MINERALS OF ARIZONA

Twenty-Second Annual Symposium

Sponsored By
Flagg Mineral Foundation
April 4-6, 2014
Co-Chairpersons
Phil Richardson - Chair, Flagg Mineral Foundation
Ray Grant - Past President, Mineralogical Society of Arizona

FLAGG MINERAL FOUNDATION

Minerals of Arizona

Twenty-second Annual Symposium

Sponsored by the Flagg Mineral Foundation

Friday, Saturday, and Sunday
April 4, 5, and 6, 2014

Co-chairpersons:
Phil Richardson and Ray Grant

Clarion Hotel at Phoenix Tech Center
5121 E. La Puente Ave, NW corner of Elliot Rd
and Interstate 10.

Williams

Symposium Cover Credits

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Upper left:
Gold
Sunshine #8 claim, near Castle Hot Springs, Arizona
Les and Paula Presmyk specimen
Jeff Scovil photo

Upper right:
Gold
Mystic mine, near Sun City, Arizona
Les and Paula Presmyk specimen
Jeff Scovil photo

Middle:
Gold pyritohedron crystal
Gold Eye #3mine, La Cholla Placers, Arizona
Size: 1 cm across crystal face
Steve Hunt specimen
Erik Melchiorre photo

Lower left:
Gold on goethite
50 miles south of Quartzsite, Arizona
Les and Paula Presmyk specimen
Jeff Scovil photo

Lower right:
Gold
Yuba mine, Greaterville, Arizona
Les and Paula Presmyk specimen
Jeff Scovil photo

Friday Program: Micromineral Symposium

2:00 Welcome by Ron Gibbs

Trade / give-away session - Microscopes available or bring your own. Please bring minerals to share, trade, and/or brag about.

4:00 Presentation: Micromineral Collecting, When Bigger Isn't Better – Ron Gibbs

The talk will feature a review of micromineral collecting, exploring the history and reasons why so many seek out and enjoy microminerals. Some people permanently mount their specimens and are known as micromounters while others leave them in temporary mounts. These people might be known as micromineral collectors. The talk will end with a micromineral tour around Arizona highlighting some of the interesting minerals found on field trips and the stories behind them.

4:45 What's Next? Open discussion on how to improve the micromineral session

Ron Gibbs

Mineral collector since a youngun'. Collecting all sizes with an emphasis on self-collected specimens.

- Geologist and Mining Engineer now employed by Freeport McMoRan Copper and Gold in Oro Valley.
- BA in Geology from Humboldt State College in California and a BS Mining Engineering from the Mackay School of Mines at the University of Nevada, Reno.
- Written several articles for Mineralogical Record, Rocks and Minerals and Mineralien Weld.
- Presented several talks to Arizona and New Mexico Mineral Symposium's and at the annual meetings of several micromineral groups around the country.
- Found unknown lead aluminum silicate subsequently approved as the new mineral rongibbsite.

Saturday Program: Continental Breakfast 8 AM, talks from 9 AM to 4:30 PM followed by a Dinner at 6 PM with a speaker and an auction of donated items.

8:00 - 8:45 -	Coffee Hour
8:45 – 9:00 -	Welcoming Remarks and Introductions
✓ 9:00 – 9:40–	Geobacter in Arizona – Brian Beck
✓ 9:40 – 10:20 -	Forty Years of Field Collecting: Colorado and Arizona – Barbara Muntyan
10:20 – 10:50 -	Break
✓ 10:50 – 11:30 -	Geodes, Septarians and Thunder Eggs, Their Structure and Origin - Dick Zimmerman
✓ 11:30 – 12:10 –	A Brief History of Mineral Magazines of the World – Gunther Neumeier
12:10 – 1:30 -	Lunch
✓ 1:30 – 2:10 –	Arizona's Gold and Silver Mining, Why More Specimens Were Not Saved or Why We Should Be Thankful for the Ones that Were - Les Presmyk
✓ 2:10 – 2:50 –	Fingerprinting origins of placer gold from Vulture and Rich Hill – Trica Reed and Chelsea Sheets-Harris
2:50 – 3:20 -	Break
✓ 3:20 – 4:00 –	Revisiting the Eastern Flanks of the Santa Rita Mountains, Greaterville and Rosemont, Pima County - Anna Domitrovic
4:00 – 4:20 -	New Ideas on the Origin of Oil and Real Diamonds: A Herkimer Quartz Diamond and Diamondoid Case History from New York - Stan Keith
4:30 – 6:00 -	Happy hour, visit dealers

6:00 **Dinner and evening speaker** - Dr. Erik Melchiorre, Professor of Geology, California State University at San Bernardino, "In-situ gold nugget formation in AZ: the little miners did it, and other amazing things about Arizona gold." Erik has authored and co-authored many articles and books about Arizona gold. There will also be an auction of donated items.

Sunday Program

9:00 to 10:30

1. Portable XRF for analyzing gold and other minerals - Dr. Erik Melchiorre

2. Trimming and cleaning minerals – Les Presmyk

3. Fluorescent minerals - Mardy Zimmerman

10:30 to 12:00

Trading session

GEOBACTER IN ARIZONA

By Brian A. Beck, PG, QP, CRS

During the re-exploration of the Aqua Fria Mining District in Yavapai County, Arizona, a series of adits and tunnels from several mines were reopened. They dated from the 1880's through the 1970's. In these underground workings, clay-like coatings were noted on the walls, ceiling and floors with striking color variations from a mat gray to bright yellows and greens.

For mapping of the workings, the walls were washed off and thin coatings of numerous minerals were found below and in the coatings. These mineral coatings did not extend into any of the rock surfaces, but were only found on open surfaces (fractures, voids, etc.).

This prompted a closer inspection of the rock surfaces before washing. The mats under a microscope showed a webbing and cellular textures. Samples were sent off for determination of biological content. The samples were identified as various Geobacters (metal and sulfide reducing bacterial forms).

Since the Geobacter mats were only found on the workings exposed surfaces, their formation occurred after the mining activities stopped. Thickness and extent of the mats did not appear to be related to the age of the workings, but to the exposed sulfide content in the wall rock.

Elemental sulfur crystals were found in the mat, where the sulfide mineral content was mostly Pyrite. When moisture contents were more than 50%, numerous Iron Oxides stringers were also observed.

Copper sulfates were found in areas with pH's over 4, moisture contents near liquid states, and the presence of Chalcopyrite. Copper Arsenates were found in association with Bornite and Arsenopyrite. In Bornite rich veins without the Arsenopyrite, Gold was found in rounded masses on the surface exposures.

Surface mapping and re-examination of the previously described Azurite and Malachite exposures found that most of these exposures had Copper Arsenates with similar mode of occurrences as observed underground.

This shows mineral formation occurring at surface temperatures and pressures and in periods of less than 40 years. Also, this makes an initial case for supergene enrichment by bacterial actions.

various varieties / estimated
Origin of bacteria + Length of time for colonization
colonies

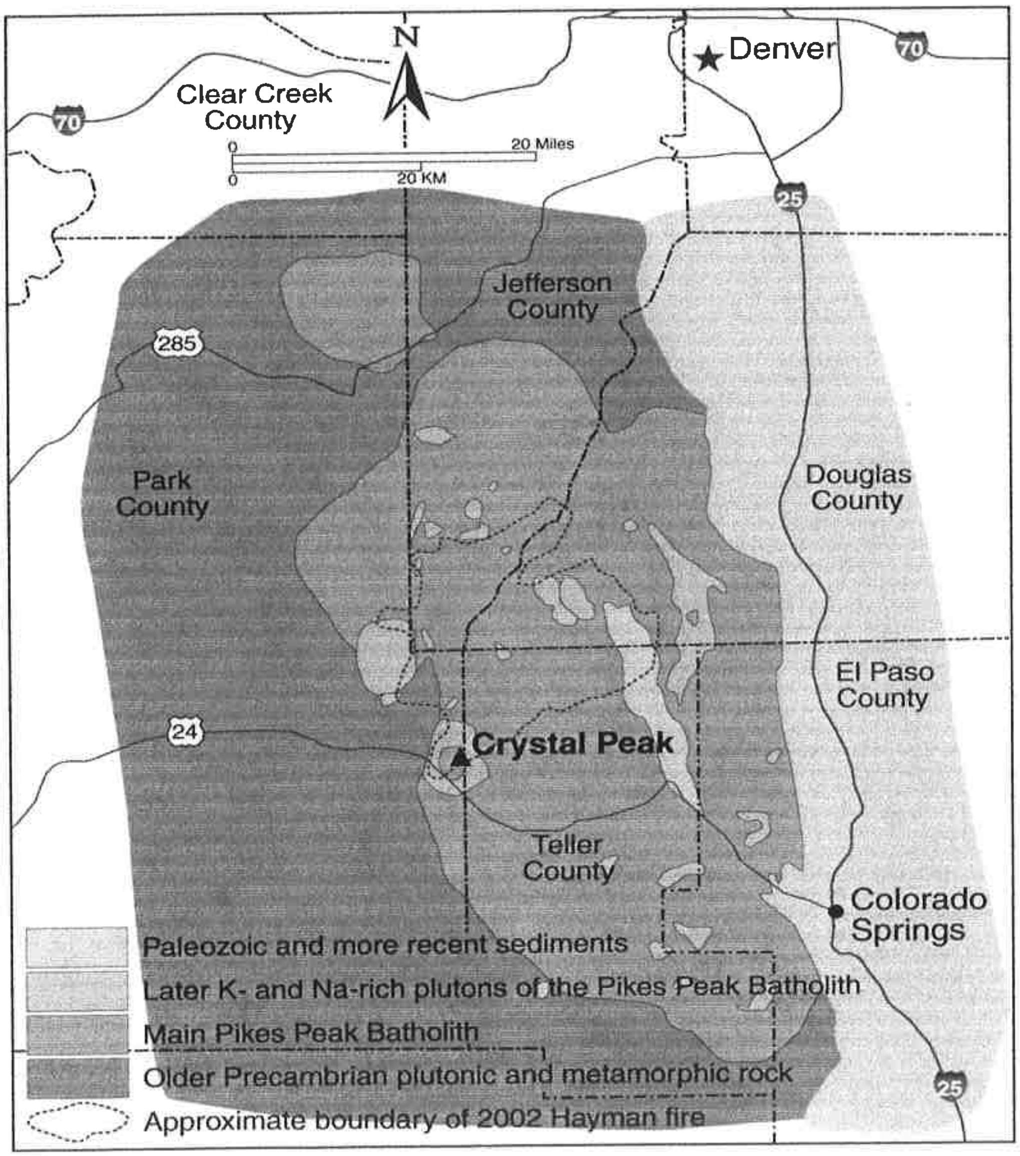
FORTY YEARS OF FIELD COLLECTING: COLORADO AND ARIZONA

Barbara L. Muntyan

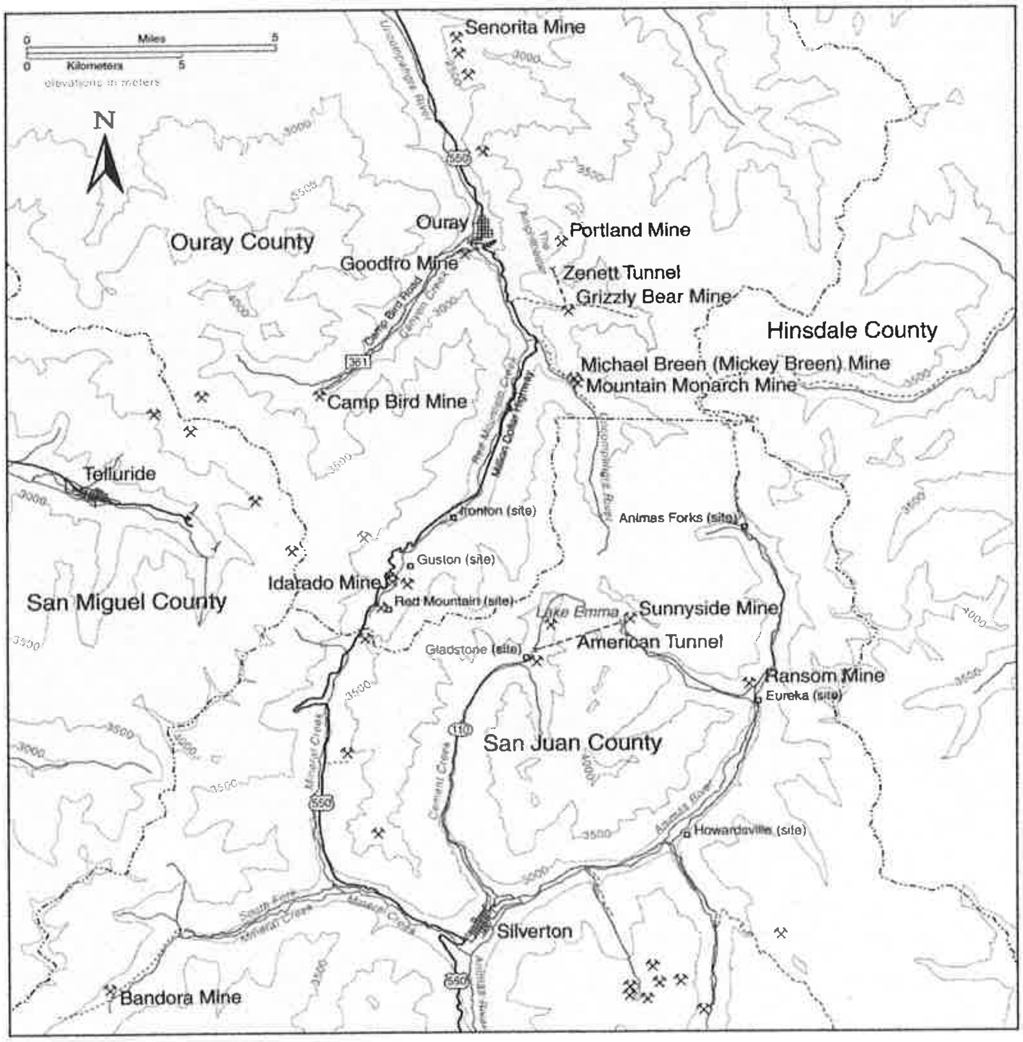
Tucson, Arizona

I have been an avid field collector for more than forty years, first in Colorado and then in Arizona. During that time, I have enjoyed both the excitement of the hunt, the rush of success, and the friendship of many collecting friends.

My first fifteen years of collecting focused primarily on the minerals of the Pike's Peak granite: amazonite, quartz, fluorite, goethite, and microcline. My regular digging partners were John Muntyan and Larry and Carmen Piekenbrock. Digging in the Lake George area three out every four weekends from the end of March until early November, we were rewarded with some fine examples of these common species.



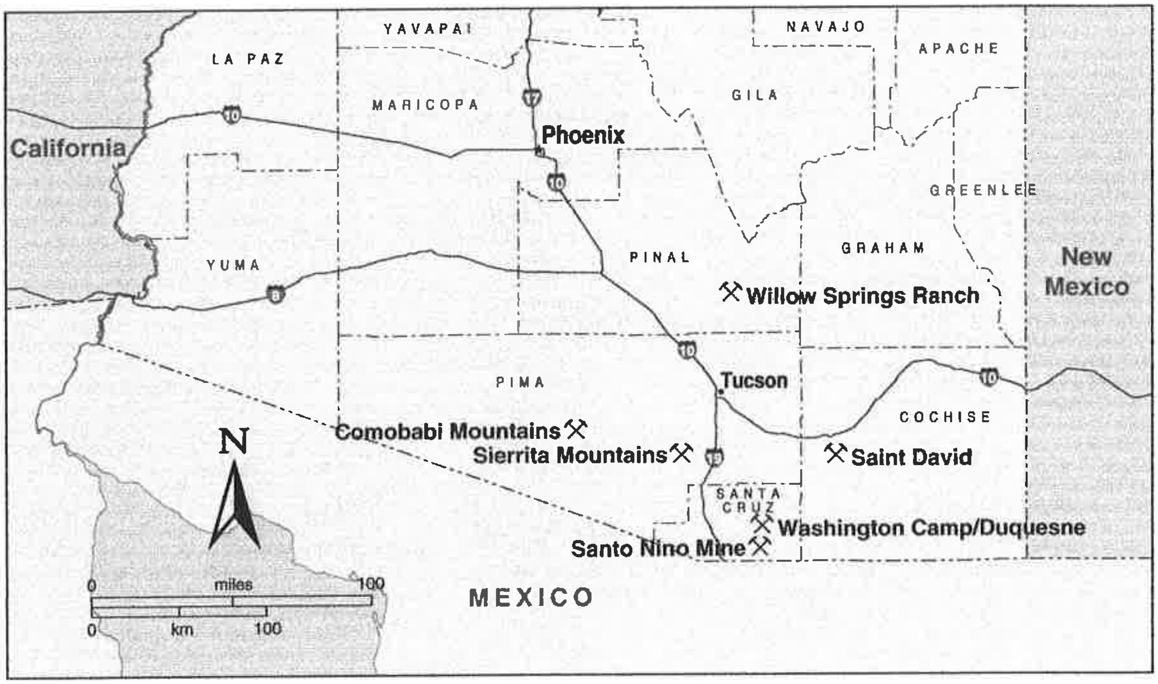
The second focus of field collecting in Colorado was in the San Juan Mountains in the southwest corner of the state. Visiting there several times each summer from the 1975 until 1987 with John and the Piekenbrocks, I finally moved to Ouray in 1988 and became a fulltime resident. My regular digging partners became Benjy Kuehling and Robert Stoufer, both long-time residents of Ouray. Here, the focus was on collecting quartz, rhodochrosite, fluorite, barite. calcite and less-common minerals like enargite and pyrite. Collecting centered on the high valleys above 11,000 ft. and the many mines of the San Juan Triangle. During a twenty-five period, I was able to collect a fine suite of mineral of the area.



In 1998, after retiring from the Ouray County Museum, I built a winter home in Tucson, and divided my time between Ouray and Tucson until 2009. Now I could mineral collect year-round. While my digging partners in Ouray remained Benjy and Robert, I acquired new mineral collecting buddies in Arizona. Don Belsher and I collected in southeastern Arizona, mainly in the Weshington Camp and South Comobabi areas from the late 1980s until his death. We were quite successful in both areas, collecting some fine quartz, garnets, quartz pseudomorphs after calcite, and amethyst scepters.

I then began collecting regularly with Sheila Powell of Tucson, first in the Huachuca Mountains for quartz, in the South Comobabi Mountains for a wide variety of quartz after calcite pseudomorphs, and then in the Sierrita Mountains southwest of Tucson for aquamarine and for fluorite and barite.

Most recently, I have collected regularly with Bill Besse after he settled in Green Valley. Much of our collecting endeavors have centered on calcite specimens from Malpais Hill and Gringo Gulch, amethyst scepters from Patagonia, and other forays to various areas in southeastern Arizona.



During the period from 1975 until the present, I have written a number of articles on my collecting experiences, have given numerous presentations to mineral clubs, to the New Mexico Mineral Symposium, the Arizona Mineral Symposium, as well as groups in Colorado, Arizona, New Mexico, and California.

Field collecting has been my passion and a major part of my adult life.

Geodes, Thunder Eggs, and Septarian Nodules

Structure and Origin

Dick Zimmermann

Spherical rock structures containing minerals or agates are collected worldwide. Though they are greatly appreciated by both rock hounds and mineral collectors, the formation of these fascinating structures is not well understood. For well over a century, many explanations have been offered, and there are many related scientific publications. Some explanations are more plausible than others, and some have been shown to be improbable or impossible. However, within the scientific community, there is still no consensus on the origins of these structures.

Geodes are found in both igneous and sedimentary rocks. Though similar in form, their origins are quite different. Igneous geodes are a primary geological structure formed during the cooling and solidification of certain lava flows. Sedimentary geodes are secondary structures formed by replacement of spherical concretions. Most concretions are not spherical, and the formation of spherical ones has been a subject of extended debate in the scientific literature. Competing theories include mineral cementation of as yet un-compacted sediment around a nucleus, capillary action, microbial action around organic debris, and rolling mud. The transformation of the spherical concretion into a geode is somewhat better understood. It usually involves silicates replacing soluble carbonates due to the flow of groundwater or hydrothermal fluids.

The cavity for igneous geodes is a primary structure formed during the flow and subsequent solidification of a volcanic ash known as tuff. Tuff consists of small fragments of glass expelled during a volcanic eruption. It flows easily over long distances and contains dissolved gasses. As it cools, gases come out of solution. The bubbles thus formed coalesce to form the cavities for the geodes. An alternate explanation states that a glass base forms at the bottom of the tuff flow where is in contact with the relatively cold surface of the earth. Areas of radial crystallization (spherulites) form within the glass and exsolved gases collect around the spherulite. Then, the spherulites expand and break down to form the cavity. Subsequently, flowing and mineral bearing ground water deposits silicates to form the shell of the geode. Later, more flowing ground water deposits additional minerals in the geode cavity.

The origin of thunder eggs appears even more mysterious due to the box or star shaped patterns of the interiors. As in the case of geodes, the scientific literature offers numerous hypotheses for the formation of these structures, but no consensus. It is general accepted that they are a primary structure with the cavity shapes formed during the cooling of rhyolite flows. Their formation in rhyolite but not basalt is believed to be related to the much higher viscosity of rhyolite. The formation of the basic spheres has been attributed to the presence of immiscible globs of rhyolite in molten pearlite, radial crystal growth (christobalite, quartz, and feldspar), rolling balls formed between flow bands, and thermal stress cracking. The formation of the cavities is generally believed to be caused by gas expansion. Dissolved gases such as carbon dioxide and hydrogen

Syneresis - separation of water from a gel - eggs / OBx-1?

sulfide may be contributors, but the transformation of supercritical water to vapor due to pressure drop is perhaps the major contributor. The star and box shapes are probably caused by tensile failure in solidified, but still hot and plastic, rhyolite or selectively crystalized rhyolite components. Silicates and other minerals are later deposited in the cavities by flowing ground water or hydrothermal fluids.

Septarian nodules are an altered primary structure. As with sedimentary geodes, their formation begins with a spherical concretion. However, the concretion is not replaced. It is cracked and then in-filled with various minerals. The literature presents a variety of hypothesis for the formation of the unique crack patterns. They include dehydration, syneresis, overburden pressure, shrinkage of the center, pressure from mineral growth, growth of the shell, and even earthquakes. Syneresis is the spontaneous separation of liquid from a gel due to Van der Waals forces, and may be the most plausible explanation for nodules with large interior voids. The structure is usually complicated by a series of primary cracks combined with a series of secondary cracks, the causes for which are probably different.

The cavities of geodes and thunder eggs frequently contain a variety of agates. Typically, they are horizontally banded or concentrically banded agates. These are usually explained by partial filling or complete filling by a succession of silica rich mineral bearing waters. Those commonly accepted explanations are probably incorrect. More likely, they both result from complete filling with solutions or gels and selective mineral precipitation controlled by gravity dependent or gravity independent processes. As with the formation of the various spherical structures, there is extensive literature on agate formation and no current consensus.

The understanding of these structures has been hampered by the limited scope of related studies. Generally, research teams study specimens of a specific type from a single location. Their conclusions may differ because the specimens they were studying were actually formed by a somewhat different process. A broader study, in which multiple research teams study the same specimens and where specimens from various locations and formations are included, might lead to a better understanding of the origins of geodes, thunder eggs, and septarian nodules.

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A Brief History of Mineral Magazines

Guenther Neumeier, Mineralogical Record

Mineralogical publications for scientists have been around since the 18th century. Publications for collectors, however, did not appear until the late 19th century in Europe with Gustav von Tschermak's *Mineralogische Mittheilungen* in 1872 and J. G. von Lenz's *Mineralogisches Taschenbuch* (1798, 1799).

A brief tour of the history of mineral magazines for collectors from the United States to Europe, and then to Australia and China, reveals ambitious magazine-publishing projects in the mineral community.

The first such magazine published in the US was the *American Mineralogical Journal*, modeled after the *Journal des Mines* of the Paris School of Mines, France. From 1810 until 1814, Archibald Bruce published a total of four issues of the Journal. It covered field trip reports, locality descriptions, discoveries of new species, chemical analyses and reviews of recently published mineralogical literature.

In 1884, 17-year-old Theodore H. Wise published *The Young Mineralogist and Antiquarian* in Wheaton, Illinois. In May of 1885 Wise incurred the wrath of W. E. Skinner, publisher of *The Agassiz Journal*, by accusing him of copyright infringement, fraud and criminal activities, and Wise's publication disappeared the same year.

The year 1885 saw the birth of another collectors' publication: *The Exchangers' Monthly*, published by Arthur Chamberlain, appeared in November 1885. In November 1890 the name of the magazine was changed to *The Mineralogists' Monthly*, and the price advanced to fifty cents per year. The magazine contained twelve pages of reading matter and eight pages of advertisements. The last number of this monthly appeared under the date of March 1893. It may safely be said that the heyday of wealthy American mineral collectors was about this period.

The journal *Minerals* was first published in January 1892. It was a much larger publication than the *Mineralogists' Monthly*, and as there seemed room for but one magazine of this character it was arranged to merge the two. *Minerals* ended with a double number—November-December, 1893—and *The Mineral Collector* appeared in March 1894 as a monthly until March 1909.

The well-known *American Mineralogist* was founded in 1916 under the auspices of the Philadelphia Mineralogical Society, the New York Mineralogical Club, and the Mineral Collectors' Association. Initially it was a collector's journal designed to replace *The Mineral Collector*. Today, the *American Mineralogist* is a highly regarded, purely scientific journal published by the Mineralogical Society of America.

Rocks & Minerals, the oldest surviving mineral magazine, was founded in 1926 by Peter Zodac (1894–1967) in Peekskill, New York, as a small-format, black and white publication. The number of issues per year varied from four to twelve. Zodac, a "one-man band," continued as editor, publisher, circulation and advertising manager, and frequent author until his death in 1967. In 1975, *Rocks & Minerals* was sold it to the Helen Dwight Reid Educational Foundation (HELDREF) in Washington, D.C. In the summer of 2009, *Rocks & Minerals* was purchased by Taylor & Francis, an internationally acclaimed UK-based publishing company with more than two centuries of experience and over seventeen hundred journals in its portfolio.

In 1933 Henry Dake founded *The Mineralogist* as a higher-level competitor to *Rocks & Minerals. The Mineralogist* was taken over by Don MacLachlan in 1960 and ceased publication in 1964.

Lapidary Journal was established by Leland Quick in 1947; it took on its current title, *Lapidary Journal Jewelry Artist*, in 2005, when it was purchased by Interweave Press.

Before taking over *The Mineralogist* in 1960, Don MacLachlan had started *Gems & Minerals* in 1952. The magazine ran until 1985. Don wanted to provide a place for mineral collecting articles to be published together with lapidary articles, and that was the policy followed in *Gems & Minerals*.

The 1970s saw a number of startup mineral magazines:

In 1970, John White, then curator of Mineralogy at the Smithsonian Institution, founded the *Mineralogical Record*, a bimonthly publication written by and for mineral enthusiasts worldwide.

Another mineral magazine launched in 1970 was *Mineral Digest*, founded by Argentinean mineral dealer Julio Tanjeloff (1916–1980). *Mineral Digest* was not strictly a mineral magazine; it also covered gemstones, rocks, fossils, petrified wood, moon rocks and tektites. Its purpose was to promote minerals generally and Tanjeloff's business in particular. Though *Mineral Digest* ran for only eight widely spaced issues it still ranks as the most extravagant mineral periodical of all time.

Just one year later, in 1971, *Rock & Gem*, which claims to be the leading magazine for the lapidary and mineral hobbyist.

The bimonthly *Rockhound Magazine*, published by John Latham of Texas, started in 1972 and was published until 1980.

Mineral News, a monthly newsletter for mineral collectors, was founded in 1985 by Lanny Ream of Coeur d'Alene, Idaho; it was purchased by Tony Nickischer of Excalibur Mineral Company in 2003.

In 1988, Jay Lininger and Lawrence Conklin founded *Matrix* as a bimonthly and later quarterly journal of the history of minerals.

The quarterly magazine *The Vug*, founded by Justin Zzyzx and Brandy Naugle in 2008, was an ambitious project to promote mineral businesses on various Internet platforms. A total of 16 issues were published from 2008 until 2011.

The most recent addition to American mineral magazines will be *American Rockhound*, based in Asheville, North Carolina. It is planned as a quarterly magazine focused on promoting the hobby of rock, gem, mineral and fossil collecting. The first issue is scheduled for April.

Foreign Mineral Magazines

Europe has a multitude of publications for collectors; however, most of the mineral "magazines" in many European countries are club newsletters with a more or less professional approach. The focus here is on a few important magazines that cover not only local subjects but also worldwide mineral topics.

The one that first comes to mind is certainly *Lapis*, a mineral magazine founded in 1976 by Christian Weise. *Lapis* is a monthly magazine with ca. 10,000 subscribers. Next in line is *Mineralien Welt*, a bimonthly magazine founded in 1990 by Rainer Bode. *Aufschluss* (Outcrop) started as a newsletter for the Friends of Mineralogy and Geology in Germany and developed into a widely respected periodical for collectors. It covers not only mineralogy but also geology, paleontology and mining.

Across the border in France, Louis Dominique Bayle established the bimonthly *Le Regné Minéral* in 1995, while in Italy the quarterly *Rivista Mineralogica Italiana*, established in the mid-1970s, thrives. Spain has *Mineral Up*, a quarterly since 2006. Switzerland has its quarterly *Schweizer Strahler*, published since 1967 by the Swiss Federation of Strahler, Mineral and Fossil collectors.

In England, the Russel Society founded the *Journal of the Russell Society* in 1982. It includes papers, topographical reports and brief notes on all aspects of mineralogy, together with book reviews and information relating to members of the Society. The *U.K. Journal of Mines & Minerals* was begun in 1986 as *Rockbottom* by a group of British mineral enthusiasts; later its subtitle became its main title. And finally, *Rock'n'Gem*, a quarterly publication with a wide range of topics all relating to minerals whether untouched, faceted, carved, shaped, polished, fossilized, set in jewelry or made into beads, started up in 1997.

In Scandinavia, the Swedish/Norwegian magazine *Stein* was introduced in 1973. Published by the Association of Amateur Geologists, it covers rocks, minerals and fossils.

In 2010, Tomasz Praszkier founded the Polish *Minerals* (*The Collector's Newspaper*), and in Russia, in 1999, the *Mineralogical Almanac*, now called *Mineral Observer*, succeeded the magazine *World of Stones.* The entrepreneurial Russians Michael Leybov and Ludmila Egerova from Moscow founded both magazines.

Heading to Australia, the *Australian Journal of Mineralogy*, a joint publication of the Australian Mineralogical Societies, has promoted Australian mineralogy, as well as providing information of interest to mineral collectors, in two issues per year since 1996.

Last stop is China, where *Mineral Lover* is published out of Hong Kong.

MAINE MINERALS

Arizona Gold and Silver Mining -
Why More Specimens Were Not Saved or Why We Should Be Thankful for the Ones That Were

Les Presmyk

Gold and silver. The first 350 years of exploration of Arizona was limited to the search for these two metals. The Lost Dutchman Gold Mine stories pale in comparison to those about the Seven Cities of Cibola, which truly is the grandfather of all Arizona treasure stories. In 1539, the first expedition searched for these seven golden cities with a supposed siting by Friar Marcos de Niza. Coronado then mounted a serious expedition in 1540 but came home empty handed. In 1583 another smaller expedition did not find any gold but probably were the first white men to stand on the rich copper outcrops of Jerome.

The Spanish conquistadors were not miners. They were more interested in finding the indigent peoples who had already found the gold, having fashioned it into jewelry and ornaments. Civilizations like the Inca and the Aztecs had amassed large quantities of gold, which inspired the Spanish to figure out ways to relieve those folks of their riches.

As they moved north into what is now Arizona and New Mexico, they were following the stories of untold riches like they had found in Mexico and South America. But, their good fortune had run out. The native tribes of the southwest had not developed any interest in gold or silver. As Spanish missionaries established settlements in southern Arizona very little mining was done because it was mostly about converting the Indians into Christians and developing sustainable communities.

The real mining of these two metals began with the discovery of a very rich deposit of placer silver at a small town called Arizonac in the Mexican State of Sonora in 1736. But, the stage for mining was not really set until the New Mexico Territory was won from Mexico in 1848 and the Gadsden Purchase in 1853 completed the southern area of Arizona. Up until the mid-1850's Arizona was just 500 miles of dry desert to cross in order to get to the gold fields of California. As the disappointed explorers and would-be miners left California for points back east, they started prospecting the washes and outcrops of Arizona. The areas along the Colorado River, the Santa Cruz river valley and up north into the settlement and territorial capital of Prescott all began to give up their hidden riches.

Because of the remoteness of the area, most of the gold discovered in these early years found its way to the U.S. Mint and very few specimens were saved. There are two nuggets in the Smithsonian collection that date from this period. Deposits like La Paz, Walker, and Rich Hill are now part of Arizona's history, were all found in the 1850's and early 1860's. Some serious mining began but with the advent of the Civil War, all of the Army troops were moved to the east. The few settlers who remained had their hands full just trying to keep the Apaches from killing them. Some mining still took place, including the rich Mowry silver mine near Harshaw, Arizona. In 1863, President Lincoln established the territories of Arizona and New Mexico. To honor his act, 400 ounces of Arizona silver were fashioned into an inkwell which was presented to him in 1865. This inkwell is in the Library of Congress collection.

Following the end of the Civil War and the return of a military presence, life was still not safe but prospectors renewed their push into the mountains of Arizona. The rich gold placers around Prescott continued to produce but now the lode deposits were beginning to be exploited. In 1874 and 1875, attention was turning to the central part of the territory and the Silver King, Silver Queen, Richmond Basin, Globe, and the Stonewall Jackson mine were all discovered and mining began. The rich silver deposits of Tombstone were discovered in 1877 and the rush into the southern part of the territory was on. Mineral deposits north of Prescott near Mineral Park and Oatman were all discovered but in some cases mining would not take place for several decades. More importantly, life was not just about staying alive and people could start saving specimens. This is really the glory time for silver specimens from the Silver King, Globe and the Stonewall Jackson mine. Unfortunately, as rich in minerals as the mine of Tombstone were, very little was saved. We now know many of the silver and gold ores contained some a number of new and unique telluride minerals.

As rich as these deposits were, they were all short-lived. A ten year silver mining camp was a long lived settlement. Fortunately, because of Bisbee and Morenci, there were mineral dealers travelling through the territory and there was interest in saving specimens.

The Silver King, just north of modern day Superior, was found in 1875 by an army scout. He went to work for ranchers in the Florence area and showed them the heavy black rocks he had picked off the outcrop. After he disappeared, the ranchers decided to go exploring and over two such expeditions managed to locate both the Silver King and the Silver Queen claims. By 1878 The Silver King was in full production. The crushing and milling facilities were located a few miles away at Hastings, near Picket Post mountain, and the closest source of water. By 1885 the Silver King was closed, with a main shaft that had been sunk 1000 feet deep. At one time the mine superintendent was said to have worn a three foot long wire of silver as a hat band on his cowboy hat. The men who operated the ore haulers from the mine to the mill had learned early on to use chunks of ore rather than whips to spur their teams to move faster. It was said this road ran $10 to the ton. Some of Arizona's best silvers were recovered from here including wires, herringbone crystals and spinel twins up to five inches long.

Thirty miles to the east, the Stonewall Jackson mine at McMillanville was just as rich, although with a shorter life. Crystalline silvers weighing up to 1 kg were preserved.

Turning our attention to the central and western mining regions of the state, the small mines around Prescott and Crown King were working to exploit these rich veins. Again, most of the operations were short-lived, either because they are started as stock promotions or because the enriched and oxidized ores only lasted for a few hundred feet into the earth. One crystallized silver is known from one of these mines. A number of mines in Mohave County also produced specimens, at least based on the news and geologists reports but again, very few specimens have survived.

Gold specimens were not so fortunate. Because of their higher value, very few specimens survive from mining activities before 1950. There are a few nuggets in the Smithsonian that date from before 1880. There is a small collection of gold nuggets and leaf gold in the Wells Fargo collection. Unfortunately, the only information available is they are all from Yavapai County. They were kept intact for years by the bank president in Prescott who would show valued customers this small collection. Since one of the nuggets is palm-sized and weighs around 10 ounces, it was indeed a treat.

Most of the gold specimens available today are from fairly recent mining activities but usually from much older mines. Greaterville, while getting its start as a gold camp in the 1870's, gave up additional treasure in the 1950's when a small miner, supposedly with his last blast, found 50 ounces of gold, some of which did not hit the market until the 1980's when his heirs sold a small batch of finely crystallized gold to local Phoenix collectors. With the rise in gold prices in the late 1970's a number of modern-day prospectors started searching for gold using metal detectors, both in placer environments and the dumps of old mines. They had a fair amount of success and a number of fine (at least for Arizona) gold specimens were recovered. This continues to today, with several new localities being discovered around the state. Small batches of nuggets, leaf, crystallized and crystalline gold have been found in and around Greaterville, the south end of the Bradshaw Mountains, near Kingman and even near Rich Hill. These locales are usually given as "50 miles south of Quartzsite" or something equally vague.

As the old saying goes, "Gold is where you find it". There is gold in them thar hills and it is just waiting for someone to go out and find it.

Fingerprinting origins of placer gold from Vulture and Rich Hill, AZ

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Placer gold at Rich Hill, Arizona contains trace element distributions which provide a geochemical "fingerprint" that suggests possible lode origins for the placer gold. There are three main placer units at Rich Hill: The lower-most "black placers," the middle "white placers," and the uppermost "red placers." In addition, there are remnants of a special fourth unit, called the "potato patch," which is much smaller in volume. The most prominent geochemical feature of the placer gold from the three main units is that it all exhibits leaching of silver, and enrichment of copper in the outermost rims, suggesting long transport or long exposure at the surface. Trends of geochemistry within the cores of individual placer gold grains show changing trace element chemistry over time. These trends suggest placer formation from the downward erosion of a single hydrothermal vein source with typical chemical zonation. The potato patch gold typically has its own unique geochemistry, suggesting origins from a separate lode source, or a more complex weathering history.

Placer gold within Red Cloud Wash, Arizona has gold purity values and shape classifications which vary significantly from north to south. Red Cloud Wash flows past the Red Cloud Mine, approximately 1 ½ miles southward towards the Vulture gold mine. Modern topography suggests the Red Cloud Mine is the source of the placer gold in the wash. This is supported by a shift in placer gold grain shape, which becomes more rounded with increasing distance from the Red Cloud Mine. It is also supported by the increasing purity of placer gold with increasing distance from the Red Cloud Mine. It is believed that this increasing gold purity results from differential leaching of silver from the gold-silver nugget alloy, with increasing distance or time of exposure from the lode source.

RE-VISITING THE EASTERN FLANKS OF THE SANTA RITA MTS (GREATERVILLE and ROSEMONT) PIMA COUNTY, ARIZONA

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Arizona-Sonora Desert Museum
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Much has been written and said about the mines in the Santa Rita Mts., especially about the Glove Mine near Amado in the southwestern part of the range and the numerous mines surrounding Helvetia at the northen end. This presentation will focus on the eastern flanks of the Santa Ritas, in particular, gold occurrences in the Greaterville District and the copper deposits surrounding Rosemont in the northeastern portion of the Helvetia District.

The Santa Rita Mts have the most complete stratigraphic section of Paleozoic rocks in southern Arizona. These older rocks are overlain, and in some instances unconformably, by Mesozoic- and Cenozoic-age rocks. Mineralization occurs along structural alignments and contacts with Laramide intrusives in the northern part of the mountains. The eastern slopes have been highly eroded and dissected by numerous canyons, gulches, arroyos and washes, which served as depositional environments for placer gold occurrences.

The Greaterville District and the mining camp of the same name, on the southeastern flanks of the Santa Rita Mts, was named after an early settler who had claims in the mid- to late-1800's. Cretaceous rocks dominate the stratigraphy. Lode gold occurs in numerous and irregular quartz veins. Erosion of the rocks resulted in the placer deposits which drew prospectors to the area. Lode gold deposits were discovered about 1873, but records of the placers figure more prominently in mineralization production. Estimated production records a century after the peak production era amount to about 2000 tons of lode ore which contained gold, silver, lead, copper and zinc.

The mineral deposits associated with Rosemont at the northeastern end of the Santa Rita Mts are included in the Helvetia District. Most of the mines in the district surround Helvetia Camp, but we will only consider those to the northeast and east in close proximity to Rosemont. The camp at Rosemont was originally called McCleary, after William McCleary, whose claims date back to the late 1870's to early 1880's. He sold his claims in 1894 to L. J. Rose, thus the origin of the current known name of the site. Pre-Cambrian rocks are overlain by thick sequences of Paleozoic sediments and capped by Mesozoic sediments and volcanics. Ore occurs in fault zones and along metamorphosed contacts with carbonate rocks and late Laramide porphyry intrusions. Mineralization was discovered and staked in the late 1870's. Metal production records for the Rosemont area mines are included with those of Helvetia. A century after the first discoveries, roughly 426 thousand tons of ore came from the Helvetia District containing copper, zinc, lead, silver and gold.

THE MINERALS
(includes minerals from both Greaterville and Helvetia Districts)

acanthite
actinolite
albite
almandine
andradite
anglesite
anthophyllite
antimony
antlerite
apophyllite
"asbestos"
aurichalcite
azurite
barite
bayldonite
bindhemite
biotite
bornite
bournanite
brezinaite
calcite
cerussite
chalcanthite
chalcedony
chalcocite
chalcopyrite
"chert"
chlorargyrite
"chlorite" group
chrysocolla
"clay"
conichalcite
copper
"copper stain"
covellite
cuprite
cuprotungstite
datolite
diopside
dioptase
djurleite
enstatite
epidote
"feldspar" group
fluorite
forsterite
galena
"garnet"
goethite
gold
grossular
gypsum
hematite
"hornblende"
jarosite
kamacite
kinoite
libethenite
"limonite"
magnetite
malachite
marcasite
microcline
mimetite
molybdenite
muscovite
nontronite
opal
orthoclase
osarizawaite
powellite
prehnite
pyrite
pyrrhotite
quartz
rosasite
scheelite
schreibersite
sericite
smithsonite
sphalerite
taenite
tenorite
tetrahedrite
tremolite
uraninite
vanadinite
vesuvianite
wollastonite
wulfenite
zircon

THE MINES

GREATERVILLE DISTRICT

Argonaut placer group
Arrastra
Buckhorn
Colchis placer group
Comstock Mn group
Conglomerate Mn group
Copper Valley
Depression
Enzenberg
Fortuna No. !
Friez
Fulton
Gold Bell
Hancock
Hardscrabble
Harshaw
Hughes
Ironwood
Laura
Logan & Bluebird
Oak Park
*placer gulches (Boston, Chispa, Colorado, Succor, Graham, Harshaw, Hughes, St Louis, Kentucky, Los Pozos, Louisiana, Ophir & Empire)
Quebec
Royal Mountain
Santa Rita group
Silver Butte
Silver Dime
Silver Glance
Silver Leaf
Silver Queen
St Louis
St Patrick
Summit
Sunset & Silver Star
Yuba

ROSEMONT AREA

Broadtop
Chicago
Coconino claim
Daylight
Dick Murphy property
East Helvetia
Eclipse group
Falls claim
Franklin, Cushing & Marion group
Fremont
Gold Fish
Golden Gate group
Gray Copper
Heavy Weight
Humming Bird property
Hunter
Jumper property
King-Exile group
McCormick property
Merchant
Mohawk Silver
Narraganset claim
Old Pap claim
Old Put claim
Oregon
Peach
Pickwick prospect
Record Excelsior
Ridley
Rosemont
Santa Rita Mountains
South End
Sweet Bye & Bye claim
Tally-Ho
Tiptop group
Tres Amigos

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NOTES

REAL DIAMONDS IN OIL-BEARING HERKIMER 'DIAMOND QUARTZ':

AN IMPORTANT CLUE TO OIL FORMATION

By Stanley B. Keith

ZARO MTNS, PAKISTAN

March 10, 2014

Gas Chromatographic/Mass Spectrometric (GC/MS) analyses of hydrocarbons in/or associated with Herkimer-habit, 'diamond quartz' have yielded a striking result: 'real diamonds' are present in 'diamond quartz'. The diamonds occur as nano-molecules (1 billionth to 1 millionth of a meter) dissolved in kerosene-like liquid oils or possibly as solid-state nano-crystals suspended in solid-state ozokerite, which is an x-ray-amorphous, alkane-bearing hydrocarbon. These hydrocarbons contain macroscopic, Herkimer quartz crystals (from an undisclosed location near Fonda, New York) (Figure 1) and contain nano-crystals that are suspended in alkane-bearing waxes within Herkimer quartz samples. The GC/MS analyses identified the quantitative presence of Adamantane and Diamantane, which are alkane hydrocarbon compounds. The analyses also identified the qualitative presence of the Triamantane, Tetramantane, Pentamantane, Hexamantane, Heptamantane, and Octamantane members of the Diamondoid series.

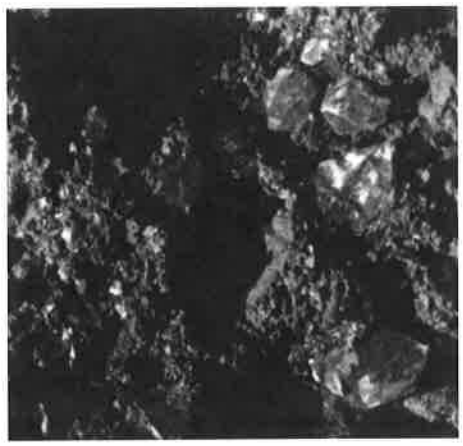
Diamondoids have yet to be recognized as an official mineral species. Follow-up studies in the literature have shown that each diamondoid has an identifiable structure, a unique chemical composition (the general formula is $C_{4n+6}H_{4n+12}$), and physical properties in synthesized, solid-state materials. Diamantane has been physically observed in solid-state scales on pipes in oil field production complexes in Canada and Louisiana, USA (Figure 2a and 2b). Thus, prior to the discovery of Diamantane and the other seven diamondoid compounds in the Fonda, New York ozokerite, pipe-scale Diamantane was the best candidate for a naturally occurring, diamondoid mineral compound/species.

Diamondoids are analytically present in all alkane oils analyzed and occur in amounts up to the ratio of one part total diamondoid series to 100 parts oil (or about one spoonful of diamondoid per gallon of oil). Because of their small nano-size, diamondoids have yet to be physically recognized in the solid state as nano-crystals suspended in liquid oil (they may also be present as dissolved molecules). However, in solidified oil bitumens, such as the Fonda ozokerite, the additional inference can be made that the diamondoids Adamantane and Diamantane occur as solid-state nano-crystals that were precipitated during rapid depressurization and cooling of hydrothermal oils in the Herkimer area of New York circa 450 Ma. As such, the Adamantane- and Diamantane-saturated hydrocarbon compounds would qualify as legitimate, naturally occurring, hydrocarbon mineral species. The Adamantane and Diamantane would additionally occur as mineral species members of the Diamondoid series, which at present potentially consists of at least 11 identifiable mineral species. In terms of natural abundance however, Adamantane, Diamantane, and Triamantane are by far the most abundant diamondoids in oil and would correspondingly be by far the most abundant mineral compounds in any solidified oil bitumens, such as ozokerite.

In any case, to get the mineralogical world ready for a new mineral series with some potentially new species, the mineral series name 'Diamondoid' is proposed for the 'Diamondoid Series.' The mineral name, 'Hodoninite' is proposed for the adamantine diamondoid, which was first discovered in the Hodonin oil field cluster in Moravia, of the now eastern Czech Republic in 1933. Analogously, the mineral name, 'Schleyerite' is proposed for the diamondoid mineral, Diamantane. The name recognizes

P. v. R. Schleyer, the inventor of the Lewis acid-catalyzed, hydrogenation rearrangement scheme, whereby typically tri-aromatic hydrocarbon compounds (e.g., phenanthrene) are rearranged into what are now the lower three diamondoids. These diamondoids include diamantane that was first synthesized/discovered by this protocol.

The Schleyer synthesis scheme may also closely mimic halogen-rich, acidic, hydrothermal conditions that attended the formation of Herkimer quartz. These conditions also accompanied the associated rearrangements of polyaromatic hydrocarbons (PAH) in kerogen into diamondoid series minerals plus alkane hydrocarbons at a growing number of locations on this planet. Many, if not all, oil accumulations may have been formed by this process.



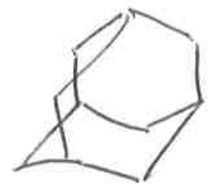


Figure 1. Herkimer 'diamond quartz' floating in dark carbonaceous ozokerite matrix rock, which contains eight diamondoid 'diamond' compounds that may be considered for a new mineral species

Figure 2a. This plateful of diamondoid was distilled from a tank car of Louisiana crude oil (Dahl and Carlson short course, July 2013).

Diamondoids are found in mature high-temperature petroleum fluids (volatile oils, condensates and wet gases). These fluids can have up to a spoonful of diamondoids per gallon (about 3.78 liters) (from Wikepedia).

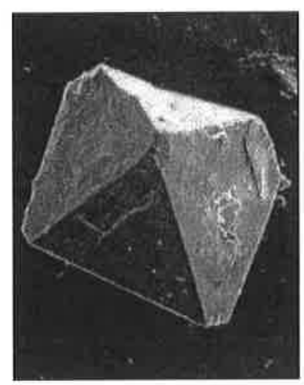


Figure 2b. SEM image of a cyclohexamantane crystal magnified 150x.

from Dahl & others, 2003

In-situ gold nugget formation in AZ: the little miners did it, and other amazing things about Arizona gold

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Placer gold miners in the 1800s often argued that new gold sometimes "grows" within mined-out placers. These accounts were often discounted out of hand, attributed to inefficiencies of past mining and "tall tales." But truth is often stranger than fiction, and modern science is proving the old-timers were often right. In Alaska, gold has been documented growing on the "Parker Goldpiece." This 1908 $20 gold coin was recovered near Fairbanks in 1959 by a mining engineer. The outer surface was covered in small gold crystals and the coin had gained mass. More recently, Australian scientists have documented that biological activity is responsible for some *in situ* gold nugget formation in Queensland, Australia (Reith et al, 2010). In Arizona, work by the author and his colleagues at Rich Hill (Weaver II District) found similar evidence (Kamenov et al., 2013). At Rich Hill, some of the youngest placer gold occurs as overgrowths on older placer gold in the bottom section of this placer deposit. This gold is of high-purity and contains inclusion pockets of carbon and nitrogen-rich material, as well as overgrowth mats with similar chemistry. This inferred biological material from internal pockets was cultured in the laboratory, and found to host an entirely new species of chemosynthetic bacteria, similar to the gold-precipitating bacteria found within placer gold formed *in situ* at Queensland, Australia. Placer gold may also form directly within Arizona placers by abiological means. In the La Cholla placers near Quartzsite, pyritohedron gold crystals up to 1 cm across a face are found within a silicified high-energy gravel. It is unlikely that soft gold crystals would survive for long in an environment capable of forming and transporting well-rounded golf ball to softball-sized quartz clasts. Field and geochemical evidence suggest that this gold formed *in situ* when reducing hot springs flowed through a pre-existing placer gold deposit. These fluids locally dissolved placer gold and later precipitated it as crystals when the fluids cooled and their chemistry changed.

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