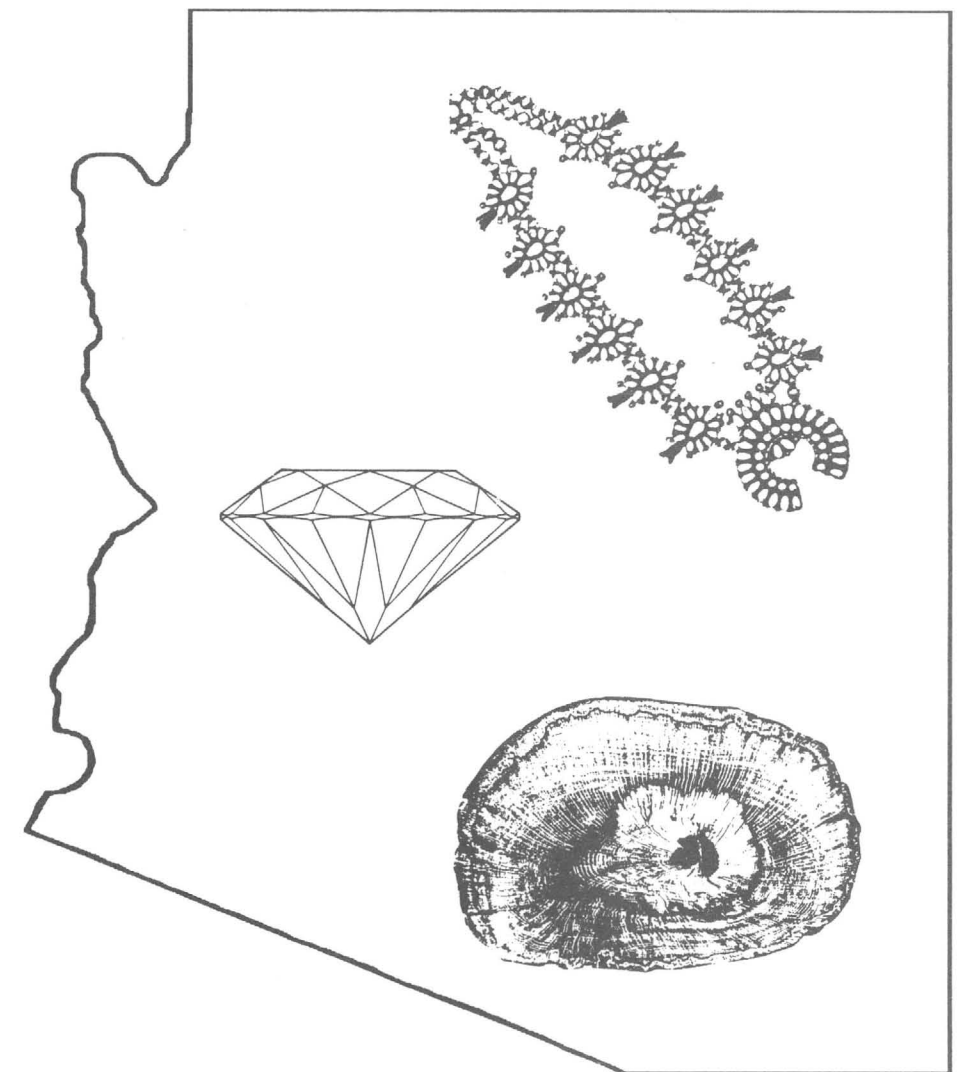




GEMSTONE PRODUCTION IN ARIZONA

by Ken A. Phillips, Chief Engineer

Mineral Report No. 5



ARIZONA DEPARTMENT OF MINES
AND MINERAL RESOURCES

**ARIZONA DEPARTMENT OF MINES AND MINERAL
RESOURCES**

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THE 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 data base and disseminating information through publications, personal contacts and seminars.

The Department's mining engineers and geologists assist mining and exploration companies, prospectors and others interested in Arizona's minerals with mineral processing, mineral land acquisition, exploration, mine development, financing, government regulations and marketing.

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 differing needs of the public. The following is a partial list of services which the Department offers:

- Maintain a site specific data base of unpublished reports and maps that includes 5,000 mine files and indexes of 10,000 computerized Arizona mineral occurrences.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mining information including a mine map library (hard copy and microfilm), government publications, periodicals, and unpublished master and doctorate theses.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.
- Suggest target areas for possible exploration activity.
- Suggest prospects and individual properties for study and acquisition.
- Assist individuals and companies in their dealings with State 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 include Laws and Regulations Governing Mineral Rights in Arizona, Directory of Active Mines in Arizona, Manual for Determination of Status and Ownership of Arizona Mineral and Water Rights, and others. A current listing of the Department publications is available upon request.

SPECULARITE

Specularite or specular hematite is the lustrous steel gray variety of the common iron oxide mineral hematite. It is also known as "Alaskan Diamond". It occurs in hydrothermal vein and replacement deposits in a number of locations. Specularite of gem quality is collected from the Bouse area of western Arizona and cut into cabochons and beads.

APACHE TEARS

Apache Tears are a rounded, naturally occurring opaque to translucent, black to gray globule of structurally homogenous volcanic glass. They occur as both obsidian nodules and as perlite nodules. They are locally abundant in the commercial perlite deposits in the Superior area of central Arizona. After being tumbled and polished they are sold as pendants or used in assorted silver jewelry. One perlite producer has made a business of operating a fee collecting area open to the public.

ONYX

Gem onyx, also called Mexican Onyx, is the banded variety of dense limestone produced by springs. To command a market as gem material the onyx should be dense, banded with multi-colored or multi-shaded bands and able to take a good polish. Such onyx is produced from at least two quarries in Arizona. Lessor quality onyx from these same quarries is sold as decorative stone.

CONCLUSION

Prase, gem smithsonite and alabaster have also been found and produced at various times. Even though Arizona is thought of as a non-ferrous metal producing state, both the value and beauty of Arizona's gemstones are very important to the State and its mining industry. Arizona's number one gemstone mining status will continue to be dependent on the popularity of its gems.



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mercial gem quality amethyst is collected from the Maricopa Mine at the southern end of the Mazatzal Mountains in central Arizona. The deposit is popularly called the Four Peaks Amethyst Mine and is a private patented claim within the Four Peaks Wilderness in the Tonto National Forest. Material thus must be packed or flown out from the property. Although officially idle and posted against trespassing, top quality material continues to be removed from the deposit and finds a ready market in both the commercial and hobby industry. The best amethyst from the Four Peaks locality is considered to be as good as the best found any where in the world. The deposit has been described as solution cavity fillings in quartzite. Amethyst is also collected from a number of other sites in Arizona by hobbyists and a small amount also finds its way into retail rock shops.

QUARTZ FAMILY MINERALS

Gemstones in the quartz mineral family produced in Arizona not already discussed include the various agates and jaspers. These cryptocrystalline varieties occur in nearly every conceivable color and pattern. They are often given descriptive names such as plume agate, crazy lace agate, or chalcedony roses, or locality names such as Cave Creek jasper or Burro Creek agate, all names that to the trade indicate a particular gem material. The rough gem material is typically mined by hobbyists for their own use and the excess sold to wholesale/retail suppliers and cutters. Additional production is by transitory operators who contract mine for independent brokers.

GARNET

Arizona is probably much more famous for its garnet than are Arizona's garnets famous. Gemstone literature of the first three decades of this century highly tout the gem pyrope garnet of northeastern Arizona. The small deep red garnets were often referred to as Arizona Rubies. Pyrope garnets occur and are collected from the area of Garnet Ridge about 5 miles west of Mexican Water just south of the Utah border and at Buell Park about 10 miles north of Fort Defiance. Both localities are on the Navajo Indian Reservation. Commercial production of pyrope garnet from these areas is not known but it is suspected that small amounts are collected by local residents and sold to hobbyists through the trading companies active on the Reservation. The best are over 3 carats and of very good quality. Common garnet occurs at many localities in Arizona, some of which are famous for their specimen grade material. Spessartite garnets occur as accessory minerals in numerous pegmatites throughout Arizona. Wine red gem quality spessartites up to an inch in diameter have been found, but reports of such occurrences are very rare.

AQUAMARINE

Aquamarine, the clear, light blue gem variety of beryl has been collected from at least one locality in Arizona - Pima County. No commercial production has ever been attempted. Aqua-marine of cabochon cutting quality does not need to be clear. Such material could be produced from a number of beryl properties as a byproduct of hand sorted and hand cobbled beryl production.

lands to 250 pounds plus one piece per year. Therefore, commercial production must only come from private lands. Quality material is distributed over large areas of private range land in the northeastern part of the state where it is collected and excavated by property owners or processors who lease petrified wood rights. At least one land owner has an integrated collecting-processing-marketing operation.

Gem petrified wood is cut and polished into a variety of gem objects, some rather large. Objects or products include such items as tumbled and polished pebbles, cabochons, pen-pencil set bases, clock faces, and coffee tables. Fears in the early 1900's that petrified wood would all be exploited led to the creation of the Petrified Forest National Monument. This National Monument contains an excellent display of petrified wood in its natural mode of occurrence.

COPPER MINERALS

In addition to turquoise a number of other secondary copper minerals are used as gemstones. These include azurite, malachite, chrysocolla, shattuckite, ajoite, tenorite, and chalcopyrite in schist. These copper minerals find their place as gemstones because of their brilliant colors and ability to take a fine polish. When naturally coated with sufficient silica or occurring as silicified specimens, these minerals are also very durable. Commercial production is as a byproduct of active large copper mines, typically by contractors and from a few small copper mines that produce gem and specimen material only.

OPAL

Opal is an amorphous mineral species of silicon dioxide which occurs as a mineral gel. The well known gem variety called precious opal is translucent with a internal play of colors sometimes called fire. Milky blue precious opal has been produced from a deposit in southern Arizona where it occurs in rhyolite. Production has been by claim owner-miners and sold directly to cutters and hobby lapidaries.

FIRE AGATE

Fire agate is the cryptocrystalline variety of quartz known as chalcedony in which the inclusion of iron oxides causes a fire or play of colors much like that exhibited in precious opal. Fire agate occurs at a number of localities in Arizona where it is either merely collected as residual pieces on the surface or mined by simple open pit methods. The fire agate most often occurs as a secondary chalcedony "cement" filling spaces between basaltic boulders in near surface flows. The basalt flows are drilled, shot with quarry type explosives, and the shot material dozed into shallow heaps. The heaps are watered to wash fines from the broken material and to enhance the visual recognition of any exposed fire agate. Fire agate is then collected by hand with any excess matrix material removed by hand cobbing. Cleaned, graded rough material is marketed internationally to cutters. The Arizona industry consists of three or four commercial mines and a couple of fee collecting areas open to the public.

AMETHYST

Arizona is one of the few, if not the only, state which produces gem quality amethyst. Com-

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Turquoise is or has been mined from a number of Arizona copper mines as a byproduct, usually by contractors. Some contract operators are little more than commercial collectors of material while others run essentially a full scale open pit mining operation, independent of, but simultaneous with the active copper mine. Mining is done by the usual open pit methods using mechanized equipment until a vein, lens or pod of turquoise is encountered. At that point the turquoise is carefully extracted using hand methods.

Once mined, the rough turquoise is sorted and graded. The best quality material is sold by the piece, and the remainder sold or processed for sale by the pound. Standard terminology has been developed to describe natural and processed turquoise. Natural turquoise is that material of sufficient hardness and acceptable color that it can be cut and polished into usable gemstones. Stabilized turquoise is material of acceptable color that has been treated to enhance hardness and durability. Treated turquoise is material in which both color and hardness has been enhanced. Durability is improved by the addition of hard plastics or resins. Turquoise of a quality too low to be marketed as either natural, stabilized, or treated is used to produce reconstituted and artificial substitutes.

Turquoise is used in jewelry in the form of cut and polished cabochons, tumbled and polished free form nuggets, and carved objects. It is either set in silver or drilled and strung as beads. It is the primary stone used in traditional Navajo, Hopi, and Zuni Indian jewelry.

PERIDOT

Peridot ranks second to turquoise in value of Arizona gemstone production. Peridot is the gem variety of the mineral olivine. Arizona

peridot from the Peridot Mesa area of the San Carlos Apache Indian Reservation east of Globe is some of the finest quality material in the world. Further the deposit is one of the most prolific. The olivine crystals occur as single crystals and as pockets of granular masses in an olivine basalt flow. Commercial production of peridot consists of individual pieces 1/4 inch in diameter and larger. Individual gem quality crystals of over an inch in diameter have been produced. Mining is done by shallow drilling and blasting of productive zones followed by hand breaking and hand screening and sorting. Mining is done by individual Indians and occasionally by small tribal contractors. Production is sold through local and Phoenix brokers. Peridot is tumbled or faceted to produce commercial gems for setting or stringing.

PETRIFIED WOOD

Petrified wood or fossil wood, although occurring in nearly every state, is best known as an Arizona gem material. Petrified wood probably ranks third in value as an Arizona gemstone. Petrified wood is a fossil in which a mineral, usually silica, has replaced the original cellular structure of the wood. Often the internal ring structure and even the external bark and knot appearances remain. That petrified wood in which replacing silica has taken on various colors or in which the ring structures are well preserved finds value as a gemstone.

Petrified wood occurs in all Arizona counties, but that occurring in Navajo and Apache Counties in northeastern Arizona supplies nearly all of the gem market. Pieces as small as 1/4 inch pebbles to trunk sections larger than 5 feet in diameter find use in the trade. Federal law limits the amount of petrified wood which can be collected by any individual from public

world. The State's geology and climate have combined to make it the number one rockhound state in the Nation.

The State's gemstone industry consists of 40 to 50 commercial operations including mines, brokers and processors with a few hundred people earning a full time living from the business. Mining methods range from the most simple to state of the art open pit technology. However, all gemstone production has in common the need for, at some point, very selective mining using hand sorting and cobbing. The simplest methods amount to no more than collecting of suitable material from the surface of the ground. Brokers play an important role in the State's gemstone production. Much production is done on a casual basis by part time and itinerant operators without a regular market. Broker-buyers provide both a market for the producer and a steady source of supply to the jewelry fabrication industry. Arizona gemstone processors include gem cutters and polishers, manufacturers of such items as pen-pencil bases, and stabilizers and treators of turquoise. Traditional Southwestern Indian turquoise jewelry is crafted by Indians both working individually and in production factories.

Mineral rights to gemstone deposits on Federal Lands are acquired under the location patent system of the General Mining Law. One notable exception is petrified wood which is specifically excluded from the mining law.

TURQUOISE

Turquoise ranks first in value of the State's gemstone production. Turquoise is a sky blue to greenish-gray hydrous phosphate of aluminum and copper. In the last decade it became so popular that it was instrumental in

making Arizona the number one ranking gemstone producing state.

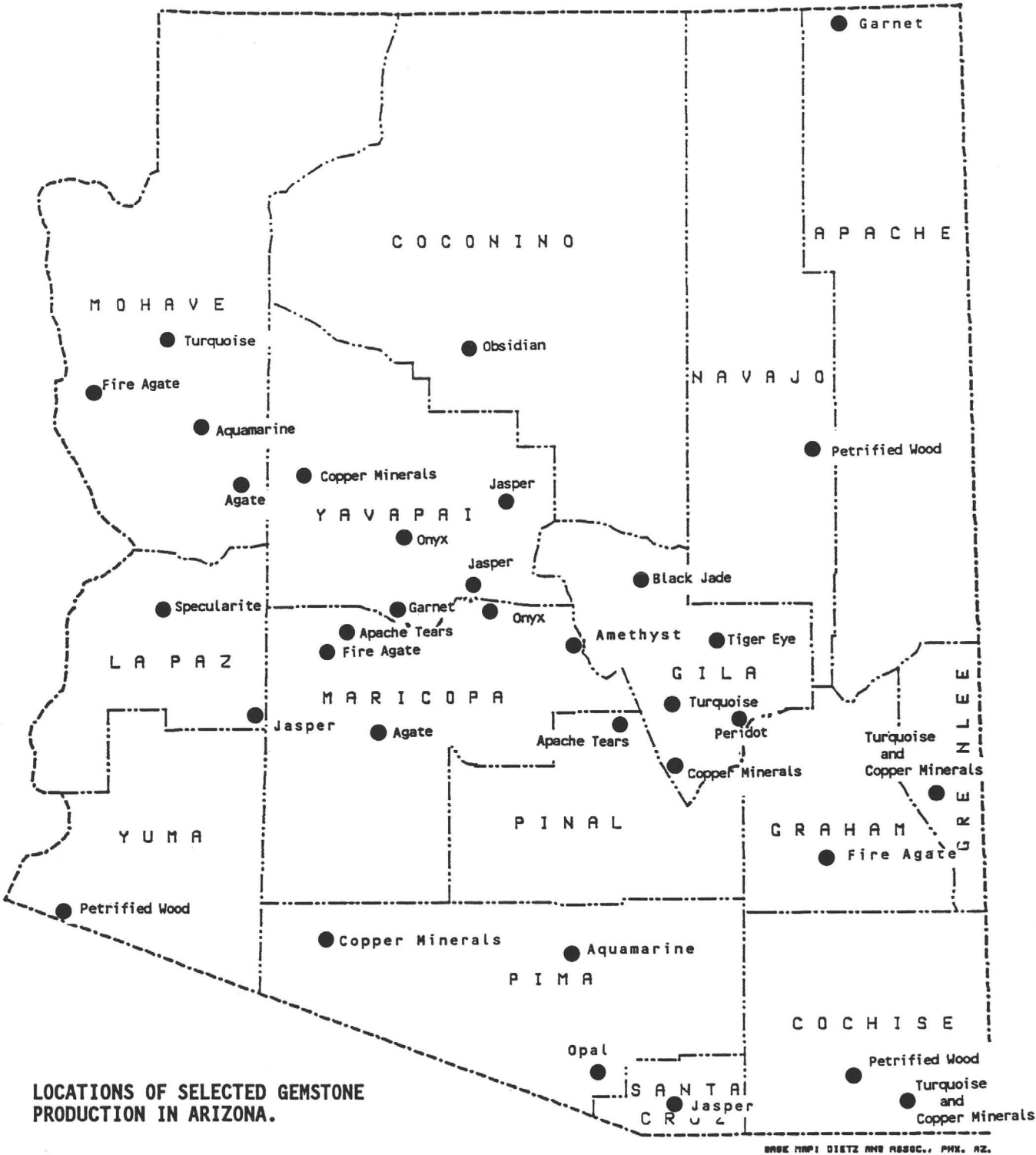
Turquoise is prized for its color and its use in traditional Southwestern American Indian jewelry. The mineral is colored by the copper present in the structure. Variscite, a beautiful green gem mineral, is very similar in composition and appearance to turquoise but lacks the copper. Varying amounts of impurities can cause the color of turquoise to vary from blue to green, reddish brown, chocolate brown, violet and white. When pure and solid, turquoise has a hardness of 6 and a specific gravity of 2.7. Turquoise is generally massive which is the form used in jewelry.

Nearly all the important deposits of turquoise are located in the arid desert regions of the world. Turquoise is a secondary mineral. It is derived from other minerals under the action of ground water, surface water, and reaction with elements from the air, notably oxygen.

Early production of turquoise was from mines of the Sinai Peninsula and Egypt. From 1000 A.D. to the early 1800's, Persia (Iran) produced the majority of the world's quality material. After 1800 Western Hemisphere deposits produced the gem for worldwide distribution. Within the past twenty years, the southwestern United States has become the source of a major quantity of the world's material.

Turquoise was traditionally set in gold as yellow gold formed a distinctive background for the light blue, traditional Persian stones. These stones originally considered the standard of comparison, are often so pale that they are not wanted by modern workers in silver. The deep blue and green stones, typical of the Southwest, are most effective when set in silver.

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Text of a presentation made before the Arizona Industrial Mineral program of the 117th Annual Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, January 25 - 28, 1988

ABSTRACT

Arizona leads all other states in the value of gemstones mined with an annual production that exceeds \$3,000,000. Gemstones are an important component of the mineral wealth of the State. Turquoise, peridot, chrysocolla, petrified wood, fire agate, and crystallized mineral specimens are among the gemstones commercially mined. Numerous additional deposits are operated by hobbyists. The State's reputation as a source of gemstones and specimens for the collector and lapidary adds to the economy of the State by attracting tourists. Production of gemstones further adds to the State's economy through employment in the value added gemstone processing industries and by employment of Native American craftsmen.

GEMSTONE PRODUCTION IN ARIZONA

Arizona ranks number one in the value of gemstone mining in the United States. Approximately \$3 million worth of commercial gemstone production was reported for Arizona by the U.S. Bureau of Mines in 1986. Turquoise, peridot and petrified wood account

for most of the value with amethyst, chrysocolla, azurite, malachite, fire agate, Apache tears, and gem smithsonite making up all but a small amount of the remainder. These data do not include the large amount of gem material collected and consumed, traded or resold by the rockhound-hobbyist. The official number on status for Arizona may change or have already changed because of the high value of fresh water pearl production in Tennessee. Although technically produced by aquaculture and not mined, pearls are classified by the U.S. Bureau as gemstones and their value is included in official totals.

It is likely that rockhounds collect as much or more than the \$3 million in official production. It would only take 3,000 rockhounds to collect 1,000 pounds of material each worth only \$1.00 per pound to exceed the reported production. Although much of the rockhound production does not enter commerce directly, the rockhound-lapidary-mineral collecting hobbies do have a multimillion dollar impact on Arizona's retail trade and hospitality industries. For example a single gem and mineral event known as the Quartzsite Pow Wow held in February typically draws over 250,000 participants while the Tuscon Gem and Mineral show draws dealers and exhibitors from throughout the