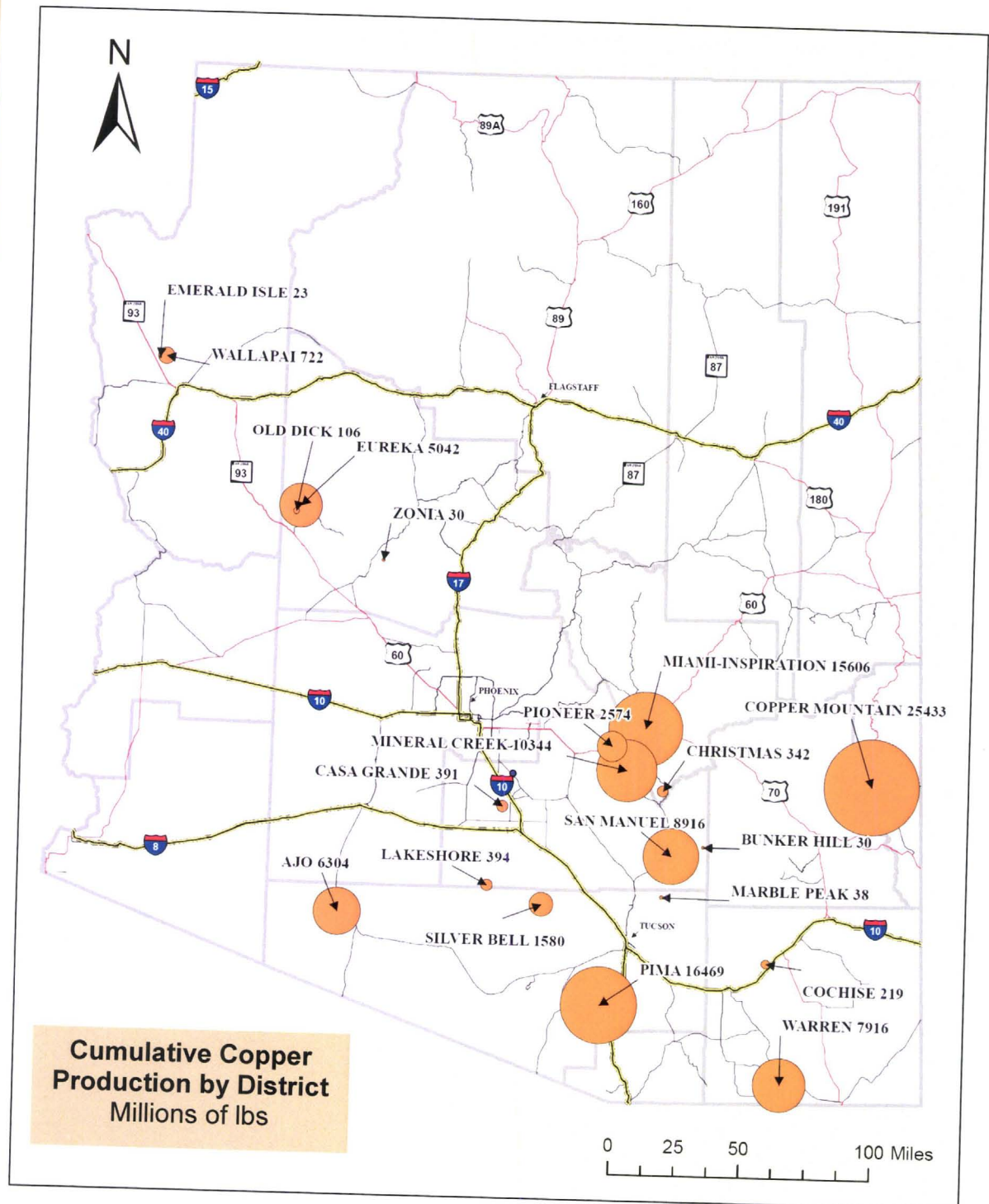


# Arizona's Metallic Resources Trends and Opportunities – 2008



Arizona Department of Mines  
and Mineral Resources

Mining Summary  
2008 Exploration Overview  
Additional Information Sources

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# ARIZONA'S METALLIC RESOURCES TRENDS AND OPPORTUNITIES

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## Open File Report 08-26

February, 2008 v1.1

by Nyal J. Niemuth

### Preface

This report was prepared to briefly highlight Arizona's metallic mineral potential and current projects. It was released to coincide with the Department's participation at the Prospectors and Developers Association of Canada (PDAC) convention held in Toronto in March 2008. It has been compiled from annual reports, websites, personal interviews, news articles, and other sources. It is acknowledged that there are additional activities and available properties not listed in this report.

### About: 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.

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- ◆ **Maintain a site-specific database of unpublished reports and maps that includes 4,000 mine files and indexes of 10,000 computerized Arizona mineral occurrences.**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mining information including a mine map library (hard copy and microfilm), government publications, periodicals, and unpublished master and doctorate theses.**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.**
- ◆ **Operate the Arizona Mining and Mineral Museum.**

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## Mining in Arizona

As it has for many years, **Arizona ranked first in nonfuel mineral production** in the U.S. in 2007 with a production value of \$7.58 billion according to preliminary unpublished figures of the USGS and ADMMR. Arizona leads the Nation in **copper** and ranks in the top five in **molybdenum, sand and gravel, gemstones, perlite, silver, zeolites, and pumice**. 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 2006 Arizona accounted for 62 percent of the U.S. copper production. The copper industry had a \$4.7 billion direct and indirect impact on the Arizona economy.

### Arizona Mineral Production

Commodity	2005 Value <sup>3</sup>	2006 Value <sup>3</sup>	2007 Value <sup>3</sup>
Clay (bentonite)		\$1,710,000	1,730,000
Copper	2,640,000,000	4,950,000,000	5,540,000,000
Gemstones	1,370,000	1,560,000	1,580,000
Sand & gravel	516,000,000	662,000,000	597,000,000
Stone, crushed	69,300,000	102,900,000	116,000,000
Other <sup>1</sup>	1,120,000,000	1,040,000,000	1,120,000,000
Coal <sup>2</sup>	290,000,000	190,000,000	200,000,000
<b>Total</b>	<b>\$4,640,000,000</b>	<b>\$6,940,000,000</b>	<b>\$7,580,000, 000</b>

1) Includes cement, clay, lime, gypsum, gold, molybdenum, perlite, pumice, silver, salt, dimension stone, and zeolites

2) ADMMR estimate

3) Unpublished USGS data, subject to change; data rounded and may not add to totals shown; final 2005 -2007 data will be published in the Arizona Chapter of the USGS Mineral Yearbook, Area Reports: Domestic 2005 - 2007, volume II

### Copper Mine Production

Mine	2006 (million lbs.)	2007 (million lbs.)
Morenci	815.6	808.0
Ray	232.9	228.9
Bagdad	165.4	202.0
Sierrita	161/6	150.0
Mission	95.6	121.3
Silver Bell	49.9	46.7
Miami	19.0	20.0
Pinto Valley	18.1	27.6
Mineral Park	9.5	11.2
Tohono	5.2	3.0
Safford	0.0	1.0
<b>Total</b>	<b>1,569.8</b>	<b>1,619.7</b>



## 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. Current production accounts for over 60% of the United States' newly mined copper. Arizona's output reached an all time annual high in 1997 of 2.7 billion lbs. while value reached an all time high of \$5.5 billion in 2007. 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. See the reference listing for an introduction to the literature and deposits.

**History:** Deposits with current or recent production include: Morenci, Ray, Sierrita, Bagdad, Mission, Silver Bell, Miami (Inspiration), Mineral Park, Tohono (Lakeshore), San Manuel, Johnson Camp, and Copper Queen. Three properties began or renewed production in 2007: Pinto Valley open pit, the Safford project from Dos Pobres and Johnson Camp. Significant deposits awaiting development or redevelopment include: San Juan, Lone Star, Sanchez, Rosemont (aka Helvetia), Twin Buttes, New Cornelia, Cochise, Copper Creek, Zonia, and Resolution Copper. Not to be overlooked are, Carlota, production anticipated in the 2<sup>nd</sup> half of 2008, and Emerald Isle, both exotic copper deposits derived from porphyry copper systems.

Prior to the last copper price downturn, development of two deposits as in-situ leach operations seemed likely. Although it appears Santa Cruz may become a victim of its high real estate value, a portion of Poston Butte (aka Florence) is an Arizona State Land Dept. mineral lease. The Land Dept. would like to see the 300 million-ton-oxide portion of the deposit begin production. Magma Copper/BHP's feasibility study and technical data may be viewed by signing a release with Merrill Mining/Vanguard Properties.

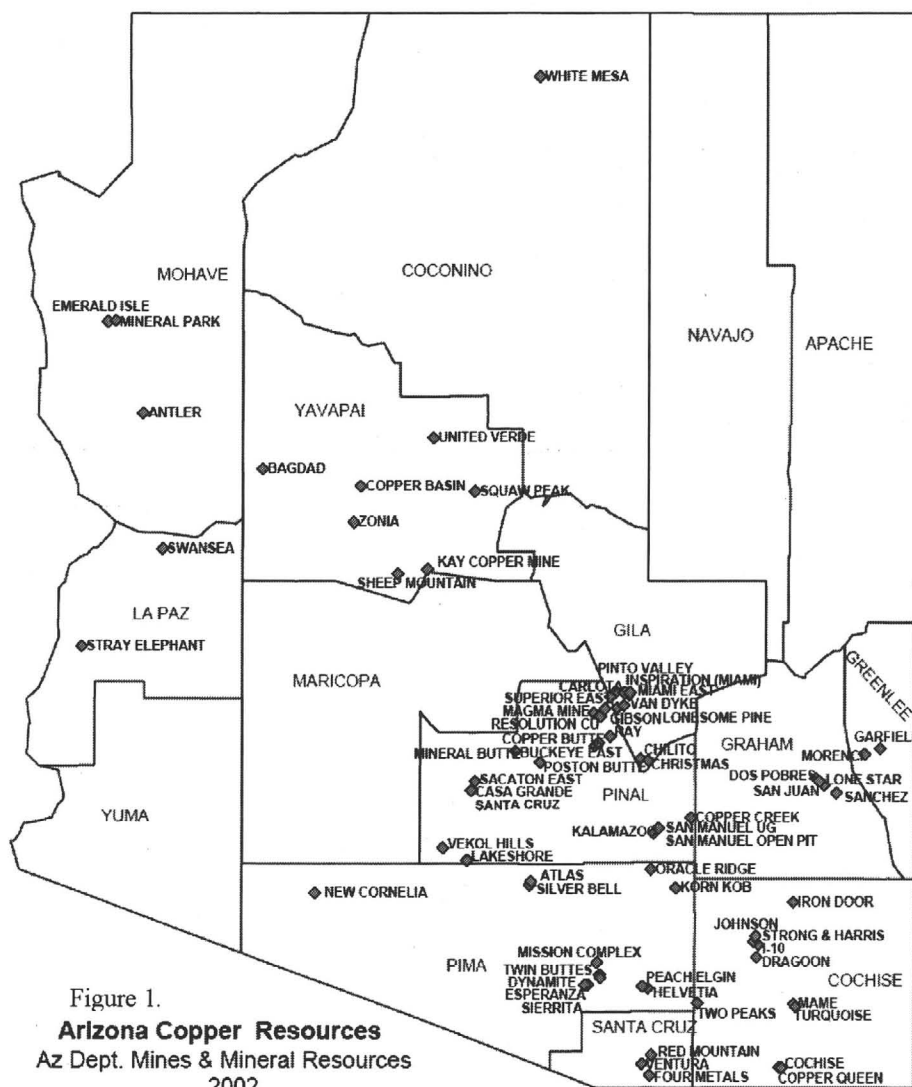


Figure 1.  
**Arizona Copper Resources**  
Az Dept. Mines & Mineral Resources  
2002

**Highlights of Current Activity:** Copper prices that averaged \$3.28/pound in 2007 resulted in a record production value of \$5.5 billion. Continued strong demand and high price are driving exploration and development activity to the highest level in many years.

**Morenci:** Freeport McMoRan and Sumitomo invested \$241 million to build the first commercial-scale copper concentrate pressure leach operation. Morenci, Arizona's largest mine, resumed concentration in 2006 to supply feed to the new plants. Two leach vessels have been installed and production is ramping up. Copper production of cathodes will be via electrowinning solutions from the new plants and continuing from heap and dump leaches. Production was 790 million lbs. in 2007. An additional \$100 million will be invested in 2008 to expand mining and EW capacity, increasing production capacity by 100 million lbs. per year.

**Safford Project:** Expenditures of \$675 million were required to construct the giant Safford leach pad, associated SX-EW plant and development of the Dos Pobres pit. First cathode production was reached ahead of schedule in December 2007 and production will increase over the next half year. Development of the adjacent San Juan deposit should begin in two years. Expected output will be 250 million lbs. of copper per year for 18 years.

**Mineral Park:** While continuing to mine and produce cathode copper via leach SX-EW, Mercator has pursued a plan to renew sulfide concentration of copper and the deposit's high-grade 0.04% molybdenum. Construction of a two-stage expansion of a 50,000-TPD mill has been underway since mid 2007. The \$128 million first phase includes a 25,000 TPD mill that should start up in the 2<sup>nd</sup> quarter of 2008. Most of the equipment for phase 2 has been purchased and expansion to 50,000 TPD should be completed by 1<sup>st</sup> quarter of 2009.

Immediately north of Mineral Park Searchlight Exploration has assembled a 2,000 acre prospect that includes the Alum Wash/Apex Hill zone and is seeking a JV partner or lessee to conduct additional exploration.

**Pinto Valley:** BHP reopened the Pinto Valley mine in October of 2007 with an investment \$140 million to rehabilitate the 75k TPD sulfide concentrator. They issued a \$300 million contract to the Washington Group to finish mining the slice 6 pushback containing 85 million tons of mill ore at 0.41% Cu and 37 million tons of leach material at 0.21% Cu. Depending on copper prices, slices 7 and 8 may be mined.

**Other Producers:** A number of Arizona's other producing copper mines are receiving investments of up to \$100 million to increase production to take advantage of the continued high copper prices. These include Asarco's Ray, Mission, and Silver Bell properties and Freeport McMoRan's Bagdad and Sierrita mines.

**Carlota:** In March 2007 a \$200 million loan was arranged for the copper leach project. Quadra has moved forward rapidly with construction of the open-pit and SX-EW facility at Carlota. Completion is anticipated in the second half of 2008. Forecast annual recovery is expected to be up to 75 million lbs. per year for the mine's 11-year life.

**Miami:** Freeport McMoRan plans to restart mining for leach at Miami in 2010. It will invest about \$100 million, primarily for mining equipment. Leaching from existing heaps produced about 20 million lbs. in 2007.

**Rosemont:** Since acquiring the Rosemont property in 2005 Augusta Resource has moved quickly. It completed a 30,000-meter drill program to produce a NI43-101-compliant resource estimate. Proven and probable reserves total 493 million tons at 0.47% Cu and 0.015% Mo. Plus an additional 50 million tons at 0.18% oxide ore. A progressive mining plan has been submitted to the Coronado Forest for mine dumps and plant. Augusta Resource obtained rights to Central Arizona Project (Colorado River) water to store for later withdrawal. Plans include filtering to produce "dry tailings" of less than 15% moisture to reduce water usage. Tailings will be disposed of with the carbonate rock waste that will minimize future acid mine drainage impacts on ground water quality. Additional mineralized areas of the property are beginning to be drill tested.

**Resolution Copper:** This deposit, with its massive size and high primary grade, continues to inspire exploration in Arizona. Resolution Copper Co., a 55/45 joint venture of Rio Tinto and BHP-Billiton continues to define the resource via surface drilling. Preliminary reports indicate a 1.25 to 1.75 billion-

ton deposit grading 1.25% - 1.75% copper plus molybdenum. Rehabilitation work to upgrade the Neversweat tunnel and dewatering of the Magma mine continues in preparation for deepening of the No. 9 shaft. In the fall of 2007 Congress began hearings on the Southeast Arizona Land Exchange and Conservation Act to acquire land essential to development of the deposit. When in production the mine will provide approximately 25% of the United States copper needs.

**Copper Creek district:** Redhawk Resources has acquired a large portion of this district consisting of high-level breccia pipes and lower level porphyry copper deposits. The company has completed a NI43-101-compliant resource estimate for Mammoth, Childs-Aldwinkle, and Old Reliable and Keel zone totaling 6.4 million tons at 1.755% copper equivalent. A drilling program to expand and better define the Mammoth breccia was completed in late 2007 and will update the resource figure. Environmental studies were completed in fall 2007 allowing submittal of permit applications to develop an exploration decline into the breccia resource area. A 70,000-foot drill program to expand the American Eagle porphyry, inferred resource of 150 million tons reported, and connect it to the Keel zone commenced in late 2007. The first step-out drill hole of the program contained an interval of 840.5 feet grading an average 1.4% copper and 0.033% molybdenum. Additional work is being conducted with the goal of preparing updated resources and scoping study for the project in late 2008.

Bell Resources began a 10-hole, 4,500-foot drill program on the Sombrero Butte property including portions acquired from Silver Nickel Mining in 2006. Results reported have included grades of 4.7% copper over plus 20 meters. Encouraged by the earlier results and having tested only 8 of plus 20 breccia pipe targets a Phase 2 drill 12-hole program began in fall 2007 and has recently been completed.

**Zonia and Emerald Isle:** Ascendant Copper Corp. (ACX) announced plans in late 2007 to acquire St. Genevieve Res. (SGV) including its assets Zonia and Emerald Isle. An October 2006 NI43-101 compliant report commissioned by SGV on Zonia in Yavapai County reported an inferred resource of 63 million tons grading 0.37% copper. A third party engineering report prepared as part of ACX's due diligence estimates that the Zonia property can be put back into leach production within 24 months producing approximately 20 million lbs. of copper annually for 17 years.

Emerald Isle is an exotic oxide copper deposit with a small "mothballed" SX-EW plant located west of Mineral Park. A NI43-101 compliant report in March 2006 based on historical drilling concluded that the property contained 2.3 million tons grading 0.62% copper.

**Safford District:** In addition to the major construction project being finished by Freeport McMoRan, there is also much exploration activity in the district. Freeport continues a major drilling campaign in the district with plans to further evaluate the Lone Star deposit.

Franconia Resources confirmed by drilling that the Red Knoll area contains widespread potential host rocks for porphyry copper mineralization at reasonable depths. Three holes were completed in 2007. Hole RK-4 intersected Laramide meta-volcanics displaying intense phyllic alteration, 1-3% pyrite and anomalous copper values from 979 to 2,456 feet. This may indicate proximity to a porphyry copper system. Follow up geophysics and further drilling is planned.

Entrée Gold began to test an IP anomaly on its Sol Dos property with a 6,550-foot drill program planned. Entrée Gold also entered into an agreement with Empirical Discovery LLC to explore for porphyry copper targets in southeastern Arizona.

High Desert Gold (previously General Minerals/Sprott Res.) reported in November 2007 that two 600-meter drill holes were completed at the Markham Wash property optioned by Teck Cominco. Assay results are pending.

Nord Resources completed IP and resistivity geophysical surveys in early 2007 on Coyote Springs. A drill program was planned to test anomalous IP values.

Southwest Exploration Group has assembled biogeochemical and geophysical data identifying two large alluvium covered targets, Safford West and Teague Springs, both available for additional exploration.

**Copper Hill:** In the Turquoise District, Aurelio Resource Corp. is developing a copper-zinc project comprised of the MAN, Courtland and South Courtland areas. Work during the last 3 years included consolidation of surface and mineral control of over 5,000 acres, acquisition of historic information including 190,000 feet of drilling data from 270 holes, as well as 76,780 feet of core from 95 holes. In

addition Aurelio has drilled 41 holes to confirm, step-out and infill the historic drilling data, which has resulted in an additional discovery of near-surface mineralization in the Courtland and South Courtland areas. An independent estimate of the Inferred Resource on the initial MAN discovery has confirmed the mineralization; 63.7 million tons at an average 0.56% copper-equivalent grade. A NI 43-101 Technical Report for the Hill Copper-Zinc project is being prepared.

**Sheep Mountain:** Lone Tree Exploration LLC has acquired this partially delineated copper molybdenum deposit and assembled historic exploration data. The property has had 56 core and rotary holes drilled totaling 75,000 feet. A 2007 preliminary feasibility study on only the supergene portion of the deposit concluded an 8-10k TPD operation could generate a 28% rate of return at \$1.50/lb. Cu and \$12/lb. Mo. The report is available at [www.ammexgoldmining.com](http://www.ammexgoldmining.com) The property is available for lease or purchase.

Lebon Gold Mines controls a second area of mineralization at Sheep Mountain, west of the previously mentioned area. A drill program of 3 holes totaling 2,026 feet in 2007 found significant thicknesses of copper oxide mineralization. The holes however failed to reach to the redox boundary where historic reports of higher grades of chalcocite up to 0.8% had been reported. The company is debating further solo work or opting for a joint venture partner.

**Troy Ranch:** Big Bar Gold completed 4 drill holes late 2007 on the Troy Ranch prospect east of Ray where it has earned a 51% interest in a joint venture with Freeport McMoRan. Numerous intercepts of copper and molybdenum mineralization were encountered along with long potassic-altered intervals coincident with an AMT geophysical target.

**Yuma King:** Step out drilling by Big Bar Gold resulted in the discovery of a porphyry copper system with significant molybdenum values in a Jurassic age thrust fault complex. Favorable geology continues to the northeast and southeast that remains to be tested.

**Kabba:** An initial 4-hole 3,600-meter drill program by Bell Resources targeted a suspected down-faulted porphyry copper system indicated by geophysical surveys. All holes showed indications of proximity to a porphyry copper/molybdenum system. Drill hole K-4 penetrated altered and weakly mineralized granite that may be the outer shell of a porphyry copper system. A follow up drill program is being planned.

**Four Metals:** Black Pearl Minerals Consolidated completed a Phase 1 drilling program on this breccia pipe in 2007. The 7-hole drilling program totaled 996 meters. It confirmed grades of historic efforts while adding width and depth to the south and east sides of the deposit. Permitting is underway for additional drilling.

**Monitor:** Monitor is a silver gold prospect located 3 miles northeast of the Ray mine. High Desert Gold (previously General Minerals/Sprott Res.) reported that Teck Cominco terminated the joint venture agreement. Their final report recommended that two IP anomalies be drill tested for deeper porphyry copper mineralization.

**Gold Hill:** Teryl Resources reported in early 2008 that five RC drill holes had been completed on four separate copper targets on this patented property southeast of Bisbee. The highest grade intersect was at a depth of 275-280 feet with 4.84% Cu reported.

**Mesa West, Red Hills, Silver Bell West and Superior West:** In April 2007 Bell Resources entered into an alliance with Bronco Creek Exploration to jointly explore these projects, drawing on the strength of the geologic team of Bronco Creek. A drilling program has begun at Mesa Well to test a magnetic anomaly below gravel cover. Red Hills, based on previous exploration, has been reported to contain 500 million tons at 0.1% of copper oxides. Structural reinterpretation and geophysics suggests rotation of the deposit. Deeper portions of the system will be drill tested. Work at Silver Bell West is focusing on mapping and geochemical sampling to identify porphyry/skarn targets hosted in Paleozoic rocks below Mesozoic volcanics. Permitting is underway for a 2008 drill program. At Superior West there are two target types, the down-dropped extension of the high grade Magma vein system and the suspected deep-seated porphyry copper source for the vein mineralization. Drilling is scheduled to begin in the 1st quarter of 2008.

**Middlemarch:** This district contains multiple copper zinc silver skarn and deep-seated porphyry copper targets. In fall 2007 Southern Silver acquired an option on 68 claims and 4 state leases and is



planning a 3 to 5-hole, 1,500 meter core drilling program. Separately Minquest reports its claim block in the district is available for joint venture or lease.

**Tombstone South:** Southern Silver has acquired a large land package that contains multiple porphyry copper and silver replacement targets. Late in 2007 it began an initial core drill program that may total 2,000 meters.

**Squaw Peak, Copper Springs, CB, and Sunnyside:** American Copper has acquired these four porphyry copper molybdenum properties that contain resources reported by major companies during the early 1970s. Squaw Peak is reported to contain 20 million tons grading 0.4% Cu and 0.03% Mo. Copper Springs has a reported 20 million tons grading 0.4% Cu. Both properties are expected to have drilling programs initiated in the first quarter of 2008.

At the CB and Sunnyside, American Copper's current work program is geologic mapping and data compilation. The CB property in Yavapai County is estimated to contain 500 million tons of low-grade copper molybdenum mineralization based on previous wide spaced drilling. The Sunnyside has been reported by the USGS to contain a deep resource of 1.5 billion tons of 0.33% Cu with associated molybdenum and silver mineralization. A skarn zone containing a core drilling intercept of 124 feet grading 14% Zn, 1% Pb, 0.03 Mo and 1.4 opt Ag is adjacent to the porphyry copper resource. Four additional targets are possible. The CB and Sunnyside projects are being considered as joint ventures with larger mining groups.

**Twin Peaks:** The property, located in the northeastern Vulture Mountains, demonstrates widespread surface mineralization. Southwest Exploration Group reports this partially drilled, only 5 holes, copper oxide target is available.

**Mohave West:** Southwestern Exploration Group also has available an 800 acre claim block in Mohave county containing a target evaluated in the 1960s and 1970s. Geologic mapping and IP surveys outlined a large Laramide porphyry copper target. Only four drill holes have tested the system but all intersected thick intercepts of copper mineralization.

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## Uranium

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**Description:** Arizona's uranium production is largely attributed to deposits located in the southwestern corner of the Colorado Plateau Uranium Province. Between 1980 and 1989 Arizona was one of the leading suppliers of uranium in the United States, producing more than 13 million lbs. of  $U_3O_8$  from four high-grade breccia pipes.

**General Characteristics:** Arizona's uranium deposits occur in four principal geologic environments: solution collapse breccia pipes, roll front type fluvial deposits in sandstone, deposits associated with lacustrine/paludal sedimentary facies, and metasomatic related vein deposits.

**History:** The first uranium production in Arizona was in 1918 from carnotite-bearing sandstone deposits located in the Carrizzo Mts. Arizona reached its production peak in 1958 with 1.6 million lbs. of  $U_3O_8$  from 82 mines. Between 1947 and 1970 Arizona produced more than 18 million lbs. of uranium oxide and 42 million lbs. of vanadium oxide.

Price decline caused a reduction in uranium exploration and mining in the early 70s and again in the 90s. The late 70s and early 80s saw renewed interest in Arizona's uranium potential with the

producing breccia pipes averaging 0.65 percent  $U_3O_8$ . Previously mined breccia pipes include the Orphan, Kanab North, Pigeon, and Hack deposits with total production exceeding 17 million lbs. of  $U_3O_8$ .

Renewed exploration in the Date Creek Basin resulted in a major discovery. Estimates based on drilling done by U.S. Department of Energy in the 1970s indicate that the Date Creek Basin Miocene lacustrine sediments may host 1.2 billion lbs. of  $U_3O_8$  at depths up to 3,500 feet.

**Breccia Pipes:** Breccia pipes are collapse structures formed when sedimentary strata collapses into caverns formed from the dissolution of the underlying Mississippian Redwall limestone. The pipes are generally 300 feet in diameter and may extend 3,000 feet vertically. Thousands of these collapse structures exist in northern Arizona; most are hidden and require diligent exploration to find. The potential for new discoveries of high-grade uranium breccia pipes is excellent. Dozens of mining and exploration companies continue aggressive land and claim acquisitions. Exploration work continues with companies utilizing ground and aerial geophysics, surface mapping, geochemistry, and follow up drilling to confirm stratigraphy and mineralization at high priority targets. Geological investigations done in the Hualapai Reservation show over 900 pipes with approximately 8% of them having recognizable mineralization or anomalous gamma radiation. In the 1980s hundreds of suspected breccia pipes were discovered through the use of satellite imagery and surface ground domain electromagnetic geophysical surveys. Hundreds, or perhaps thousands, of potentially mineralized breccia pipes, remain untested.

**Current Activity:** Denison Mines Corp. controls seven mineralized breccia pipes and a sandstone type deposit on the Arizona Strip. Denison anticipates its fully developed Arizona 1 (70,000 tons at 0.68%  $U_3O_8$ ) will be on-line by mid-2008. Denison's other Arizona properties include the developed Pine Nut deposit (99,000 tons at 0.40%  $U_3O_8$ ), the partially developed Canyon Pipe property (70,000 tons at 1.0%  $U_3O_8$ ), and the Moonshine Springs sandstone deposit with a resource estimate of 775,000 tons grading 0.16%  $U_3O_8$ .

Liberty Star Uranium and Metals continues exploration on their North Pipes Project in the Arizona Strip, with encouraging results from their extensive geochemical sampling campaign. Drilling is underway on the Neola property, a confirmed breccia pipe, with three other high priority targets scheduled to be drilled.

Mesa Uranium drilled two holes to test and confirm previous drilling conducted on the Moonshine Springs deposit by Exxon in the 1970s. The drill holes confirmed the Exxon intercepts of 6 feet at 0.40%  $U_3O_8$ . The deposit is a mile from Denison's Moonshine Springs deposit.

Vane has five confirmed pipes out of 39 properties, with the Miller Pipe containing a 20-foot drill intercept of 1.8%  $U_3O_8$ . Seventeen targets have shown mineralization at the surface.

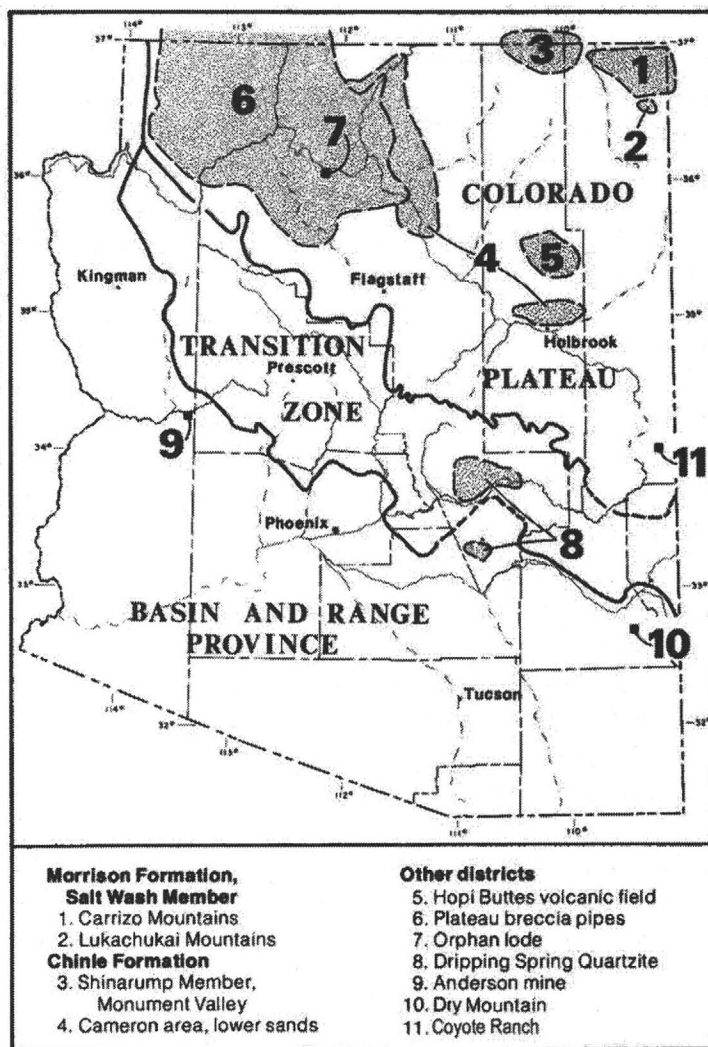


Figure 2. Areas of uranium production and occurrences – Adapted from Fieldnotes Vol. 10 no. 4

Quaterra, in early 2007, contracted Geotech Ltd. to conduct the first extensive test of an airborne time-domain electromagnetic system on the Arizona Strip to identify mineralized collapse structures. The VTEM system has identified anomalies related to collapse structures in a majority of the known breccia pipes as well as 200 additional anomalies with similar geophysical signatures. The VTEM system may prove to be a successful breccia pipe exploration tool. Quaterra has drilled 17 prospective targets; 9 tested negative, 5 intersected breccia structures and need deep drilling, 2 intercepted mineralization and need additional drilling, and 1 VTEM anomaly is being drilled.

VMX Resources has optioned the Rose pipe from Energy Metals (now Uranium One). Historic drill information on the Rose pipe shows an intercept of 11 feet of 1.0%  $U_3O_8$ .

Takara Resources and DIR Exploration's Kaibab Joint Venture project has identified seven drill ready breccia pipe targets discovered as a result of previous geophysical and geochemical surveys.

Tournigan continues active drill programs on prospective targets in the Arizona Strip and Coconino Plateau.

Dumont Nickel has acquired 132 unpatented mining claims (Redwall Uranium Property) also on Strip. Air photo and remote imagery interpretation completed in October 2007 identified 43 circular photo-anomalies on the property that are possible manifestations of buried breccia pipes. Ground follow-up of the targets by Dumont field crews during November led to the discovery of five collapse features with diameters ranging 200 to 600 feet. Continuation of field surveys will delineate future drilling targets.

Energy Fuels has 25 pipe targets. Five of the targets are confirmed breccia pipes based on historical data from prior drilling results. Exploration efforts are underway to systematically explore all of the potential pipe targets.

Eagle Hill Exploration has acquired the Rimshot and Lombardo exploration properties with a total of 157 potential pipe targets.

**Metasomatic Veins:** The Dripping Springs formation in central Arizona is a past uranium producer. The uranium occurs as narrow veins and disseminations within low-grade metamorphic rocks of Proterozoic age. The ore zones are typically stratabound and occur near diabase dikes and sills. Ore from past production averaged 0.12 % to 0.22 % uranium.

**Current Activity:** Rodinia Minerals currently controls the Workman Creek and Red Bluff properties in the Sierra Ancha Mountains. Recent estimates from drilling indicate resources of over 9 million lbs. of  $U_3O_8$ . Previous production from mines in the area total more than 115,000 lbs. of  $U_3O_8$ .

Golden Patriot's multi-hole drilling project on the past producing Lucky Boy mine has returned positive results showing  $U_3O_8$  grades from 0.12% to 0.13%. Past production from the mine included more than 2,000 tons of 0.16 % ore in the 1950s and 10,000 lbs. of  $U_3O_8$  from heap leach operations in 1979.

**Lacustrine/Paludal Type:** Resource studies show that the Date Creek Basin may contain large low-grade resources on the order of 1.2 billion lbs. of uranium. There are a number of past producing mines and previously drilled properties that have been acquired in the Date Creek, Safford Basin, and New River areas of Arizona. Most of the properties are situated within Tertiary age lacustrine/paludal sedimentary rocks. The uranium mineralization occurs as stratabound units in carbonaceous siltstones and mudstones. These sedimentary rocks were deposited in alkaline or saline lakes. Uranium mineralization is related to the calcrete deposit model that hosts some of the largest uranium resources in the world.

**Current Activity:** Concentric Energy is evaluating extensive historic data on the past producing Anderson Mine. Confirmation drilling, completed in late 2006 verified 43% of historic resource estimates. Universal Uranium has acquired properties further west in the Artillery Peak area with uranium mineralization and stratigraphy similar to the past producing Anderson Mine. Uranium Energy is evaluating historic data for its Dry Mountain deposit southeast of Safford and New River, aka Los Cuatros, property located north of Phoenix.

**Roll front/Fluvial deposits:** The Mogollon Rim in central Arizona has 80 linear miles of Paleozoic rock outcrops. Anomalous radioactivity and anomalous uranium in outcrops is widespread. Excepting Promontory Butte, little systematic exploration of the area has occurred. The host rocks for the deposit are the Pennsylvanian and Permian age Supai group. Mineralization is associated with coalified plant remains and is located in fluvial channels with variable lithology grading from black shale to conglomerate.



**Current Activity:** Rodinia Minerals drilled its Mormon Lake property to confirm stratigraphy and mineralization outlined in previous exploration data. Uranium Energy is currently reviewing historic information on its recently acquired Coyote Ranch property east of Springerville. Occidental Petroleum drilled 14 holes in 1981 that indicated uranium mineralization in the Tertiary age de Baca formation at depths less than 300 feet that may be amenable to in situ recovery.

**Arizona's Exploration Potential:** Fueled by high uranium prices exploration for uranium in Arizona is at level not seen since the uranium boom of the 1950s. Facilitating uranium mining in Arizona, Denison's White Mesa Mill located in southeast Utah has initiated an ore-buying program for independent uranium mining operations to sell their uranium ore to Denison. The ore-buying schedule ranges from \$55.31 for 0.01% grade material to \$281.16 for 0.35% grade material. Denison is also offering a transportation allowance ranging from \$5.00 to \$22.50 per ton depending on transport distance.

#### **References:**

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- Scarborough R. B., 1980, Uranium in Arizona: ABGMT Fieldnotes, Vol. 10, No. 4. p. 1-5.
- Scarborough, R.B., 1981, Radioactive occurrences and uranium production in Arizona: U.S. Department of Energy Report GJBX-143 (81). [www.mines.az.gov/DigitalLibrary/AEC-DOE/](http://www.mines.az.gov/DigitalLibrary/AEC-DOE/)
- 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>
- Arizona's Uranium 2008, Google Earth KML file, available on line at: [www.mines.az.gov/info/AzUranium.zip](http://www.mines.az.gov/info/AzUranium.zip)

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## **Gold**

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**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. Arizona hosts a number of deposits with known potential to produce a few hundred thousand ounces or more. 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), Verdstone, Congress, and Gold Road, the last to operate, closed in 1998.

#### **Current Activity:**

**Copperstone:** The property, with 335,000 oz of measured and indicated resources, is viewed as having potential as a near-term, oxide, high-grade, underground producer with a short permitting and construction timeline. Two new gold zones were discovered in the recently completed two-phase drilling program, consisting of 44 drill holes totaling 43,227 feet. In February 2008 owner American Bonanza signed a letter of intent to merge the company into a wholly owned subsidiary of Gryphon Gold Corporation.

**Yarnell:** Kinross acquired Yarnell by acquisition of BEMA Gold in late-2006. CaNev Resources Corp. then acquired the property. In January 2008 General Properties signed a letter of intent with CaNev and Yarnell Mining to acquire a 70% interest. Asarco has previously identified 7.3 million tons of 0.037 oz. per ton Au.

**Verdstone:** Two additional resources have been identified at past producer Verdstone. A drift to collect a bulk sample for metallurgical testing is being permitted. A private group holds the property; Fred Brost of Phoenix is the project engineer. The group plans to develop a millsite on private land nearby.



**Margarita:** Patriot Gold controls the Margarita mine area covering approximately 900 acres of patented and unpatented mining claims. A historic resource of approximately 35,000 ounces of gold exists near the center of the claim holdings. A drilling program will be carried out the first quarter of 2008 to test for high-grade faults that feed the near surface cap of disseminated mineralization.

**Burro Creek:** Northern Freegold Resources controls this 2,000-acre property consisting of four patented claims and 100 surrounding unpatented claims. It covers a low-sulphidation epithermal vein system that has been traced for over 1.7 km and exhibits widths of up to 45 meters. Previous reverse circulation, diamond drilling and underground development conducted on the property focused on a 300-meter strike length in the central block of the exposed vein system and outlined a historical gold and silver resource of 2.6 million tons with an average grade of 0.03 oz gold and 1.1 oz silver per ton. Within this historical drill-proven resource, an open pitable resource of 1.2 million tons grading 0.04 oz gold and 1.470 oz silver per ton respectively with a 1:1 stripping ratio was defined.

**Rosebud:** Kent Exploration Inc. holds a 100% option on the property. It includes 40 unpatented claims and adjacent deeded land with 2,600 feet of underground workings that were developed between 1928 and 1930. A 1,500-meter diamond drill program was started in Sept. 2007 with assay results received on three of the seven holes in February 2008. The highest grades were 18.45 g/t Au and 18.9 g/t Ag over 1.5 feet between 193 to 194.5 feet and 5.73 g/t Au and 42.9 g/t Ag over 1.5 feet between 223-224.5 feet.

**Gold Gulch:** In August 2007 Ventura Gold commenced a core drilling program at the 100% held property located approximately two miles southwest of Freeport McMoRan's Morenci copper mine. One core drill rig has been mobilized to site and completed the first hole to a depth of 1,195 feet. They plan to complete six to eight drill holes for a total of 10,000 feet.

**Hardshell:** Wildcat Silver Corporation is an 80% owner along with Arizona Minerals Inc. The company commenced a 7,500-foot drill program in July 2007 to obtain material for metallurgical testing and to explore as-yet untested deeper extensions of Hardshell mineralization. In February 2007 a preliminary

assessment of an inferred resource of 53.5 million ounces of silver along with 1.2 billion lbs. of manganese was announced.

**Tombstone District:** Tombstone Exploration Corp. has assembled a large land package in the historic silver district and conducted sampling of surface and underground workings. They completed a RC drill hole in March 2007 to a depth of 500 feet.

**Gold Hill:** Sage Gold entered into an option to acquire 50% of mineral rights at Gold Hill. Based on 1981 sampling the property has reserves of 30,000 tons at 0.27 opt Au.

**Gold Chain, Roadside:** Goldrea Resources acquired this property with 40,000 oz delineated previously by Western States.

**Burnt Well, Silver District, Clanton Hills:** Columbus Gold is exploring these projects in western Arizona. Columbus sampling of the Burnt Well shaft yielded values up to 1.0 opt gold. Also of considerable interest are disseminated values ranging from 0.01 to 0.03 opt Au in silicified Tertiary

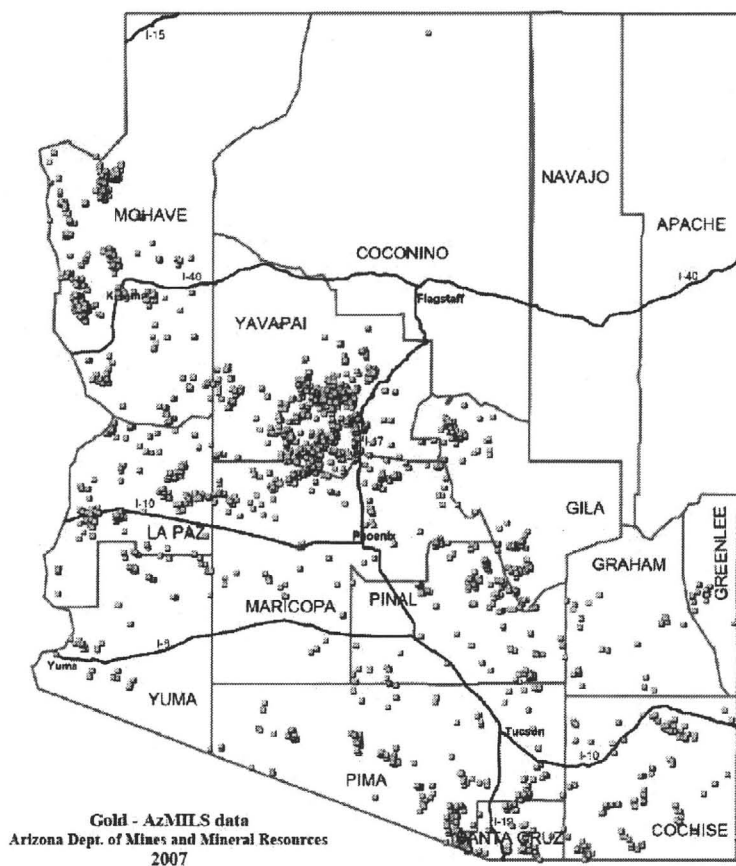


Figure 3. Primary and by-product gold occurrences.

siltstones, over widths up to 20 feet or more. At Silver District past programs delineated a resource of 3,820,000 tons grading 4.60 ounces per ton silver (17,500,000 ounces) plus potentially commercial fluorite, barite and zinc-lead in a number of deposits. At Clanton Wells reconnaissance sampling of irregularly shaped bodies of quartz and calcite in silicified breccia yielded several samples running from 2-7 opt silver with low gold values (up to 170 ppb).

**Moss:** The mine is controlled by Patriot Gold and consists of over 1,400 acres of patented and unpatented mining claims. Historic reports suggest a resource of between 250,000 and 300,000 ounces of gold occurs within the property boundary. Recent work by Patriot includes drilling and metallurgical sampling. The project may be considered for joint venture.

**Bullard:** Canadian Mining Company Inc. is conducting a soil exploration program to delineate drill targets on the detachment-fault related property.

**Tiger:** Q-Resources Ltd. has entered into a purchase option agreement with Silver Nickel Mining Co. for a land package that includes past-producers in the Tiger - Oro Belle area.

**Cruce Gold:** Fischer-Watt is starting its first drill program on its Cruce Gold property in Pinal County, Arizona. The company will be using an Air-track drill rig to drill a close spaced grid of shallow holes to test four target zones on this 1,200-acre property. The four targets identified to date are surface geochemical anomalies with three of them being areas anomalous in gold and one being anomalous in copper.

The following gold or gold/silver properties are available from the McIntyre & Bauman Group. See [www.mcintyrebaumangroup.com](http://www.mcintyrebaumangroup.com) for locations and details.

**Ambassador:** Precambrian gold and silver deposit with underground and possible open pit.

**Bonanza:** Detachment fault gold / silver deposit. Former Phelps Dodge project.

**Bouse:** Gold and silver detachment fault deposit in La Paz County, Arizona. Former Homestake Gold project.

**Clara Moro, Silverfield Gold:** Gold deposit in detachment fault environment. The Clara property has encouraging results from a drill campaign by Nevada Pacific. The Silverfield may be a hot springs high grade gold/silver deposit in detachment fault environment. It is close to Clara Moro and could be jointly explored.

**Ester Basin:** Gold, silver and copper deposit spatially associated with diatreme in detachment fault environment. Former Phelps Dodge project.

**McCracken Gold:** Gold with silver and copper in breccia zone adjacent to one of Arizona's historic silver producers.

**Mockingbird:** Gold and silver deposit related to detachment fault. Anaconda/Chevron work indicated potential.

**North Rawhide:** Upper plate gold, silver and copper deposit. Former Phelps Dodge project.

**Oatman:** A dozen mines in Arizona's largest primary gold district. Includes patented Lexington gold mine. High-grade Tertiary vein deposit in volcanics with potential for low-grade open pit resource.

**South Copperstone:** Large contiguous claim block adjacent to the Copperstone Mine, Arizona's largest recent open pit gold producer.

#### 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, Database for Mineral Districts in the State of Arizona, Arizona Geological Survey DI-23, 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](http://pubs.usgs.gov/bul/b2004/html/bull2004detachmentfaultrelate_polymetall.htm)

## Volcanogenic Massive Sulfides

**Geology:** Volcanogenic massive sulfide occurrences of Arizona formed 1.7–1.8 Ga. Deposits occur as stratabound-strataform 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 targets, 48 have reported production. Cu-Zn mineralization with precious metals is economically important in these 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 currently contain over 20 million tons of mineralization grading 6.6% Zn plus Cu 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. The United Verde mineralization is located within the axis of a major steeply plunging fold. 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 surface expression. The geographic extent of favorable host rocks is wider than that of known VMS deposits suggesting exploration potential for new discoveries. Lindberg suggested a number of exploration ideas and targets that remain untested.

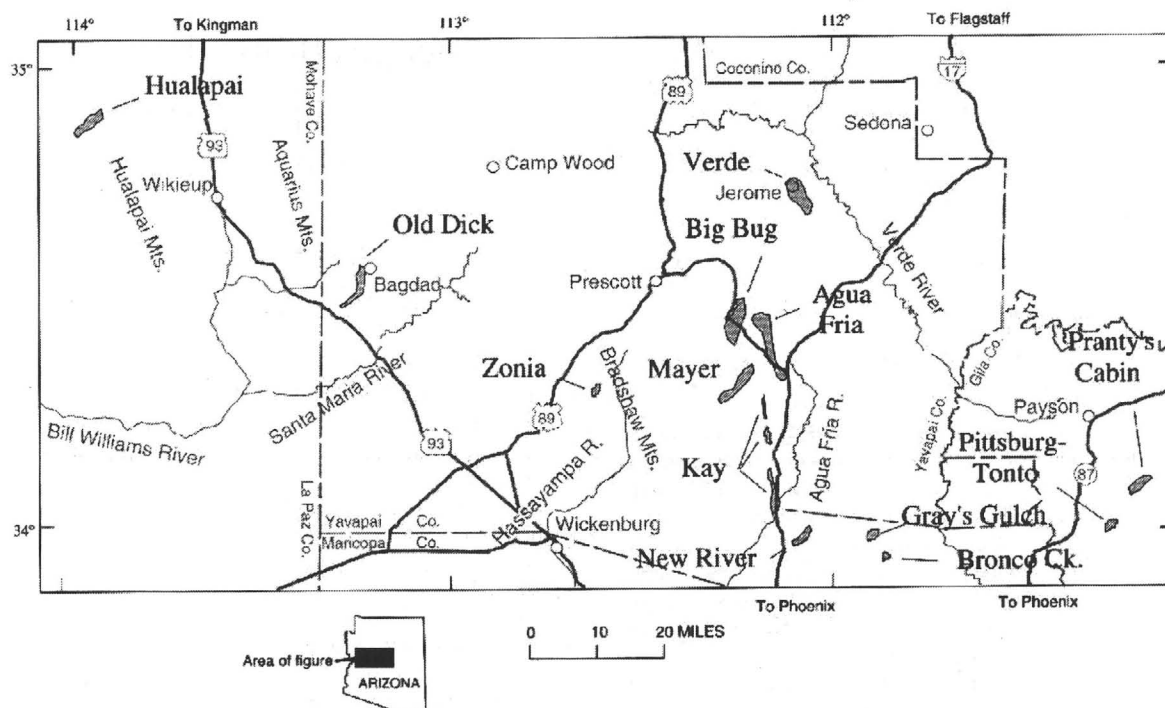


Figure 4. Proterozoic massive sulfide deposits in Arizona. From: USGS Bulletin 2138.

**Current Activity:** The Exploration Syndicate Inc. conducted VTEM surveys during 2007 over broad areas of central Arizona, including the Verde, Agua Fria, and Old Dick districts. Follow-up surface investigation and land acquisition is underway. Mohave Resources has optioned the Blue Bell and De Soto properties and is evaluating their oxide copper potential. The joint venture of Ivy Minerals and Kaaterskill Exploration (IKE JV) has generated geochemical and VLF-EM anomalies within fold axes on two new exploration targets in the Mayer district known as the Cobre Sud and Cordes Peak prospects. These properties are currently available for lease-option agreement to a company willing to accept a work commitment that includes a drill program. Although past exploration by major mining companies

generated much data (see ADMMR files) in the VMS target districts, these areas are currently under-explored (Figure 4).

Many promising prospects, not limited to the few described here, are available for exploration.

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-90s effort.

Freeport McMoRan controls the United Verde zinc resource discussed above. Teck Cominco completed a multi-year effort there without releasing results.

The Kay mine near Black Canyon has a Cu-Zn resource defined by Exxon and Rayrock with drill data available at ADMMR.

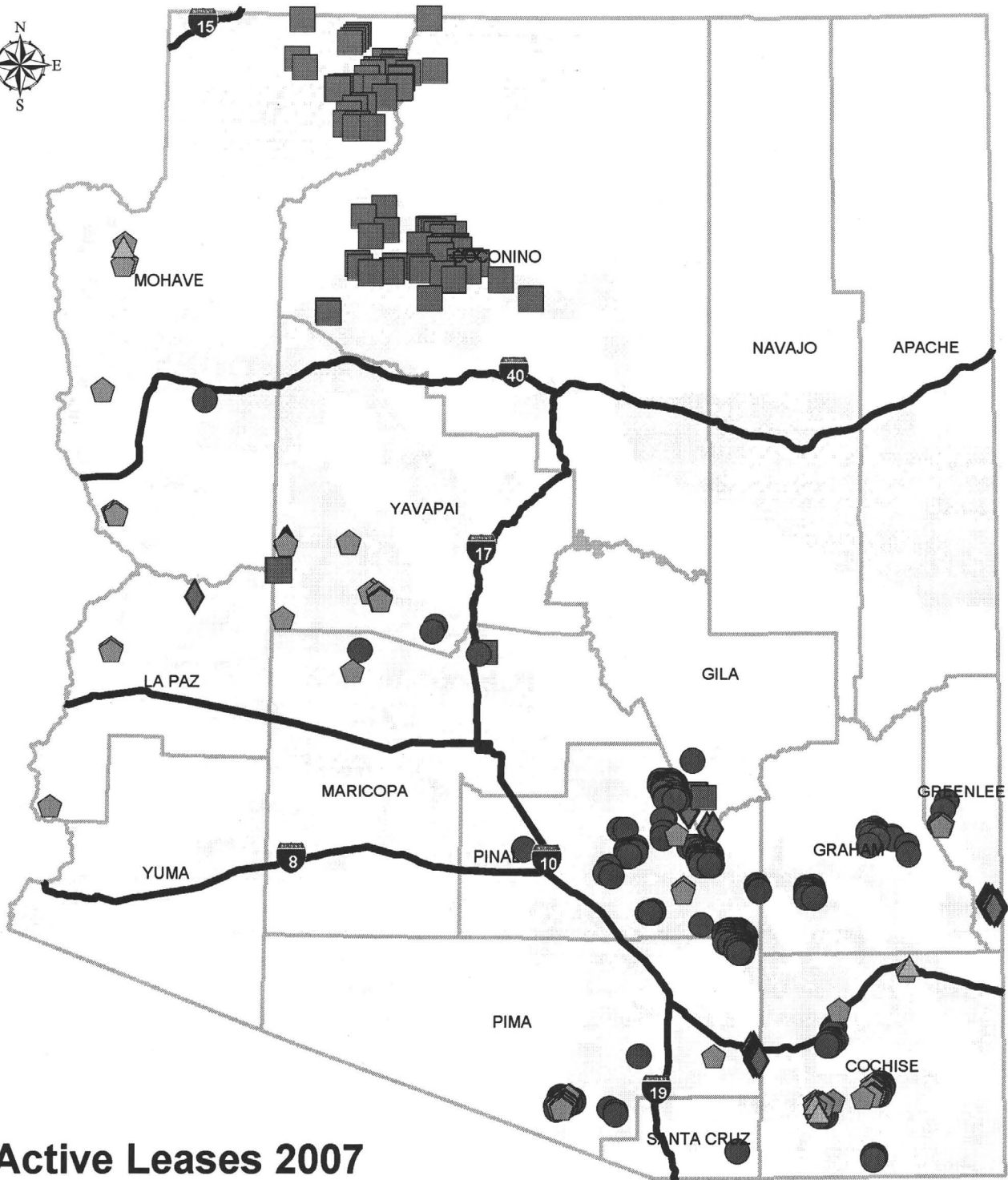
Ricks Brothers Enterprises controls a copper resource near Mayer with both disseminated and limited massive mineralization and have project data available. The McIntyre Bauman Group also has large claim holdings in the Copper Mountain trend. In addition, the McIntyre Bauman Group has the following 3 VMS related properties available. Treasure King has a 150,000-ton deposit at a grade of 0.06 oz/ton gold resource along with four additional areas untested by drilling. The nearby Yaba is a high-grade silver deposit with gold. Near Jerome the Middle Verde comprises 5 claim groups and 3 patented claims along the Verde fault that contain un-drilled anomalies from prior work of Phelps Dodge and Oxymin.

Also in the Verde district, Southwest Exploration Group has available the West Jerome VMS located west of Freeport McMoRan's patented ground. The target has favorable stratigraphy under Paleozoic cover with 2 widely spaced drill holes that show strong chloritic alteration with anomalous copper and zinc values.

#### **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.
- Lindberg, Paul A., 1989, Precambrian ore deposits of Arizona: Arizona Geological Society Digest, Volume 17. p. 187 - 210.
- O'Hara, Patrick F. and Armstrong, Dale, G., 1986, Proterozoic greenstone belts and mineral deposits of central Arizona - Jerome and Bradshaw Mountains: Arizona Geological Society Digest, Volume 16, p. 319 - 328.

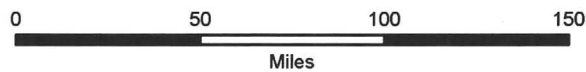




## Active Leases 2007

### Commodity

- ▲ Silver
- ⬠ Gold
- Copper
- Uranium
- ◆ Other Metals



State Trust Land

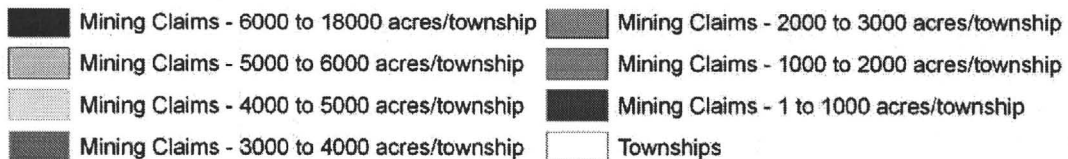


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Map produced by the Arizona State Land Department  
January 25, 2008

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Michael Dennis

## Mining Claim Distribution on Federal Lands



United States Department of the Interior  
Bureau of Land Management  
Arizona State Office

Map created on Dec 4, 2006



No warranty is made by the Bureau of Land Management  
for the use of the data for purposes not intended by the BLM.

25,600 mining claims in 2004  
31,000 mining claims in 2005  
35,000 mining claims in 2006  
38,000 mining claims in 2007 (estimate)

**Mining claim records are online at:**  
[www.blm.gov/lr2000](http://www.blm.gov/lr2000) (database)  
[www.geocommunicator.gov](http://www.geocommunicator.gov) (mapper)



## Department of Mines and Mineral Resources

1502 West Washington, Phoenix, Arizona 85007  
(602) 771-1600 Toll Free in Arizona - 1-800-446-4259  
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### Publications – Partial Listing February, 2008

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

#### DIRECTORIES

**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 \***

**D51 Directory of Active Mines in Arizona - 2007**, N.J. Niemuth, D.R. Bain, F.S. Kimbler, 2007. This directory lists corporate addresses, key personnel, number of employees, websites, mine, mill, or smelter location, and operation description. Includes a 1:1,000,000 color map showing the locations of all active mines. 34 p. **\$20.00**

#### SPECIAL REPORTS

**SR1 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. Includes discussions and forms for locating claims on both public domain and State-owned lands. 91 p. **\$8.00**

**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 Arizona industrial mineral occurrences. Location tables and maps. 185 p. **\$12.00**

**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

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.

Number-County	Number of Maps	Index Pages	Mines	Price
CM-1 - Apache	18	6	353	20.00
CM-2 - Cochise	9	17	698	15.00
CM-3 - Coconino	28	12	594	30.00
CM-4 - Gila	9	19	731	15.00
CM-5 - Graham/ Greenlee	12	16	516	20.00
CM-6 - LaPaz/Yuma	15	15	583	20.00
CM-7 - Maricopa	11	21	915	15.00
CM-8 - Mohave	20	33	1,411	25.00
CM-9 - Navajo	17	5	232	20.00
CM-10 - Pima/ Santa Cruz	14	36	1,487	20.00
CM-11 - Pinal	9	30	1,024	15.00
CM-12 - Yavapai	12	47	1,948	20.00

#### DIGITAL DATA FILES

Complete databases of the AzMILS information for the state are available as dBase IV files on CD-ROM disc and will run on any database application, including Excel. Bibliographies include reference information on individual mines. **\$20.00**

## OPEN-FILE REPORTS

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**OFR90-5 Publications of the Department of Mines and Mineral Resources from 1939 to 1990.** by D.R. Bain, 1990. 15 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

**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

**OFR01-17 Arizona Copper Reserves**, 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 \*

**OFR07-24 Arizona's Metallic Resources – Trends and Opportunities**, by N.J. Niemuth, 2007. 22 p. Free\*

**OFR07-25 Checklist of Arizona Minerals**, by Raymond W. Grant, 2007 Lists all 861 Arizona minerals, including the 61 new ones added since the third edition of *Mineralogy of Arizona*. 57 p. \$15.00

**OFR08-26 Arizona's Metallic Resources – Trends and Opportunities**, by N.J. Niemuth, 2008. 22 p. Free\*

## CIRCULARS

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**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. \*

**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. \*

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

**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. \*

**C119 Listing of U.S. Bureau of Mines Mineral Land Assessment Open File Reports in Arizona**, 2006, A listing of all MLA Open File Reports conducted in Arizona. \*

**C120 State Agencies Concerned with Mining & Mineral Resources in Arizona**, 2007. Contains names, addresses, and pertinent people at state agencies concerned with mines and mineral resources. \*

**C121 Federal Agencies Concerned with Mining in Arizona**, 2007. Contains addresses of Bureau of Land Management, Forest Service offices, and other Federal agencies. \*

**C122 County Agencies Concerned with Mining & Mineral Resources in Arizona**, 2007. Includes a listing of addresses, phone numbers, and websites. \*

**C123 Arizona Gem Shows, 2007-2008**. Includes date, location, sponsoring group, contact person. \*

**C125 Arizona Mining Update, 2006**, 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. \*

**C126 Guide to Online Land Status Records**. A guide to the online availability of ownership records for mining claims and other lands. Includes records of the Bureau of Land Management, State Land Department, and County Recorder Offices in Arizona. \*

## MAPS

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

**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

**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 \*

**MO7-3 Active Mines Map – 2007**, cartography by S. Eastman. Scale 1:1,000,000. Shows all 402 active mines in Arizona, including sand and gravel. Color. \$10.00

## NON-ADMMR PUBLICATIONS

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**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

**Arizona Mining Summit – Guide to Permitting Mining Operations in Arizona**, 1999. 157 p. \*



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 2008.

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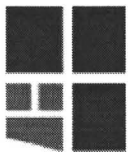
**Arizona Geological Survey**



**Arizona Mining Association**



**BLM - Arizona**



**State Land Department -  
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## THE IMPACT OF THE COPPER INDUSTRY ON THE ARIZONA ECONOMY

- ◆ In 2006, the Arizona copper industry had a combined direct and indirect impact on the Arizona economy of:

**\$4.719 Billion**

- ◆ including combined direct and indirect contributions of:

<b>\$1.404 Billion</b>	in personal income, equivalent to 28,600 jobs for Arizonans
<b>\$2.990 Billion</b>	in business income, and
<b>\$325 Million</b>	in state and local government revenues

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

**\$2.120 Billion**

- ◆ that included direct payments of:

<b>\$141.305 Million</b>	to the State and its local governments in taxes and fees,
<b>\$1,439.740 Million</b>	to other Arizona businesses for products and services, and
<b>\$538.3567 Million</b>	in personal income for Arizonans, including wages and salaries for the industry's
<b>8,200</b>	employees

- ◆ who labored to produce:

**787,236** tons of copper and other minerals with a total value of

**\$5.628 Billion**

(59% more than in 2005)

Compiled by **WEAC** for the



**Arizona Mining Association**  
5150 N. 16th St., Ste. B134  
Phoenix, AZ 85016  
602-266-4416 Fax: 602-230-8413  
[www.azcu.org](http://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.

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### 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](http://www.land.state.az.us)

### Other Useful Contacts:

Arizona Department of Mines & Mineral Resources  
602-771-1600  
[www.mines.az.gov](http://www.mines.az.gov)

Arizona Geological Survey  
520-770-3500  
[www.azgs.az.gov](http://www.azgs.az.gov)

Arizona Mine Inspector  
602-542-5971  
[www.asmi.az.gov](http://www.asmi.az.gov)

Arizona State Museum  
520-621-4011  
[www.statemuseum.arizona.edu](http://www.statemuseum.arizona.edu)

Bureau of Land Management  
Land and Mineral Records  
602-417-9200  
[www.blm.gov](http://www.blm.gov)

U.S. Geological Survey  
Western Mineral Resources Tucson Office  
520-670-5544  
<http://minerals.usgs.gov/west/tucson.htm>



## **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](http://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. Master Card or Visa are accepted for orders over \$10.00. Please include card number, expiration date, and signature on order form. Do not send cash. Arizona residents must add 8.1% sales tax to the order. 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.arizonageologicalsociety.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: \$20 for 1-year membership  
\$35 for 2-year membership,  
\$50 for 3-year membership,  
full-time student - free

## **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 see the order form on the society's website or contact the Survey at 416 W. Congress #100, Tucson, AZ 85701, Phone 520-770-3500

**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

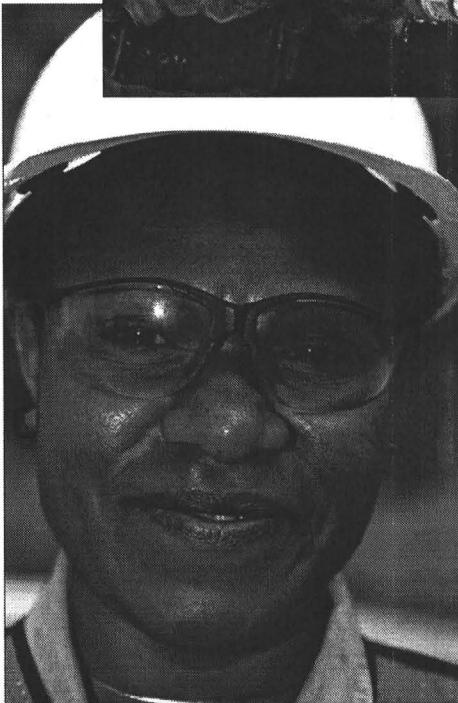
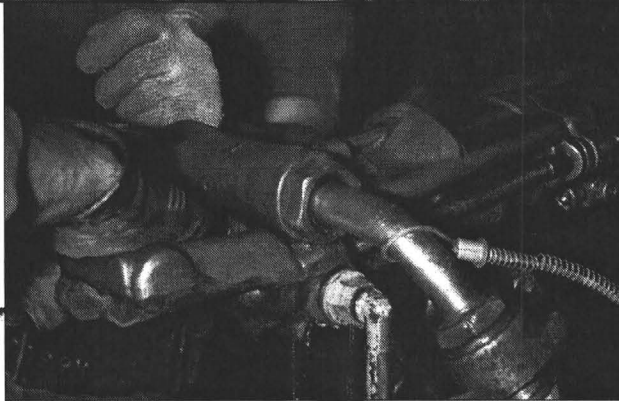
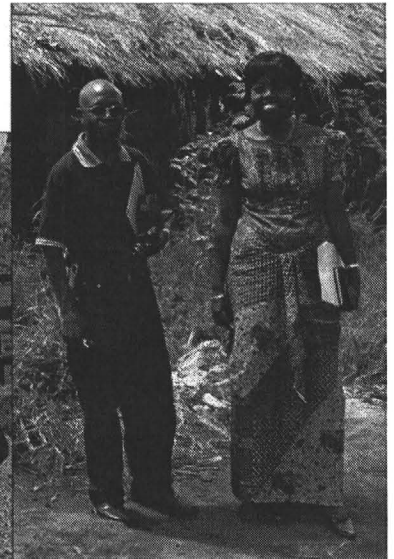
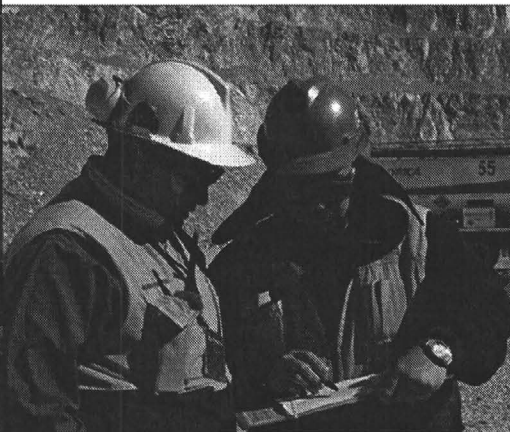
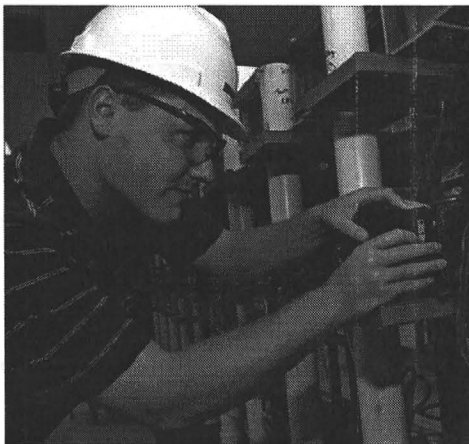
**Digest 17: GEOLOGIC EVOLUTION OF ARIZONA**, edited by J. P. Jenney & S. J. Reynolds. 866 p., 35 papers, hardbound, 1989, 1 plate - Arizona Geologic Map 1988 scale 1:1MM by Reynolds. \$60.00  
Includes chapters on Precambrian, Laramide, and Mid Tertiary metalliferous ore deposits, uranium, petroleum,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

**Digest 16: FRONTIERS IN GEOLOGY AND ORE DEPOSITS OF 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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<http://grad.arizona.edu>

Complete the Master of Engineering Application at:  
[www.oneflexibledegree.com](http://www.oneflexibledegree.com)

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### **Arizona Department of Mines and Mineral Resources**

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