Metallic Mineral Districts of Arizona

- Porphyry copper and stratabound Cu
- Copper veins w/wo Au/Pb
- Gold w/wo Cu/Pb
- Silver w/wo Pb/Zn
- Pb Zn veins and replacements
- Volcanogenic massive sulfide
- Uranium breccia pipes, stratabound, or veins
- Iron stratabound or taconite like

Arizona Department of Mines and Mineral Resources

Mining Summary
2005 Exploration Overview
Additional Information Sources
Arizona Department of Mines and Mineral Resources

The objective of the Department is to promote 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.

The Department is a service agency and does not regulate, tax, or require any type of registration. The agency provides assistance that is tailored to meet the diverse needs of the public. The following is a partial list of services that the Department offers:

♦ Maintain a site-specific database of unpublished reports and maps that includes 4,000 mine files and indexes of 10,000 computerized Arizona mineral occurrences.

♦ Maintain an information bank and library of mineral and mining information including a mine map library (hard copy and microfilm), government publications, periodicals, and unpublished master and doctorate theses.

♦ Gather and disseminate information on commodities and markets.

♦ Assist individuals and companies in their dealings with regulatory agencies to facilitate their mining and exploration activity.

♦ Produce publications in the form of mineral reports, annual directories, technical reports, annual mineral industry surveys and information circulars. These publications include:

♦ Operate the Arizona Mining and Mineral Museum.

Contact Information:
Arizona Department of Mines and Mineral Resources
1502 West Washington
Phoenix, Arizona 85007
602-255-3795
www.admmr.state.az.us

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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 traditionally ranks first, or among the top three, in mineral production in the US. In 2003 Arizona’s mineral production value was $2.4 billion. Arizona leads the Nation in copper production, is first in 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 2003 Arizona accounted for 67 percent of the U.S. copper production. The copper industry has a $2.7 billion direct and indirect impact on the Arizona economy. Arizona’s three largest copper producers, Asarco Incorporated, 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 842 million pounds of copper in 2003, has the largest EW plant in the world, and is the world’s fifth largest mine.

Exploration companies are reviewing known districts in the light of current metal prices, but also, new orebodies are being discovered and new mines are coming into production. 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’s Safford Project has received its final EIS, and when completed, will produce up to 250 million pounds of copper a year.

Although gold takes a backseat to copper production, Arizona has produced over 16 million ounces of gold. American Bonanza Gold Mining is working underground at their Copperstone deposit where surface drilling has returned exciting results. At least five other gold exploration projects have been active in response to the price of gold and Arizona’s favorable geology and mining climate.

Arizona Mineral Production - 2003¹
Short tons unless otherwise noted

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<td>Molybdenum (lb)</td>
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<td>w</td>
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<td>Sand &amp; gravel</td>
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1. USGS preliminary data except as noted
2. Includes cement, clay, lime, gypsum, gold, molybdenum, perlite, salt, dimension stone, zeolites, and iron oxides.
3. ADMMR estimate
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 account for 65% of the United States newly mined copper production. Arizona hit an all time annual high output in 1997 at 2.7 billion pounds. By-products of mining these porphyry copper deposits has 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 and as well as provide details of many specific Arizona deposits thus making it unproductive to provide a detailed review here. It is worth mentioning that Arizona’s porphyry copper deposits generally contain economically important quantities of silver, sometimes molybdenum, and far less commonly gold.

History: Deposits with current or recent past production include: Morenci, Ray, Sierrita, Bagdad, Mission, Silver Bell, Inspiration, Mineral Park, Pinto Valley, Lakeshore, San Manuel, New Cornelia, Johnson Camp, Twin Buttes, Magma, Copper Queen.

Significant deposits awaiting development or redevelopment include: Dos Pobres, San Juan, Lone Star, Carlota, Helvetia, Twin Buttes, New Cornelia, Cochise, Copper Creek, Zonia, and Resolution Copper.

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 them.

Current Activity:
Resolution Copper: This deposit is a surprising new 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/BHP-Billiton. Surface drilling resumed in February 2005. Mine development and shaft deepening studies are underway. These will address the high rock temperatures and stresses encountered in the 5,000’ deep deposit.

Safford Project: Phelps Dodge awaits Dept. of Interior ruling prior to starting construction of 2 open pits, Dos Pobres and San Juan, and the world’s largest heap leach pad. Anticipated production rate is 250 million pounds annually.

Carlota: This deposit is permitted and awaiting open pit SX-EW development by Cambior. The exotic copper deposit has resource of 105 million tons at 0.45% oxide copper.
Monitor: General Minerals identified this target by mapping and geophysics. They announced an option to Teck Cominco in February 2005.

Others: Additional areas of activities by various companies includes but not limited to the Ajo Cornelia, Copper Creek, Copper Mountain, Emerald Isle (exotic copper) Mineral Creek, Pima, Pioneer, Safford, Wallapai and Zonia district as well as the Soza Canyon, Little Dragoon and Dragoon Mountains areas.

References:

Uranium in Arizona

**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 U₃O₈. Drilling by the U.S. Department of Energy drilling indicates potential for the basin to host as much as 126 million pounds U₃O₈ 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 and Energy Metals have acquired land positions. Both are acquiring and digitizing historic data as well as evaluating various development options.

**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% U₃O₈. A typical pipe is 300’ in diameter and could be up to 3,000 vertically. During the 1980s 40 million pounds was discovered.

**Production:** 13 million pounds were produced during the period 1981-9 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 the 1980 rate experts predicted that by year 2000 over 100 million pounds of new mineralization would have

---

**Figure 2. Areas of Uranium Production and Occurrences**

From: Fieldnotes Vol. 10, No. 4.
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! Interest in breccia pipes on the Coconino and Kaibab plateaus has returned in the last year as indicated by property acquisition on federal and state lands.

**Current Activity:** International Uranium controls the Arizona One and Pine Nut deposits developed and on standby and also holds the partially developed Canyon pipe. Previously mined material was sent to the company’s processing plant located in southern Utah near Blanding. Other companies are currently acquiring previously drilled pipes and suspected pipes as exploration targets. These include: Good Fellow Resources – 11 Pipes North and South of Grand Canyon, Clan (now Energy Metals) - Wate and 4½ pipes with identified resources and 30 other pipes, Quincy Gold and others.

**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 south of the Workman Creek area and also east of the Red Bluff mine area.

**Current Activity:** Cooper Minerals has recently leased a claim group to Rodinia Minerals. Drilling planned.

**References:**


---

**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 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, volcanogenic massive sulfide and. Economic deposits have formed during 4 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 has completed half of a 40,000-meter drill program to define reserves at the detachment hosted Copperstone deposit. Others companies recently active include Abington Ventures, Capital Hill, Galaxy Minerals, Gold Spring, and Patriot Gold.

**References:**


---

![Fig. 3. Primary and by-product gold occurrences](http://www.arizona.gov/mines/gold/primarybyproductgoldoccurrences.png)

From: Arizona Dept. Mines and Mineral Resources GIS
**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 3 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 as 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:** Phelps Dodge controls the United Verde zinc resource discussed above. Teck Cominco recently completed a multi-year effort without publishing any results. In the Old Dick district Silver Nickel Mining has acquired the Pinafore mine and collected exploration data including drill results from Arizona Explorations Inc. (syndicate of American Barrick, Homestake and Placer Dome) mid-90’s effort. The joint venture of Ivy Minerals/Kaaterskill Exploration has been working on 2 new exploration targets in the Mayer district where it identified geochemical and VLF-EM anomalies at the Cobre Sud and Cordes Peak prospects.

**References:**
Mining Claim Distribution on Federal Lands

21,483 mining claims in 2003
25,616 mining claims in 2004

Mining claim records are online at:
www.blm.gov/lr2000/
LIST OF AVAILABLE PUBLICATIONS

January, 2005

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Prepayment is required on all orders. Make checks payable to the Dept. of Mines & Mineral Resources.

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- $20.02 - $30.00, add $5.50
- $30.01 - $40.00, add $6.00
- $40.01 - $50.00, add $6.50
- Over $50.01, add 15% of total

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 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


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


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

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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 .

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 floppy 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 89-2 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 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**


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


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. *


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. *


C90 Mining Claim Forms, 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. *

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. *

CIRCULARS

Circulars are 25 cents each.


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


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. *

C106 *Arizona Gem Shows, 2004-2005*, Includes date, location, sponsoring group, contact person.


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.


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

**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


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

M02-2 *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. $5.00 *

See also: County Mine Map Series - see page 2

**REPRINTED MAPS AND REPORTS**


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. Blackline print. $2.00


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

**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.


**MINERAL EDUCATION KIT**

A boxed set of 40+ rock and mineral samples including a collection of Arizona’s commonly mined minerals, 7 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.
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Send this form with payment to:

**Department of Mines and Mineral Resources**

1502 West Washington

Phoenix, Az 85007

Do you need this information in an alternate format?

Please call the Department at 602-255-3791.
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 2005.

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 2003, the Arizona copper industry had a combined direct and indirect impact on the Arizona economy of:

$2.691 Billion

♦ including combined direct and indirect contributions of:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$817 Million</td>
<td>in personal income, equivalent to 18,000 jobs for Arizonans</td>
</tr>
<tr>
<td>$1.718 Billion</td>
<td>in business income, and</td>
</tr>
<tr>
<td>$156 Million</td>
<td>in state and local government revenues</td>
</tr>
</tbody>
</table>

♦ as a result of the circulation (and multiplication) of the copper industry’s total direct impact of

$1.087 Billion

♦ that included direct payments of:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$62.555 Million</td>
<td>to the State and its local governments in taxes and fees,</td>
</tr>
<tr>
<td>$656.801 Million</td>
<td>to other Arizona businesses for products and services, and</td>
</tr>
<tr>
<td>$367.563 Million</td>
<td>in personal income for Arizonans, including wages and salaries for the industry’s 5,900 employees</td>
</tr>
</tbody>
</table>

♦ who labored to produce:

823,490 tons of copper and other minerals with a total value of

$1.532 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.

- 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 & 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

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

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

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

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

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

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

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

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602-417-9528
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U.S. Geological Survey
520-670-6671 ex. 221
www.usgs.gov
ARIZONA GEOLOGICAL SURVEY
Partial list of Mineral and Energy Resource Publications


Metallic Mineral Resources


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

Indexes of Mining Properties

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

Bibliographies


Industrial Minerals

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


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. Peartree, 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


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:

<table>
<thead>
<tr>
<th>SHIPPING AND HANDLING CHARGES</th>
<th>In the United States</th>
</tr>
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<tbody>
<tr>
<td>Less than $2.00</td>
<td>add $2.50</td>
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<tr>
<td>$2.01 to $10.00</td>
<td>add $6.00</td>
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<td>$10.01 to $20.00</td>
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<td>add $17.00</td>
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<td>More than $200.00</td>
<td>call</td>
</tr>
</tbody>
</table>

Other countries, request price quotation

Shipping and handling charges include insurance.
For rolled maps, add $1.00 for a mailing tube.
Purpose of the Society

The purpose of the Arizona Geological Society, Inc. 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 other side). AGS was founded in 1948.

Meetings

Monthly meetings are held in Tucson and include a social hour, cash bar, dinner, and a presentation by a guest speaker on a topic of geologic interest. Social hour starts at 6:00 PM; dinner at 7:00 PM, and the talk at 8:00 PM.

Field Trips

Arizona Geological Society conducts field trips during the year which appeal to a range of interests, including structural geology, petrology, ore-deposit geology, geomorphology, and industrial minerals. Field trips are open to members and non-members alike. A modest fee covers snacks and the guidebook for the trip.

Courtright Scholarship

The Courtright Scholarship was initiated to honor J. Harold Courtright. It is awarded to students working on field-related projects in the North or South American Cordillera at one of the Arizona universities. The Society awards approximately two scholarships per year.

2007 Symposium

The Society is planning a symposium in Tucson in September of 2007. The title is “Ores and Orogenesis: Circum Pacific Tectonics, Geologic Evolution, and Ore Deposits.”

Membership

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

Membership Application Form

Dues:

____ $15 for 1-year membership
____ $30 for 2-year membership,
____ $40 for 3-year membership,
____ full-time student-free

Rates are likely to go up in 2006, so $30 for 2 years is actually a good deal.

Name:___________________________________
Company:________________________________
Position:_________________________________
Mailing Address:__________________________
________________________________________
(Street City State Zip)
Work Phone:_____________________________
Home Phone:_____________________________
Fax:___________________________________
E-Mail:_________________________________
If registered geologist, indicate registration no. and state (optional, will appear in the directory):
_____________________________________

(Also enclosed is a _________ tax- deductible contribution to the J. Harold Courtright Scholarship Fund)
Arizona Geological Society Publications List

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)-670-5544
Rachel.Aragon@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 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 9**, Discusses geophysics, volcanism, sedimentation and miscellaneous geology articles. Edited by E. J. McCullough. 265 p., 16 papers, softbound, 1972, $6.00

**Digest 7**, Discusses geology of mineralized areas and general geology articles. Edited by E. J. McCullough. 171 p., 14 papers, softbound, 1964, $5.00
**Vision**
An Arizona-based, national center that bridges pure and applied science, engineering, business leadership, health, and responsible stewardship that has a global impact.

**What’s in it for you?**
- Commodity and region-focused short courses
- Entrepreneurship and business skills-focused education and outreach
- Exploration, extraction, processing research
- Sample libraries and databases
- Professional development for licensure
- Belong to a professional community focused on mineral resources
- Interdisciplinary research and education related to mineral resources industry
- Access to students
- Continuing education courses
- And more

**What is the IMR?**
The Institute for Mineral Resources (IMR) is a newly created interdisciplinary research center at the University of Arizona, jointly administered by the economic geology faculty in the Geosciences Department and the faculty in Mining and Geological Engineering. The IMR will have a director with responsibility for coordinating mineral resources related research across campus, an outreach coordinator to work on K-12 outreach as well as technical training for the skilled labor workforce, a research/teaching staff. The IMR will have a technical advisory board of industry, government, and outside academic stakeholders as well as an independent board that provides oversight for the entire enterprise.

**A new model for partnership**
The IMR provides a unique mechanism for industry and government to influence the direction of academia and for academia to be a stakeholder in industry. The IMR represents a novel vehicle for integration across disciplines, across industry-academic-government divides, and to a broader society via outreach.
### Stakeholders influence direction
A complete list of members of the MGE and IMR boards is available on the MGE and IMR websites:
- Jack Thompson, Jr., Vice-Chair Barrick
- Thomas O'Neil, retired COO Cleveland-Cliffs Mining
- Paul Jones, Exec VP, St. Andrew Goldfields
- Bruno Hegner, GM, Resolution Copper Co.
- Stephen Enders, VP Exploration, Newmont Mining
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### Depth and breadth of expertise
The UA has very impressive strengths in a wide variety of academic disciplines. The opportunity exists to make the UA the pre-eminent institution in the country for broad competence in issues facing the minerals business in the decades ahead. We know of no other university that sees or has this potential.

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- Geosciences faculty in geochemistry, economic geology, structural geology, geophysics,
- Mining and geological engineering
- Hydrology and Water resources
- & 7 other engineering departments
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- Mining law
- Anthropology
- Soil and water science
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### What support is needed?
- Endowed professorships
- Support for short courses and workshops
- Support for mining engineering program
- Curation of mineral collection
- Scholarships and fellowships
- Director position for IMR

### Why here... Why now...?
- Highest ranked research university with a mining engineering program
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- Hydrogeology ranked #1 in US
- Partnership with College of Public Health
- Expanding USGS presence on campus
- Top-ranked business school
- Caterpillar & Komatsu proving grounds
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- Professional Science Master's Degree in the Lowell Program in Economic Geology
  [http://econ.geo.arizona.edu/](http://econ.geo.arizona.edu/)
- Master of Engineering Program
  [http://triuniv engr.arizona.edu/](http://triuniv engr.arizona.edu/)