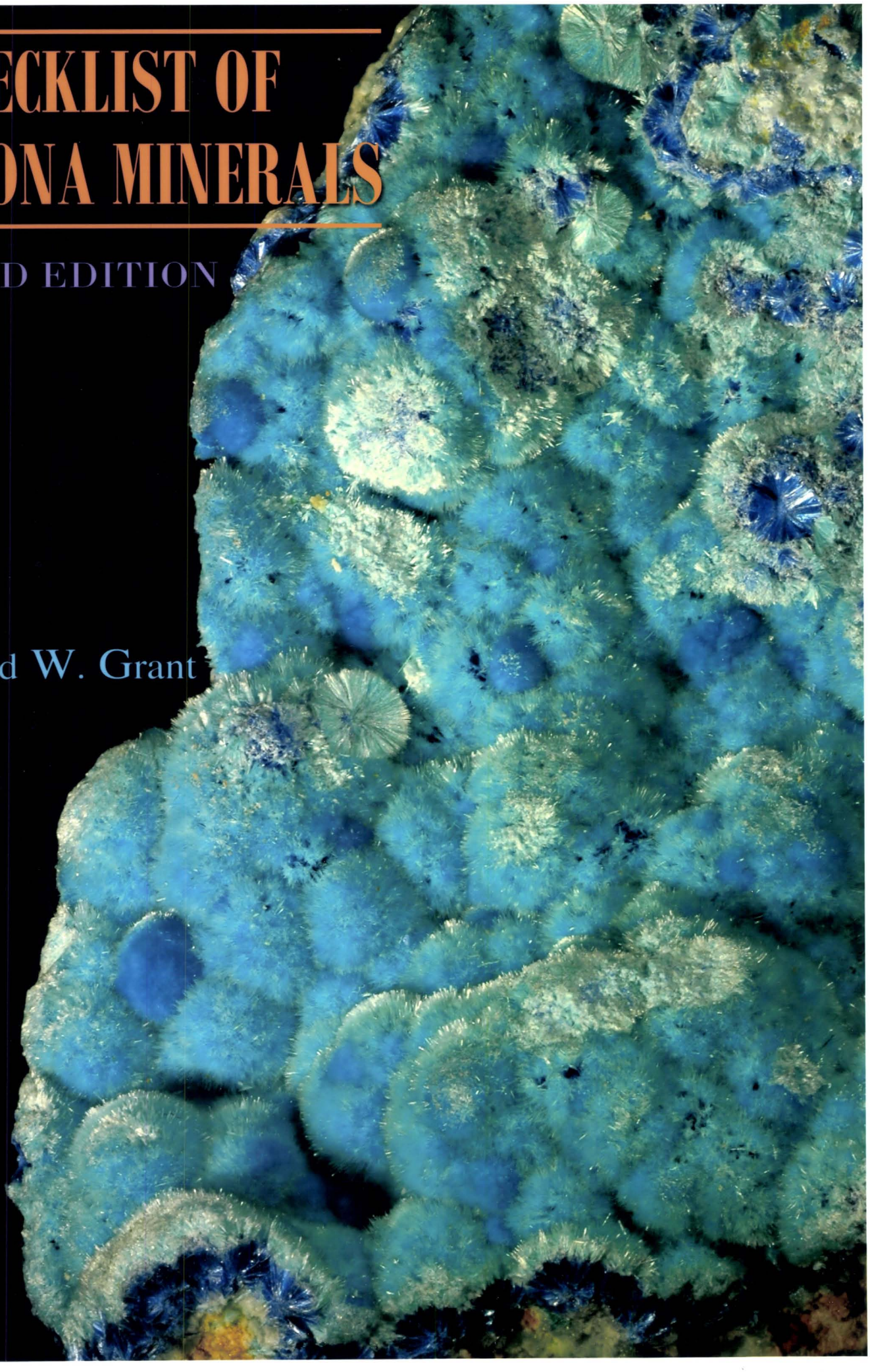
☑ CHECKLIST OF ARIZONA MINERALS

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; calcioaravaipaite 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, molybdite, 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), 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** 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).

*** ANILITE**
Copper sulfide, Cu_7S_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 $Ca(Fe,Mg,Mn)(CO_3)_2$ p. 113

*** ANNABERGITE**
Nickel arsenate hydrate, $Ni_3(AsO_4)_2 \cdot 8H_2O$. 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 $CaAl_2Si_2O_8$ listed under plagioclase in 3rd edition p. 329
ANORTHOCLASE $(Na,K)AlSi_3O_8$ p. 114
ANTHONYITE $Cu(OH,Cl)_2 \cdot 3H_2O$ p. 114
ANTHOPHYLLITE $Mg_7Si_8O_{22}(OH)_2$ p. 114
ANTIGORITE $Mg_3Si_2O_5(OH)_4$ listed under serpentine p. 367
ANTLERITE $Cu_3(SO_4)(OH)_4$ p. 115
APACHITE $Cu_9Si_{10}O_{29} \cdot 11H_2O$ p. 116
Apatite see FLUORAPATITE, HYDROXYLAPATITE
Apophyllite see FLUORAPOPHYLLITE, HYDROXYAPOPHYLLITE, CHLORAPATITE
ARAGONITE $CaCO_3$ p. 118
ARAVAIPAITE $Pb_3AlF_9 \cdot H_2O$ p. 118
Argentite see ACANTHITE
ARGENTOJAROSITE $AgFe_3(SO_4)_2(OH)_6$ p. 119
Arizonite not considered a valid species (see appendix 3) p. 119
ARSENIC As p. 119
ARSENIOSIDERITE $CaFe_3(AsO_4)_3O_2 \cdot 3H_2O$ p. 119
ARSENOLITE As_2O_3 p. 120
ARSENOPYRITE FeAsS p. 120
Arsenosulvanite see COLUSITE p. 120
ARTROEITE $PbAlF_3(OH)_2$ p. 120
Asbestos see ANTIGORITE, LIZARDITE, CHRYSOTILE
Attapulgite see PALYGORSKITE
ATACAMITE $Cu_2Cl(OH)_3$ p. 121
AUGELITE $Al_2(PO_4)(OH)_3$ p. 122
AUGITE $(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$ p. 122
AURICHALCITE $(Zn,Cu)_5(CO_3)_2(OH)_6$ p. 122

AURORITE $(Mn,Ag,Ca)Mn_3O_7 \cdot 3H_2O$ p. 123

AUSTINITE $CaZn(AsO_4)(OH)$
Cochise County: Warren district, Southwest mine, 7th 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 $Ca(UO_2)_2(PO_4)_2 \cdot 10\text{-}12H_2O$ p. 124
Axinite see MANGANAXINITE AND TINZENITE
AZURITE $Cu_3(CO_3)_2(OH)_2$ p. 125
BARITE $BaSO_4$ p. 127
BARRINGERITE $(Fe,Ni)_2P$ p. 129
Basaluminite see FELSOBANYAITE p. 129
BASSANITE $2CaSO_4 \cdot H_2O$ p. 130
BASSETITE $Fe(UO_2)_2(PO_4)_2 \cdot 8H_2O$ p. 130
BAYLDONITE $PbCu_3(AsO_4)_2(OH)_2$ p. 130
BAYLEYITE $Mg_2(UO_2)(CO_3)_3 \cdot 18H_2O$ p. 130
BEAVERITE $Pb(Fe,Cu)_3(SO_4)_2(OH,H_2O)_6$ p. 131

*** BECHERERITE**
Zinc copper hydroxide sulfate silicate, $Zn_7Cu(OH)_{13}[SiO(OH)_3SO_4]$. 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 $Ca(UO_2)_6O_4(OH)_6 \cdot 8H_2O$ p. 131
BEIDELLITE $(Na,Ca_{0.5})_{0.3}Al_2(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$ p. 131
BEMENTITE $Mn_7Si_6O_{15}(OH)_8$ p. 132
BERLINITE $AlPO_4$ p. 132
BERMANITE $MnMn_2(PO_4)_2(OH)_2 \cdot 4H_2O$ p. 132
BERTRANDITE $Be_4Si_2O_7(OH)_2$ p. 133
BERYL $Be_3Al_2Si_6O_{18}$ p. 133
BEUDANTITE $PbFe_3[(As,S)O_4]_2(OH,H_2O)_6$ p. 134
BEYERITE $(Ca,Pb)Bi_2(CO_3)_2O_2$ p. 135
BIANCHITE $Zn(SO_4) \cdot 6H_2O$ p. 135
BIDEAUXITE $Pb_2AgCl_3F(OH)$ p. 135
BIEBERITE $CoSO_4 \cdot 7H_2O$ p. 136

***BONATTITE**

Copper sulfate hydrate, $CuSO_4 \cdot 3H_2O$. 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, $CuSO_4 \cdot 7H_2O$. 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).

*** BRUSHITE**

Calcium hydrogen phosphate hydrate, $CaHPO_4\cdot 2H_2O$. 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).

***BUSTAMITE**

Calcium manganese silicate, $(Ca,Mn)_3Si_3O_9$. 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).

BUTTGENBACHITE $Cu_{19}(NO_3)_2Cl_4(OH)_{32}\cdot 2H_2O$
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

*** CALCIOARAVAIPAITE**

Lead calcium aluminum fluoride hydroxide, $PbCa_2Al(F,OH)_9$. 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).

CARBONATE-CYANOTRICHITE $Cu_4Al_2(CO_3,SO_4)(OH)_{12}\cdot 2H_2O$.
Coconino County: Grandview mine, Grand Canyon National Park (Peter Williams, pers. commun., 2006). p. 154

*** CARMICHAELITE**
Titanium chromium oxide hydroxide, $(Ti,Cr)O_{1.5}(OH)_{0.5}$. 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).

***CLINOATACAMITE** – Copper chloride hydroxide, $Cu_2Cl(OH)_3$.
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, 5th 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).

CREEDITE – $Ca_3Al_2(SO_4)(OH)_2F_8 \cdot 2H_2O$. *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, $(Sr,La,Ce,Y)(Ti,Fe,Mn)_{21}O_{38}$. 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).

*** CUPROCOPIAPITE**
Copper iron sulfate hydroxide hydrate, $CuFe_4(SO_4)_6(OH)_2 \cdot 20H_2O$. 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).

***ERIOCHALCITE**

Copper chloride hydrate, $CuCl_2\cdot 2H_2O$. A rare water soluble mineral found around volcanic fumeroles 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).

ETTRINGITE $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$ p. 217
EUCRYPTITE $LiAlSiO_4$ p. 217
EUGENITE $Ag_{11}Hg_2$ p. 217
EUXENITE-(Y) $(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6$ p. 217
FAIRBANKITE $PbTeO_3$ p. 218
FAIRCHILDITE $K_2Ca(CO_3)_2$ p. 218
FAIRFIELDITE $Ca_2(Mn,Fe)(PO_4)_2\cdot 2H_2O$ p. 218
FAMATINITE Cu_3SbS_4 p. 219
FAYALITE Fe_2SiO_4 p. 219
FELSÖBÁNYAITE $Al_4SO_4(OH)_{10}\cdot 4H_2O$ was Basaluminite p. 129
FERBERITE $FeWO_4$ p. 422
FERGUSONITE $YNbO_4$ p. 219
FERNANDINITE $(Ca,Na,K)_x(V,Fe)_8O_{20}\cdot 4H_2O$ p. 219
FERRICOPIAPITE $Fe_{2/3}Fe_4(SO_4)_6(OH)_2\cdot 20H_2O$ p. 220
FERRIERITE $(Na,K)_2Mg(Al_5Si_{31}O_{72}\cdot nH_2O$ p. 220
FERRIMOLYBDITE $Fe_2(MoO_4)_3\cdot 8H_2O$ p. 220
FERRO-ACTINOLITE $Ca_2Fe_5Si_8O_{22}(OH)_2$ p. 221
FERROCOLUMBITE $FeNb_2O_6$ p. 221

***FERROHEXAHYDRITE**
Iron sulfate hydrate, $FeSO_4\cdot 6H_2O$. 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).

***FERROHORNBLENDE**
Calcium, iron, aluminum silicate hydroxide, $Ca_2[Fe_4(Fe,Al)](Si_7\ Al)O_{22}(OH)_2$. 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).

FERROKAERSUTITE $NaCa_2Fe_4TiSi_6Al_2O_{23}(OH)$ p. 221

***FERROSELITE**
Iron selenide, $FeSe_2$. Occurs in sedimentary uranium deposits in the Colorado Plateau.
Navajo County: found at the Mitten #2 mine in Monument Valley.

FERROTAPIOLITE $FeTa_2O_6$ p. 221
FERVANITE $Fe_4(VO_4)_4\cdot 5H_2O$ p. 222
FIBROFERRITE $Fe(SO_4)(OH)\cdot 5H_2O$ p. 222

***GLAUCOCERINITE**
Zinc copper aluminum sulfate hydroxide hydrate, $(Zn,Cu)_{10}Al_6(SO_4)_3(OH)_{32}\cdot 18H_2O$. 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, (Co,Fe)AsS. Forms in hydrothermal veins.
Graham County: Blue Bird mine, near Mount Trumbull with cobaltite (MRDS database ID# 10067567).

***GLUSHINSKITE**

Magnesium oxalate hydrate, $Mg(C_2O_4)\cdot 2H_2O$. 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).

***GORDAITE**

Sodium zinc sulfate hydroxide chloride hydrate, $NaZn_4(SO_4)(OH)_6Cl\cdot 6H_2O$. 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).

***GRANDVIEWITE**

Copper Aluminum sulfate hydroxide, $Cu_3Al_9(SO_4)_2(OH)_{29}$. 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).

***HOPEITE**

Zinc phosphate hydrate $Zn_3(PO_4)_2 \cdot 4H_2O$. 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).

HYDROCERUSSITE $Pb_3(CO_3)_2(OH)_2$ p. 254

***HYDROGLAUBERITE**

Sodium calcium sulfate hydrate, $Na_{10}Ca_3(SO_4)_8 \cdot 6H_20$. 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 $Zn_2Mn_4O_8 \cdot H_2O$

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, $Ni_6Fe_2(SO_4)(OH)_{16} \cdot 7H_2O$. 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 $Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$ p. 255

Hydromuscovite see ILLITE

HYDRONIUM JAROSITE $(H_3O)Fe_3(SO_4)_2(OH)_6$ p. 255

HYDROXYAPOPHYLLITE $KCa_4Si_8O_{20}(OH,F) \cdot 8H_2O$ p. 255

HYDROXYLAPATITE $Ca_5(PO_4)_3(OH)$ p. 255

HYDROZINCITE $Zn_5(CO_3)_2(OH)_6$ p. 255

HYPERSTHENE not a valid species p. 256

"ILLITE" (a series) $K_{0.65}Al_{2.0}Si_{3.35}O_{10}(OH)_2$ p. 256

ILMENITE $FeTiO_3$ p. 257

ILSEMANNITE $Mo_3O_8 \cdot H_2O(?)$ p. 258

ILVAITE $CaFe_3Si_2O_7O(OH)$ p. 258

INGODITE $Bi_2(TeS)$ p. 259

IODARGYRITE AgI p. 259

IRANITE $Pb_{10}Cu(CrO_4)_6(SiO_4)_2(OH)_2$ p. 259

IRIGINITE $(UO_2)Mo_2O_7 \cdot 3H_2O$ p. 260
IRON Fe see Kamacite - p.265, Taenite - p. 388

***JACOBSITE**
Manganese iron magnesium oxide, $(Mn,Fe,Mg)(Fe,Mn)_2O_4$. 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 $Na(Al,Fe)Si_2O_6$ p. 260
JAHNSITE $CaMn(Fe,Mg)_2Fe_2(PO_4)_4(OH)_2 \cdot 8H_2O$ p. 260
JALPAITE Ag_3CuS_2 p. 260
JAMESONITE $Pb_4FeSb_6S_{14}$ p. 260
JAROSITE $KFe_3(SO_4)_2(OH)_6$ p. 261
Jeromite not considered a valid species (see appendix 3) p. 262

JOHANNITE $Cu(UO_2)_2(SO_4)_2(OH)_2 \cdot 8H_2O$.
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 $CaMnSi_2O_6$ p. 263

***JÔKOKUITE**
Manganese sulfate hydrate, $MnSO_4 \cdot 5H_2O$. 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 MoS_2 p. 263
JUNITOITE $CaZn_2Si_2O_7 \cdot H_2O$ p. 263
JURBANITE $Al(SO_4)(OH) \cdot 5H_2O$ p. 264
KAERSUTITE $Ca_2Na(Mg_4Ti)(Si_6Al_2)O_{23}(OH)$ p. 264
Kamacite see IRON p. 265

***KAMITUGAITE**
Lead aluminum uranyl phosphate arsenate hydroxide hydrate,

$PbAl(UO_2)_5[(P,As)O_4]_2(OH)_9 \cdot 9.5H_2O$. 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).

***KIESERITE**
Magnesium sulfate hydrate, $MgSO_4 \cdot H_2O$. Found commonly in evaporite deposits.
Coconino County: found as an efflorescent mineral in the Grand Canyon (Quick et al., 1989).

***KINOSHITALITE**
Barium potassium magnesium manganese aluminum silicate hydroxide, $BaMg_3Si_2Al_2O_{10}(OH)_2$. Found in manganese rocks.
Apache County: found in an ultrmafic 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).

***LANSFORDITE**

Magnesium carbonate hydrate, $MgCO_3 \cdot 5H_2O$. 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).

***LIROCONITE**

Copper aluminum arsenate hydroxide hydrate, $Cu_2Al(AsO_4)(OH)_4 \cdot 4H_2O$. 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).

LONSDALEITE C 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).

***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).

***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).

***MONOHYDROCALCITE**

Calcium carbonate hydrate, $CaCO_3 \cdot H_2O$. 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, $Bi_2TeO_6 \cdot 2H_2O$. 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.

***MONTROYDITE**

Mercury oxide, 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).

***NAMIBITE**

Copper bismuth oxide vanadate hydroxide, $Cu(BiO)_2(VO_4)(OH)$. A rare secondary mineral in hydrothermal deposits.

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

NATROALUNITE $NaAl_3(SO_4)_2(OH)_6$ p. 310

***NATRODUFRÉNITE**
Sodium iron aluminum phosphate hydroxide hydrate, $NaFe(Fe,Al)_5(PO_4)_4(OH)_6 \cdot 2H_2O$. 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 $NaFe_3(SO_4)_2(OH)_6$ p. 310
NATROLITE $Na_2Al_2Si_3O_{10} \cdot 2H_2O$ p. 310
NAUMANNITE Ag_2Se p. 311
NAVAJOITE $(V,Fe)_{10}O_{24} \cdot 12H_2O$ p. 311
NEKOITE $Ca_3Si_6O_{15} \cdot 7H_2O$ p. 311
NEKRASOVITE $Cu_{26}V_2(Sn,As,Sb)_6S_{32}$ p. 312
NELTNERITE $CaMn_6SiO_{12}$ p. 312
NEOTOCITE $(Mn,Fe)SiO_3 \cdot H_2O(?)$ p. 312
NEPHELINE $(Na,K)AlSiO_4$ p. 312

***NESQUEHONITE**
Magnesium bicarbonate hydroxide hydrate, $Mg(HCO_3)(OH) \cdot 2H_2O$. 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 $Pb_7(Cu,Ag)_2Bi_6S_{17}$ p. 312

***NICKEL-BOUSSINGAULTITE**
Ammonium nickel magnesium sulfate hydrate, $(NH_4)_2Ni(SO_4)_2 \cdot 6H_2O$. 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 hydrohonessite (Williams and Cesbron, 1995).

NICKELINE NiAs p. 313
NICKEL-SKUTTERUDITE $(Ni,Co,Fe)As_{2-3}$ p. 313
NICKEL-ZIPPEITE $Ni_2(UO_2)_6(SO_4)_3(OH)_{10} \cdot 16H_2O$ p. 313
NITER KNO_3 p. 313
NITRATINE $NaNO_3$ p. 314
NITROCALCITE $Ca(NO_3)_2 \cdot 4H_2O$ p. 314
NOLANITE $(V,Fe,Ti)_{10}O_{14}(OH)_2$ p. 314

NONTRONITE $Na_{0.3}Fe_2(Al,Si)_4O_{10}(OH)_2 \cdot nH_2O$ p. 314
NORDSTRÖMITE $Pb_3CuBi_7(S_{10}Se_4)$ p. 315
NSUTITE $Mn_xMn_{1-x}O_{2-2x}(OH)_{2x}$ p. 315
NUKUNDAMITE $(Cu,Fe)_4S_4$ p. 315
OBOYERITE $H_6Pb_6(TeO_3)_3(TeO_6)_2 \cdot 2H_2O$ p. 315
OFFRÉTITE $KCaMg[Al_5Si_{13}O_{36}] \cdot 16H_2O$ p. 316
OKENITE $Ca_5Si_9O_{23} \cdot 9H_2O$ p. 316
OLIVENITE $Cu_2(AsO_4)(OH)$ p. 316
Olivine is a group name
OMPHACITE $(Ca,Na)(Mg,Fe,Al)Si_2O_6$ p. 318
OPAL $SiO_2 \cdot nH_2O$ listed under Cristobalite p. 192
ORPIMENT As_2S_3 p. 318
ORTHOCLASE $KAlSi_3O_8$ p. 318

***ORTHOSERPIERITE**

Calcium copper zinc sulfate hydroxide hydrate, $Ca(Cu,Zn)_4(SO_4)_2(OH)_6 \cdot 3H_2O$.

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).

OSARIZAWAITE $Pb(CuAl)_3(SO_4)_2(OH)_6$ p. 319
PALYGORSKITE $(Mg,Al)_2Si_4O_{10}(OH) \cdot 4H_2O$ p. 319
PAPAGOITE $CaCuAlSi_2O_6(OH)_3$ p. 319

***PARACOQUIMBITE**

Iron sulfate hydrate, $Fe_2(SO_4)_3 \cdot 9H_2O$. 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).

PARAGONITE $NaAl_2(Si_3Al)O_{10}(OH)_2$ p. 320
PARAKHINITE $Cu_3PbTeO_6(OH)_2$ p. 320
PARALAURIONITE $PbCl(OH)$ p. 320
PARAMELACONITE Cu_4O_3 p. 320
PARAMONTROSEITE VO_2 p. 321
PARARAMMELSBERGITE $NiAs_2$ p. 321
PARATACAMITE $Cu_2Cl(OH)_3$ p. 321
PARATELLURITE TeO_2 p. 321
PARGASITE $NaCa_2(Mg_4Al)Si_6Al_2O_{22}(OH)_2$ p. 322
PARISITE $Ca(Ce,La)_2(CO_3)_3F_2$ p. 322

PARNAUITE $Cu_9(AsO_4)_2(SO_4)(OH)_{10}\cdot 7H_2O$ p. 322
PARSONSITE $Pb_2(UO_2)(PO_4)_2$ p. 322
PARTZITE $Cu_2Sb(O,OH)_7$ p. 322
PASCOITE $Ca_3V_{10}O_{28}\cdot 17H_2O$ p. 323
PAULKERRITE $(H_2O,K)_2Ti(Mg,Mn)_2(Fe,Al)_2(PO_4)_4(OH)_3\cdot 14H_2O$ p. 323
PEARCEITE $(Ag,Cu)_{16}As_2S_{11}$ p. 323
PECORAITE $Ni_3Si_2O_5(OH)_4$ p. 323

PECTOLITE $NaCa_2Si_3O_8(OH)$
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 $PbCuBi_{11}S_{18}$ p. 324

***PENTAHYDRITE**
Magnesium sulfate hydrate, $MgSO_4\cdot 5H_2O$. Occurs with efflorescent salts.
Coconino County: found as an efflorescent mineral in the Grand Canyon (Quick et al., 1989).

PENTLANDITE $(Fe,Ni)_9S_8$ p. 324
PERICLASE MgO p. 325
PERITE $PbBiO_2Cl$ p. 325
PEROVSKITE $CaTiO_3$ p. 325
PETZITE Ag_3AuTe_2 p. 325
PHARMACOSIDERITE $KFe_4(AsO_4)_3(OH)_4\cdot 6\text{-}7H_2O$ p. 325
PHILLIPSITE $(K,Na,Ca_{0.5})_9Al_9Si_{27}O_{72}\cdot\sim 24H_2O$ p. 326
PHLOGOPITE $KMg_3AlSi_3O_{10}(OH)_2$ p. 326
PHOENICOCHROITE $Pb_2O(CrO_4)$ p. 327

PHOSGENITE $Pb_2(CO_3)Cl_2$
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, $Ca_2Pb_3(PO_4)_3Cl$. 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.

***PYROCHLORE**
Calcium sodium niobium oxide fluoride, $(Ca,Na)_2Nb_2O_6F$. 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).

PYROLUSITE MnO_2 p. 342
PYROMORPHITE $Pb_5(PO_4)_3Cl$ p. 343
PYROPE $Mg_3Al_2(SiO_4)_3$ p. 344
PYROPHYLLITE $Al_2Si_4O_{10}(OH)_2$ p. 345
Pyroxene is a group name
PYRRHOTITE $Fe_{1-x}S$ p. 345
QUARTZ SiO_2 p. 346
QUEITITE $Pb_4Zn_2(SiO_4)(Si_2O_7)(SO_4)$ p. 350
QUETZALCOATLITE $Cu_3Zn_6(TeO_3)_2O_6(Ag_xPb_y)Cl_{x+2y}$ p. 350
RALSTONITE $Na_xMg_xAl_{2-x}(F,OH)_6{\cdot}H_2O$ p. 350
RAMEAUITE $K_2CaU_6O_{20}{\cdot}9H_2O$ p. 351
RAMMELSBERGITE $NiAs_2$ 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 the79 mine (R. Downs, pers. commun., 2006).

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

REEVESITE $Ni_6Fe_2(CO_3)(OH)_{16}{\cdot}4H_2O$ 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).

RHODOCHROSITE $MnCO_3$ p. 353
RHODONITE $CaMn_4Si_5O_{15}$ p. 354

***SCHMIEDERITE**
Lead copper selenite selenate hydroxide, $Pb_2Cu_2(SeO_3)(SeO_4)(OH)_4$. A rare secondary mineral.
Maricopa County: collected from the main vein at the Tonopah-Belmont mine (R. Thomssen and J. Marty, pers. commun., 2001).

SCOLECITE $CaAl_2Si_3O_{10}\cdot 3H_2O$ p. 365
SCORODITE $FeAsO_4\cdot 2H_2O$ p. 365

SCORZALITE $(Fe,Mg)Al_2(PO_4)_2(OH)_2$
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 $Cu(UO_2)_2(VO_4)_2\cdot 6H_2O$ p. 366
SEPIOLITE $Mg_4Si_6O_{15}(OH)_2\cdot 6H_2O$ p. 366
SERPIERITE $Ca(Cu,Zn)_4(SO_4)_2(OH)_6\cdot 3H_2O$ p. 368

***SHANNONITE**
Lead oxide carbonate, Pb_2OCO_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 $Cu_5(Si_2O_6)_2(OH)_2$ p. 369
SHERWOODITE $Ca_9Al_2V_{28}O_{80}\cdot 56H_2O$ p. 370
SICKLERITE $Li(Mn,Fe)PO_4$ p. 370
SIDERITE $FeCO_3$ p. 370
SIDEROTIL $Fe(SO_4)\cdot 5H_2O$ p. 371
SIEGENITE $CoNi_2S_4$ p. 371
SILLIMANITE Al_2SiO_5 p. 371
SILVER Ag p. 372
SKUTTERUDITE $CoAs_3$ p. 373
SMITHSONITE $ZnCO_3$ p. 374

***SODDYITE**
Uranyl silicate hydrate, $(UO_2)_2SiO_4\cdot 2H_2O$. A secondary mineral formed from the alteration of uraninite.
Yavapai County: from the Steel City mine with kasolite and uranium rich thorite (Frondel, 1958).

***SRILANKITE**

Titanium zirconium oxide, $(Ti,Zr)O_2$. 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).

***STRACZEKITE**

Calcium potassium barium vanadium oxide hydrate, $(Ca,K,Ba)_2V_8O_{20}\cdot 3H_2O$. 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).

***SURITE**

Lead calcium aluminum iron magnesium silicate hydroxide carbonate, $Pb(Pb,Ca)(Al,Fe,Mg)_2(Si,Al)_4O_{10}(OH)_2(CO_3)_2$.

A very rare secondary mineral found in oxidized lead-zinc deposits.
Pinal County: Mammoth district, Mammoth-St. Anthony mine (J. Ruiz, pers. commun., 2005).

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

***WAGNERITE**
Magnesium iron phosphate fluoride, $(Mg,Fe)_2(PO_4)F$. 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).

***WEDDELLITE**
Calcium oxalate hydrate, $Ca(C_2O_4) \cdot 2H_2O$. 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).

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

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

***ZINCOCOPIAPITE**

Zinc iron sulfate hydroxide hydrate, $ZnFe_4(SO_4)_6(OH)_2 \cdot 20H_2O$. 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).

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Appendix 1 - List of Arizona Mineral Species

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

CINNABAR
CLARINGBULLITE
CLAUDETITE
CLAUSTHALITE
CLINOATACAMITE
CLINOBISVANITE
CLINOCHLORE
CLINOCLASE
CLINOHEDRITE
CLINOHUMITE
CLINOPTILOLITE
CLINOZOISITE
CLINTONITE
COBALTITE
COCONINOITE
COESITE
COFFINITE
COHENITE
COLEMANITE
COLUSITE
CONICHALCITE
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
DUFRÉNOYSITE
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
FERROHORNBLENDE
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
JÔKOKUITE
JORDISITE
JUNITOITE
JURBANITE
KAERSUTITE
KAMITUGAITE
KANONAITE
KAOLINITE
KASOLITE
KËSTERITE
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-
HORNBLENDE
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
METANOVÁCEKITE
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
ORTHOSERPIERITE
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
PSEUDOBOLÉITE
PSEUDOBROOKITE
PSEUDOGRANDREEFITE
PSEUDOMALACHITE
PUMPELLYITE
PURPURITE
PYRARGYRITE
PYRITE
PYROCHLORE
PYROLUSITE
PYROMORPHITE
PYROPE
PYROPHYLLITE
PYRRHOTITE
QUARTZ
QUEITITE
QUETZALCOATLITE
RALSTONITE
RAMEAUITE
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
TETRADYMITE
TETRAHEDRITE
TETRATAENITE
THALÉNITE-(Y)
THAUMASITE
THENARDITE
THOMSONITE
THORITE
TILASITE
TINZENITE
TITANITE
TLAPALLITE
TOBERMORITE
TODOROKITE
TOLBACHITE
TOPAZ
TORBERNITE
TREMOLITE
TRIDYMITE
TRIPHYLITE
TRIPLITE
TRIPLOIDITE
TROILITE
TSCHERMAKITE
TSUMEMBITE
TUNGSTITE
TURQUOISE
TYROLITE
TYUYAMUNITE
ULVÖSPINEL
UMOHOITE
URANINITE
URANOCIRCITE
URANOPHANE
URANOPHANE-BETA
URANOPILITE
URANOSPINITE
UVANITE
UVAROVITE
UYTENBOGAARDTITE
VAESITE
VALLERIITE
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)
XOCOMECATLITE
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, artroeite, 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: $(K,Na)Cu_7AlSi_9O_{24}(OH)_6 \cdot 3H_2O$ – 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: $Na_2Ca(UO_2)(CO_3)_3 \cdot 6H_2O$ – 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: $Cu_3(SO_4)(OH)_4$ – 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: $Cu_9Si_{10}O_{29}\cdot 11H_2O$ – 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: $Pb_3AlF_9\cdot H_2O$ – 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: $PbAlF_3(OH)_2$ – 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: $Mg_2(UO_2)(CO_3)_3\cdot 18H_2O$ – 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: $Zn_7Cu(OH)_{13}[SiO(OH)_3SO_4]$ – 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: $Mn_3(PO_4)_2(OH)_2\cdot 4H_2O$ – 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: $Pb_3AgCl_3F(OH)$ - 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: Cr_3S_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: $Fe(SO_4)(OH)\cdot 2H_2O$ – 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: $K_2Ca(CO_3)_2$ – 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: $PbCa_2Al(F,OH)_9$ – 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: $(Ti,Cr)O_{1.5}(OH)_{0.5}$ – 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: $CuAl_4(SO_4)(OH)_{12}\cdot 3H_2O$ – 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: $Fe_2Al_2(UO_2)_2(PO_4)_4(SO_4)(OH)_2\cdot 20H_2O$ – 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: 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: $PbMn_8O_{16}$ – 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: $CaAl_2Si_3O_{10}\cdot 5.3H_2O$ – 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: $Pb_2Cu_2Fe_2Si_5O_{17}\cdot 6H_2O$ – 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: KMn_8O_{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: $Cu_3(WO_4)_2(OH)_2$ – 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: $Pb_3Zn_3TeO_6(AsO_4)(OH)$ – 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: $Fe_2Te_3O_9\cdot 2H_2O$ – 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: $PbTeO_3$ – 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: $K_2Ca(CO_3)_2$ – 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: $C_{10}H_{22}O_3$ – 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: $Cu_2(NO_3)(OH)_3$ – 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: $Cu_5Si_6O_{17}{\cdot}7H_2O$ – 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: $Pb_3H_2(TeO_3)(TeO_6)$ – 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: $CuTeO_3{\cdot}H_2O$ – 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: $Pb_2(SO_4)F_2$ – 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: $Cu_3Al_9(SO_4)_2(OH)_{29}$ – 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: $CuFe(SO_4)_2(OH)\cdot 4H_2O$ – 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 fumerolic conditions at the United Verde mine. *Amer. Min.* 13: 203-229.

Haxonite: $(Fe,Ni)_{23}C_6$ – 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: $Pb_{10}Zn(CrO_4)_6(SiO_4)_2F_2$ – 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: $Cu_4Ag_3Te_4$ – 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) Heneryite, a new copper-silver telluride from Bisbee, Arizona. *Bull. Min.* 106: 511-517.

Junitoite: $CaZn_2Si_2O_7\cdot H_2O$ – 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: $Al(SO_4)(OH)\cdot 5H_2O$ – named after **J**oseph **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: $PbCu_3TeO_6(OH)_2$ – 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: Cu_6SnWS_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: $Ca_2Cu_2Si_3O_8(OH)_4$ – 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: $Na_2Mg_4Cr_2Si_6O_{20}$ – 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: $Pb_7F_{12}Cl_2$ – 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: $Fe_2(SO_4)_3 \cdot 6H_2O$ – 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: $Pb_2Cu_2Si_5O_{14} \cdot 14H_2O$ – 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: $Cu_2Al_2(AsO_4)_2(OH)_4 \cdot H_2O$ – 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: $Pb_3Cu(CrO_4)SiO_3(OH)_4 \cdot 2H_2O$ – 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: $Pb_6Cu_4AlSbO_2(OH)_{16}Cl_4(SO_4)_2$ – 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: $(Pb_7Ca_2)[Al_{12}Si_{36}(O,OH)_{100} \cdot nH_2O$ (n~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: 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: $PbCu_6O_{6.5}Cl$ – 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: $(V,Fe)_{10}O_{24} \cdot 12H_2O$ – 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: $Ni_2(UO_2)_6(SO_4)_3(OH)_{10} \cdot 16H_2O$ – 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: $Pb_6H_6(TeO_3)_3(TeO_6)_2 \cdot 2H_2O$ – named for **O**liver **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: $CaCuAlSi_2O_6(OH)_3$ – 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: $PbCu_3TeO_6(OH)_2$ – 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: Cu_4O_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: $(H_2O,K)_2(Mg,Mn)_2(Fe,Al)_2Ti(PO_4)_4(OH)_3 \cdot 14H_2O$ – 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: $Pb_3WO_5Cl_2$ – named after the discovery locality the Mammoth-St. Anthony mine, Tiger, **Pinal** County. Dunn, P.J., J.D. Grice, ad R.A. Bideaux (1989) Pinalite, a new lead tungsten chloride mineral from the Mammoth mine, Pinal County, Arizona. *Amer. Min.* 74: 934-935.

Pseudograndreefite: $Pb_6(SO_4)F_{10}$ – from the Greek **pseudos** (false) and **grandreefite** which it is similar to. The type locality is the Grand Reef mine, Graham Couty. 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: $CuFe_2(SO_4)_4 \cdot 6H_2O$ – 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: $Ca_2Mn_2Si_4O_{11}(OH)_4 \cdot 2H_2O$ – 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.

Schieffelinite: $Pb(Te,S)O_4 \cdot H_2O$ – 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) Schieffelinite, 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) Contibutions to crystallography: Claudetite, minasragrite, samsonite, native selenium, iridium. *Amer. Min.* 19: 194-205.

Shannonite: Pb_2OCO_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: $Cu_5(Si_2O_8)_2(OH)_2$ – 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: $Cu_6Al(SO_4)(OH)_{12}Cl \cdot 3H_2O$ – 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: 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: $CaMg(UO_2)(CO_3)_3 \cdot 12H_2O$ – 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: $PbCu_2(SO_4)_4(SiO_4)_2(OH)_2$ – 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: $Pb_3CaAl_2Si_{10}O_{27}(H_2O)_3$ – 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: $TiTe_3O_8$ – 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: $(Co,Mg,Ni)Al_2(SO_4)_4 \cdot 22H_2O$– 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: $KFe(SO_4)_2$ – 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: $Pb_6CrCl_6(O,OH)_8$ – 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: $Zn_2(UO_2)_6(SO_4)_3(OH)_{10} \cdot 16H_2O$ – 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, 3rd Edition, page number given below.

ARIZONITE – $Fe_2Ti_3O_9$ (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, illmenite, anatase, and rutile) and formed as a weathering product of ilmenite. There is a current valid species pseudorutile that has the formula $Fe_2Ti_3O_9$ and is a weathering product of ilmenite. Ilmenite has the formula $Fe_3Ti_3O_9$ 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 – $CuSiO_3 \cdot H_2O$(?) (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 - $Cu_4Pb_2Bi(VO_4)_4(OH)_3 \cdot 8H_2O$ (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 – $As(S,Se)_2$ (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 – $CuCa_5Si_6O_{17}(CO_3)(OH)_2 \cdot 4H_2O$ (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

***CUMEN*GEI*TE**
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 releationship 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

$(Ca,Th,Ce)(PO_4)\cdot H_2O$.
Maricopa County: Found at the US mine, a crushed rock quarry in the Belmont granite, northeast of the Belmont Mountains, as small acicular yellow tuffs 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

$CuFe_6(PO_4)_4(OH)_8\cdot 4H_2O$.
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.