

Arizona's Metallic Resources Trends and Opportunities 2006



**Arizona Department of Mines
and Mineral Resources**

**Mining Summary
2006 Exploration Overview
Additional Information Sources**

ARIZONA'S METALLIC RESOURCES TRENDS AND OPPORTUNITIES

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by Nyal J. Niemuth

Arizona Department of Mines and Mineral Resources

The Department promotes the development of Arizona's mineral resources. This is accomplished through technical research, field investigations, compilation of information into a mineral occurrence database, and disseminating information through publications, personal contacts, and seminars.

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Mining in Arizona

The Southwest is the United States' richest storehouse of metals and industrial minerals and is likely to remain so for many years. Arizona ranked first in mineral production in the US in 2005 with a production value of \$4.73 billion according to preliminary figures released by the USGS. Arizona leads the Nation in **copper** and **molybdenum** production, and ranks in the top five in **gemstones, perlite, silver, zeolites, iron oxide, pumice, and sand and gravel**. Additionally, Arizona produces, or has produced, **zinc, lead, beryllium, vanadium, uranium, tungsten, rare earths, manganese, coal, and at least 18 varieties of industrial minerals**.

In 2004, Arizona accounted for 62 percent of the U.S. copper production. The copper industry has a \$3.3 billion direct and indirect impact on the Arizona economy. Arizona's three largest copper producers, Asarco Inc., BHP Copper Inc., and Phelps Dodge also produce significant amounts of molybdenum, gold, and silver as byproducts in the production of copper. Phelps Dodge's Morenci mine produced 800 million pounds of copper in 2005, has the largest EW plant in the world, and is the world's fifth largest mine.

Exploration and development increased significantly coincident with the strongly improving metal prices. This was especially true for copper and molybdenum as those commodities hit record prices and also for uranium closing at a many year high. A newly discovered porphyry copper deposit may be the largest copper deposit in North America. Resolution Copper, a joint venture of Rio Tinto and BHP Billiton, owns the deposit that has at least 1 billion tons of mineralization at 1.5 percent copper. Phelps Dodge approved the expenditure of \$210 million to build the first commercial scale copper concentration pressure leach direct electrowinning plant at Morenci. Production will begin in 2007 in conjunction with the resumption of concentration. The development of the nearby Safford Project received conditional approval from Phelps Dodge's board. Expenditures of \$500 million are expected to build 2 pits and a leaching complex. When complete in the second half of 2008 the project will produce 250 million pounds of copper a year. Quadra purchased the Carlota copper leach project for \$37.5 million in cash and gold. Construction should begin in July 2006.

Although gold takes a backseat to copper production, Arizona has produced over 16 million ounces of gold. American Bonanza Gold Mining recently completed a lengthy surface and underground drilling program that defined a resource of over 330,000 ounces of gold.

Arizona Mineral Production¹

Commodity	2003 Value ⁴	2004 Value ⁴	2005 Value ⁴
Copper	\$1,350,000,000	\$2,130,000,000	na
Gemstones	1,450,000	1,450,000	na
Gold (troy oz)	w	w	na
Molybdenum (lb)	w	w	na
Sand & gravel	319,000,000	372,000,000	na
Stone, crushed	57,500,000	52,000,000	na
Other²	393,300,000	447,100,000	na
Coal³	315,000,000	312,000,000	290,000,000
Total	\$2,436,350,000	\$3,312,000,000	\$5,020,000,000

1) USGS preliminary data except as noted

2) Includes cement, clay, lime, gypsum, gold, molybdenum, perlite, silver, salt, dimension stone, zeolites, and iron oxides.

3) ADMMR estimate

4) Unpublished USGS data, subject to change; official preliminary 2004 and final 2003 data will be published in the Arizona Chapter of the USGS Mineral Yearbook, Area Reports: Domestic 2004, volume II.

Porphyry Copper

Description: Arizona hosts an impressive number of economically important porphyry copper deposits. Over 90% of the copper deposits shown in Figure 1 are of, or related to, that style of mineralization. These deposits account for a large portion of the current and historic value of mineral production of Arizona and Arizona's copper production accounts for approximately 65% of the United States newly mined copper production. Arizona's output reached an all time annual high in 1997 of 2.7 billion pounds. By-products of mining these porphyry copper deposits have also been significant, accounting for a large percentage of Arizona's gold, silver and molybdenum production.

General Characteristics: Volumes of literature summarize the characteristics of porphyry copper deposits in general, as well as provide details of many specific Arizona deposits, thus making it unproductive to provide a detailed review here.

History: Deposits with current or recent production include: Morenci, Ray, Sierrita, Bagdad, Mission, Silver Bell, Inspiration, Mineral Park, Pinto Valley, Lakeshore, San Manuel, New Cornelia, Johnson Camp, Twin Buttes, and Copper Queen. Significant deposits awaiting development or redevelopment include: Dos Pobres, San Juan, Lone Star, Helvetia (aka Rosemont), Twin Buttes, New Cornelia, Cochise, Copper Creek, Zonia, and Resolution Copper. Also included are Carlota and Emerald Isle, exotic copper deposits derived from porphyry copper systems.

Prior to the last copper price downturn, development of the Poston Butte and Santa Cruz deposits as in-situ leach operations seemed likely. Now it appears that these deposits may become victim of their high real estate value unless a pioneering mining company comes forward to purchase and develop them.

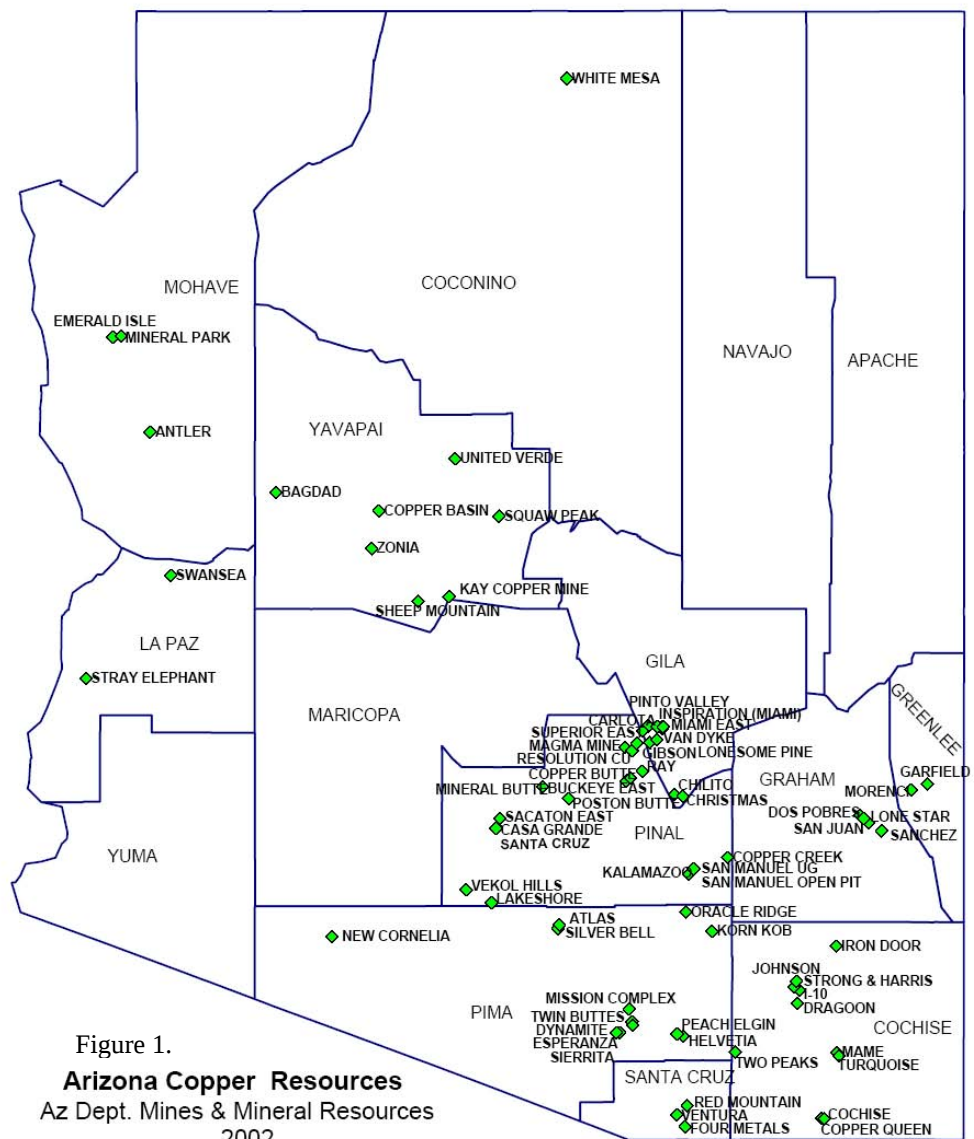


Figure 1.
Arizona Copper Resources
Az Dept. Mines & Mineral Resources
2002

Highlights of Current Activity: Record copper prices (U.S. \$2.23/lb. as of late February 2006) and anticipation of continuing strong demand are driving a resurgence of acquisition, exploration and development activity including the entry of a number of new companies.

Morenci: Phelps Dodge and Sumitomo are investing \$241 million to build the first commercial-scale copper concentrate pressure leach direct electrowinning plant. Morenci, Arizona's largest mine, will resume concentration in 2007 coinciding with completion of the project.

Safford Project: Development of Dos Pobres and San Juan received conditional approval from Phelps Dodge's board. Expenditures of \$550 million are expected to be required to build two open pits and the leaching SX-EW complex. When completed in the second half of 2008 the project is expected to produce 250 million pounds of copper a year for at least 18 years.

Carlota: Quadra Mining acquired the mine, mining equipment, and SX-EW plant for \$37.5 million US in cash and gold from Cambior in late 2005. Construction is scheduled to begin in July 2006 with production targeted for late 2007. The deposit has resources of 105 million tons grading 0.45% oxide copper.

Mineral Park: Mercator continued expansion of its SX-EW plant attaining 11 million pounds annual capacity by the end of 2005. The company is conducting a feasibility study evaluating the economics of concentrating not only copper, but also the deposit's significant quantity of contained molybdenum. Working to achieve that goal, it purchased a 20,000 tpd concentrator from Asarco.

Resolution Copper: This deposit is a surprising discovery in a geologic terrain previously thought to be well understood. It is significant for its large size and high grade, preliminarily reported to be a 1 billion ton deposit grading 1.5% Cu. The property is held by Resolution Copper Co., a 55/45 joint venture of Rio Tinto and BHP-Billiton. Surface drilling resumed in February 2005 and is continuing as of February 2006. Exploration and related expenditures are expected to exceed \$100 million. Plans to deepen the No. 9 shaft and other mine development studies are underway. These will address the high rock temperatures and stresses encountered in the 5,000' deep deposit. Work on a land exchange has begun. That effort includes the introduction of the Southeast Arizona Land Exchange and Conservation Act of 2005 in Congress. Reclamation work at the west plant and Magma mine areas is also underway.

Helvetia Rosemont: Augusta Resources acquired the Rosemont property in June 2005 and has completed a 30,000-foot drill program to produce a NI43-101 compliant resource estimate. The company is currently conducting a pre-feasibility study of a possible 60-80,000 tpd copper molybdenum project.

Copper Creek: Redhawk Resources acquired a large portion of this district consisting of high-level breccia pipes and lower level porphyry copper targets. The company is evaluating reserves previously announced for three pipes by AMT International Mining Corporation to determine exploration and mining plans.

Emerald Isle: St. Genevieve Resources (SGV) acquired this exotic oxide copper deposit with a small "mothballed" SX-EW plant and plans to return it to production.

Monitor: General Minerals optioned this property to Teck Cominco who began a drilling program in November 2005 to test previously identified copper and silver targets.

Dragoon: BHP Billiton optioned this prospect from General Minerals who developed a geophysical target. Drilling to test this buried 1 x 3 km zone began in mid January, 2006.

Others: Additional areas of activity include, but are not limited to the Ajo, Copper Mountain, Kabba, Maynard, Mineral Creek, Pima, Pioneer, Tombstone, Wallapai, Zonia, Soza Canyon, and Markham Wash and Coyote Springs projects in the Safford area.

References

- Titely, S.R. editor, *Advances in Geology of the Porphyry Copper Deposits, Southwestern North America*, 1982, 560 p.
- Pierce, F.W. and Bolm, J.G. editors, 1995, *Porphyry Copper Deposits of the American Cordillera*, Arizona Geological Society Digest 20, 656 p.
- Titely, S.R., and Anthony, E.Y., 1989, Laramide mineral deposits in Arizona, in *Geologic evolution of Arizona: Arizona Geological Society Digest* 17, p. 485-514.
- Niemuth, N.J., 2001, *Arizona Copper Reserves: Arizona Department of Mines and Mineral Resources Open File Report OFR01-17*, 85 p.

Uranium

Basin and Range Province

Tectonostratigraphic Setting: Felsic middle Miocene volcanism including rhyolite flows and ignimbrites, and airfall debris adjacent to basin contributed to the lacustrine and paludal facies of the host Chapin Wash Fm.

Host Rocks: carbonaceous tuffaceous mudstone of early to late Miocene age

Mineralization Age: early to mid Miocene

Mineralizing Solutions: diagenetic alkaline carbonate lacustrine pore water

Resource Estimate: 30 million pounds U_3O_8 . Drilling by the U.S. Department of Energy indicates potential for the basin to host as much as 126 million pounds U_3O_8 at depths up to 3,500 feet.

Key Properties: Date Creek Basin, Anderson Mine, Boomer.

History: First discovered in the mid 1950s with small open pit production. Renewed exploration in the 1970s resulted in major discovery.

Current Activity: Concentric Energy has acquired the Anderson mine and Energy Metals has acquired an adjacent land holding on drilled ground. Both are acquiring and digitizing historic data as well as evaluating various development options. Concentric Energy is gathering baseline environmental data and planning confirmation drilling.

Exploration Potential: Other basins in central and western Arizona are likely to have had similar conditions conducive to concentrating uranium mineralization during Miocene time.

Colorado Plateau

Major Types: Solution-collapse breccia pipes, Tabular sandstone. Current interest is restricted to breccia pipes.

Tectonostratigraphic Setting: sandstones, limestones and shales with thick overlying fine grained volcaniclastic facies deposited in intracratonic sedimentary basins.

Host Rocks: Coconino Sandstone, Hermit Shale, Supai Group.

Age of Host Rocks: Pennsylvanian, Permian.

Mineralization Age: Late Triassic.

Mineralizing Solutions: Groundwater.

Classic Deposit: Orphan Mine.

Properties: many hundreds of breccia pipe targets, widespread on Kaibab and Coconino plateaus.

Resource Estimate: vertically elongated individual pipes grading 0.4 - 0.75% U_3O_8 . A typical pipe is 300' in diameter and could be up to 3,000 vertically. During the 1980s 40 million pounds were discovered.

Production: 13 million pounds were produced during the period 1981-1989 from pipes on the Kaibab Plateau. Earlier production totaled 4.25 million pounds.

Exploration Potential: Arizona has excellent potential for development of new uranium resources. If exploration had continued at

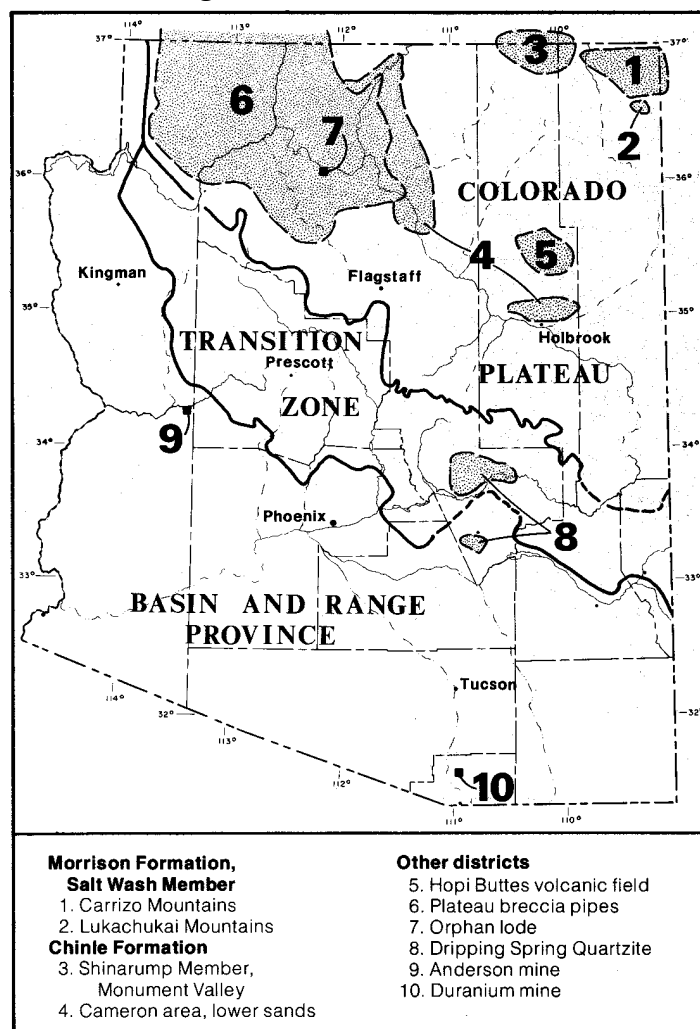


Figure 2. Areas of Uranium Production and Occurrences - From: Fieldnotes Vol. 10, No. 4.

the 1980 rate, experts predicted that by year 2000 over 100 million pounds of new mineralization would have been identified. Instead, low prices greatly limited activity during the last 10 years. Properties with drilling history and known mineralization were offered for sale and/or dropped! Fueled by rising prices interest in breccia pipes on the Coconino and Kaibab plateaus has returned during the last two years as indicated by property acquisition on federal and state lands.

Current Activity: International Uranium controls the Arizona One and Pine Nut deposits that are developed and on standby and also holds the partially developed Canyon pipe. Previously, material mined was sent to the company's processing mill located in southern Utah near Blanding.

In late 2005 Uranium Power Corp. and joint venture partner US Energy Corp were drilling to test stratigraphy to confirm breccia pipe structures. Quaterra Resources acquired claims covering 36 targets and in early 2006 the company began a 15,000-foot drilling program on nine suspected breccia pipes. Quincy Energy entered into an option agreement with Energy Metals covering eight properties and plans 3,000 feet of drilling on the mineralized Rose breccia pipe.

Other companies acquiring previously drilled pipes and suspected pipes as exploration targets include: Standard Uranium – 11 Pipes North and South of Grand Canyon, Energy Metals -Wate and 4½ pipes with identified resources, and 30 other pipes, Liberty Star Gold, Standard Uranium, and Vane Minerals.

Dripping Springs

Description: Deposits occur in Proterozoic Dripping Springs Quartzite in strata bound diagenetically altered potassium-rich and carbonaceous volcanogenic siltstones. Mineralization occurs in veins and as “paleo”-roll front deposits.

History: Uranium production has been from a series of narrow, vertical pitchblende-bearing veins. In the 1970s drilling discovered sizeable deposits containing a geological resources of over 9 million pounds south of the Workman Creek area and also east of the Red Bluff mine area.

Current Activity: Cooper Minerals has leased a claim group in the Workman Creek area to Rodinia Minerals. Additional claims have been staked on nearby properties and drilling is planned.

Rodinia and joint venture partner Patriot Power have conducted drilling and sampling programs on the Lucky Boy and Mormon Lake (Pennsylvanian sediments) properties also located in Gila county.

References:

Finch, W., 1996, Uranium Provinces of North America – their definition, distribution, and models: USGS Bulletin 2141, 18 p.

Scarborough R., 1980, Uranium in Arizona: ABGMT Fieldnotes, Vol. 10, No. 4. p. 1-5.

Wenrich, K., Chenoweth, W., Finch, W., and Scarborough, R., 1989, Uranium in Arizona: in Geologic Evolution of Arizona, Arizona Geological Society Digest 17, p. 759-794.

Descriptive model for solution collapse breccia pipes uranium deposits -

<http://pubs.usgs.gov/bul/b2004/model32e.pdf>

Gold

Description: Arizona's cumulative gold production exceeds 16 million ounces contributed from 219 metallic mineral districts. Twenty-six of those districts have produced more than 100,000 ounces and 46 have produced more than 10,000

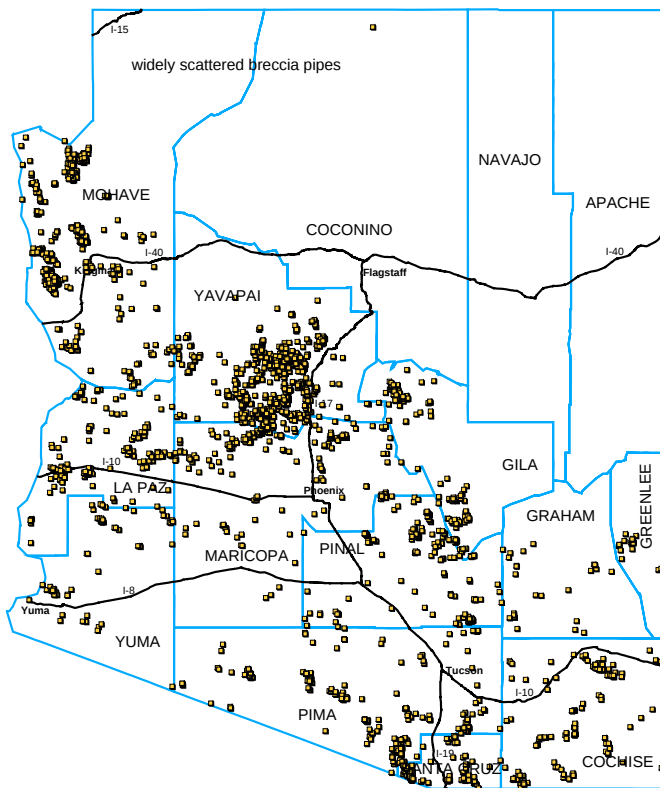


Figure 3. Primary and by-product gold occurrences
From: Arizona Dept. Mines and Mineral Resources GIS

ounces. Gold recovery has been from a wide variety of deposit model types with the most important being epithermal (quartz adularia) veins, the more recently recognized detachment fault-associated deposits, porphyry copper, and volcanogenic massive sulfide. Economic deposits have formed during four widely diverse geologic periods: Proterozoic, Jurassic, Laramide and Mid-Tertiary.

History: Recent primary producers include: Copperstone - produced 500,000 oz, McCabe (Gladstone), Verdestone, Congress, and Gold Road, the last to operate, closed in 1998.

Resources: A number of deposits with potential to produce a few hundred thousand ounces have been awaiting a period of higher prices for their development to occur. These include: Yarnell, Newsboy, Moss, Mexican Hat, Tiger, Golden Eagle and Copperstone underground.

Current Activity: American Bonanza completed a 40,000-meter drill program at the detachment hosted Copperstone deposit and in February 2006 announced NI43-101 compliant resources of 330,000 ounces. Golden Arch conducted trenching and drill programs at its Mildred Peak property. Terraco Gold conducted drilling on geophysical targets with limited success at the Bonanza mine. Galaxy Minerals purchased a pilot mill for its Yellowjacket mine.

References:

- DeWitt, Ed, Thorson, J.P., and Smith, R.C., 1991, Geology and ore deposits of the Oatman district, northwestern Arizona, in Epithermal gold deposits - Part II, Chapter I, in Shawe, D.R., and Ashley, R.P., eds., Geology and resources of gold in the United States: U.S. Geological Survey Bulletin 1857-I, p. I1-I28
- Richard, S.M., 2002, DI-23-Database for Mineral Districts in the State of Arizona, Arizona Geological Survey 1 CD-ROM.
- Spencer, J.E., and Welty, J.W., 1989, Mid-Tertiary ore deposits in Arizona, in Jenney, J.P., and Reynolds, S.J., eds., Geologic evolution of Arizona: Arizona Geological Society Digest 17, p. 585-607.
- Descriptive model of detachment fault related polymetallic deposits – http://pubs.usgs.gov/bul/b2004/html/bull2004detachmentfaultrelate_polymetall.htm

Volcanogenic Massive Sulfides

Geology: The volcanogenic massive sulfide occurrences of Arizona formed 1.7 –1.8 b.y. ago. Mines and prospects occur as stratabound accumulations of iron and base-metal sulfides with variable amounts of gold and silver. They are hosted in a thick sequence of submarine volcano-sedimentary strata metamorphosed to greenschist and occasionally amphibolite facies.

Economic Geology: Of the 70 known VMS deposits, 48 have reported production. Most mineralization occurs as Cu-Zn with precious metals economically important in many of the deposits. Production totals over 55 million tons and three deposits have yielded over 4 million tons each. The majority of the production is from the Verde district. The United Verde mine is reported to contain over 20 million tons of mineralization grading 6.6% Zn plus copper and precious metals.

Structure and Distribution: Most orebodies are highly deformed and exhibit high ratios of plunge to strike length. Larger deposits are described as elliptical lenses, or rod like bodies, that plunge steeply and parallel major or minor fold axes. Ratios of plunge length to strike ratio of 3:1 are common and ratios as high as 8:1 are known. Thus most deposits present only limited exploration targets at the surface. The geographic distribution of favorable host rocks for VMS deposits is wider than that of known occurrences and has potential for hosting undiscovered deposits.

Current Activity: Little work is presently occurring in the VMS districts. See Figure 4. Many promising prospects, not limited to the few described here, are available. Phelps Dodge controls the United Verde zinc resource discussed above. Teck Cominco recently completed a multi-year effort there without releasing results. In the Old Dick district Silver Nickel Mining has acquired the Pinafore mine (Cu-Zn) and collected exploration data including drill results from Arizona Explorations Inc's. (syndicate of American Barrick, Homestake and Placer Dome) mid-90's effort. The joint venture of Ivy Minerals and Kaaterskill Exploration has been working on two new exploration targets in the Mayer district where it identified geochemical and VLF-EM anomalies at the Cobre Sud and Cordes Peak prospects.

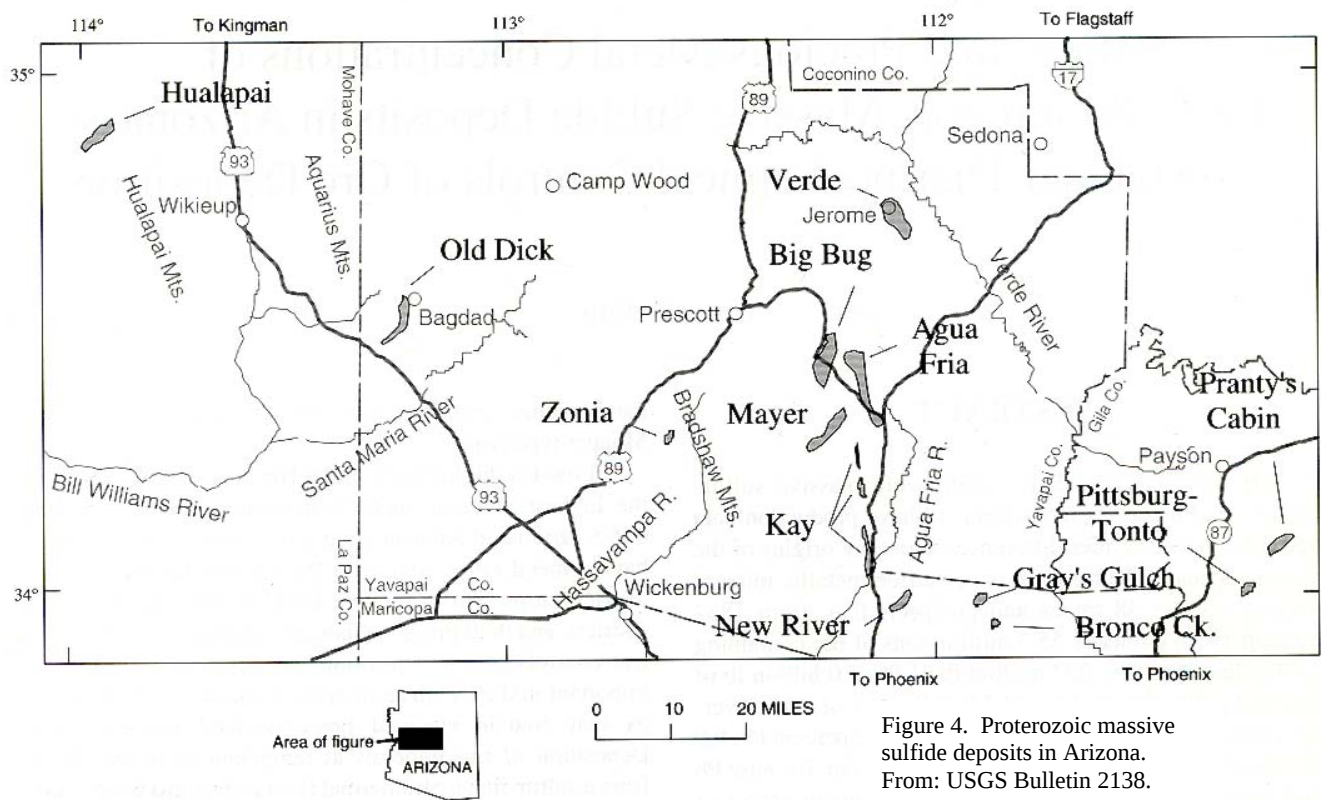


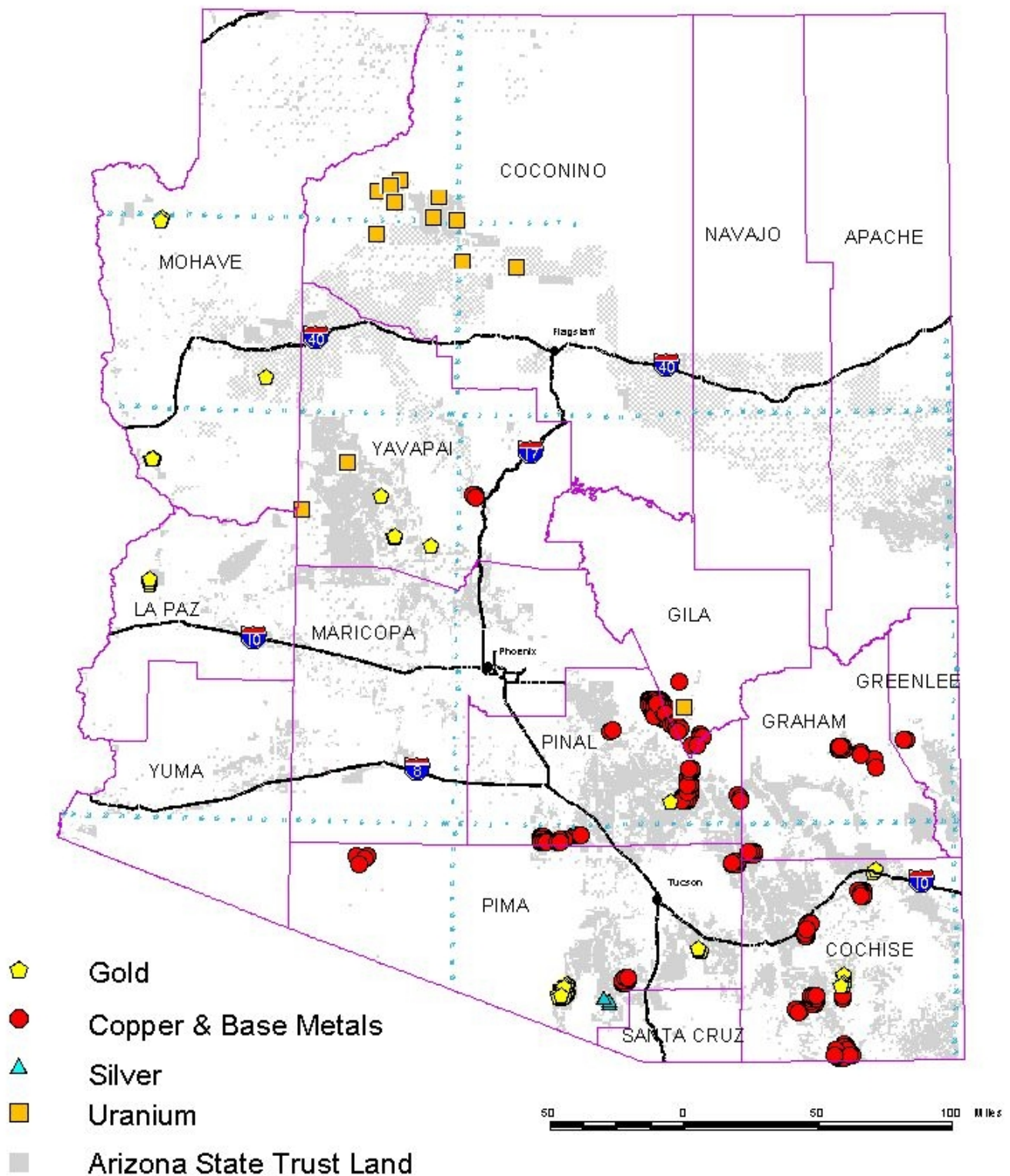
Figure 4. Proterozoic massive sulfide deposits in Arizona. From: USGS Bulletin 2138.

Ricks Brothers Enterprises controls a copper resource near Mayer with both disseminated and limited massive mineralization and have project data available. Searchlight Exploration's Treasure King has a 150,000 ton deposit at a grade of 0.06 oz/ton gold proven resource along with four additional areas untested by drilling. The Kay mine has a Cu-Zn resource defined by Exxon and Rayrock with drill data available at ADMMR.

References:

- DeWitt, Ed, 1995, Base and precious-metal concentrations of Early Proterozoic massive sulfide deposits in Arizona -- Crustal and thermochemical controls of ore deposition: U.S. Geological Survey Bulletin 2138, 36 p.
- Donnelly, M.E., and Conway, C.M., 1988, Metallogenic map of volcanogenic massive-sulfide occurrences in Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1853-B, scale 1:1,000,000.
- Donnelly, M.E., Conway, C.M., and Earhart, R.L., 1987, Records of massive sulfide occurrences in Arizona: U.S. Geological Open-File Report 87-0406, 42 p.
- Donnelly, M.E., and Hahn, G.A., 1981, A review of the Precambrian volcanogenic massive sulfide deposits in central Arizona and the relationship to their depositional environment, in Dickinson, W.R., and Payne, W.D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 11-21.

Metal Exploration Permits on Arizona State Trust Lands - 2005

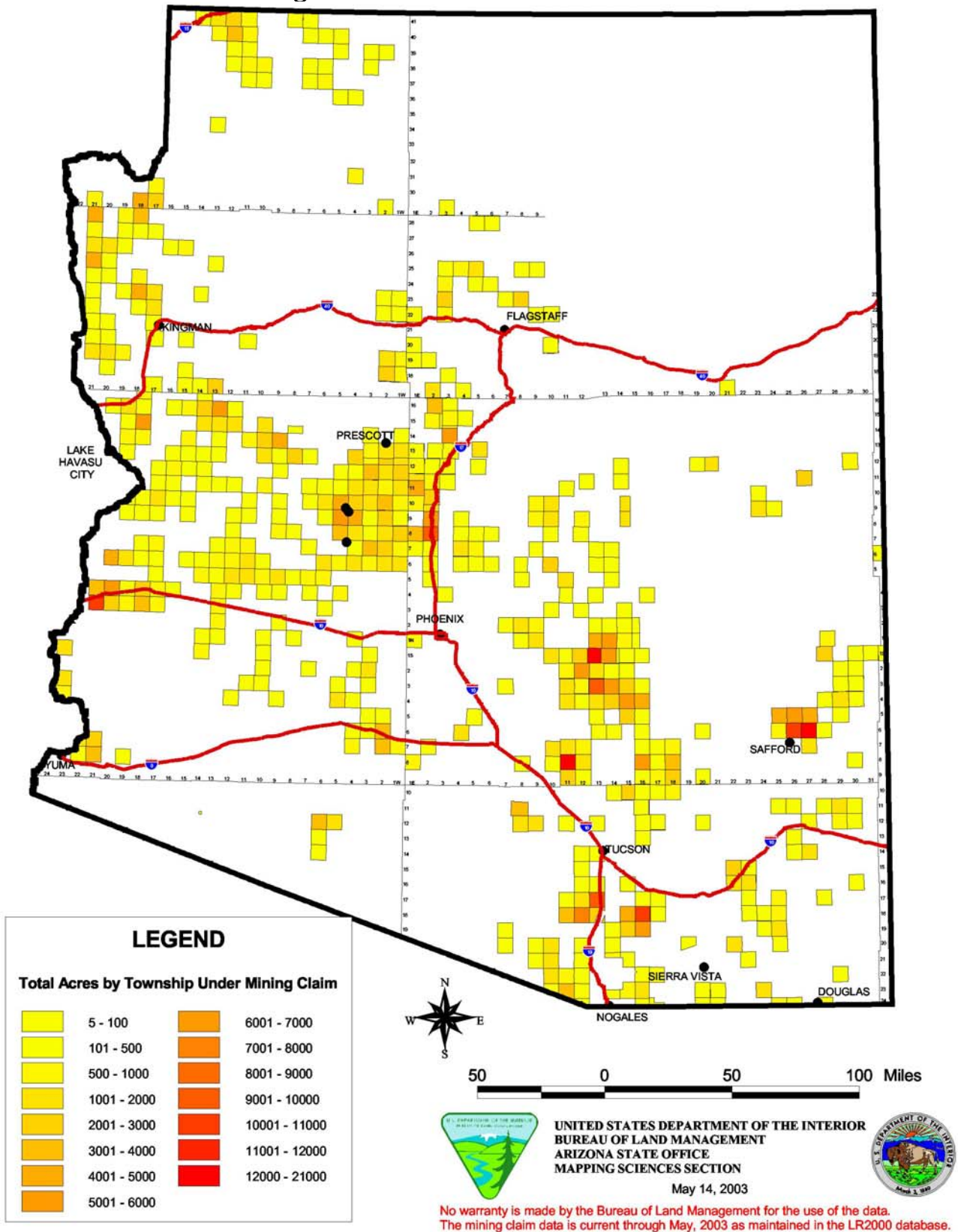


The Arizona State Land Department
 reserves the right to revise, replace or
 amend this map without notice.
 Map prepared by the
 Arizona State Land Department
 on February 15, 2006.



ASLD permit map revised by Arizona Dept. of
 Mines and Mineral Resources, 2006.
 Includes permits up for renewal as well as new
 permits. Permits given initial approval but not
 necessarily issued.

Mining Claim Distribution on Federal Lands



21,483 mining claims in 2003
25,616 mining claims in 2004
31,000 mining claims in 2005

Mining claim records are online at:
<http://www.blm.gov/lr2000/>



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Photocopies of out-of-print publications are available for \$.15 per page (see OFR90-5 and OFR04-21).

* Indicates that the publication is available on the Department website.

DIRECTORIES

D49 *Directory of Active Mines in Arizona - 2001/2*, K.A. Phillips, N.J. Niemuth, D.R. Bain. The listings are alphabetical, giving company name, address, key personnel, mine name, and location. A separate listing of sand and gravel operations is provided. Includes 1:1,000,000 scale map showing the locations of the active mines and mine offices. 34 p. **\$6.00**

D50 *Arizona Mining Consultants*, N. J. Niemuth, 2004. A listing of Arizona-registered consultants for the following mining related disciplines: assayers, geological engineers, geologists, geophysical engineers, metallurgical engineers, and mining engineers. 22 p. **\$3.00 ***

SPECIAL REPORTS

SRI *Uranium Prospector's Guide*, by K.A. Phillips & M.N. Greeley, 1979. A guide for the independent prospector searching for occurrences of uranium. Chapters on mineralogy and geology of uranium and prospecting methods. 34 p. **\$6.00**

SR12 *Laws and Regulations Governing Mineral Rights in Arizona*, by V.H. Verity and L.D. Clark. 9th Edition, reprinted 1988. A lay language interpretation of federal and state laws applicable to mineral rights within Arizona. Includes discussions and forms for locating (staking) and maintaining claims on both public domain and State-owned lands. 91 p. **\$8.00**

SR19 *From the Ground Up*, by Gov. Jack Williams, 2nd ed. 1994. Colorful stories of Arizona's early mineral discoveries and the men who made them. Includes tales of the Vulture, United Verde, Bisbee and others. 36 p. **\$1.00**

SR23 *Manual for Determination of Status and Ownership, Arizona Mineral and Water Rights*, by J.C. Lacy, 1999. A detailed explanation of land, mineral rights and water rights ownership status. Includes annotated samples of status maps and indexes. 29 p. **\$3.00**

MINERAL REPORTS

MR3 *Molybdenum Occurrences in Arizona*, by C.J. Hicks, 1979. Occurrences are listed by county with a brief description of each. The mineralogy, geology, uses and history of molybdenum are provided. 37 p. **\$6.00**

MR4 *Arizona Industrial Minerals*, by K.A. Phillips, 1987. Covers 1400 known Arizona industrial mineral occurrences. Includes location tables and maps. 185 p. **\$12.00**

MR6 *Beryl - A Unique Opportunity for the Prospector and Small Mine Operator*, by K.A. Phillips, 1986. Describes the mineral beryl, prospecting techniques and its amenability to production by small mine operators. 7 p. **\$2.00**

MR7 *Gold Panning in Arizona*, by D.R. Bain, 1990. Includes the origin of placer gold in Arizona, prospecting tips, panning instructions, and maps to panning locations. 30 p. **\$3.00**

COUNTY MINE MAP SERIES

Number - County	Number of Maps	Index Pages	Mines	Price \$
CM-1 - Apache	18	6	353	15.00
CM-2 - Cochise	9	16	698	10.00
CM-3 - Coconino	28	11	594	20.00
CM-4 - Gila	9	19	731	10.00
CM-5 - Graham/ Greenlee	12	16	516	15.00
CM-6 - La Paz/ Yuma	15	15	583	15.00
CM-7 - Maricopa	11	20	915	15.00
CM-8 - Mohave	20	31	1,411	25.00
CM-9 - Navajo	17	5	232	15.00
CM-10 - Pima/ Santa Cruz	14	34	1,487	20.00
CM-11 - Pinal	9	29	1,024	15.00
CM-12 - Yavapai	12	46	1,948	20.00

The data in this series was initially compiled from a study done in cooperation with the U. S. Bureau of Mines. The data is computerized and updated on a continuous basis by the Department in a series of county databases known as AzMILS.

The County Mine Map series consists of sets of 20" x 24" maps showing the locations of mines, prospects, quarries, and processing mills and plants. They are plotted on Arizona Department of Transportation base maps (scale 1" = 2 miles) by the Department's Arizona Mineral Industry Location System (AzMILS) number. Each map set includes a geographically sorted mine index that lists AzMILS number, primary mine name, alternate names, a file reference, topographic quadrangle name, township, range, section, quarter section, and up to 7 commodities. Over 10,400 locations cover the entire series of 12 sets for Arizona's 15 counties. Samples of the maps and indexes may be viewed at the Department website.

Digital Data Files

Complete databases of the AzMILS information for the state are available as dBase IV files on a 3.5" PC-compatible disc. The databases can be sorted on any field or combination of fields, including commodities. Bibliographies include reference information on individual mines. **\$20.00**

OPEN-FILE REPORTS

OFR 89-1 Industrial Minerals in Arizona's Paint Industry, by K.A. Phillips, 1989. The State's paint manufacturing industry is described emphasizing the wide variety of industrial minerals consumed, their specifications and the quantities used. 13 p. \$2.50 *



OFR 89-2 Industrial Minerals in Arizona's Wallboard Joint Cement Industry, by K. A. Phillips, 1989. The State's wallboard joint cement manufacturing industry is described emphasizing the specifications and quantities of industrial minerals consumed. 9 p. \$2.50 *

OFR 89-3 Industrial Minerals in Southern California's Wallboard Joint Cement Industry, (A Potential for Mineral Development in Arizona), by K.A. Phillips, 1989. The region's wallboard joint cement manufacturing industry is described emphasizing the specifications and quantities of industrial minerals consumed. 12 p. \$2.50*

OFR 90-5 Publications of the Department of Mines and Mineral Resources from 1939 to 1990, by D.R. Bain , 1990. 15 p. \$2.50 *

OFR 91-6 Industrial Minerals in Arizona's Cultured Marble Industry, by K.A. Phillips, 1991. The State's cultured marble industry is described emphasizing the specifications and quantities of industrial minerals consumed. 11 p. \$2.50

OFR91-8 Pumice and Pumicite in Arizona, by J.M. Hoffer, 1991. Describes over 50 pumice occurrences in Arizona. Includes deposit map, scale 1:1,000,000. 67 p. **\$10.00**

OFR92-10 Copper Oxide Resources, by N.J. Niemuth and K.A. Phillips, 1992. A listing of over 800 Arizona deposits that contain copper oxide. 18 p. **\$5.00**

OFR93-12 *Economic Geology of the Sierra Estrella, Maricopa and Pinal Counties, Arizona*, by E.B. Melchiorre, 1993. Includes site descriptions of metallic and nonmetallic resources. 29 p. **\$2.50**

OFR95-13 *Listing of the Grover Heinrichs file Collection*, compiled by N.J. Niemuth, 1995. 31 p. **\$3.00**

OFR97-15 *The Art of Making a Cabochon*, by Walter Peck, revisions by Doug Duffy and Shirley Cote, 1997. 15 p. **\$2.40**

OFR01-17 *Arizona Copper Reserves*, An update of OFR92-11. Reserve and ownership information for 80 major copper properties. The information is continually updated. 85 p. **\$10.00**

OFR02-18 *The Crushed Stone Industry Grows Up, A History of Mineral Material Trespass on Public Lands in Central Arizona*, by W. Scott Donaldson, 2002. 21 p. **\$2.50**

OFR02-20 *Arizona Mining Scams and Unassayable Ore Projects of the Late 20th Century*, by W. Scott Donaldson, 2002. 28 p. **\$3.00** *

OFR04-21 *Publications of the Department of Mines and Mineral Resources From 1990 to 2004*, by D.R. Bain, 2004. 7 p. **\$2.50** *

OFR05-22 *Arizona's Metallic Resources - Trends and Opportunities*, by N.J. Niemuth, 2005. 22 p. **Free** *

OFR06-23 *Arizona's Metallic Resources - Trends and Opportunities*, by N.J. Niemuth, 2006. 2 2 p. **Free** *

CIRCULARS

Circulars are 25 cents each.

C2 *Arizona Land Ownership Status*, by K.A. Phillips, Revised June, 1995. Brief instructions on determination of land status. *

C3 *Platinum in Arizona*, by K.A. Phillips, 1980. Answers commonly asked questions about platinum group metals, minerals, and potential in Arizona. *

C4 *Prospecting for Barite*, by C.J. Hicks & K.A. Phillips, 1981. Brief discussion of barite and its deposits. Provides prospecting guidelines applicable to most minerals. *

C7 *Services of the Department to Potential Purchasers of Arizona Mineral Commodities*, by K.A. Phillips, 1988 *

C9 *Titanium*, by M.N. Greeley, 1982. Describes titanium, its minerals, geology, and Arizona's potential for the prospector. *

C10 *Services and Help From the Arizona Department of Mines and Mineral Resources*, by K. A. Phillips, 1985. *

C20 *Maps and Books for Arizona Gold and Gold Prospecting*, Authors, titles, and publishers' names and addresses are provided. *

C27 *Treating Gold Ores by Amalgamation*, by R. R. Beard, 1987. Text of a presentation at a mining seminar. *

C30 *Arizona Mining Law Change - 1989, 1990*, Explains the changes in lease and claim procedures for State Trust Lands. *

C36 *Arizona Recordation Law Change, 1991*, 1991. *

C51 *Pertinent Data for New or Prospective Mining Operations in Arizona*, by N.J. Niemuth, 1993. Briefly discusses permits and regulatory requirements of state, federal, and county agencies for mining operations. *

C52 *Jig Recovery Systems*, by H.M. Coggin, 1995. Describes how jigs operate and summarizes various types. *

C56 *Annual Assessment Work Requirements Under Arizona Statute*, by John C. Lacy. 1994, An explanation of assessment work requirements *

C59 *Mining Scams*, by M.N. Greeley, 1995. Discusses common features of mining scams and ways to avoid being a victim of one. *

C63 *Reference Material Listing*, 1996. Library holdings on mines, mining, and recovery technology. *

C65 *Arizona Industrial Minerals and Their Processing Methods*, by K. A. Phillips, 1996. *

C91 *Assayers and Assay Offices in Arizona*, 2001. List of commercial assay laboratories in Arizona with registered assayers. Includes information on the history of assaying and the assaying process. *

C92 *Arizona Rockhound Information*, by D. R. Bain. Includes information on mine tours, mineral collecting fee areas, gold panning, and a short bibliography. *

C103 *A Historic Review of Mercury Mining in the Phoenix Mountains, Maricopa County*, by D.R. Bain, November, 2003. *

C104 *Mining Laws and Regulations, Changes and Revisions, 2003*, Summarizes recent changes in laws and regulations governing mineral rights acquisition and surface management regulations. *

C108 *Arizona Mining Update, 2002-2003*, N.J. Niemuth. A review of mining activity in Arizona. Describes copper, gemstone, industrial mineral, and coal mines as well as mineral exploration and government news.

C109 State Agencies Concerned with Mining & Mineral Resources in Arizona, 2005. Contains names, addresses, and pertinent people at state agencies concerned with mines and mineral resources.*

C110 Federal Agencies Concerned with Mining in Arizona, 2005. Contains addresses of Bureau of Land Management, Forest Service offices, and other Federal agencies.*

C111 County Agencies Concerned with Mining & Mineral Resources in Arizona, 2005. Includes a listing of addresses, phone numbers, and websites.*

C112 Arizona Gem Shows, 2005-2006. Includes date, location, sponsoring group, contact person.*

C113 Earth Science Clubs, 2005-2006. Includes rockhound, lapidary, and prospecting organizations.*

C114 Arizona Mining Update, 2004, N.J. Niemuth. A review of mining activity in Arizona. Describes copper, gemstone, industrial mineral, and coal mines as well as mineral exploration and government news.*

C115 Mining Claim Forms, 2006. Includes Location Notices for lode and placer claims, Claim Map, Affidavit of Performance of Annual Work, Notice of Non-liability for Labor and Materials Furnished, Notice of Intent to Hold Mining Claims, and Attachment for Additional Claims.*

MAPS

All maps are shipped folded. Contact the Department to special order rolled maps or a different scale or media.

M84-1 Arizona Mineral Potential Map, by K. A. Phillips, 1984. Scale 1:1,000,000. Map showing areas favorable for future discovery and development of mineral deposits for land use planning considerations. **\$2.50**

MM-17 Metallogenic Provinces of Arizona, by P.F. O'Hara, N. J. Niemuth, and G. Ryberg, 1989. Scale 1:1,000,000, Preliminary edition showing 49 metallogenic provinces in Arizona. Blackline **\$2.50**

MA-49 Active Mines in Arizona, 2001-2, by K. Phillips, N. Niemuth, D. Bain, 2002. Scale 1:1,000,000. Shows the locations of the active mines (excluding sand and gravel), plants, and mine offices. (Also included in the Directory of Active Mines.) **\$2.50**

MO2-2 Map of Arizona Copper Resources, by N.J. Niemuth, 2002. Scale 1:3,000,000. Provides names and locations of principal deposits. Order OFR 1-17 for details of the deposits. **\$.50 ***

See also: County Mine Map Series

REPRINTED MAPS AND REPORTS

Arizona Mining District Map, by E. Wilson, R.T. O'Haire, and F. McCoy, 1961. Scale 1:1,000,000. Originally compiled by Arizona Bureau of Geology and Mineral Technology. Blackline print. **\$2.50** **Gold Placer Map,** by M. Johnson, 1970. Scale 1:1,000,000. Map showing location of placer gold deposits in Arizona. Reprint of Bulletin 1355, Plate 1. Black-line print. **\$2.00**

Geologic Map of Maricopa County, Arizona, by E. Wilson, R. Moore, and H. W. Peirce, 1957. Scale 1:375,000. Originally published by Arizona Bureau of Geology and Mineral Technology. Blackline print. **\$1.50**

Geologic Map of Pima and Santa Cruz Counties, Arizona, by E. Wilson, R. Moore, and R. O'Haire, 1960. Scale 1:375,000. Originally published by Arizona Bureau of Geology and Mineral Technology. Blackline print. **\$1.50**

Stone in Arizona, by R. Townsend, 1962. Information on occurrences of stone in Arizona and production techniques. Originally prepared by the Arizona Development Board. 50 p. Photocopy. **\$8.00**

OTHER NON-ADMMR PUBLICATIONS

Principal Deposits of Strategic and Critical Minerals in Arizona, 1992. Published by the U.S. Bureau of Mines. A comprehensive review of Arizona's mineral commodities and infrastructure. 334 p. **\$8.00**

Digital Reprint-1 CD-ROM. Text in pdf format, plates in jpg and pdf format. CD includes both titles below. **\$20.00.**

Ore Deposits of the Jerome and Bradshaw Mountain Quadrangles, Arizona, by W. Lindgren, 1926, U.S. Geological Survey Bulletin 782, 192 p., 2 plates, scale 1:125,000. OCR processed.

Reconnaissance of Iron Resources in Arizona, by C.M. Harrer, 1964, U.S. Bureau of Mines IC 8236, 204 p. OCR processed.

MINERAL EDUCATION KIT

A boxed set of 40+ rock and mineral samples including a collection of Arizona's commonly mined minerals, seven of the Mohs' scale of hardness minerals, and examples of sedimentary, igneous, and metamorphic rocks. Includes a 55-page booklet. **\$40.00, plus \$8.50 postage.**

* Available at www.admmr.state.az.us

In addition to the Department of Mines and Mineral Resources, many other Arizona agencies and organizations cooperate to encourage and support Arizona's mining industry. The Department wishes to thank the following organizations for providing information for PDAC 2006.



**Arizona Department of
Commerce**



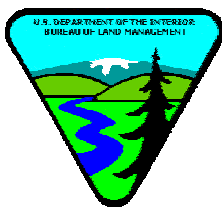
Arizona Geological Society



Arizona Geological Survey



Arizona Mining Association



BLM Arizona



**State Land Department -
Mineral Section**



**University of Arizona,
Institute for Mineral Resources**

THE IMPACT OF THE COPPER INDUSTRY ON THE ARIZONA ECONOMY

- ◆ In 2004, the Arizona copper industry had a combined direct and indirect impact on the Arizona economy of:

\$3.316 Billion

- ◆ including combined direct and indirect contributions of:

\$1.048 Billion	in personal income, equivalent to 18,000 jobs for Arizonans
\$2.073 Billion	in business income, and
\$194 Million	in state and local government revenues

- ◆ as a result of the circulation (and multiplication) of the copper industry's total direct impact of

\$1.296 Billion

- ◆ that included direct payments of:

\$64.493 Million	to the State and its local governments in taxes and fees,
\$788.153 Million	to other Arizona businesses for products and services, and
\$443.340 Million	in personal income for Arizonans, including wages and salaries for the industry's
6,400	employees

- ◆ who labored to produce:

803,518 tons of copper and other minerals with a total value of

\$2.603 Billion

Compiled by **WEAC** for the



Arizona Mining Association
141 E. Palm Lane #100
Phoenix, AZ 85004
602-266-4416
www.azcu.org

Exploration Permits and Mining Leases on Arizona State Trust Land

The Minerals Section of the Arizona State Land Department (ASLD) is responsible for mining/mineral activities on State Trust land. Its primary obligation is to maximize revenues for the Trust from the disposition and management of mineral commodities while considering the long-term best interest of the Trust. Arizona's public schools are the primary State Trust beneficiary.

Mineral commodities are classified into three separate categories:

Hard Rock Minerals refer primarily to *base and precious metals* as well as *industrial minerals* that are unique and distinct.

Common Variety Minerals, also referred to as salable minerals or mineral materials, include *construction and landscaping materials* (cinders, sand, gravel, boulders, loose rock and common clay) and *minerals of similar occurrence* commonly used as aggregate, riprap, ballast, borrow or fill.

Energy Minerals (also leaseable) refer primarily to *oil, gas, and geothermal resources*.

The right to explore for and produce mineral commodities on State Trust land is accomplished by obtaining one of the following mineral-related permit / leases:

- Mineral Exploration Permit
- Mineral Lease
- Common Variety Mineral Lease / Sale
- Oil and Gas Lease

Details for each mineral category can be obtained from ASLD's Minerals Section.

Mineral Exploration Permits

A mineral exploration permit is permission from ASLD to prospect and explore for minerals on State Trust land. Exploration is any activity conducted for the purpose of determining the existence of a valuable mineral deposit, such as: geologic mapping, drilling, geochemical sampling, and geophysical surveys.

Prior to exploration, the Plan of Operations *must* be approved.

- The permitting process for an exploration permit takes a minimum of sixty (60) days.
- If the application is approved, the initial rent is \$2 per acre. If renewed, no additional rents are due for the second year. Rents are set at \$1 per acre for years 3 thru 5.
- Work expenditure requirements are:
\$10 per acre for years 1-2; and
\$20 per acre for years 3-5.

The permit is valid for one year from the due date of the rental and bond. If renewal requirements are met, the permit can be renewed annually for up to five years. If discovery of a valuable mineral deposit is made, the permittee must apply for a mineral lease before actual mining activities can begin.

External permitting requirements can greatly impact application processing time.

A Pre-Application Conference with ASLD is recommended for the following leases.

Hard Rock Mineral Leases

A mineral lease permits the mining of minerals discovered under the exploration permit it.

- The approval process takes a minimum of six (6) months.
- The mineral lease is issued for a term of twenty (20) years. Leases may be renewed for an additional term.
- Both *rents* and *royalties* are determined by appraisal. Royalties may be based on:
 - 1) a fixed rate subject to annual adjustment; or
 - 2) a sliding-scale rate which is linked to a commodity index price and the operation's breakeven price. There is a statutory minimum royalty rate of 2% of gross value.

Common Variety Mineral Lease

This agreement is for the purchase, mining and processing of common variety minerals (sand and gravel, and other construction and landscape materials). Statutes require these mineral commodities to be sold at public auction. It is the auction process which determines the market value (royalty rate) of the commodity. Statutes require that the sale be advertised for ten (10) weeks prior to the auction. Advertising costs are paid by the applicant. However, should the applicant not be the successful bidder, advertising costs and certain other costs are reimbursable.

- The application approval process takes a minimum of six (6) months.
- An agreement is issued initially for a ten (10) year term with provisions to extend up to a maximum of twenty (20) years.
- *Rents* are based on a percentage of the appraised surface value.
- *Royalty rates* are determined at public auction. A minimum annual production guarantee is assessed for each agreement.

Recreational mining or mineral collecting on State Trust land is prohibited

Oil and Gas Leases

The oil and gas lease is for the exploration and/or production of oil and gas resources. *All drilling must be approved by the Oil and Gas Commission* (through the Arizona Geological Survey) as well as the ASLD.

The permitting process for an oil and gas lease takes a minimum of one (1) month.

- Leases are issued for a primary term of 5 years. A secondary term of 5-years may be requested prior to the expiration of the first term for a maximum of ten (10) years, or so long thereafter as production continues.
- Annual rents are payable in advance at \$1 per acre for the primary term, and \$2 per acre if extended for a secondary term.
- Royalties: 12.5% of the value for all products sold or removed from the lease.

Applicable State Laws

ARIZONA REVISED STATUTES

Title 27: Minerals, Oil and Gas

Title 37: Public Lands

Title 41: State Government

A.R.S. § 41-844 requires parties in charge of ground disturbing projects on State [Trust] land to promptly report the discovery of any archaeological, paleontological or historic site or object to the director of the Arizona State Museum.

ARIZONA ADMINISTRATIVE CODE

Title 12: Natural Resources, Chapter 5

General Requirements

APPLICATION FEE

There is a non-refundable filing fee of \$100 per application.

OTHER FEES

Rental fees are required on all agreements.

Royalties are paid on all recovered mineral products.

Additional fees, such as appraisal or administrative fees, may also be required.

REQUIRED MAPS

A USGS topographic map showing lease boundaries, access routes, roads, utilities, etc., must be submitted with the application. Other detailed maps, related to your operation will be required in a Mineral Development Report.

MINERAL DEVELOPMENT REPORT (MDR)

All mining-related operations require a detailed MDR which includes: 1) geologic assessment, 2) economic feasibility, 3) environmental assessment, 4) mine operations plan, and 5) reclamation and closure plans. Detailed requirements for the MDR are available upon request.

OTHER NECESSARY DOCUMENTS

Exploration permits require a plan of operations. Aerial photos, contour maps and registered surveys may also be required. Surveys of cultural resources, native plants, wildlife, and endangered species are required components.

RECLAMATION BOND

The *minimum* bond required is \$3,000. The actual bond amount is based upon the type of operation and the degree of disturbance.

INDEMNITY INSURANCE

Indemnity insurance will be required for most operations.

OTHER PERMITTING REQUIREMENTS

The applicant is responsible for determining permitting requirements from other regulatory agencies *and* to be in compliance.

For More Information:

Arizona State Land Department
MINERALS SECTION
1616 West Adams Street
Phoenix, Arizona 85007
602-542-4628
fax 602-542-3507
www.land.state.az.us

Other Useful Contacts:

Arizona Department of Mines & Mineral Resources
602-255-3791
www.admmr.state.az.us

Arizona Geological Survey
520-770-3500
www.azgs.state.az.us

Arizona Mine Inspector
602-542-5971
www.asmi.state.az.us

Arizona State Museum
520-621-4011
www.statemuseum.arizona.edu

Bureau of Land Management
Land and Mineral Records
602-417-9528
www.blm.gov

U.S. Geological Survey
520-670-6671 ex. 221
www.usgs.gov

ARIZONA GEOLOGICAL SURVEY

Partial list of Mineral and Energy Resource Publications

Bulletin 180—Geology and Mineral Resources of Arizona, by U.S. Geological Survey, Arizona Bureau of Mines, and U.S. Bureau of Reclamation, 1969 (reprinted 1989), 467 p. [Photocopy only]....\$22.00

Metallic Mineral Resources

Bulletin 194—Metallic Mineral Districts and Production in Arizona, by Stanley B. Keith, D.E. Gest, Ed DeWitt, Netta Woode Toll, and B.A. Everson, 1983, 58 p., scale 1:1,000,000, [includes Map 18]....\$10.00

Map 18—Metallic Mineral Districts of Arizona, by Stanley B. Keith, D.E. Gest, and Ed DeWitt, 1983, scale 1:1,000,000. [also included in Bulletin 194]....\$7.00

Digital Information Series 3—Database Files describing Mineralized Sites in the State of Arizona, v. 1.0, Data structure and editing by S.M. Richard, 1996, 3 diskettes, 22 p.. DBase and Access 95 formats. Can be used in a GIS application.....\$10.00

Digital Information Series 21—Database for Mineral Districts in the State of Arizona, S.M. Richard, editor, 2002, 1 CD-ROM. MS Access database, ESRI shapefiles.....\$30.00

Indexes of Mining Properties

Bulletin 187—Index of Mining Properties in Cochise County, Arizona, by Stanton B. Keith, 1973, 98 p....\$5.00

Bulletin 189—Index of Mining Properties in Pima County, Arizona, by Stanton B. Keith, 1974, 156 p....\$6.00

Bulletin 191—Index of Mining Properties in Santa Cruz County, Arizona, by Stanton B. Keith, 1975 (reprinted 1990), 94 p....\$15.00

Bulletin 192—Index of Mining Properties in Yuma County, Arizona [includes La Paz County], by Stanton B. Keith, 1978, 185 p....\$6.00

Bulletin 196—Mine Index for Metallic Mineral Districts of Arizona, by J.W. Welty, S.J. Reynolds, Stanley B. Keith, D.E. Gest, R.A. Trapp, and Ed DeWitt, 1985, 92 p.....\$7.00

Bibliographies

Circular 24—Bibliography for Metallic Mineral Districts in Cochise, Graham, and Greenlee Counties, Arizona, by Lorraine Schnabel and J.W. Welty, 1986, 38 p....\$6.00

Circular 25—Bibliography for Metallic Mineral Districts in La Paz, Mohave, and Yuma Counties, Arizona, by Lorraine Schnabel and J.W. Welty, 1986, 45 p.....\$6.00

Circular 26—Bibliography for Metallic Mineral Districts in Pima and Santa Cruz Counties, Arizona, by Lorraine Schnabel, J.W. Welty, R.A. Trapp, and S.J. Reynolds, 1986, 44 p.....\$6.00

Circular 27—Bibliography for Metallic Mineral Districts in Gila, Maricopa, Pinal, and Yavapai Counties, Arizona, by J.W. Welty, Ed DeWitt, and Lorraine Schnabel, 1989, 81 p.....\$11.00

Circular 28—Bibliography for Metallic Mineral Districts in Apache, Coconino, and Navajo Counties, Arizona, by J.W. Welty and W.L. Chenoweth, 1989, 47 p.....\$9.00

OFR-88-22—Additions to Bibliographies for Metallic Mineral Districts in Cochise, Graham, Greenlee, La Paz, Mohave, Pima, Santa Cruz, and Yuma Counties, Arizona, by J.W. Welty, 1988, 32 p.....\$5.25

Industrial Minerals

Circular 30—Arizona has Salt!, by S.L. Rauzi, 2001, 40 p.....\$10.00

Special Publication 4—Proceedings of the 21st Forum on the Geology of Industrial Minerals, edited by H.W. Peirce, 1987, 134 p.....\$12.00

Energy Resources

Bulletin 182—Coal, Oil, Natural Gas, Helium, and Uranium in Arizona, by H.W. Peirce, Stanton B. Keith, and J.C. Wilt, 1970, 289 p., 15 sheets....\$10.00

Circular 29—Arizona has Oil & Gas Potential!, by S.L. Rauzi, 2001, 40 p.....\$10.00

Map 15-2—Geothermal Resources of Arizona, by J.C. Witcher, Claudia Stone, and W.R. Hahman, Sr., 1982, scale 1:500,000.....\$5.00

Geologic Maps

Map 17—Index of Published Geologic Maps of Arizona, 1903-1982, by R.B. Scarborough and M.L. Coney, 1982, scale 1:1,000,000, 6 sheets. [See also M-31] All 6 sheets....\$8.00

Map 31—Index of Published Geologic Maps of Arizona: 1982 to mid-1993, by R.C. Harris, R.A. Trapp, T.G. McGarvin, and J.E. Spencer, 1994, 45 p., scale 1:1,000,000, 3 sheets. Text and sheets....\$8.00

Map 33—Arizona Geologic Highway Map, 1998, scale 1:1,000,000. Available as a folded map only....\$10.00

Map 35—Geologic Map of Arizona, by S.M. Richard, S.J. Reynolds, J.E. Spencer, and P.A. Pearthree, compilers, 2000, scale 1:1,000,000. (For rolled map, add \$1.00 for mailing tube. Rolled maps cannot be delivered to P.O. Box)....\$5.00

Digital Geologic Map 01—Digital geologic map and cross sections of the Clifton-Morenci area, Greenlee County, Arizona, v. 1.0, compiled by C.A. Ferguson and M.S. Enders, 2000, 1 CD-ROM....\$15.00
Or purchase as three color, paper maps, scale 1:24,000 (order as **DGM-01, S**)....\$35.50

Digital Geologic Map 31—Geologic Map of the Twin Buttes 7.5' Quadrangle, Pima County, Arizona, v. 1.0, by S.M. Richard, J.E. Spencer, Ann Youberg, and B.J. Johnson, 2003, 1 CD-ROM.... \$15.00
Or purchase as one color map, scale 1:24,000 (order as **DGM-31, S**)....\$18.00

PUBLICATION ORDERING INFORMATION

You may purchase publications at the AZGS office or by mail. Address mail orders to AZGS Publications, 416 W. Congress St., Suite 100, Tucson, AZ 85701 (see www.azgs.az.gov for additional information, or call 520 770-3500 if you have questions). Orders are shipped by UPS, which requires a street address for delivery. All mail orders must be prepaid by a check or money order payable in U.S. dollars to the Arizona Geological Survey or by Master Card or Visa. Do not send cash. Add 7.6% sales tax to the publication cost for orders purchased or mailed in Arizona. Order by publication number and add the following shipping and handling charges to your order:

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Arizona Geological Society

P.O. Box 40952, Tucson, AZ 85717

520- 663-5295

www.arizonageologicalsoc.org



Purpose of the Society

is the promotion and encouragement of interest in the science of geology of the state of Arizona. To this end the Society holds monthly meetings, sponsors field trips, and publishes field trip guides and the Digest at irregular intervals. The Society has produced a distinguished publication series, see listing below. AGS was founded in 1948.

Membership

in the Society is open to all who are professionally interested in the geology of the State of Arizona.

Dues: \$15 for 1-year membership

\$30 for 2-year membership,

\$40 for 3-year membership,

full-time student - free



Ores and Orogenesis 2007 - Circum-Pacific Tectonics, Geologic Evolution, and Ore Deposits. A symposium in honor of William R. Dickinson. Location: Tucson, Arizona, 24-30 September, 2007

Arizona Geological Society Publications - partial listing

The Arizona Geological Society's publications are sold over the counter and by mail through the Arizona Geological Survey. For shipping costs contact Arizona Geological Survey, 416 W. Congress #100, Tucson, AZ 85701, (520)-770-53500, Maricella.Moreno@azgs.az.gov

GEOLOGIC HIGHWAY MAP OF ARIZONA, edited by R.J. Kamilli and S.M. Richard, scale 1:1,000,000, 1 sheet, 26" x 48", folded to 5" x 9", text and maps both sides, 1998, \$10.00

Digest 20: PORPHYRY COPPER DEPOSITS OF THE AMERICAN CORDILLERA, edited by F.W. Pierce and J.G. Bolm. 656p., 43 papers, hardbound, 1995, \$75.00

Digest 19: PROTEROZOIC GEOLOGY AND ORE DEPOSITS OF ARIZONA, edited by K. E. Karlstrom. 332 p., 25 papers, softbound, 1991, \$35.00

Digest 18: MESOZOIC ROCKS OF S. ARIZONA AND ADJACENT AREAS, edited by W. R. Dickinson & M. A. Klute. 400 p., 28 papers, softbound, 1987, \$ 17.00

Digest 17: GEOLOGIC EVOLUTION OF ARIZONA, edited by J. P. Jenney & S. J. Reynolds. 866 p., 35 papers, hardbound, 1989, 1 plate - Arizona Geologic Map 1988 scale 1:1MM by Reynolds. \$60.00 Includes chapters on Precambrian, Laramide, and Mid Tertiary metalliferous ore deposits, uranium, petroleum, and industrial minerals.

Digest 16: FRONTIERS IN GEOLOGY AND ORE DEPOSITSO F ARIZONA AND THE SOUTHWEST, edited by B. Beatty & P.A.K. Wilkinson. 555 p., 72 papers, softbound, 1986, \$25.00

Digest 15: GOLD AND SILVER DEPOSITS OF THE BASIN AND RANGE PROVINCE, WESTERN U.S. edited by Joe Wilkins, Jr.. 233 p., 19 papers, hardbound, 1984, \$17.00

Digest 14: RELATIONS OF TECTONICS TO ORE DEPOSITS IN THE SOUTHERN CORDILLERA, edited by W. R. Dickinson & W. D. Payne. 288 p., 19 papers, softbound, 1981, \$17.00

Digest 10: TECTONICS OF ARIZONA, edited by J. C. Wilt & J. P. Jenney. 430 p., 19 papers, 4 maps, softbound, 1976, \$14.00

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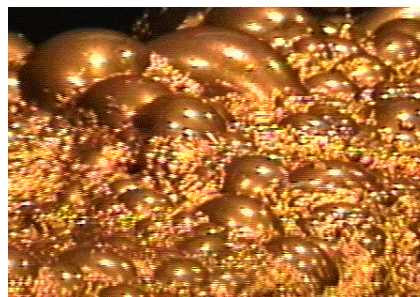


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Department of Mining & Geological Engineering

www.mge.arizona.edu



Natural Resources — People — Environment

**MS, PhD in residence
MEng on line
Joint MEng-MBA
Joint MS or MEng and MPH
Certificate Program is pending**

Contact:
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Why Study Mining and Geological Engineering?

The MGE Department does mining.....and more. We are one of the leading centers for mineral resources engineering research ranging from geomechanics to information technology to health and safety. You might be surprised to learn that many of our graduate students do not have an undergraduate degree in an engineering field. The breadth of research we do accommodates students from a wide variety of technical fields, health fields, and business backgrounds.

Why Study at Arizona?

The UA is a Research I university and a member of the elite American Association of Universities, the highest designations for quality research in the United States. We are a member of the CRC-Mining based in Brisbane Australia. Our faculty are at the cutting edge of their respective research fields. Our certificate program is pending approval and is planned to be 15 units in focused areas such as geomechanics, information technology, health and safety, and mineral processing. The courses will be offered on-line.

What Courses Can I Take?

You can choose from a wide variety of courses within the MGE Department and many other departments ranging from industrial hygiene to applied anthropology to geosciences to planetary sciences.

What Research Can I Do?

Faculty members have many exciting research projects ranging from economic indicators for sustainable development to automated imaging of fractures and particle size and many more.

Admissions



For MS, PhD and MPH
<http://grad.arizona.edu/applynow.php>

For MEng
<http://triuniv.engr.arizona.edu/>

Application Materials:

GRE for MS and PhD, TOEFL for non-English speakers, application, 3 letters of recommendation, resume, statement of interest; no GRE for MEng if other requirements met; must have 3.0 undergraduate GPA

December 1 deadline for international students

February 1 deadline for domestic students

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