PO}_4)_2(\text{OH})_6 \cdot 4\text{H}_2\text{O}$	p. 412
<b>VANOXITE</b> $\text{V}_6\text{O}_{13} \cdot 8\text{H}_2\text{O} (?)$	p. 412
<b>VARISCITE</b> $\text{AlPO}_4 \cdot 2\text{H}_2\text{O}$	p. 412
<b>VATERITE</b> $\text{CaCO}_3$	p. 412
<b>VAQUELINITE</b> $\text{Pb}_2\text{Cu}(\text{CrO}_4)(\text{PO}_4)(\text{OH})$	p. 412
<b>VELIKITE</b> $\text{Cu}_2\text{HgSnS}_4$	p. 413
<b>VERMICULITE</b> $(\text{Mg,Fe,Al})_3(\text{Al,Si})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$	p. 413
<b>VÉSIGNIÉITE</b> $\text{BaCu}_3(\text{VO}_4)_2(\text{OH})_2$	p. 413
<b>VESUVIANITE</b> $\text{Ca}_{19}(\text{Al,Mg,Fe})_{13}\text{Si}_{18}\text{O}_{68}(\text{OH,O,F})_{10}$	p. 414
<b>VIVIANITE</b> $\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$	p. 415
<b>VOGLITE</b> $\text{Ca}_2\text{Cu}(\text{UO}_2)(\text{CO}_3)_4 \cdot 6\text{H}_2\text{O} (?)$	p. 415
<b>VOLBORTHITE</b> $\text{Cu}_3\text{V}_2\text{O}_7(\text{OH})_2 \cdot 2\text{H}_2\text{O}$	p. 415
<b>VOLKONSKOITE</b> $\text{Ca}_{0.3}(\text{Cr,Mg,Fe})_2(\text{Si,Al})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$	p. 415
<b>VOLTAITE</b> $\text{K}_2\text{Fe}_8(\text{SO}_4)_{12} \cdot 18\text{H}_2\text{O}$	p. 415
<b>VOLYNSKITE</b> $\text{AgBiTe}_2$	p. 416

**\*WAGNERITE**

Magnesium iron phosphate fluoride,  $(\text{Mg,Fe})_2(\text{PO}_4)\text{F}$ . Found as a rare accessory mineral in metamorphic rocks.

*Yuma County*: from the west side of the Dome Rock Mountains in a kyanite quartzite with rutile, lazulite and topaz (Marsh and Sheridan, 1976).

**WAKEFIELDITE-(Y)**  $\text{YVO}_4$  p. 417

**WAVELLITE**  $\text{Al}_3(\text{PO}_4)_2(\text{OH,F})_3 \cdot 5\text{H}_2\text{O}$  p. 417

**\*WEDDELLITE**

Calcium oxalate hydrate,  $\text{Ca}(\text{C}_2\text{O}_4) \cdot 2\text{H}_2\text{O}$ . Found in calcareous lake-bottom sediments and biological material such as lichens and saguaros.

*Maricopa County*: found in decaying saguaro cacti in the Gila Bend Mountains (Garvie, 2003).

<b>WEEKSITE</b> $(K,Na)_2(UO_2)_2(Si_5O_{13}) \cdot 3H_2O$	p. 418
<b>WEISSITE</b> $Cu_{2-x}Te$	p. 418
Whelanite is not a confirmed species (see appendix 3)	p. 418
<b>WHERRYITE</b> $Pb_7Cu_2(SO_4)_4(SiO_2)_4(OH)_2$	p. 419
<b>WHEWELLITE</b> $CaC_2O_4 \cdot H_2O$	p. 419
<b>WICKENBURGITE</b> $Pb_3Al_2CaSi_{10}O_{27}(H_2O)_3$	p. 419
<b>WILLEMITE</b> $Zn_2SiO_4$	p. 420
<b>WINSTANLEYITE</b> $TiTe_3O_8$	p. 421
<b>WITHERITE</b> $BaCO_3$	p. 421
<b>WITTICHENITE</b> $Cu_3BiS_3$	p. 422
<b>WITTITE</b> $Pb_{12}Bi_{14}(S,Se)_{33}$	p. 422
<b>WOLLASTONITE</b> $CaSiO_3$	p. 424
<b>WOODWARDITE</b> $Cu_4Al_2(SO_4)(OH)_{12} \cdot 2-4H_2O(?)$	p. 424
<b>WULFENITE</b> $PbMoO_4$	p. 425

**\*WUPATKIITE**

Cobalt magnesium nickel aluminum sulfate hydrate,

$(Co,Mg,Ni)Al_2(SO_4)_4 \cdot 22H_2O$ . Forms as a post-mining incrustation. The Arizona occurrence is the type locality.

*Coconino County* : from the Cameron uranium district in a shallow open cut eight miles ESE of Gray Mountain. It is found as a post-mine incrustation which has formed a concrete-like crust on the walls of the open cut with pickeringite (Williams and Cesbron, 1995).

<b>WURTZITE</b> $(Zn,Fe)S$	p. 427
<b>WÜSTITE</b> $FeO$	p. 427
<b>WYLLIEITE</b> $Na_2(Mg,Fe)_2Al(PO_4)_3$	p. 427
<b>XENTIME-(Y)</b> $YPO_4$	p. 427
<b>XOCOMECATLITE</b> $Cu_3(TeO_4)(OH)_4$	p. 428
<b>XONOTLITE</b> $Ca_6Si_6O_{17}(OH)_2$	p. 428
<b>YAFSOANITE</b> $Zn_3Ca_3(TeO_6)_2$	p. 428
<b>YARROWITE</b> $Cu_9S_8$	p. 428
<b>YAVAPAIITE</b> $KFe(SO_4)_2$	p. 428
<b>YEDLINITE</b> $Pb_6CrCl_6(O,OH)_8$	p. 429
<b>YITTROTANTALITE-(Y)</b> $(Y,Ca,Fe)(Ta,Nb)O_4$	p. 429
<b>ZEUNERITE</b> $Cu(UO_2)_2(AsO_4)_2 \cdot 10-16H_2O$	p. 429
<b>ZINCITE</b> $(Zn,Mn)O$	p. 429
<b>ZINCOBOTRYOGEN</b> $(Zn,Mg,Mn)Fe(SO_4)_2(OH) \cdot 7H_2O$	p. 430



**\*ZINCOCOPIAPITE**

Zinc iron sulfate hydroxide hydrate,  $\text{ZnFe}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$ . Formed as a post mining mineral.

*Cochise County*: tunnel level, Higgins mine, Warren district. Found as a post-mining mineral with copiapite, melanterite, and romerite on sphalerite and pyrite ore (R.W. Graeme, pers. commun., 1999).

<b>ZINC-ZIPPEITE</b> $\text{Zn}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$	p. 430
<b>ZINNWALDITE</b> $\text{K}(\text{Li},\text{Fe},\text{Al})_3(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH},\text{F})_2$	p. 430
<b>ZIPPEITE</b> $\text{K}(\text{UO}_2)_2(\text{SO}_4)(\text{OH})_3 \cdot \text{H}_2\text{O}$	p. 430
<b>ZIRCON</b> $\text{ZrSiO}_4$	p. 431
<b>ZOISITE</b> $\text{Ca}_2\text{Al}_3\text{Si}_3\text{O}_{12}(\text{OH})$	p. 432
<b>ZUNYITE</b> $\text{Al}_{13}\text{Si}_5\text{O}_{20}(\text{OH})_{14}\text{F}_4\text{Cl}$	p. 432

## Bibliography

- Anthony, J.W., S.A. Williams, R.A. Bideaux, and R.W. Grant (1995) *Mineralogy of Arizona*. University of Arizona Press, Tucson, 508 pp.
- Anthony, J.W., R.A. Bideaux, K.W. Bladh, M.C. Nichols (2000) *Handbook of Mineralogy Volume IV*. Mineral Data Publishing, Tucson, 680 pp.
- Bastin, E. S. (1922) Primary native-silver ores near Wickenburg, Arizona, and their bearing on the genesis of the silver ores of Cobalt, Ontario. *U.S. Geol. Surv. Bull.* 735:101-112.
- Burke, E.A.J. (2006) A mass discreditation of GQN minerals. *Can. Min.* 44: 1557-1560
- Conway, Clay, J.R. Hassemer,, D.H. Knepper, J.A. Pitkin, R.C. Jachens (1990) Mineral Resources of the Wabayuma Study Area, Mohave County, Arizona in Grey, Floyd, et al. (1990) *U.S. Geol. Surv. Bull.* 1757-E.
- Evans, H. and J. Hughes (1990) Crystal chemistry of the natural vanadium bronzes. *Amer. Min.*, 75: 508-521.
- Fron del, C. (1958) Systematic Mineralogy of Uranium and Thorium. *U.S. Geol. Surv. Bull.* 1064: 400pp.
- Frost, R.L., P.A. Williams, W. Martens, P. Leverett, and J.T. Kloprogge (2004) Ramon spectroscopy of basic copper(II) and some complex copper(II) sulfate minerals: Implications for hydrogen bonding. *Amer. Min.* 89:1130-1137.
- Garvie, L.A.J. (2003) Decay-induced biomineralization of the saguaro cactus (*Carnegiea gigantea*). *Amer. Min.* 88:1879-1888.
- Giester, G. and B. Rieck (1996) Bechererite,  $(\text{Zn,Cu})_6\text{Zn}_2(\text{OH})_{13}[(\text{S,Si})(\text{O,OH})_4]_2$  a novel mineral species from the Tonopah-Belmont mine, Arizona. *Amer. Min.* 81: 244-248.
- Grant, R.W. (1982) Checklist of Arizona Minerals. Special Paper 1 Mineralogical Society of Arizona, Phoenix, 78pp.
- Hanson, S.L., A.U. Falster, and W. B. Simmons (2000) Mineralogy of fumarole deposits from Sunset Crater Volcano, Northern Arizona. Abstracts of the 27<sup>th</sup> Rochester Mineralogical Symposium, p. 9.

- Hill, C.A. (1999) Mineralogy of Kartchner Caverns, Arizona. *Jour. Cave and Karst Studies* 61(2):73-78.
- Jahns, R.H. (1952) Pegmatite deposits of the White Picacho district, Maricopa and Yavapai Counties, Arizona. *Ariz. Bur. Mines Bull.* 162: 105p.
- Kampf, A. and E.E. Foord (1996) Calcioaravaipaite a new mineral and associated lead fluoride minerals from the Grand Reef mine, Graham County, Arizona. *Mineral. Record* 27: 293-300.
- Kampf, A., Ian Steele, and Robert Jenkins (2006) Phosphohedyphane  $\text{Ca}_2\text{Pb}_3(\text{PO}_4)_3\text{Cl}$ , the phosphate analog of hedyphane: Description and crystal structure. *Amer. Min.* 91:1909-1917.
- Krause, W., U. Kolitsch, H.J. Bernhardt, H. Effenberger (2003) Duhamelite discredited. *Neues Jarhb. Mineral. Mon.*, 75: 96.
- Marsh, S.P. and D.M. Sheridan (1976) Rutile in Precambrian sillimanite-quartz gneiss and related rocks, east-central Front Range, Colorado. *U.S. Geol. Surv. Prof. Paper* 959-G:15.
- Quick, T.J., R.G. Corbett, and B.M. Manner (1989) Efflorescent minerals occurring in the gorge of the Grand Canyon. *Abs. with Programs, Geol. Soc. Am.* 21(4): 44-45.
- Roberts, A.C., J.A.R. Stirling, G.J.C. Carpenter, A.J. Criddle, G.C. Jones, T.C. Birkett, and W.D. Birch (1995) Shannonite,  $\text{Pb}_2\text{OCO}_3$ , a new mineral from the Grand Reef mine, Graham County, Arizona, USA. *Min. Mag.* 59: 305-310.
- Shannon, David (1996) Orthoserpierite from the Copper Creek District, Pinal County, Arizona. *Mineral. Record* 27: 189-190.
- Tenny, J.B. (1913) Unpublished report on 2,200 hand specimens and thin-section determinations. Phelps Dodge Corp. files.
- Vajdak, J. (1995) New Mineral Finds in 1995. *Mineral News*, 11 (12), p.1.
- Vajdak, J. (2002) New Mineral Finds in the Second Half of 2001. *Mineral News*, 18, (1), p. 1, 5-7.
- Wang, L., E.J. Essene, and Y. Zhang (1999) Mineral inclusions in pyrope crystals

from Garnet Ridge, Arizona, USA: implications for processes in the upper mantle. *Contrib. Mineral. Petrol.*, 135, 164-178.

Wang, L., R.C. Rouse, E.J. Essene, D.R. Peacor, and Y. Zhang (2000) Carmichaelite, a new hydroxyl-bearing titanite from Garnet Ridge, Arizona, *Amer. Min.* 85: 792-800.

Williams, P., A.P. Leverett, D.R. Klish, D.M. Colchester (2007) Grandviewite, a new mineral from the Grandview mine, Coconino County, Arizona. In press.

Williams, S.A. and F. P. Cesbron (1995) Wupatkiite from the Cameron Uranium District, Arizona, a new member of the halotrichite group. *Min. Mag.* 59: 553-556.

## Appendix 1 - List of Arizona Mineral Species

ABERNATHYITE	AUTUNITE	BROOKITE
ACANTHITE	AZURITE	BRUCITE
ACTINOLITE	BARITE	BRUSHITE
ADAMITE	BARRINGERITE	BUSTAMITE
AEGIRINE	BASSANITE	BUTLERITE
AENIGMATITE	BASSETITE	BÜTSCHLIITE
AIKINITE	BAYLDONITE	BUTTGENBACHITE
AJOITE	BAYLEYITE	CACOXINITE
AKAGANÉITE	BEAVERITE	CALAVERITE
ALABANDITE	BECHERERITE	CALCIOARAVAIPAITE
ALAMOSITE	BECQUERELITE	CALCITE
ALBITE	BEIDELLITE	CALEDONITE
ALLANITE-(Ce)	BEMENTITE	CALOMEL
ALLOCLASITE	BERLINITE	CANFIELDITE
ALLOPHANE	BERMANITE	CANNIZZARITE
ALMANDINE	BERTRANDITE	CARBONATE-
ALTAITE	BERYL	CYANOTRICHITE
ALUNITE	BEUDANTITE	CARBONATE-
ALUNOGEN	BEYERITE	FLUORAPATITE
AMBLYGONITE	BIANCHITE	CARLSBERGITE
AMESITE	BIDEAUXITE	CARMICHAELITE
ANALCIME	BIEBERITE	CARNALLITE
ANATASE	BILINITE	CARNOTITE
ANDALUSITE	BINDHEIMITE	CASSITERITE
ANDERSONITE	BIOTITE	CELADONITE
ANDRADITE	BIRNESSITE	CELESTINE
ANGLESITE	BISMITE	CELSIAN
ANHYDRITE	BISMUTH	CERUSSITE
ANILITE	BISMUTHINITE	CERVANTITE
ANKERITE	BISMUTITE	CESÀROLITE
ANNABERGITE	BIXBYITE	CESBRONITE
ANORTHITE	BLÖDITE	CHABAZITE
ANORTHOCLASE	BOGDANOVITE	CHALCANTHITE
ANTHONYITE	BÖHMITE	CHALCOALUMITE
ANTHOPHYLLITE	BOKITE	CHALCOCITE
ANTIGORITE	BOLÉITE	CHALCOMENITE
ANTLERITE	BOLTWOODITE	CHALCOPHANITE
APACHITE	BONATTITE	CHALCOPHYLLITE
ARAGONITE	BOOTHITE	CHALCOPYRITE
ARAVAIPAITE	BORNITE	CHALCOSIDERITE
ARGENTOJAROSITE	BOTALLACKITE	CHAMOSITE
ARSENIC	BOTRYOGEN	CHENEVIXITE
ARSENOSIDERITE	BOULANGERITE	CHEVKINITE -(Ce)
ARSENOLITE	BOURNONITE	CHLORAPATITE
ARSENOPYRITE	BRACKEBUSCHITE	CHLORARGYRITE
ARTROEITE	BRANNERITE	CHLORITOID
ATACAMITE	BRAUNITE	CHOLOALITE
AUGELITE	BRAZILIANITE	CHONDRODITE
AUGITE	BREZINAITE	CHROMITE
AURICHALCITE	BROCHANTHITE	CHRYSOBERYL
AURORITE	BROCKITE	CHRYSOCOLLA
AUSTINITE	BROMARGYRITE	CHRYSOTILE



CINNABAR  
CLARINGBULLITE  
CLAUDETITE  
CLAUSTHALITE  
CLINOATACAMITE  
CLINOBISVANITE  
CLINOCLORE  
CLINOCLASE  
CLINOHEDRITE  
CLINOHUMITE  
CLINOPTILOLITE  
CLINOZOISITE  
CLINTONITE  
COBALTITE  
COCONINOITE  
COESITE  
COFFINITE  
COHENITE  
COLEMANITE  
COLUSITE  
CONICALCITE  
CONNELLITE  
COOKEITE  
COPIAPITE  
COPPER  
COQUIMBITE  
CORDIERITE  
CORKITE  
CORNETITE  
CORNUBITE  
CORNWALLITE  
CORONADOITE  
CORRENSITE  
CORUNDUM  
CORVUSITE  
COSALITE  
COTUNNITE  
COVELLITE  
COWLESITE  
CRANDALLITE  
CREASEYITE  
CREDNERITE  
CREEDITE  
CRICHTONITE  
CRISTOBALITE  
CROCOITE  
CRONSTEDTITE  
CRYPTOMELANE  
CUBANITE  
CUMMINGTONITE  
CUPRITE  
CUPROCOPIAPITE  
CUPROPAVONITE  
CUPROTUNGSTITE  
CYANOTRICHITE

DANALITE  
DANBURITE  
DARAPSKITE  
DATOLITE  
DAUBRÉELITE  
DAVIDITE-(La)  
DELAFOSSITE  
DESCLOIZITE  
DEVILLINE  
DIABOLÉITE  
DIADOHCITE  
DIAMAOND  
DIASPORE  
DICKINSONITE  
DICKITE  
DIGENITE  
DIOPSIDE  
DIOPTASE  
DJURLEITE  
DOLOMITE  
DOLORESITE  
DOMEYKITE  
DRAVITE  
DUFRENOYSITE  
DUFTITE  
DUGGANITE  
DUMONTITE  
DUMORTIERITE  
DYSCRASITE  
ECLARITE  
EDENITE  
EGLESTONITE  
ELBAITE  
EMMONSITE  
EMPLECTITE  
EMPRESSITE  
ENARGITE  
ENSTATITE  
EOSPHORITE  
EPIDOTE  
EPSOMITE  
ERIOCHALCITE  
ERIONITE  
ERYTHRITE  
ETTRINGITE  
EUCRYPTITE  
EUGENITE  
EUXENITE-(Y)  
FAIRBANKITE  
FAIRCHILDITE  
FAIRFIELDITE  
FAMATINITE  
FAYALITE  
FELSÖBÁNYAITE  
FERBERITE

FERGUSONITE  
FERNANDINITE  
FERRICOPIAPITE  
FERRIERITE  
FERRIMOLYBDITE  
FERRO-ACTINOLITE  
FERROCOLUMBITE  
FERROHEXAHYDRITE  
FERROHORNBLLENDE  
FERROKAERSUTITE  
FERROSELITE  
FERROTAPIOLITE  
FERVANITE  
FIBROFERRITE  
FILLOWITE  
FLAGSTAFFITE  
FLUORAPATITE  
FLUORAPOPHYLLITE  
FLUORITE  
FORNACITE  
FORSTERITE  
FOURMARIERITE  
FRAIPONTITE  
FREIBERGITE  
FREIESLEBENITE  
FRIEDRICHITE  
FROHBERGITE  
GADOLINITE  
GAHNITE  
GALENA  
GARRONITE  
GEARKSUTITE  
GEDRITE  
GEIKIELITE  
GERHARDITE  
GERSDORFFITE  
GIBBSITE  
GILALITE  
GIRDITE  
GISMONDINE  
GLADITE  
GLAUBERITE  
GLAUCOCERINITE  
GLAUCODOT  
GLAUCONITE  
GLUSHINSKITE  
GMELINITE  
GOETHITE  
GOLD  
GOLDFIELDITE  
GONNARDITE  
GORDAITE  
GORMANITE  
GOSLARITE  
GRAEMITE

GRANDREEFITE  
GRANDVIEWITE  
GRAPHITE  
GREENOCKITE  
GROSSULAR  
GROUTITE  
GRUNERITE  
GUILDITE  
GYPSUM  
GYROLITE  
HALITE  
HALLOYSITE  
HALOTRICHITE  
HARMOTOME  
HAUSMANNITE  
HAWLEYITE  
HAXONITE  
HECTORITE  
HEDENBERGITE  
HELVITE  
HEMATITE  
HEMIHEDRITE  
HEMIMORPHITE  
HENRYITE  
HERCYNITE  
HERSCHELITE  
HESSITE  
HETAEROLITE  
HEULANDITE  
HEWETTITE  
HEXAHYDRITE  
HIDALGOITE  
HILLEBRANDITE  
HINSDALITE  
HISINGERITE  
HOCARTITE  
HODRUSHITE  
HOLLANDITE  
HOPEITE  
HÖRNESITE  
HÜBNERITE  
HUMMERITE  
HUNTITE  
HURÉAULITE  
HYDROBASALUMINITE  
HYDROBIOTITE  
HYDROCERUSSITE  
HYDROGLAUBERITE  
HYDROHETAEROLITE  
HYDROHONESSITE  
HYDROMAGNESITE  
HYDRONIUM JAROSITE  
HYDROXYAPOPHYLLITE  
HYDROXYLAPATITE

HYDROZINCITE  
HYPERSTHENE  
ILLITE  
ILMENITE  
ILSEMANNITE  
ILVAITE  
INGODITE  
IODARGYRITE  
IRANITE  
IRIGINITE  
IRON  
JACOBSITE  
JADEITE  
JAHNSITE  
JALPAITE  
JAMESONITE  
JAROSITE  
JOHANNITE  
JOHANNSENITE  
JÓKOKUITE  
JORDISITE  
JUNITOITE  
JURBANITE  
KAERSUTITE  
KAMITUGAITE  
KANONAITE  
KAOLINITE  
KASOLITE  
KĚSTERITE  
KETTNERITE  
KHINITE  
KIDDCREEKITE  
KIESERITE  
KINOITE  
KINOSHITALITE  
KOECHLINITE  
KORNELITE  
KOSMOCHLOR  
KOSTOVITE  
KRENNERITE  
KRINOVITE  
KTENASITE  
KULANITE  
KURAMITE  
KUTNOHORITE  
KYANITE  
LANARKITE  
LANGITE  
LANSFORDITE  
LAUMONTITE  
LAURELITE  
LAUSENITE  
LAUTITE  
LAWRENCITE  
LAWSONITE

LAZULITE  
LEAD  
LEADHILLITE  
LEPIDOCROCITE  
LEPIDOLITE  
LEUCITE  
LEUCOPHOSPHITE  
LEUCOSPHENITE  
LEVYNE  
LIBETHENITE  
LIEBIGITE  
LIME  
LINARITE  
LINDGRENITE  
LINNAEITE  
LIROCONITE  
LITHARGE  
LITHIOPHILITE  
LITHIOPHORITE  
LIZARDITE  
LÖLLINGITE  
LONSDALEITE  
LOVERINGITE  
LUDDENITE  
LUDWIGITE  
LUETHEITE  
LUZONITE  
MACKAYITE  
MACKINAWITE  
MACPHERSONITE  
MACQUARTITE  
MAGHEMITE  
MAGNESIOCHROMITE  
MAGNESIOCOPIAPITE  
MAGNESIO-  
HORNBLLENDE  
MAGNESITE  
MAGNETITE  
MALACHITE  
MAMMOTHITE  
MANANDONITE  
MANGANAXINITE  
MANGANBABINGTONITE  
MANGANITE  
MANJIROITE  
MARCASITE  
MARIALITE  
MARICOPAITE  
MASSICOT  
MATILDITE  
MATLOCKITE  
MAWSONITE  
MCKINSTRYITE  
MEIONITE  
MELANOTEKITE

MELANOVANADITE  
MELANTERITE  
MELILITE  
MELONITE  
MERCURY  
MESOLITE  
META-ALUNOGEN  
META-AUTUNITE  
METACINNABAR  
METAHEWETTITE  
METANOVÁČEKITE  
METAROSSITE  
METASIDERONATRITE  
METATORBERNITE  
METATYUYAMUNITE  
META-URANOCIRCITE  
METAVOLTINE  
METAZEUNERITE  
MIARGYRITE  
MICROCLINE  
MICROLITE  
MIERSITE  
MILLERITE  
MIMETITE  
MINIUM  
MIRABILITE  
MIXITE  
MOISSANITE  
MOLYBDENITE  
MOLYBDITE  
MOLYBDOFORNACITE  
MONAZITE  
MONOHYDROCALCITE  
MONTANITE  
MONTEBRASITE  
MONTICELLITE  
MONTMORILLONITE  
MONTROSEITE  
MONTROYDITE  
MOORHOUSEITE  
MORDENITE  
MORENOSITE  
MOTTRAMITE  
MROSEITE  
MURDOCHITE  
MUSCOVITE  
NACRITE  
NAMIBITE  
NANTOKITE  
NATROALUNITE  
NATRODUFRÉNITE  
NATROJAROSITE  
NATROLITE  
NAUMANNITE  
NAVAJOITE

NEKOITE  
NEKRASOVITE  
NELTNERITE  
NEOTOCITE  
NEPHELINE  
NESQUEHONITE  
NEYITE  
NICKEL-  
BOUSSINGALTITE  
NICKELINE  
NICKEL-SKUTTERUDITE  
NICKEL-ZIPPEITE  
NITER  
NITRATINE  
NITROCALCITE  
NOLANITE  
NONTRONITE  
NORDSTROMITE  
NSUTITE  
NUKUNDAMITE  
OBOYERITE  
OFFRÉTITE  
OKENITE  
OLIVENITE  
OMPHACITE  
OPAL  
ORPIMENT  
ORTHOCLASE  
ORTHOSERPHERITE  
OSARIZAWAITE  
PALYGORSKITE  
PAPAGOITE  
PARACOQUIMBITE  
PARAGONITE  
PARAKHINITE  
PARALAURIONITE  
PARAMELACONITE  
PARAMONTROSEITE  
PARARAMMELSBERGITE  
PARATACAMITE  
PARATELLURITE  
PARGASITE  
PARISITE  
PARNAUITE  
PARSONSITE  
PARTZITE  
PASCOITE  
PAULKERRITE  
PEARCEITE  
PECORAITE  
PECTOLITE  
PEKOITE  
PENTAHYDRITE  
PENTLANDITE  
PERICLASE

PERITE  
PEROVSKITE  
PETZITE  
PHARMACOSIDERITE  
PHILLIPSITE  
PHLOGOPITE  
PHOENICOCHROITE  
PHOSGENITE  
PHOSPHOHEDYPHANE  
PHOSPHOSIDERITE  
PHOSPHURANYLITE  
PICKERINGITE  
PIEMONTITE  
PIGEONITE  
PINALITE  
PINTADOITE  
PLANCHÉITE  
PLATINUM  
PLATTNERITE  
PLUMBOGUMMITE  
PLUMBOJAROSITE  
PLUMBONACRITE  
PLUMBOTSUMITE  
POLLUCITE  
POLYBASITE  
POLYCRASE  
POLYHALITE  
POLYLITHIONITE  
POSNJAKITE  
POWELLITE  
PREHNITE  
PROSOPITE  
PROUSTITE  
PSEUDOBOLEITE  
PSEUDO BROOKITE  
PSEUDOGRANDREEFITE  
PSEUDOMALACHITE  
PUMPELLYITE  
PURPURITE  
PYRARGYRITE  
PYRITE  
PYROCHLORE  
PYROLUSITE  
PYROMORPHITE  
PYROPE  
PYROPHYLLITE  
PYRRHOTITE  
QUARTZ  
QUEITITE  
QUETZALCOATLITE  
RALSTONITE  
RAMEAUTE  
RAMMELSBERGITE  
RAMSBECKITE  
RAMSDELLITE

RANCIEITE  
RANSOMITE  
RAUVITE  
REALGAR  
RECTORITE  
REEVESITE  
REICHENBACHITE  
RHODOCHROSITE  
RHODONITE  
RHODOSTANNITE  
RHOMBOCLASE  
RICHTERITE  
RICKARDITE  
RIEBECKITE  
ROALDITE  
ROBERTSITE  
RODALQUILARITE  
ROEDDERITE  
ROMANÈCHITE  
ROMÉITE  
RÖMERITE  
ROSASITE  
ROSCOELITE  
ROSSITE  
ROZENITE  
RUCKLIDGEITE  
RUIZITE  
RUTILE  
SABUGALITE  
SALÉEITE  
SAMARSKITE-(Y)  
SANADINE  
SANTAFEITE  
SAPONITE  
SAPPHIRINE  
SAUCONITE  
SCAWTITE  
SCHEELITE  
SCHIEFFELINITE  
SCHMIEDERITE  
SCHOEPITE  
SCHORL  
SCHREIBERSITE  
SCHRÖCKINGERITE  
SCHUBNELITE  
SCOLECITE  
SCORODITE  
SCORZALITE  
SELENIUM  
SENGIERITE  
SEPIOLITE  
SERPIERITE  
SHANNONITE  
SHATTUCKITE  
SHERWOODITE

SICKLERITE  
SIDERITE  
SIDEROTIL  
SIEGENITE  
SILLIMANITE  
SILVER  
SKUTTERUDITE  
SMITHSONITE  
SODDYITE  
SODIUM-ZIPPEITE  
SONORAITE  
SPANGOLITE  
SPERTINIITE  
SPESSARTINE  
SPHAEROCOBALTITE  
SPHALERITE  
SPINEL  
SPIONKOPITE  
SPIROFFITE  
SPODUMENE  
SRILANKITE  
STANNITE  
STANNOIDITE  
STARKEYITE  
STAUROLITE  
STEIGERITE  
STELLERITE  
STEPHANITE  
STERNBERGITE  
STETEFELDTITE  
STEVENSITE  
STEWARTITE  
STIBICONITE  
STIBNITE  
STILBITE  
STILPNOMELANE  
STISHOVITE  
STOLZITE  
STRACZEKITE  
STRENGITE  
STRINGHAMITE  
STROMEYERITE  
STRONTIANITE  
STÜTZITE  
SULFUR  
SURITE  
SVANBERGITE  
SWARTZITE  
SWITZERITE  
SYLVANITE  
SYLVITE  
SZOMOLNOKITE  
TALC  
TALMESSITE  
TANGEITE

TANTALITE  
TEINEITE  
TELLURITE  
TELLURIUM  
TELLUROBISMUTHINITE  
TENNANTITE  
TENORITE  
TEPHROITE  
TETRADYMIT  
TETRAHEDRITE  
TETRATAENITE  
THALÉNITE-(Y)  
THAUMASITE  
THENARDITE  
THOMSONITE  
THORITE  
TILASITE  
TINZENITE  
TITANITE  
TLAPALLITE  
TOBERMORITE  
TODOROKITE  
TOLBACHITE  
TOPAZ  
TORBERNITE  
TREMOLITE  
TRIDYMIT  
TRIPHYLITE  
TRIPLITE  
TRIPLOIDITE  
TROILITE  
TSCHERMAKITE  
TSUMEMBIT  
TUNGSTITE  
TURQUOISE  
TYROLITE  
TYUYAMUNITE  
ULVÖSPINEL  
UMOHOITE  
URANINITE  
URANOCIRCITE  
URANOPHANE  
URANOPHANE-BETA  
URANOPILITE  
URANOSPINITE  
UVANITE  
UVAROVITE  
UYTENBOGAARDTITE  
VAESITE  
VALLERITE  
VANADINITE  
VANDENDRIESSCHEITE  
VANMEERSSCHEITE  
VANOXITE  
VARISCITE

VATERITE  
VAQUELINITE  
VELIKITE  
VERMICULITE  
VÉSIGNIÉITE  
VESUVIANITE  
VIVIANITE  
VOGLITE  
VOLBORTHITE  
VOLKONSKOITE  
VOLTAITE  
VOLYNSKITE  
WAGNERITE  
WAKEFIELDITE-(Y)  
WAVELLITE  
WEDDELLITE  
WEEKSITE  
WEISSITE  
WHERRYITE  
WHEWELLITE

WICKENBURGITE  
WILLEMITE  
WINSTANLEYITE  
WITHERITE  
WITTICHENITE  
WITTITE  
WOLLASTONITE  
WOODWARDITE  
WULFENITE  
WUPATKIITE  
WURTZITE  
WÜSTITE  
WYLLIEITE  
XENTIME -(Y)  
XOCOMECA TLITE  
XONOTLITE  
YAFSOANITE  
YARROWITE  
YAVAPAIITE  
YEDLINITE

YITTROTANTALITE  
ZEUNERITE  
ZINCITE  
ZINCOBOTRYOGEN  
ZINCOCOPIAPITE  
ZINC-ZIPPEITE  
ZINNWALDITE  
ZIPPEITE  
ZIRCON  
ZOISITE  
ZUNYITE



## Appendix 2 - Arizona Type Minerals

The locality where a mineral is first found is called the type locality. Sometimes a mineral is found at two different localities at the same time and these are referred to as co-type localities. Arizona has 79 minerals that were first found here or found here and at another place at the same time. The person who describes the new mineral gets the right to pick the name. For the type minerals of Arizona, 50 are named after people, 20 are named for the locality where they were found, two are named for their chemistry, three are named for a physical property, and three are a combination of two of the above. One mineral, native selenium, is named after the Greek word for moon.

Here are examples of the origins of some of the Arizona type mineral names. The ones named after localities are mostly after cities, counties, or the mines where they were found. Wickenburgite, ajoite, and flagstaffite are examples of minerals named after cities. Maricopaite, yavapaiite, pinalite, gilalite, and coconinoite are named after the counties in which they were found. Grandreefite, antlerite, and coronadite were named after mines. Wupatkiite, one of Arizona's newer minerals was named after the National Monument.

Most of the people who had minerals named after them were geologists, mineralogists, mineral collectors, or miners. Minerals such as andersonite, artroite, bermanite, bideauxite, coesite, graemite, henryite, junitoite, luddenite, ruizite, shannonite, were named after these people. Apachite, papagoite, and navajoite were named after indian tribes. Kinoite was named for the historical Padre Kino.

Chalcoalumite and cuprotungstite are named for their chemistry and the names hemihedrite, cryptomelane and paramelaconite are related to something about their physical appearance. Nickel-zippeite and zinc-zippeite are named for chemistry and a mineralogist Franz Xavier Maximillian Zippe. Calcioaravaipaite is named for chemistry and the locality in the Aravaipa mining district.

**Ajoite:**  $(\text{K},\text{Na})\text{Cu}_7\text{AlSi}_9\text{O}_{24}(\text{OH})_6 \cdot 3\text{H}_2\text{O}$  – was named after the discovery locality, the New Cornelia mine in **Ajo**, Pima County. Schaller, W.T., and A.C. Vlisidis (1958) Ajoite, a new hydrous aluminum copper silicate. *Amer. Min.* 47: 672-699.

**Andersonite:**  $\text{Na}_2\text{Ca}(\text{UO}_2)(\text{CO}_3)_3 \cdot 6\text{H}_2\text{O}$  – was named for Charles Alfred **Anderson** (1902-1990) of the U.S. Geological Survey, who discovered the mineral. The type locality is the Hillside mine in Yavapai County. Axelrod, J.M., F.S. Grimaldi, C. Milton, and K.J. Murata (1951) The uranium minerals from the Hillside mine, Yavapai County, Arizona. *Amer. Min.* 36: 1-22.

**Antlerite:**  $\text{Cu}_3(\text{SO}_4)(\text{OH})_4$  – was named for the discovery locality, the **Antler** mine, Mohave County. Hillebrand, W.F. (1889) Antlerite, a basic cupric sulfate, *U.S. Geol. Surv. Bull.* 55: 54-55.

**Apachite:**  $\text{Cu}_9\text{Si}_{10}\text{O}_{29}\cdot 11\text{H}_2\text{O}$  – named for the **Apaches**, native people in the area of the discovery locality, the Christmas mine, Gila County. Cesbron, F.P., and S. A. Williams (1980) Apachite and gilalite, two new copper silicates from Christmas, Arizona. *Mineral. Mag.* 43: 639-641.

**Aravaipaite:**  $\text{Pb}_3\text{AlF}_9\cdot\text{H}_2\text{O}$  – was named for the **Aravaipa** mining district in which the Grand Reef mine, the discovery locality, is located. Kampf, A.R., P.J. Dunn, and E.E. Foord (1989) Grandreefite, pseudograndreefite, laurelite, and aravaipaite: Four new minerals from the Grand Reef mine, Graham County, Arizona. *Amer. Min.* 74: 927-933.

**Artroeite:**  $\text{PbAlF}_3(\text{OH})_2$  – was named after **Arthur Roe** (1912-1993), a Professor of Chemistry, University of North Carolina and active volunteer at the University of Arizona Mineral Museum and the Arizona Sonora Desert Museum. The Grand Reef mine, Graham County is the type locality. Kampf, A.R., and E.E. Foord (1996) Artroeite, a new mineral from the Grand Reef mine, Graham County, Arizona: Description and crystal structure. *Amer. Min.* 80: 179-183.

**Bayleyite:**  $\text{Mg}_2(\text{UO}_2)(\text{CO}_3)_3\cdot 18\text{H}_2\text{O}$  – named after William Shirley **Bayley** (1861-1943), Professor of Geology, University of Illinois and geologist with U. S. Geological Survey. The type locality is the Hillside mine in Yavapai County. Axelrod, J.M., F.S. Grimaldi, C. Milton, and K.J. Murata (1951) The uranium minerals from the Hillside mine, Yavapai County, Arizona. *Amer. Min.* 36: 1-22.

**Bechererite:**  $\text{Zn}_7\text{Cu}(\text{OH})_{13}[\text{SiO}(\text{OH})_3\text{SO}_4]$  – named for Karl **Becherer** (b. 1926), Professor of Mineralogy, University of Vienna, Austria. The Tonopah-Belmont mine, Maricopa County is the type locality. Giester, G., and B. Rieck (1996) Bechererite, a novel mineral species from the Tonopah-Belmont mine, Arizona. *Amer. Min.* 81: 244-248.

**Bermanite:**  $\text{Mn}_3(\text{PO}_4)_2(\text{OH})_2\cdot 4\text{H}_2\text{O}$  – was named for Harry **Berman** (1902-1944), Professor of Mineralogy, Harvard University. The type locality is the 7U7 Ranch, Yavapai County. Hurlbut, C.S., Jr. (1936) A new phosphate, bermanite, occurring with triplite in Arizona. *Amer. Min.* 21: 656-661.

**Bideauxite:**  $\text{Pb}_3\text{AgCl}_3\text{F}(\text{OH})$  - named after Richard A. **Bideaux** (1935-2005) of Tucson Arizona, who discovered the mineral, co-author of the *Mineralogy of Arizona*. The type locality is Mammoth – St. Anthony mine, Tiger, Pinal County.

Williams, S.A. (1970) Bideauxite, a new Arizona mineral. *Mineral. Mag.* 37: 637-640.

**Brezinaite:**  $\text{Cr}_3\text{S}_4$  – was named for Aristides **Brezina** (1848-1909), Austrian Mineralogist at the Natural History Museum in Vienna. The mineral was found in the Tucson meteorite. Bunch, J.E., and L.H. Fuchs (1969) A new mineral: Brezinaite, and the Tucson meteorite. *Amer. Min.* 54: 1509-1518.

**Butlerite:**  $\text{Fe}(\text{SO}_4)(\text{OH})\cdot 2\text{H}_2\text{O}$  – named for Gurdon Montague **Butler** (1881-1961), mining geologist, University of Arizona, Tucson. The type locality is the United Verde mine, Yavapai County. Lausen, C. (1928) Hydrous sulfates formed under fumerolic conditions at the United Verde mine. *Amer. Min.* 13: 203-229.

**Bütschliite:**  $\text{K}_2\text{Ca}(\text{CO}_3)_2$  – named for Otto **Butschli** (1848-1920), Professor of Zoology, University of Heidelberg, who studied the synthetic compound. Described from Arizona and Idaho so Arizona is a co-type locality. It was found in a partly burned tree from a fire on the north side of Kanabownits Canyon on the north rim of the Grand Canyon. Milton, C., and J. Axelrod (1947) Fused woodash stones: Fairchildite, butschliite, and calcite, their essential components. *Amer. Min.* 32: 607-624.

**Calcioaravaipaite:**  $\text{PbCa}_2\text{Al}(\text{F},\text{OH})_9$  – the name reflects the **calcium** content and the relationship to **aravaipaite**. The type locality is the Grand Reef mine in the Aravaipa mining district, Graham County. Kampf, A.R. and E.E. Foord (1996) Calcioaravaipaite, a new mineral and associated lead fluoride minerals from the Grand Reef mine, Graham County, Arizona. *Mineral. Record.* 27: 293-300.

**Carmichaelite:**  $(\text{Ti},\text{Cr})\text{O}_{1.5}(\text{OH})_{0.5}$  – named for Ian S.E. **Carmichael**, Professor of Geology at the University of California, Berkeley. The type locality is Garnet Ridge, Apache County. Wang, L., R.C. Rouse, E. J. Essene, D.R. Peacor, and Y. Zhang (2000) Carmichaelite, a new hydroxyl-bearing titanate from Garnet Ridge, Arizona. *Amer. Min.* 85: 792-2000.

**Chalcoalumite:**  $\text{CuAl}_4(\text{SO}_4)(\text{OH})_{12}\cdot 3\text{H}_2\text{O}$  – was named for its composition: Greek **chalkos** (copper) and Latin **alum** (aluminum) - copper aluminum sulfate. The type locality is an unspecified locality in Bisbee, Cochise County. Larsen, E.S., and H.E. Vassar (1925) Chalcoalumite, a new mineral from Bisbee, Arizona. *Amer. Min.* 10: 79-83.

**Coconinoite:**  $\text{Fe}_2\text{Al}_2(\text{UO}_2)_2(\text{PO}_4)_4(\text{SO}_4)(\text{OH})_2\cdot 20\text{H}_2\text{O}$  – named after the discovery locality, the Sun Valley mine, **Coconino** County. Young, E.J., A. D. Weeks, and R. Meyrowitz (1966) A new uranium mineral from Utah and Arizona. *Amer. Min.* 51: 651-663.

**Coesite:**  $\text{SiO}_2$  – named after Loring Coes, Jr. (b. 1915), research chemist at Norton Company, Worcester, Massachusetts, who first synthesized the material. Meteor Crater, Coconino County is the type locality. Chao, E.C.T., E.M. Shoemaker, and B.M. Madsen. (1960) First natural occurrence of coesite. *Science* 132: 220-222.

**Coronadite:**  $\text{PbMn}_8\text{O}_{16}$  – is named after the discovery locality, the **Coronado** vein, Clifton-Morenci district, Greenlee county, and the Spanish explorer, Francisco Coronado (ca. 1500-1554). Lindgren, W., and W.F. Hillebrand (1904) Minerals from the Clifton-Morenci district, Arizona. *Amer. Jour. Sci.* 18: 448-460.

**Cowlesite:**  $\text{CaAl}_2\text{Si}_3\text{O}_{10}\cdot 5.3\text{H}_2\text{O}$  – named after John Cowles a collector from Rainer, Oregon. Described from Oregon and Arizona, the co-type locality is 5.5 miles south of Superior, Pinal County. Wise, W.S., and R.W. Tschernich (1975) Cowlesite, a new calcium zeolite. *Amer. Min.* 60: 951-956.

**Creaseyite:**  $\text{Pb}_2\text{Cu}_2\text{Fe}_2\text{Si}_5\text{O}_{17}\cdot 6\text{H}_2\text{O}$  – named after Saville C, Creasey (b. 1917), geologist with the U.S. Geological Survey. The type locality is the Mammoth-St. Anthony mine, Tiger, Pinal County. Williams, S.A., and R.A. Bideaux (1975) Creaseyite, a new mineral from Arizona and Sonora. *Mineral. Mag.* 40: 227-231.

**Cryptomelane:**  $\text{KMn}_8\text{O}_{16}$  – from the Greek **kryptos** (concealed) and **melanos** (black), because the identity was hidden by ill-defined manganese oxides. Described from India and Arizona, the co-type locality is Tombstone, Cochise County. Richmond, W.E, and M. Fleischer (1942) Cryptomelane, a new name for the commonest of the “psilomelane” minerals. *Amer. Min.* 27: 607-610.

**Cuprotungstite:**  $\text{Cu}_3(\text{WO}_4)_2(\text{OH})_2$  – the name reflects the **copper** content and the similarity to **tungstite**. The type locality is the Cave Creek district, Maricopa County. Schaller, W.T, (1932) Chemical composition of cuprotungstite. *Amer. Min.* 17: 234-237.

**Dugganite:**  $\text{Pb}_3\text{Zn}_3\text{TeO}_6(\text{AsO}_4)(\text{OH})$  – was named for Marjorie Duggan, analytical chemist. The type locality is the dumps of the Empire mine in Tombstone, Cochise County. Williams, S.A. (1978) Khinite, parakinite, and dugganite, three new minerals from Tombstone, Arizona. *Amer. Min.* 63: 1016-1019.

**Emmonsite:**  $\text{Fe}_2\text{Te}_3\text{O}_9\cdot 2\text{H}_2\text{O}$  – named for Samuel Franklin Emmons (1814-1911), economic geologist with U.S. Geological Survey. The type locality is Tombstone, Cochise County, although the original material was likely some other mineral. Hillebrand, W.F. (1885) Emmonsite, a ferric tellurite. *Proc. Colo. Sci. Soc.* 2: 20-23.

**Fairbankite:**  $\text{PbTeO}_3$  – named after Nathaniel Kellogg **Fairbank**, an important person in the early mining history of Tombstone. The type locality is the dump of the Grand Central mine in Tombstone, Cochise County. Williams, S.A. (1979) Girdite, oboyerite, fairbankite, and winstanleyite, four new tellurium minerals from Tombstone, Arizona. *Mineral. Mag.* 43: 453-457.

**Fairchildite:**  $\text{K}_2\text{Ca}(\text{CO}_3)_2$  – named for John Gifford **Fairchild** (1882-1965), chemist for the U.S. Geological Survey. Described from Arizona and Idaho so Arizona is a co-type locality. It was found in a partly burned tree from a fire on the north side of Kanabownits Canyon on the north rim of the Grand Canyon. Milton, C., and J. Axelrod (1947) Fused woodash stones: Fairchildite, bütschliite, and calcite, their essential components. *Amer. Min.* 32: 607-624.

**Flagstaffite:**  $\text{C}_{10}\text{H}_{22}\text{O}_3$  – is named for the discovery locality north of **Flagstaff**, Coconino County. It was found in cracks of buried tree trunks washed down from the San Francisco peaks. Guild, F.N. (1920) Flagstaffite, a new mineral from Arizona. *Amer. Min.* 5: 169-172.

**Gerhardtite:**  $\text{Cu}_2(\text{NO}_3)(\text{OH})_3$  – named after Charles Frederic **Gerhardt** (1816-1856), American chemist who studied the synthetic compound. The type locality is the United Verde mine, Yavapai County. Wells, H.L., and S.L. Penfield (1885) Gerhardtite and artificial cupric nitrates. *Amer. Jour. Sci.* 30: 50-57.

**Gilalite:**  $\text{Cu}_5\text{Si}_6\text{O}_{17}\cdot 7\text{H}_2\text{O}$  – named for **Gila** County, the type locality is the Christmas mine, Gila County. Cesbron, F.P., and S. A. Williams (1980) Apachite and gilaite, two new copper silicates from Christmas, Arizona. *Mineral. Mag.* 43: 639-641.

**Girdite:**  $\text{Pb}_3\text{H}_2(\text{TeO}_3)(\text{TeO}_6)$  – Named after Richard **Gird**, mining engineer in early Tombstone. The type locality is the dump of the Grand Central mine in Tombstone, Cochise County. Williams, S.A. (1979) Girdite, oboyerite, fairbankite, and winstanleyite, four new tellurium minerals from Tombstone, Arizona. *Mineral. Mag.* 43: 453-457.

**Graemite:**  $\text{CuTeO}_3\cdot\text{H}_2\text{O}$  – named for Richard **Graeme**, geologist and collector of Bisbee minerals. The type locality is the Cole Shaft in Bisbee, Cochise County. Williams, S.A., and P. Matter, III (1975) Graemite, a new Bisbee mineral. *Mineral. Rec.* 6: 32-34.

**Grandreefite:**  $\text{Pb}_2(\text{SO}_4)\text{F}_2$  – named for the discovery locality, the **Grand Reef** mine, Graham County. Kampf, A.R., P.J. Dunn, and E.E. Foord (1989) Grandreefite, pseudograndreefite, laurelite, and aravaipaite: Four new minerals from the Grand Reef mine, Graham County, Arizona. *Amer. Min.* 74: 927-933.



**Grandviewite:**  $\text{Cu}_3\text{Al}_9(\text{SO}_4)_2(\text{OH})_{29}$  – named after the discovery locality the **Grandview** mine, Coconino County (also known as the Last Chance mine), Horseshoe Mesa, Grand Canyon National Park. Williams, P.A., A.P. Leverett, D.R. Klish, D.M. Colchester (2007) Grandviewite, a new mineral from the Grandview mine, Coconino County, Arizona. In press.

**Guildite:**  $\text{CuFe}(\text{SO}_4)_2(\text{OH})\cdot 4\text{H}_2\text{O}$  – named for Frank Nelson **Guild** (1870-1939), Professor at the University of Arizona in Tucson. The type locality is the United Verde mine in Jerome, Yavapai County. Lausen, C. (1928) Hydrous sulfates formed under fumarolic conditions at the United Verde mine. *Amer. Min.* 13: 203-229.

**Haxonite:**  $(\text{Fe},\text{Ni})_{23}\text{C}_6$  – named for H.J. **Axon**, a metallurgist at the University of Manchester, England. Discovered in the Canyon Diablo meteorite. Scott, E.R.D. (1971) New carbide found in meteorites. *Nat. Phys. Sci.* 229: 61-62.

**Hemihedrite:**  $\text{Pb}_{10}\text{Zn}(\text{CrO}_4)_6(\text{SiO}_4)_2\text{F}_2$  – from the Greek **hemi** (half) and **hedra** (base), describing the triclinic hemihedral habit of the crystals. The Florence Lead-Silver mine, Tortilla Mountains, Pinal County is the type locality. Williams, S.A., and J.W. Anthony (1970) Hemihedrite, a new mineral from Arizona. *Amer. Min.* 55: 1088-1102.

**Henryite:**  $\text{Cu}_4\text{Ag}_3\text{Te}_4$  – named for Norman F. M. **Henry** (1909-1983), mineralogist at St. John's College and Cambridge University, England. The type locality is the Campbell orebody, Bisbee, Cochise County. Criddle, A.J., C.J. Stanley, J.E. Chilsolm, and E.E. Fejer (1983) Henryite, a new copper-silver telluride from Bisbee, Arizona. *Bull. Min.* 106: 511-517.

**Junitoite:**  $\text{CaZn}_2\text{Si}_2\text{O}_7\cdot\text{H}_2\text{O}$  – named for **Jun Ito** (1926-1978), mineralogist and chemist at the University of Chicago. The type locality is the Christmas mine, Gila County. Williams, S.A. (1976) Junitoite, a new hydrated calcium zinc silicate from Christmas, Arizona. *Amer. Min.* 61: 1255-1258.

**Jurbanite:**  $\text{Al}(\text{SO}_4)(\text{OH})\cdot 5\text{H}_2\text{O}$  – named after **Joseph Urban** (b. 1915), a Tucson mineral collector who discovered the mineral. The type locality is the San Manuel mine, Pinal County. Anthony, J.W., and W.J. McLean (1976) Jurbanite, a new post-mine aluminum sulfate mineral from San Manuel, Arizona. *Amer. Min.* 61: 1-4.

**Khinite:**  $\text{PbCu}_3\text{TeO}_6(\text{OH})_2$  – was named for BaSaw **Khin**, mineralogist for Phelps Dodge, who discovered the mineral. The type locality is the dumps of the Old Guard mine, Tombstone, Cochise County. Williams, S.A. (1978) Khinite,



parakhinite, and dugganite, three new minerals from Tombstone, Arizona. *Amer. Min.* 63: 1016-1019.

**Kiddcreekite:**  $\text{Cu}_6\text{SnWS}_8$  – named for the discovery locality **Kidd Creek** mine, Ontario, Canada. The Campbell mine, Bisbee, Cochise is the co-type locality. Harris, D.C., A.C. Roberts, R.I. Thorpe, A.J. Criddle, and C. J. Stanley (1984) Kiddcreekite, a new mineral species from the Kidd mine, Timmins, Ontario, and from the Campbell orebody, Bisbee, Arizona. *Can. Min.* 22: 227-232.

**Kinoite:**  $\text{Ca}_2\text{Cu}_2\text{Si}_3\text{O}_8(\text{OH})_4$  – named after Eusebio Francisco **Kino** (1645-1711), Jesuit explorer of the American southwest. The type locality is the Santa Rita Mountains where it was found in a drill core. Anthony, J.W. and R.B. Laughon (1970) Kinoite, a new hydrous copper calcium silicate mineral from Arizona. *Amer. Min.* 55: 709-713.

**Krinovite:**  $\text{Na}_2\text{Mg}_4\text{Cr}_2\text{Si}_6\text{O}_{20}$  – named after Evgeny Leonidovich **Krinov**, Russian meteorite researcher. It was found in the Canyon Diablo meteorite. Olsen, E., and L. Fuchs, (1968) Krinovite, a new meteorite mineral. *Science* 161: 786-787.

**Laurelite:**  $\text{Pb}_7\text{F}_{12}\text{Cl}_2$  – named for the locality, the Grand Reef mine that is located in **Laurel Canyon**, Graham County. Kampf, A.R., P.J. Dunn, and E.E. Foord (1989) Grandreefite, pseudograndreefite, laurelite, and aravaipaite: Four new minerals from the Grand Reef mine, Graham County, Arizona. *Amer. Min.* 74: 927-933.

**Lausenite:**  $\text{Fe}_2(\text{SO}_4)_3 \cdot 6\text{H}_2\text{O}$  – named for Charles **Lausen**, a mining engineer who first described the mineral. The type locality is the United Verde mine in Jerome, Yavapai County. Lausen, C. (1928) Hydrous sulfates formed under fumerolic conditions at the United Verde mine. *Amer. Min.* 13: 203-229 and Butler, G.M. (1928) Corrections to Volume 13. *Amer. Min.* 13: 594.

**Lonsdaleite:** **C** – named for Kathleen **Lonsdale** (1903-1971), crystallographer, University of London, England. Found in the Canyon Diablo meteorite. Frondel, C., and U.B. Marvin (1967) Lonsdaleite, a new hexagonal polymorph of diamond. *Nature* 214: 587-589.

**Luddenite:**  $\text{Pb}_2\text{Cu}_2\text{Si}_5\text{O}_{14} \cdot 14\text{H}_2\text{O}$  – named for Raymond W. **Ludden**, geologist for Phelps-Dodge Corporation. The type locality is a small dump near the Rawhide mine, Mohave County. Williams, S.A. (1982) Luddenite, a new copper-lead silicate mineral from Arizona. *Mineral. Mag.* 46: 363-364.

**Luetheite:**  $\text{Cu}_2\text{Al}_2(\text{AsO}_4)_2(\text{OH})_4 \cdot \text{H}_2\text{O}$  – named for Robert **Luethe**, geologist from Douglas, Arizona who discovered the mineral. The type locality is near the

Humbolt mine, Patagonia district, Santa Cruz, County. Williams, S.A. (1976) Luetheite, a new mineral from Arizona compared with chenevixite. *Mineral. Mag.* 41: 27-42.

**Macquartite:**  $\text{Pb}_3\text{Cu}(\text{CrO}_4)\text{SiO}_3(\text{OH})_4 \cdot 2\text{H}_2\text{O}$  – named for Louis Charles Henri **Macquart** (1745-1803), French chemist who brought samples of crocoite to France from Russia. The type locality is the Mammoth-St. Anthony mine, Pinal County. Williams, S.A., and M. Duggan (1980) La macquartite: Un nouveau silico-chromate de Tiger, Arizona. *Bull. Mineral.* 103: 530-532.

**Mammothite:**  $\text{Pb}_6\text{Cu}_4\text{AlSbO}_2(\text{OH})_{16}\text{Cl}_4(\text{SO}_4)_2$  – named after the discovery locality, the Mammoth-St. Anthony mine, **Mammoth** district, Pinal County. Peacor, D., P.J. Dunn, G Schnorrer-Kohler, and R.A. Bideaux (1985) Mammothite, a new mineral from Tiger, Arizona and Laurium, Greece. *Mineral. Record* 15: 117-120.

**Maricopaite:**  $(\text{Pb}_7\text{Ca}_2)[\text{Al}_{12}\text{Si}_{36}(\text{O},\text{OH})_{100} \cdot n\text{H}_2\text{O} (n \sim 32)]$  – named after the discovery locality, the Moon Anchor mine near Tonopah, **Maricopa** County. Peacor D., P.J. Dunn, and W. B. Simmons, F.J. Wicks, and M. Raudsepp (1988) Maricopaite, a new hydrated Ca-Pb, zeolite-like silicate from Arizona. *Can. Min.* 26: 309-313.

**Moissanite:**  $\text{SiC}$  – named for Ferdinand F. Henri **Moissan** (1852-1907), Professor of Chemistry at the Sorbonne, Paris, who discovered the mineral. Found in the Canyon Diablo meteorite. Kunz, G.F. (1905) Moissanite, a natural silicon carbide. *Amer. Jour. Sci.* 19: 396.

**Murdochite:**  $\text{PbCu}_6\text{O}_{6.5}\text{Cl}$  – named for Joseph **Murdoch** (1890-1973), Professor of Mineralogy, University of California at Los Angeles. The type locality is the Mammoth-St. Anthony mine, Pinal County. Fahey, J.J. (1955) Murdochite, a new copper lead oxide mineral. *Amer. Min.* 40: 905-906.

**Navajoite:**  $(\text{V},\text{Fe})_{10}\text{O}_{24} \cdot 12\text{H}_2\text{O}$  – named after the discovery locality, on the **Navajo** Reservation. The type locality is the Monument No. 2 mine, Apache County. Weeks, A.D., M.E. Thompson, and A. M. Sherwood (1954) Navajoite, a new vanadium oxide from Arizona. *Science* 119: 326.

**Nickel-zippeite:**  $\text{Ni}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$  – named after its **nickel** content and the similarity to **zippeite**. Found at several localities including the Happy Jack mine, Utah and the Hillside mine in Yavapai County (co-type locality). Frondel, C., J. Ito, R.M. Honea, and A. M. Weeks (1976) Mineralogy of the zippeite group. *Can Min.* 14: 429-436.

**Oboyerite:**  $\text{Pb}_6\text{H}_6(\text{TeO}_3)_3(\text{TeO}_6)_2 \cdot 2\text{H}_2\text{O}$  – named for **Oliver Boyer**, one of two men who staked the Grand Central lode claim in Tombstone, the type locality for this mineral. Williams, S.A. (1979) Girdite, oboyerite, fairbankite, and winstanleyite, four new tellurium minerals from Tombstone, Arizona. *Mineral. Mag.* 43: 453-457.

**Papagoite:**  $\text{CaCuAlSi}_2\text{O}_6(\text{OH})_3$  – named for the **Papago** who were early inhabitants of the area around the type locality, the New Cornelia mine, Ajo, Pima County. Hutton C.O., and A.C. Vlisidis (1960) Papagoite, a new copper-bearing mineral from Ajo, Arizona. *Amer. Min.* 45: 599-611.

**Parakhinite:**  $\text{PbCu}_3\text{TeO}_6(\text{OH})_2$  – from the Greek **para** (near) and **khinite** with which it is dimorphic. The type locality is the dumps of the Old Guard mine in Tombstone, Cochise County. Williams, S.A. (1978) Khinite, parakhinite, and dugganite, three new minerals from Tombstone, Arizona. *Amer. Min.* 63: 1016-1019.

**Paramelaconite:**  $\text{Cu}_4\text{O}_3$  – from the Greek **para** (near) and **melaconite** an old name for tenorite, because it is close to tenorite in composition. The type locality is the Copper Queen mine in Bisbee, Cochise County. Koenig, G.A. (1891) On paramelaconite and associated minerals. *Proc. Acad. Nat. Sci. Phila.* 284-291.

**Paulkerrite:**  $(\text{H}_2\text{O},\text{K})_2(\text{Mg},\text{Mn})_2(\text{Fe},\text{Al})_2\text{Ti}(\text{PO}_4)_4(\text{OH})_3 \cdot 14\text{H}_2\text{O}$  – named after **Paul Francis Kerr**, Professor of Mineralogy at Columbia University, New York. The type locality is the 7U7 Ranch in Yavapai County. Peacor D., P.J. Dunn, and W. B. Simmons (1984) Paulkerrite, a new titanium phosphate from Arizona. *Mineral. Record* 15: 303-307.

**Pinalite:**  $\text{Pb}_3\text{WO}_5\text{Cl}_2$  – named after the discovery locality the Mammoth-St. Anthony mine, Tiger, **Pinal** County. Dunn, P.J., J.D. Grice, and R.A. Bideaux (1989) Pinalite, a new lead tungsten chloride mineral from the Mammoth mine, Pinal County, Arizona. *Amer. Min.* 74: 934-935.

**Pseudograndreefite:**  $\text{Pb}_6(\text{SO}_4)\text{F}_{10}$  – from the Greek **pseudos** (false) and **grandreefite** which it is similar to. The type locality is the Grand Reef mine, Graham County. Kampf, A.R., P.J. Dunn, and E.E. Foord (1989) Grandreefite, pseudograndreefite, laurelite, and aravaipaite: Four new minerals from the Grand Reef mine, Graham County, Arizona. *Amer. Min.* 74: 927-933.

**Ransomite:**  $\text{CuFe}_2(\text{SO}_4)_4 \cdot 6\text{H}_2\text{O}$  – named after Frederick Leslie **Ransom** (1868-1935), Professor of Mining Geology at the California Institute of Technology. The United Verde mine, Jerome, Yavapai County is the type locality. Lausen, C. (1928)

Hydrous sulfates formed under fumerolic conditions at the United Verde mine. *Amer. Min.* 13: 203-229.

**Ruizite:**  $\text{Ca}_2\text{Mn}_2\text{Si}_4\text{O}_{11}(\text{OH})_4 \cdot 2\text{H}_2\text{O}$  – named for Joe **Ruiz** of Mammoth, Arizona, who discovered the mineral and was an underground miner at Ray, a pharmacist and Justice of the Peace. The type locality is the Christmas mine, Gila County. Williams, S.A., and M. Duggan, (1977) Ruizite, a new silicate mineral from Christmas, Arizona. *Miner. Mag.* 41: 429-432.

**Schieffelite:**  $\text{Pb}(\text{Te,S})\text{O}_4 \cdot \text{H}_2\text{O}$  – named for Ed **Schieffelin**, who discovered the Tombstone ore deposits. The dumps of the Joe shaft, Tombstone, Cochise County is the type locality. Williams, S.A., (1980) Schieffelite, a new lead tellurate-sulfate from Tombstone, Arizona. *Mineral. Mag.* 43: 771-773.

**Selenium:** **Se** – from the Greek **Selene** (moon) because of the close association with tellurium (Latin Tellus (earth)). The United Verde mine, Yavapai County is the type locality. Palache, C. (1934) Contributions to crystallography: Claudetite, minasragrite, samsonite, native selenium, iridium. *Amer. Min.* 19: 194-205.

**Shannonite:**  $\text{Pb}_2\text{OCO}_3$ – named for David M. **Shannon** (1942-2004) who acquired the discovery material. The Grand Reef mine, Graham County is the type locality. Roberts, A.C., J.A.R. Stirling, G.J.C. Carpender, A.J. Criddle, G.C. Jones, T.C. Birkett, and W.E. Birch (1995) Shannonite, a new mineral from the Grand Reef mine, Graham County, Arizona, USA. *Mineral. Mag.* 59: 305-310.

**Shattuckite:**  $\text{Cu}_5(\text{Si}_2\text{O}_8)_2(\text{OH})_2$  – named for the discovery locality, the **Shattuck** mine, Bisbee, Cochise County. Schaller, W.T. (1915) Four new minerals. *Jour. Wash. Acad. Sci.* 5: 7.

**Spangolite:**  $\text{Cu}_6\text{Al}(\text{SO}_4)(\text{OH})_{12}\text{Cl} \cdot 3\text{H}_2\text{O}$  – named after Norman **Spang** (b. 1842) of Etna, Pennsylvania, who supplied the original specimen. The type locality was given as Tombstone, but later studies suggest that the type locality is really Bisbee, Cochise County. Penfield, S.L. (1890) On spangolite, a new copper mineral. *Amer. Jour. Sci.* 39: 370-378.

**Stishovite:**  $\text{SiO}_2$  – named for Sergei Mikhailovich **Stishov**, crystallographer, Academy of Sciences, Moscow, Russia, who synthesized the material. The type locality is Meteor Crater, Coconino County. Chao, E.C.T., J.J. Fahey, and J. Littler (1962) Stishovite, a very high pressure new mineral from Meteor crater, Arizona. *Jour. Geophys. Res.* 67: 419-421.

**Swartzite:**  $\text{CaMg}(\text{UO}_2)(\text{CO}_3)_3 \cdot 12\text{H}_2\text{O}$  – named after Charles Kephart **Swartz** (1861-1949) Professor of Geology at John Hopkins University, Baltimore,

Maryland. The type locality is the Hillside mine, Yavapai county. Axelrod J.M., F.S. Grimaldi, C. Milton, and K.J. Murata (1951) The uranium minerals from the Hillside mine, Yavapai County, Arizona. *Amer. Min.* 36: 1-22.

**Wherryite:**  $\text{PbCu}_2(\text{SO}_4)_4(\text{SiO}_4)_2(\text{OH})_2$  – named for Edgar Theodore **Wherry** (1885-1982), mineralogist and plant ecologist. The type locality is the Mammoth-St. Anthony mine, Tiger, Pinal County. Fahey, J.J., E.B. Daggett, and S. G. Gordon (1950) Wherryite a new mineral from the Mammoth mine, Arizona. *Amer. Min.* 35: 93-98.

**Wickenburgite:**  $\text{Pb}_3\text{CaAl}_2\text{Si}_{10}\text{O}_{27}(\text{H}_2\text{O})_3$  – from the discovery locality, the Potter-Cramer mine, near **Wickenburg**, Maricopa County. Williams, S.A. (1968) Wickenburgite, a new mineral from Arizona. *Amer. Min.* 53: 1433-1438.

**Winstanleyite:**  $\text{TiTe}_3\text{O}_8$  – named after B.J. **Winstanley**, amateur mineralogist from Douglas who first found the mineral. The type locality is the dumps of the Grand Central mine, Tombstone, Cochise county. Williams, S.A. (1979) Girdite, oboyerite, fairbankite, and winstanleyite, four new tellurium minerals from Tombstone, Arizona. *Mineral. Mag.* 43: 453-457.

**Wupatkiite:**  $(\text{Co,Mg,Ni})\text{Al}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$  – from the **Wupatki** ruin which is located near the discovery location. The type locality is an open cut 8 miles ESE of Gray Mountain, Coconino County. Williams, S.A. and F.P. Cesbron (1995) Wupatkiite from the Cameron Uranium district, Arizona, a new member of the Holotrichite group. *Mineral. Mag.* 59: 553-556.

**Yavapaiite:**  $\text{KFe}(\text{SO}_4)_2$  – from the **Yavapai** people who lived in the area. The United Verde mine, Jerome, Yavapai County is the type locality. Hutton, C.O. (1959) Yavapaiite, an anhydrous potassium, ferric sulfate from Jerome, Arizona. *Amer. Min.* 44: 1105-1114.

**Yedlinite:**  $\text{Pb}_6\text{CrCl}_6(\text{O,OH})_8$  – named after Leo Neal **Yedlin** (1908-1977), mineral collector from New Haven, Connecticut, who discovered the mineral. The type locality is the Mammoth-St. Anthony mine, Tiger, Pinal County. McLean, W.J., R.A. Bideaux, and R.W. Thomssen (1974) Yedlinite, a new mineral from the Mammoth mine, Tiger, Arizona. *Amer. Min.* 59: 1157-1159.

**Zinc-zippeite:**  $\text{Zn}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$  – the name is derived from the **zinc** content and the similarity to **zippeite**. The Hillside mine, Yavapai County is the type locality. Frondel, C., J. Ito, R.M. Honea, and A. M. Weeks (1976) Mineralogy of the zippeite group. *Can Min.* 14: 429-436.



### Appendix 3 -Doubtful and Discredited Arizona Minerals

The following minerals are minerals which have the type locality in Arizona, but have been discredited, are doubtful species, or have not been fully described. Information is presented here for historical purposes and it is possible that some of these will be validated in the future. There are descriptions of these minerals and some of the history associated with them in the *Mineralogy of Arizona*, 3<sup>rd</sup> Edition, page number given below.

**ARIZONITE** –  $\text{Fe}_2\text{Ti}_3\text{O}_9$  (page 119). Arizonite was described in 1909, since then it has been on and off as a species. It was determined that the type specimen was a mixture of minerals (hematite, ilmenite, anatase, and rutile) and formed as a weathering product of ilmenite. There is a current valid species pseudorutile that has the formula  $\text{Fe}_2\text{Ti}_3\text{O}_9$  and is a weathering product of ilmenite. Ilmenite has the formula  $\text{Fe}_3\text{Ti}_3\text{O}_9$  and if the iron is oxidized from plus 2 to plus 3, then only two irons are needed in the structure. So there is a mineral with the correct formula, but the original arizonite is probably a mixture?

**BISBEEITE** –  $\text{CuSiO}_3 \cdot \text{H}_2\text{O}(?)$  (page 137). Considerable work has been done on this mineral and Dick Bideaux (personal communication) was convinced that it was a valid species, but there is not enough data at present to have the IMA approve it.

**DUHAMELITE** -  $\text{Cu}_4\text{Pb}_2\text{Bi}(\text{VO}_4)_4(\text{OH})_3 \cdot 8\text{H}_2\text{O}$  (page 209). Duhamelite was described by Williams in 1981 and two localities are given in *Mineralogy of Arizona*. Krause et al., 2003 discredited duhamelite and said it was mimetite. There is good chemical data given for duhamelite and it is nothing like mimetite, so there needs to be further study of this mineral.

Krause, W., U. Kolitsch, H. J. Bernhardt, H. Effenberger (2003) Duhamelite discredited. *Neues Jarhb. Mineral. Mon.*, 75: 96

**JEROMITE** –  $\text{As}(\text{S},\text{Se})_2$  (page 262). Jeromite is an amorphous phase of variable composition and therefore not considered a valid species (Burke, 2006).

Burke, E.A.J. (2007) A mass discreditation of GQN minerals. *Can. Min.* 44: 1557-1560

**WHELANITE** –  $\text{CuCa}_5\text{Si}_6\text{O}_{17}(\text{CO}_3)(\text{OH})_2 \cdot 4\text{H}_2\text{O}$  (page 418). The description of this mineral from the Christmas mine has never been submitted to the IMA for approval, but seems to be a valid species from all of the known data.



## Addendum – Updated July 2008

### New Minerals Species for Arizona

#### **\*CUMENGEITE**

Lead copper chloride hydroxide,  $Pb_2Cu_{20}Cl_{42}(OH)_{40}$ . A secondary mineral formed in lead-copper deposits.

*Maricopa County*: Collected on the dumps of the Rowley mine as small crystals and masses with boleite, atacamite, cerussite, caledonite, wulfenite, and mimetite (M. Klein, pers. commun., 2008).

#### **\*MATTHEDDLEITE**

Lead silicate sulfate chloride,  $Pb_{20}(SiO_4)_7(SO_4)_4Cl_4$ . A very rare mineral formed with other oxidized lead minerals.

*Pinal County*: Mammoth district, Mammoth-St. Anthony mine (J. Ruiz, pers. commun., 2008).

#### **\*MILARITE**

Potassium calcium aluminum beryllium silicate hydrate,  $KCa_2AlBe_2Si_{12}O_{30} \cdot 0.5H_2O$ . A hydrothermal mineral found in alpine veins and granites.

*Maricopa County*: Found at the US mine, a crushed rock quarry in the Belmont granite, northeast of the Belmont Mountains. The milarite occurs in miarolitic cavities in the granite with a number of other minerals including epidote, fluorite, calcite, and quartz (Gibbs and Turzi, 2007).

Reference:

Gibbs, R. and U. Turzi (2007) Minerals in the Miarolitic Cavities of the Belmont Granite Belmont Mountains, Maricopa County. Minerals of Arizona, Fifteenth Annual Symposium, March 2007.

#### **\*PHARMACOLITE**

Calcium hydrogen arsenate hydrate,  $CaHAsO_4 \cdot 2H_2O$ . A secondary mineral formed from other arsenic minerals.

*Mohave County*: Found at Corkscrew Cave on the Hualapai Reservation as green nodular speleothems with hornesite and talmessite. Listed as suspected based on chemical composition and crystal morphology (Onac et al., 2007).

Reference:

Onac, B.P., J.W. Hess, and W.B. White (2007) The relationship between the mineral composition of speleothems and mineralization of breccia pipes: evidence from Corkscrew Cave, Arizona, USA. *Can. Min.* 45: 1177-1188

## **New Localities for Minerals in Arizona**

Brockite (This is the second occurrence for Arizona.)

Chalcosiderite (These are the second and third localities in Arizona)

### **BROCKITE**

$(\text{Ca, Th, Ce})(\text{PO}_4) \cdot \text{H}_2\text{O}$ .

*Maricopa County*: Found at the US mine, a crushed rock quarry in the Belmont granite, northeast of the Belmont Mountains, as small acicular yellow tufts in miarolitic cavities in the granite (Gibbs and Turzi, 2007).

Reference:

Gibbs, R. and U. Turzi (2007) Minerals in the Miarolitic Cavities of the Belmont Granite Belmont Mountains, Maricopa County. Minerals of Arizona, Fifteenth Annual Symposium, March 2007.

### **CHALCOSIDERITE**

$\text{CuFe}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$ .

*Pima County*: Silver Bell mine, with other phosphates (Gibbs, 2004).

*Santa Cruz County*: Patagonia district, outcrop near the Humbolt mine with luetheite, and chenevixite (J. Ruiz, pers. commun., 2008).

Reference:

Gibbs, R. (2007) Phosphate Microminerals of the Silver Bell Mine, Pima County, Arizona. Minerals of Arizona, Twelfth Annual Symposium, March 2004.