G&G

Gem News International

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TUCSON 2017

The 2017 Tucson gem and mineral shows drew eager buyers from all over the globe. Although many dealers reported lower traffic this year, most were content with the volume of business and noted that buyers were "serious."

As in previous years, we identified some strong trends:

- Demand for special one-of-a-kind pieces in both pearls and colored gemstones
- Continuing investment by multinational companies in colored gemstone mining and distribution
- A growing focus on ethically sourced gemstones and beneficiation
- Strong demand for high-end gems and a softening of demand for commercial goods
- Continuing importance of the secondary market in the U.S. for exceptional pieces
- Innovative partnerships emerging between individual colored gemstone mines, designer cutters, and television merchandisers

This year's big story was the emergence of Ethiopia as a potentially major source of gem-quality emerald. These new gems resemble other schist-hosted emeralds, especially those from Brazil and Zambia. Although most of the material is less saturated and included, dealers are excited that the new source also produces fine gem-grade crystals of exceptional size, color, and clarity.

Editors' note: Interested contributors should send information and illustrations to Stuart Overlin at soverlin@gia.edu or GIA, The Robert Mouawad Campus, 5345 Armada Drive, Carlsbad, CA 92008.

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Dealers also talked about the October 2016 removal of U.S. sanctions on Myanmar, legalizing the import of Burmese jadeite and rubies. According to Edward Boehm of RareSource, the lifting of the ban was widely welcomed, but Myanmar government reforms of the gem mining sector have some way to go. Conditions on the ground are much improved, however. Boehm told us new production might take some time to appear, which would impact prices and selection of available goods in the short term.

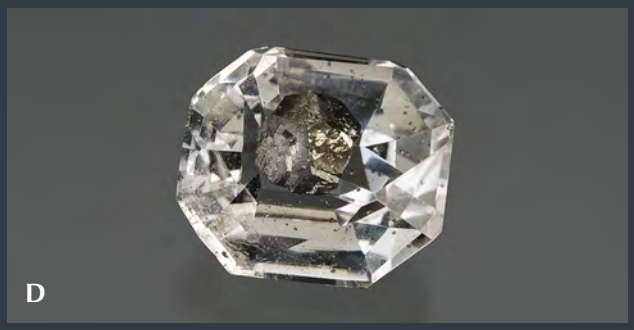
Large multinational companies have significantly impacted colored gemstone mining and distribution over the last decade. Gemfields' Kagem and Montepuez mines supply approximately one-third of global emerald and 70% of global ruby production, respectively. At this year's show we were able to interview Gemfields CEO Ian Harebottle for his perspective on the company's operations and its 2013 merger with luxury brand Fabergé.

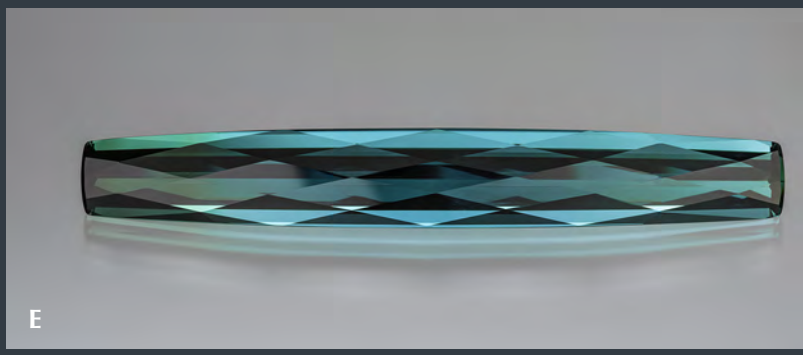
Representing another publicly traded company intending to mine ruby in Mozambique, Christiaan Jordaan of Mustang Resources LLC told us about Mustang's initial 2016 bulk sampling and exploration activities. The company hopes to become an important supplier of commercial and gem-quality ruby.

Marcello Ribeiro of Belmont Group updated us on developments at the company's Belmont and Canaan emerald mines at Itabira, Brazil. He emphasized the importance of sound mine planning through fieldwork and trace-element analysis of potential emerald host rocks.

David Bindra of B&B Fine Gems confirmed the importance of the secondary market for exceptional gems, which are in very high demand. He noted less consumption of commercial to mid-grade material.

A partnership between Morocco's Geostone Group and U.S. gem carver Glenn Lehrer illustrates another interesting development. Production from Geostone's Moroccan amethyst mine is cut to Lehrer's high standards in an Indian factory, featuring a branded designer cut with high weight retention. The resulting faceted stones—and finished amethyst jewelry—are sold directly to consumers through television merchandising. The approach helps





A: 59.28 ct quartz with iron staining. B: 11.77 ct black opal cabochon from Lightning Ridge, Australia. C: 100 ct Mogok ruby crystal with a perfect termination at one end. D: Pyrite at the heart of a 46.98 ct color less quartz. E: 73.22 ct diamondback cut tourma line from Afghanistan. F: 4.31 ct pair of matched Burmese pink spinels. G: 49.36 ct purple trapiche sapphire from India. H: 3.61 ct trapiche sapphire from Kashmir. I: 53.77 ct papagoite. Photos by Robert Wel don/GIA. Courtesy of Rare Earth Mining Co. (A, D, and I); David Humphrey (B); RareSource (C); Stephen M. Avery (E); and Mayer & Watt (F, G, and H).

build a niche for Moroccan amethyst and brings the benefits of scale to designer cutting, which is usually associated with unique pieces.

Eternity Emerald's Arthur Groom shared his rough emerald buying expertise with us, especially his years of experience negotiating with miners in Afghanistan's Panjshir Valley. He noted that the quality of Afghan emerald is not realized in the West because large, fine crystals are often damaged by improper blasting and extraction techniques.

Potentate Mining's Warren Boyd showed us sapphire production from Montana's Rock Creek alluvial deposits, including a remarkable 12.61 ct blue sapphire cut from a 6.37 g rough crystal. Although most of the production has greenish or brownish pastel colors, it reacts well to heat treatment. Boyd told us bright natural colors are in high demand. He showed several suites of fancy sapphires cut by his client, Americut. Montana's alluvial sapphire deposits will be the subject of an upcoming *G&G* field report.

The trend toward ethical, sustainable business practices and transparent supply chains is exemplified by Sheahan Stephen of Sheahan Stephen Sapphires, Inc. His company documents and guarantees the integrity of the gems it sells from the mine, through treatment and cutting and directly to the customer.

Nigeria is an under-documented source of fine rubellite and indicolite tourmaline and predominantly blue basalt-hosted sapphire. For this reason, we especially welcomed talking to Zoe Michelou, who represented a Nigerian mining company. She updated us on production of these gemstones from that country's Oyo, Kwara, and Taraba states.

Gem paintings, which GIA has documented in Vietnam and Mogok, made their first appearance at Tucson. Wanlaya Suwannapirom's Than Thong Arts booth featured an array of art-inspired handmade portraits and miniatures. The technique converts otherwise unusable natural gem fragments into valuable art objects and wearable art such as pendants and pins.

Gem artist Alexander Kreis showed us a spectacular 27.20 ct freeform tanzanite complemented by a custom ring mount made by his mother Sonja, a master goldsmith. They related the importance of the story behind a jewelry piece for their clients—how details of the stone's cut and the ring's design represent the toil and effort of the Tanzanian miners and imbue the piece with added significance.

Fran Mastoloni provided a cultured pearl market update, explaining how careful selection and matching of the different cultured pearl types into a range of varied necklaces help him cater to the market's desire for distinctive "fashion-forward" yet flexible jewelry.

Dealer Bill Vance of Vance Gems exhibited rare gem-quality magnesio-axinites from just one location in Merelani, Tanzania. This material displayed remarkable fluorescence, and we hope to report further on its chemistry in the near future.

We were delighted to find a Southwest-inspired Starship Enterprise, handmade by David Freedland of David R. Freedland Jr. Designs in sterling silver. This quirky blend of science fiction and traditional inlay work is one of the show's unexpected finds.

Finally, no survey of the Tucson shows would be complete without Paula Crevoshay's one-of-a-kind designs. This year, she showcased a bracelet featuring five large freeform fire opals, a swallowtail butterfly pin with yellow and black diamonds, an elephant pin with mother-of-pearl tusks, and a stunning cuff bracelet featuring a spectacular boulder opal centerpiece.

Duncan Pay, Andy Lucas, Tao Hsu, Eric Welch, and Albert Salvato
GIA, Carlsbad

A new discovery of emeralds from Ethiopia. In recent years Ethiopia has gained considerable attention in the gem trade for large amounts of high-quality opal from an area near Wegel Tena (B. Rondeau et al., 2010, "Play-of-color opal from Wegel Tena, Wollo Province, Ethiopia," Summer 2010 *G&G*, pp. 90–105). Apart from opal, emeralds have been sporadically mined, near Dubuluk, for more than a decade. This deposit is located about 80 km from the Kenyan border. Gemfields has been exploring this deposit since July 2015 (Fall 2012 GNI, pp. 219–220).

A new deposit of high-quality emeralds (see figure 1) has been found in the rural villages of Kenticha and Dermi, in the Seba Boru district (figure 2). In November 2016, author MN and business partner Daniel Kifle visited the local trading town of Shakiso, where Ethiopian gem merchants gather to legally buy and sell emeralds that are mined several kilometers away. Shakiso is located about 160 km north of the Dubuluk emerald deposit. The mining area is divided into a few "associations." Each consists of a manager and several members who control the actual mining and distribution of the emerald rough. After the rough has been sorted, it makes its way first through Shakiso before

Figure 1. This suite of untreated emeralds is from a new find in Ethiopia's Seba Boru district. The largest faceted stone weighs 10.64 ct. The largest rough crystal weighs 63.12 g. Photo by Robison McMurtry, courtesy of Michael Nemeth Inc.

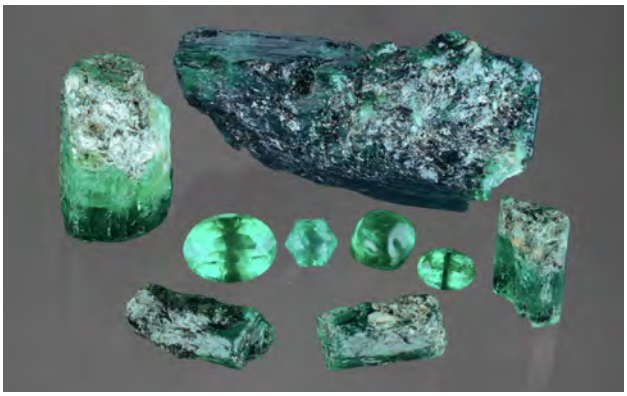


Figure 2. The new deposit of Ethiopian emerald is located near the town of Shakiso, about 12 hours from Addis Ababa.

being sold to dealers in the capital city of Addis Ababa, about a 12-hour drive from the mining area.

According to Tewoldebran Abay, the mineral marketing director of the Ministry of Mines, Petroleum and Natural Gas, more than 100 kilograms of emerald rough have been produced to date. Mining still is done the traditional way using hand tools, without heavy machinery.

Samples from the new deposit, acquired from multiple independent sources, were examined at GIA's Carlsbad and Bangkok laboratories. Even though most of the material is commercial grade, lighter in saturation, and moderately to heavily included, fine gem-grade crystals of exceptional size, color, and clarity (see figures 1 and 3) are obtainable and can produce stones that do not require clarity enhancement. Many of the rough crystals were completely covered

Figure 3. Author Michael Nemeth sorts through parcels of gem-quality rough emeralds from the open market in Shakiso. Rough crystals can weigh more than 20 g, with reports of some weighing almost 100 g. Photo by Michael Nemeth.

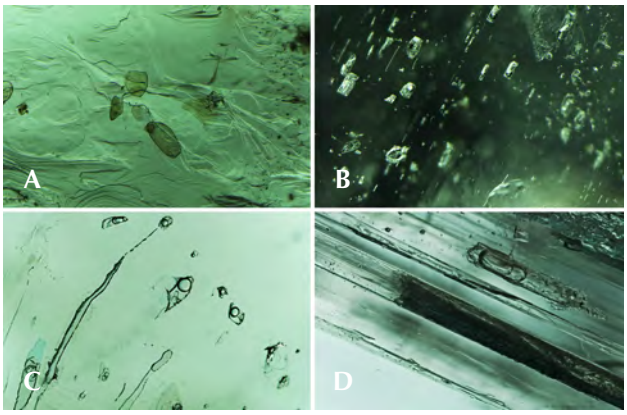


Figure 4. Microscopic observation of the Ethiopian emeralds revealed (A) biotite crystals; (B) blocky multiphase inclusions; (C) multiphase inclusions containing a liquid, gas, and multiple daughter crystals seen parallel to the c-axis; and (D) a multiphase fluid inclusion showing liquid and gaseous CO_2 phases and an immiscible aqueous liquid (parallel to this inclusion are several growth tubes). Photomicrographs by Nathan Renfro (A and B) and Victoria Raynaud (C and D). Field of view 2.04 mm (A), 1.79 mm (B), 1.07 mm (C) and 1.03 mm (D).

in dark biotite crystals, but had an extremely pleasant green color when examined with transmitted light. However, these Ethiopian crystals often do not yield large clean stones because their interior is riddled with dense, dark biotite mica crystals. Some show a double termination, but most are broken and heavily included on one end. Usually only one end of the crystal is clean enough to yield faceted gems. The matrix minerals attached to some of the emeralds were identified as dark brown to black biotite flakes, quartz, and kaolinite.

These emeralds are very similar in appearance to other schist-hosted emeralds—in particular, those from Brazil and Zambia. Among the faceted and rough samples examined, blocky multiphase inclusions and irregular biotite crystals were the most common microscopic features observed (figure 4). Otherwise, the gemological properties were very consistent with emeralds, including an average specific gravity of 2.73 and a refractive index of 1.581–1.589. These emeralds were generally inert to long- and short-wave UV exposure due to their moderately high iron content, which is typical of schist-hosted emeralds. UV-Vis-NIR spectroscopy results (figure 5) were consistent with emeralds colored by chromium and vanadium. The Fourier transfer infrared (FTIR) spectrum was consistent with beryl, as expected, but did not reveal any other diagnostic features.

Quantitative trace element chemical analysis was performed with a Thermo Scientific iCap Q inductively coupled plasma–quadrupole mass spectrometer combined

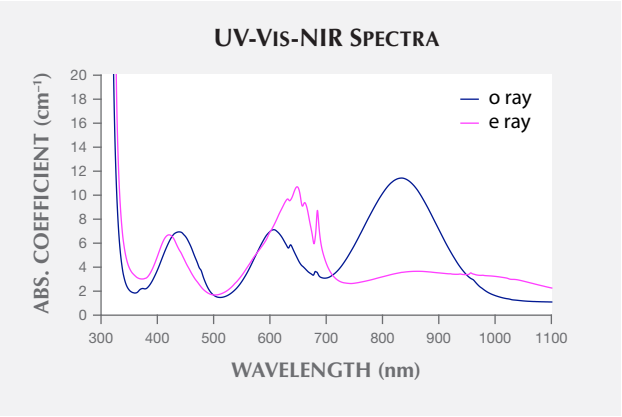


Figure 5. The characteristic UV-Vis-NIR spectra of the new emerald production from Ethiopia.

with a New Wave Research UP-213 laser ablation unit. The analyses were compared to data from other known sources using GIA reference samples, including Zambian and Brazilian schist-hosted emeralds. Based on the results, it was possible to separate the new find of Ethiopian emeralds from other sources by comparing trace alkali metals and some transition metals (figure 6).

Due to heightened tensions and fear of price instability, most of the mine area was temporarily closed by a joint effort of the mining associations and the local government from early November through December 2016. It has been reopened, but now all dealers, including Ethiopian dealers, need written permission to enter the Shakiso area for buying. The law is vigorously enforced, and penalties are severe.

This exciting discovery in Ethiopia will provide a new source of large, high-quality emeralds for the gem and jewelry trade. So far, this deposit appear to be quite promising, as significant production was seen in the recent gem shows in Tucson, Bangkok, and Hong Kong. Only time will tell how significant this deposit will be.

Nathan Renfro and Ziyin Sun
GIA, Carlsbad

Michael Nemeth
MLN Gems, San Diego, California

Wim Vertriest, Victoria Raynaud, and Vararut Weeramonkhonlert
GIA, Bangkok

Fine gems and update from Myanmar. At the AGTA GemFair, Edward Boehm (RareSource, Chattanooga, Tennessee) showed us a succession of top-quality gems. Boehm is a geologist, gemologist, and accomplished gem dealer who works with rare and higher-end gems. He noted that the price of spinel from Myanmar has increased dramatically, with recent prices at the source more than double those of previous years. He explained that spinel has gained favor in Myanmar, which is reflected by the higher prices at this year's show.

Boehm noted that a growing appreciation for spinel from all sources is driving higher market prices. As an example,

Figure 6. LA-ICP-QMS quantitative trace-element composition analysis of alkali and some transition metals (measured in ppmw) proved useful in separating this new deposit of Ethiopian emeralds from Brazilian and Zambian schist-hosted deposits.

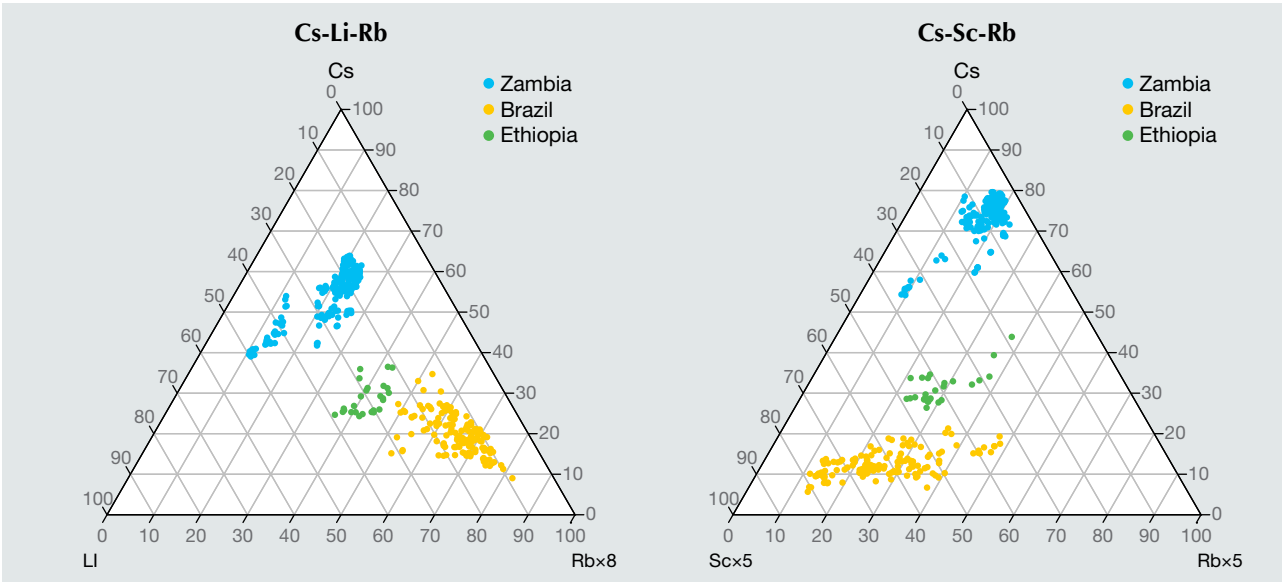


Figure 7. Suites combining blue-to-violet pastel colored spinels with red to rose-colored gems of similar tone. The blue gems range from 3.63 to 8.30 ct and the pink to red examples from 3.16 to 5.70 ct. Photo by Albert Salvato; courtesy of RareSource.

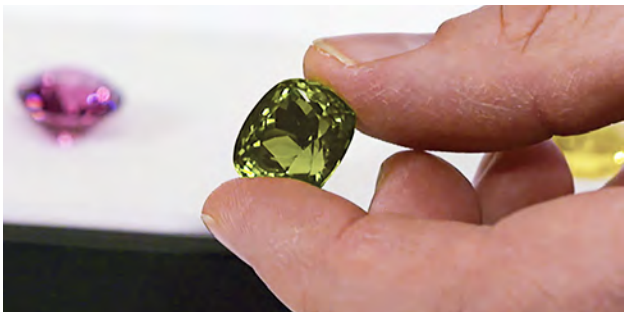


Figure 8. This cushion-cut 20.41 ct Burmese peridot shows a softer appearance due to a multitude of tiny inclusions. Photo by Albert Salvato; courtesy of RareSource.

he showed us a beautiful oval 21.56 ct Sri Lankan pink spinel cut to make the most of the gem's high clarity and moderate dispersion. The size, clarity, and brightness are reminiscent of Tajik spinel. He compared this bright lilac pink Sri Lankan spinel with a strong orangy red square cushion-cut 9.82 ct Burmese gem, which he described as having a "flame" color. The per-carat price of the flame-colored Burmese stone is almost double that of the Sri Lankan spinel—$12,000 per carat wholesale versus $7,000 per ct. A strong red "flame" color makes the price jump significantly. If the stone were above 10 ct, Boehm added, the price would further jump to around $15,000 per carat.

Pastel blue to violet spinels are also selling well for Boehm. Designers like to mix these delicate blues with pinks or "rose" colors of similar tone and saturation to produce very attractive suites and sets. The pinks help to highlight the violet or purple in the pale blues, he added. The bluish violet examples he showed us hailed from Sri Lanka and wholesaled for $1,200–$1,500 per ct (figure 7). Complementary rose-colored gems came from a variety of sources—including Vietnam, Sri Lanka, and Myanmar—and ranged from $1,000 to $1,800 per ct.

Boehm explained that the most sought-after color is the "electric" haüyne blue, which comes from Luc Yen, Vietnam, and is only sporadically available in small sizes. He added that the light-toned, gray-to-violet blue colors are more available than in the past—partly because there's more demand so more people are bringing it to market.

Like Burmese spinel, Burmese peridot is currently in vogue. Boehm showed us a fine 20.41 ct cushion-cut gem (figure 8). The presence of a multitude of tiny inclusions lend it a softness and reduce extinction. By comparison, fine Pakistani peridot—which is also available in large sizes—has a more "crystalline" appearance and deeper color, but shows more extinction. He explained that the price of Burmese peridot has recently gone up sharply. A top gem like the one in figure 8, which would formerly have been in the $250–$350 per carat range, is now wholesaling for $450–500 carat and even up to $600 per carat. He cautioned buyers to check whether a stone shows doubling in the pavilion in the face-up position, which is considered less desirable. Buyers want to ensure the stone is oriented in such a way that doubling isn't visible through the table.

Next, he showed us a rich green, 4.81 ct cushion-cut demantoid garnet from Russia, which contained a golden-colored horsetail inclusion. Such a gem would wholesale for $15,000 per ct, he said. According to Boehm, gems of such pure green color rarely come out of the ground—they are typically heated to this color. This treatment has been going on for 10–15 years, he explained. Despite this treatment, the demantoid is still an exceptional stone.

Boehm explained that judicious heating converts a yellowish green gem to a vibrant green but removes some of the stone's characteristic fire, making it an almost "electric" green color. He prefers a balance of color and fire, acknowledging that the gem's inherent fire—flashes of red and blue coming off a green bodycolor—is part of its unique appeal. In today's market, any demantoid over 2 ct is extremely rare, so this gem's size of almost 5 ct makes it very desirable.

The demantoid was from new production rather than the secondary market, Boehm explained. He added that there is still newly mined supply and treaters are perfecting heating techniques to make gems much more vivid, although not all respond like this one.

Finally, he showed us a striking 31.79 ct Sri Lankan pear-shaped sapphire with *padparadscha* color—a delicate pink flushed with a bloom of orange (figure 9). He explained that the gem had been recut three times to perfect its shape and proportions. The objective of recutting the original old-style cut was to close the window on the pavilion, but any further work would affect the brilliance and might even lose the cherished pinkish orange color. He added that when cutting padparadscha sapphire, it is very hard to keep that balance of pink and orange, because sometimes the orange might be in just one portion of the stone, which could easily be removed accidentally. A gem of this size is enormous for a padparadscha, he noted, and the wholesale asking price would be in the neighborhood of $30,000–$35,000 per ct.

Boehm noted that on October 7, 2016, President Barack

Figure 9. This 31.79 ct Sri Lankan padparadscha *sapphire shows the cherished combination of a pink bodycolor suffused with orange. Photo by Albert Salvato; courtesy of RareSource.*

Obama signed an executive order lifting U.S. sanctions on Myanmar, allowing Burmese jadeite and rubies, and any jewelry containing them, to be imported into the United States. The sanctions had been imposed in 1997 (see https://www.treasury.gov/resource-center/sanctions/Programs/pages/burma.aspx).

Boehm felt fortunate to be in Mogok (figure 10) when the ban was lifted and was able to celebrate with many of the local miners and brokers. He hoped the change would significantly improve the supply of Mogok gems but anticipated that any increase in gems reaching the U.S. from this source would likely take some time. Most if not all Mogok mining licenses have been suspended as the Burmese parliament and ministries work together to rewrite mining laws in Mogok and the jade mining areas in Pagan. These laws have been in place for more than 100 years and have changed little.

Figure 10. In October 2016, an AGTA delegation visited gem markets and mines around the world-famous locale of Mogok. Their mission was to report back on conditions within the local gem and mining industry after the new government took office. Photo by James E. Shigley.

When Aung San Suu Kyi's National League of Democracy party won a majority of seats in parliament during the November 2015 election, it was able to effect change with a special focus on the environment. The new administration's objective is to make reclamation integral to obtaining a mining or prospecting license, so that when mining finishes, the licensee will be obligated to return the land to its original condition. The government wants to ensure these laws are enforced and that environmental and ethical standards conform to Western expectations for the gem mining sector. The aim is for the new mining laws to meet the internationally accepted standards outlined by the Organization for Economic Cooperation and Development (OECD), a group of 34 democratic countries that develop economic and social policy to support free market economies. These principles are laid out in the policy paper *OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas* (http://dx.doi.org/10.1787/9789264252479-en). For more information on corporate social responsibilities and ethical colored stone supply chains, please see J. Archuleta, "The color of responsibility: Ethical issues and solutions in colored gemstones," Summer 2016 *G&G*, pp. 144–160).

Boehm mentioned the recent AGTA October 2016 delegation (figure 11) to Myanmar that visited the cities of Yangon, Nay Pyi Taw, Mandalay, and Mogok. Along with other U.S. trade and industry bodies, AGTA is seeking to reestablish responsible gemstone trade between the two countries. This is only possible because of the political and economic progress Myanmar has made in the past six years, but it also depends on Myanmar's gemstone sector meeting international standards such as OECD's guidelines.

The delegation, which included GIA researcher Dr. James Shigley and representatives from Jewelers of America, met with a cross section of stakeholders, including the U.S. ambassador, ministers and representatives of the Myanmar government, international and local organizations, trade associations, gem dealers and traders, and mine owners. They visited a number of gem markets and mines, including the Baw Maw mine (figure 12) and the Taung ruby and sapphire mine.

According to Boehm, the delegation was an impartial group sent to look at the situation "on the ground" in Myanmar, particularly in Mogok. He explained that it was an "eye-opening" experience and although conditions were much better than the group anticipated, there was room for improvement. The delegation made a series of observations that were set out in their white paper, *Step by Step – Myanmar Gem Sector Emerges from Isolation and U.S. Sanctions*, which is available from AGTA's website at http://agta.org/info/docs/burmawhitepaper2016.pdf

Figure 11. The October 2016 AGTA delegation at Mogok's Taung ruby and sapphire mine. Edward Boehm and GIA's Dr. Jim Shigley are at left. Photo courtesy of James E. Shigley.

Boehm indicated that Mogok was still beholden on the U.S. gem industry's ongoing efforts to ensure that Myanmar's government follows through with its promise to manage the gem sector properly and that the Burmese people benefit from the gems. He cautioned that a lot of mining licenses remain suspended. Therefore it's very unlikely that U.S. businesses will see much production until these are reinstated, possibly in late 2017. He forecasts that the U.S. trade at large will have to wait at least another year before production appears in earnest. At that point, he expects many more U.S. buyers will travel to Mogok and competition for scarce goods will drive prices up, but at least the goods can be legally imported into the U.S. once more.

He reported that because of the government's suspension of mining licenses, Mogok's mines are currently closed again after a brief reopening. Boehm suspects several reasons for caution on the part of the authorities. Firstly, it would be very tempting for miners to produce as much material as possible now that dealers from the U.S. can legally buy gems in Mogok, so the government wants to buy time to regulate mining ethically to make sure the Burmese people are protected (figure 13). Secondly, they want to prevent large foreign investors from taking over the mining sector. Finally, there are some security issues with traveling the new road leading into Mogok at night, which the authorities want to correct before mining licenses are reinstated. Boehm considers these good signs that demonstrate the Myanmar government's commitment to security and corporate social responsibility for the good of its citizens.

Duncan Pay

Figure 12. Workers sorting heavy mineral concentrate from the Baw Mar mine near Mogok. Photo by James E. Shigley.

Conversation with Gemfields. UK-based Gemfields is widely considered the largest producer and distributor of responsibly sourced colored gemstones. This year in Tuc-

Figure 13. During the AGTA trip, delegates watched villagers searching for peridot in the waste tailings of the Pyaung Gaung mine near Mogok. Photo by James E. Shigley.

Figure 14. The massive open-pit Kagem emerald mine in Zambia is perhaps the largest colored gemstone mining operation in the world. Photo by Andrew Lucas, courtesy of Gemfields.

son, we had an exclusive interview with CEO Ian Harebottle to get his insights on the company and the colored gemstone industry overall.

Unlike the diamond industry, almost every segment of the colored stone trade has traditionally lacked scale and systematic practices. Gemfields has dramatically changed this dynamic in some of the most influential colored stone categories. The company is actively working on three mining operations: the Kagem emerald mine (figure 14) and the Kariba amethyst mine in Zambia, and the Montepuez ruby mine in Mozambique. Among the three, Kagem and Montepuez are world-class operations, supplying about one-third of the global emerald production and 70% of ruby production. Before, both stone types experienced fluctuating supply and chronic shortages. Gemfields is very optimistic about the expected supply from Kagem and Montepuez, based on scientific field surveys and detailed geophysical and geochemical studies.

To stabilize supply for the global market, Gemfields requires the mines to reserve one year's production in case yield declines significantly. Based on the authors' research, many Gemfields clients appreciate the standards set by the company on emerald and ruby mining and distribution. The consistent supply and well-tuned rough grading systems grant buyers more time to focus on faceting, jewelry making, and sales. This practice also has a positive influence on other mining companies that aim to meet the same standards.

In 2013, Gemfields purchased the iconic luxury brand Fabergé. Harebottle explained that the deal does not reflect an interest in vertical integration but in creativity and uniqueness in the market, an area where Fabergé has a rich heritage (figure 15). Therefore, he hopes that the brand can be a platform of magnificent jewelry designs, igniting the passion for colored gemstones in the younger generation. According to Gemfields, Fabergé's sales orders jumped 95% during the second quarter of fiscal year 2017.

When it comes to corporate social responsibility, Gemfields sets a good example across its mining locations through successful joint ventures and community programs. The Kagem emerald mine is one of the only mining companies that has paid federal taxes in the past 15 years in Zambia. The Montepuez ruby mine was named Mozambique's most transparent tax payer and the most important job generator in its province. Harebottle described the different challenges the company has faced and will be facing in the future. Since the sites are usually located in areas

Figure 15. The merger of Gemfields and Fabergé should continue to inspire one-of-a-kind colored gemstone pieces. Photo courtesy of Fabergé.

that lack robust mining regulations or laws and some countries have a very long mining history, the company often applies different strategies to localize itself. To champion responsibility and sustainability on location, a foreign company such as Gemfields needs to make the local people feel confident about their future, and this is fueled by job opportunities.

Since its founding less than 10 years ago, Gemfields has always sought to rekindle the passion for colored gemstones. Harebottle likes to compare the company's role in colored stones with that of De Beers in the diamond sector, especially when the latter heavily promoted diamonds. He also feels that colored gemstones should have a stronger position in the luxury goods market. With this mission under way, and active exploration for new production sites in Colombia and Ethiopia, more accomplishments are expected from this major colored gem supplier.

Andrew Lucas and Tao Hsu

Figure 16. The washing process used by Mustang Resources is different from most jigs used for colored stone mining. Photo courtesy of Mustang Resources.

New ruby miner in Mozambique. Mustang Resources LLC, a publicly listed Australian company, is developing a ruby mining operation in northern Mozambique. With the success of the colored stone mining giant Gemfields, Mozambique has secured its position in today's global ruby market. Mustang's concession is located about 8 km northwest of Gemfields' Montepuez ruby mine. Both properties are located on the ruby mineralization belt in the Montepuez Complex, where ideal physical and chemical conditions favored the formation of gem-quality ruby. In between the two concessions there are some designated ruby-bearing areas where individual small-scale miners can legally work.

While the geology of the Mustang operation is generally similar to that of the Gemfields concession, the bulk sampling strategy and washing process are slightly different (figure 16). Currently, the miners focus on exploring and sampling the secondary deposits. They open pits of 20 × 5 meters or 20 × 7 meters and immediately refill the first pit before opening the adjacent ones; this way, no large pit is left open on the surface of the mining area. Mustang has been using scrubbers instead of log washers to break the clay bodies in the ore. A new customized scrubber system will soon be in place to optimize this process. Unlike the jig system applied by many colored gemstone mining operations around the world, the team uses a giant rotary pan to concentrate the heavy minerals, including ruby, through the centrifugal forces generated during rotation.

Since the team from Mustang started to develop the project in early 2016, the exploration, bulk sampling and ruby recovery have made significant progress. Christiaan Jordaan, the managing director of Mustang's Montepuez ruby project, informed the authors that the washing plant had been successfully relocated and tuned to operate efficiently and that grading into parcels had begun (figure 17). The team has test marketed these rubies in the United States, where some large, significant stones will be cut by well-known cutters. Mustang will also test the ruby market in Asia and other parts of the world. Jordaan reassured the authors that Mustang will focus on improving quality of life in the mining community and promoting their ruby as an ethically mined product. Since the beginning of this ruby mining project, the company has hired and trained 70 local employees to work together with foreign experts.

Andrew Lucas and Tao Hsu

New emerald production from Belmont. The Belmont mine in Brazil has been a key emerald supplier in the global market for the past 40 years. It is one of the very few companies that can guarantee a complete mine-to-market chain

Figure 17. Taking a cue from Gemfields, Mustang Resources grades rough rubies into specific quality and size parcels. Photo by Andrew Lucas and Tao Hsu, courtesy of Mustang Resources.

of custody for the emeralds it produces. As open-pit mining became more expensive over the past decade, underground mining gradually generated a larger share of production at Belmont. Today, all mining activity at the original open pit is underground. Open-pit mining will continue in the two pits to the north of the original site. General manager Marcelo Ribeiro revealed some exciting news about the Canaan mine, about 2 km away from the original pit, and expansion plans for the sorting and cutting facilities.

Belmont acquired interest in the Canaan mine through a partnership with its original owners. Exploration and underground mining infrastructure are still ongoing at this site. Although the operation just started about a year ago, Ribeiro and his team have learned a lot about this deposit through field studies and chemical analysis. The interesting finding is that there is plenty of beryllium in this area, which makes the survey of chromium concentration critical to locating the mining targets. This is the exact opposite of the situation at the original Belmont site, where beryllium is the critical factor.

According to Ribeiro, two geological events were responsible for emerald crystallization in the area. The original Belmont mine is mainly influenced by the first event, Canaan by the second. Based on research, the second event was much stronger at the Canaan mine, destroying most of the crystals formed during the first event. The second-generation emeralds have a lower chromium concentration, and therefore lighter green colors, but they are often larger and cleaner than those from the Belmont mine (figure 18). The new production is sometimes slightly yellowish or bluish. Ribeiro is very excited about the Canaan production, which allows the company to provide a greater selection to its clientele.

Belmont currently cuts 50% of the Canaan production by value. All medium- to high-quality stones are cut on-site to add more value. To increase the capacity of the operation and make mining cheaper for long-term sustainability, the company plans to add two more optical sorters and further expand the cutting facility. Belmont will also keep promoting its mine-to-market product and better communicate with younger buyers to make them feel proud of their emerald purchases.

Figure 18. Second-generation stones from Brazil's Canaan mine are often cleaner and lighter in color than those from the first geological event. Photo by Eric Welch/GIA.

Andrew Lucas and Tao Hsu

Importance of the secondary market for fine gems. At the AGTA show, Dave Bindra (B&B Fine Gems, Los Angeles) showed us some exceptional items he recently sourced from the secondary market. These are previously sold goods recirculated back into the market by the former owners or their heirs.

Bindra also updated us on his perception of U.S. traders' reaction the withdrawal of sanctions against Myanmar (Burma) and what that means for U.S. dealers like him. According to Bindra, most U.S. dealers greeted lifting of the trade embargo with enthusiasm as they can legally import and trade Burmese rubies again. Prior to this they were limited to trading items that had come into the country "preban." Bindra doesn't expect prices to come down; rather, he projects they will strengthen as American demand and consumption of Burmese goods grows. He noted that during the ban, some consumers and certain major brands stopped consuming rubies altogether, basically because they weren't open to consuming rubies from sources like Mozambique, which has become a prolific source of commercial-to-fine grade gems. Now that the ban is lifted, Bindra hopes many of these companies will start buying and selling Burmese rubies again. The main issue now is the very limited supply coming out, but he says there's definitely a strong market for fine-quality stones.

Bindra highlighted some exceptional pieces at his booth to illustrate the importance of the secondary market for his inventory. The company also procures gem materials from currently active mining areas, but the secondary market is important for larger, more important stones, which are scarce as a percentage of new production. As an example, he shows us a fine, oval-cut, 55.52 ct copper-bearing tourmaline from Mozambique (figure 19). He notes this particular stone came out of the original 2007 production from Nampula Province, northeastern Mozambique, near the village of in Mavuco (see B.M. Laurs et al., "Copper-bearing (Paraíba-type) tourmaline from Mozambique," Spring 2008 *G&G*, pp. 4–30).

B&B actually sold this stone about seven years ago, and was lucky to reacquire it when the opportunity arose in 2016. Bindra considers this fortunate as there is no production from this deposit today and it would be impossible for them to find an item like this, other than the secondary market.

Another example he cites is a beautiful 5.06 ct trillion-cut benitoite (figure 20). This gem—a barium titanium silicate—is typically colorless to blue, and is noteworthy for its high refractive indices, moderate birefringence, and strong dispersion. It comes from just one mine, located in

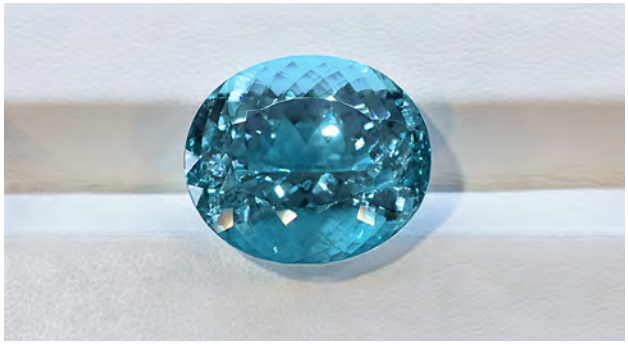


Figure 19. This exceptional oval-cut, 55.52 ct copper-bearing tourmaline from Mozambique was previously sold by B&B. They recently reacquired it through the secondary market. Photo by Eric Welch; courtesy of B&B Fine Gems.

San Benito County, California (see B.M. Laurs et al., "Benitoite from the New Idria District, San Benito County, California," Fall 1997 *G&G*, pp. 166–187). The benitoite mine has been closed for years. Bindra describes this 5 ct as an "astronomical size for this deposit"—the typical size range of commercially available finished gems from this mine was between 0.30 and 1.70 ct. He noted that this gem was a prized possession of an original mine owner.

Bindra also showed us a couple more recirculated pieces: a fine 15.06 ct double-sided black opal cabochon (figure 21) with broad flashes of play-of-color from Australia's Lightning Ridge and a 19 ct antique-cut Brazilian Imperial topaz. This last stone was old, unheated material from Ouro Preto. The stone came out of an old collection and was a little over 20 ct. They were able to recut it with minimal loss of weight to significantly improve luster and brilliance. Bindra told us these gems underscore the importance of the secondary market for his inventory. While it doesn't supply the day-to-day production B&B needs, it does produce truly exceptional items from time to time. He noted that fine colored gemstones always retain their value, which is why B&B is often able to reacquire items over a period of time. He always keeps this in mind whenever selling rare, esoteric gemstones.

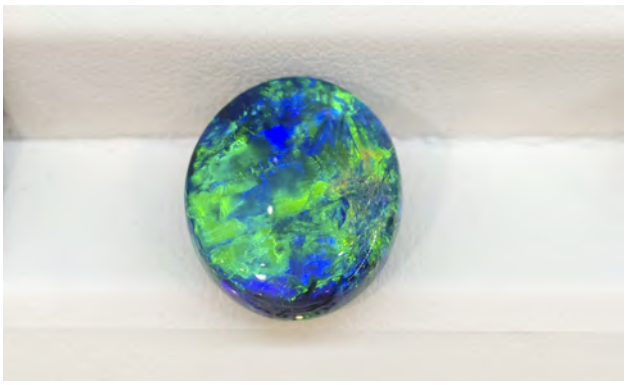
Next, Bindra showed us one of the most exceptional stones he's had in years: a 10.22 ct cushion-cut Brazilian alexandrite. He adds that B&B has trouble fulfilling orders for 6 mm (approximately 1.00 ct) round alexandrite with current Brazilian production, so finding a 10 ct size is really an anomaly. According to Bindra, it came out of an old collection in Japan, where it sat in a safe for 20 years. He said he "couldn't write the check fast enough" to get it into B&B's inventory. In this case, there was no need for repolishing. The gem is unusual not just for its size and the quality of its color change, but also because of its brilliance. He notes that Brazilian alexandrite of this rich blue-green to reddish purple color tend to be "over dark" and lack life. This stone was faceted with a typical Portuguese pavilion, which confers considerable brilliance. Due to these factors, Bindra adds, the wholesale value of a truly fine gemstone like this is well over $55,000 per carat.

Finally Bindra shows us a 20-ct-plus star sapphire with a sharp six-rayed star, strong blue bodycolor, exceptional translucency, and a well-proportioned, high-domed cabochon shape. It's another piece that's "come out of recirculation," says Bindra. He suspects the current marketplace scarcity of fine blue star sapphires is due to a newly discovered heating process, leading to a lot of fine-color examples being recut into faceted gems. He cites an example of a 23 ct star sapphire, which might be heated and refashioned into a top-gem royal blue color faceted stone in the 10–15 ct range. For some people, that's more desirable, so stars are becoming rarer. Not every stone can be heated and improved, as they might break due to the unforeseen way inclusions react to the heat.

Bindra sees strong demand from the top one percent of consumers. He notes that exceptional gemstones are in very high demand, as more than ever people find value in

Figure 20. This fine-quality 5.06 ct trillion-cut gem is exceptionally large for benitoite. Photo by Robert Weldon/GIA; courtesy of B&B Fine Gems.

Figure 21. This 15.06 ct double-sided black opal cabochon from Lightning Ridge was another recirculated gem offered by B&B. Photo by Eric Welch; courtesy of B&B Fine Gems.



hard assets—fine art, classic automobiles, fine wine, high-end watches, important diamonds—and colored gemstones are "in that same conversation." Bindra professes some skepticism about the middle of the market, where commercial to mid-grade material is not moving as well. At the top end of the market, high-end colored gemstones are difficult to find because of competition from overseas—from new markets, from new capital—especially in Southeast Asia, where there is a cultural affinity for consuming fine colored gemstones.

Duncan Pay

Cultured pearl market update. At the 2017 AGTA show, Fran Mastoloni (Mastoloni Pearls, New York City) provided a cultured pearl market update. Mastoloni is a 30-year veteran of the Tucson show and well positioned to place the ups and downs of demand in context. There is a real desire for cultured pearls, he says, but people have moved away from the traditional white necklace. Partly this is because cultured pearl sources have become much more diverse in recent years, with French Polynesia, Australia, the Philippines, Indonesia, and China contributing a diverse array of cultured pearl types, shapes, sizes, and colors (figure 22).

Mastoloni's clients are seeking—and selecting—something different. "They all want a unique necklace," he says. And since the second quarter of 2016, he's seen demand pick up considerably. Most clients don't want to spend a fortune, but they do want the piece they choose to be unique and individual. His job is to create cultured pearl necklaces that meet their needs.

To demonstrate, Mastoloni showed us his "Fantasy" necklace: a standard-length strand combining South Sea and Tahitian cultured pearls with lighter gold ones from Indonesia. This blends a repeating pattern of large (up to 16 mm) eye-catching, semi-baroque pearls with smaller examples—down to 8 mm—to create a large, mixed look. The use of light and dark pearls also confers the ability to use the piece on a variety of clothing colors for day or night use, he added, so it's very versatile. He added that products must also appeal to female self-purchasers, so the retail price point—less than $2,000 per strand—is an important consideration. This is a very important—if not the most important—market segment for him today.

Mastoloni showed us another successful cultured pearl line for the company, which he dubbed the "Cocktail" necklace (figure 23). It combines Philippine gold pearls, white Australian South Sea, and lighter Tahitian pearls to create a long necklace that can be draped twice. Again, every necklace is individual, so that a customer can "key into" an individual pearl—maybe a large South Sea or Tahitian—and identify that necklace as unique. Examples like these, he explained, transform the concept of what a cultured pearl necklace might be.

Customers are similarly drawn to baroque pearls for their uniqueness. Mastoloni used a variation of the "Cocktail" necklace to illustrate the point, this time with baroque pearls ranging from 16–17 mm plus down to 9 mm. The organic shapes bring texture and movement to the piece and "make it fun."

Figure 22. The range of necklaces at Mastoloni's AGTA booth included innovative blends of different cultured pearl types. Photo by Eric Welch; courtesy of Mastoloni Pearls.

The next necklace he showed us blended 9 mm baroque white South Sea "keshi" pearls with 14 mm dark Tahitian round cultured pearls, creating two transitions: from light to dark and from organic shapes to regular, round ones (figure 24). A customer might own all three of these necklaces, he said, and use them for different occasions.

Also popular are variations on the wave necklace, which blends a uniform strand of round white Japanese akoya cultured pearls with "waves" of graduated silvery black Tahitian cultured pearls that swell and pinch out against the white of the akoyas. The mix of the different cultured pearl types working together is what makes these

Figure 23. The "Cocktail" necklace features a combination of differently sized round cultured pearls: darker Tahitian, golden Philippine, and white Australian South Sea. Photo by Eric Welch; courtesy of Mastoloni Pearls.

designs so successful. They're the kind of "fashion-forward" pieces that stylish but price-conscious consumers pick out, he says.

Of course, sourcing pearls for all these necklaces is always a challenge for Mastoloni. One of his key considerations is maintaining standards. For the "Cocktail" necklaces he has to source pearls of the same tone, color saturation, and luster. You just can't throw pearls together and expect them to look good, he explains. It requires an understanding of the product along with consistency in both quality and look—as well as an enormous amount of pearls.

Mastoloni asked us to look at professional women of power on television, who frequently wear significant pearl necklaces. Their choice might be a necklace combining different pearl colors, or a uniform one with large round white South Sea or Tahitian cultured pearls. Fine pearls can be worn in the boardroom or at social gatherings—they show that the wearer "has arrived." No other jewelry is as versatile.

Mastoloni noted that the supply of Tahitian cultured pearls has changed. Although there looks to be a good variety of subtle colors, he's not seeing the same wide range of colors as 10–15 years ago. This appears to be because the culturing process is improving and there is more control over color consistency. This is better from the point of view of investors, because consistent colored pearls are easier to match and sell. As a result, those investing in pearl cultivation find it easier to recoup their expenses.

Next, he showed us single pearls and collection pieces, starting with a 23.3 × 28.6 mm Australian baroque South Sea pearl that was solid and unblemished on all its surfaces. Single pearls like this one are unique items that a person can make their signature piece—something they wear every day.

Figure 24. This necklace features 14 mm round Tahitian cultured pearls in the front and 9 mm South Sea "keshi." Photo by Eric Welch; courtesy of Mastoloni Pearls.

Figure 25. A pair of 15 × 18.5 mm light pistachio Tahitian cultured pearls, A matching-color drop shape measuring 16 × 22.7 mm makes up a trio. Photo by Eric Welch; courtesy of Mastoloni Pearls.

Pairs, such as the 15.0 × 18.5 mm Tahitian cultured pearls seen in figure 25, are also perfect for unique pieces. Their light pistachio color is one of the colors Mastoloni used to love but can no longer easily obtain. Serendipitously, he found a matching-color larger drop shape measuring 16.0 × 22.7 mm to make up a trio (again, see figure 25). According to Mastoloni, the right designer could make an incredible piece out of these.

His next piece was a 16 × 23 mm Tahitian drop pearl with a unusual shape and excellent luster. It was a near-perfect teardrop with a very attractive slightly asymmetrical tip, shaped almost like a drop of water. It begs attention, he explains, a pearl like this could be the center of attention in a one-of-a-kind necklace. Mastoloni confirmed that such teardrop-shaped pearls are now difficult to find in Tahitian production. As pearl culturing techniques improve, drop pearls are nowhere near as desirable—or as profitable to produce—as spherical ones. Pearl farmers are more concerned with return on investment, so they are really striving to produce more round pearls. As pearl culturing methods improve, consequently, it becomes harder and harder to find nice teardrops—producers make a lot of less attractive, misshapen examples which bring down the value of the harvest.

Finally, Mastoloni showed us a top-quality pair of 15.3 mm round golden pearls. He noted that golden pearls—which are generally produced from the gold-lipped oyster in the Philippines and Indonesia—are still a good business, with much stronger demand in Asia than in the U.S., although the market probably peaked about a year ago. He notes that there might be a little oversupply in Asian markets, but he expects it to be temporary. As far as quality is concerned, Mastoloni's advice is to look for a pearl that has a good "gold" color—he always likens it to a "ring color"—"you don't want yellow and you don't want green, but it's got to have a richer gold to it," he says. Indonesia is always going to have a steady supply of pearls, because cultivation takes place over such a large area, he says but cautions that

there's so much champagne and creamy greenish yellow production that he cannot use. He notes that their supply is getting better, but it's not quite there yet. In his opinion, cultivators in the Philippines are excellent at producing gold pearls, as their waters and their oysters are better suited for these products. Indonesia will continue to produce all colors, and Australian pearl farmers will concentrate on white, while those in Tahiti focus on the different shades and nuances of black pearls.

Duncan Pay

Moroccan amethyst: Mining and marketing. Characteristic "hourglass" color zoning (figure 26) and striking red hematite "finger" inclusions help distinguish Moroccan amethyst. Although amethyst is readily available on the market, the material from Boudi in southern Morocco stands out. While Moroccan amethyst has been featured in *G&G* previously (F. Troilo et al., "Amethyst from Boudi, Morocco," Spring 2015, pp. 32–40), we gathered some fresh insights on the mine and the marketing strategy for this material from Alaeddine Rafei, who directs grading and sales for Geostone Group in Morocco.

About 40 years ago, a group of nomads were stuck in a storm in the Anti-Atlas mountain range of southern Morocco. The next morning, they found purple crystals on the washed ground. The nomads kept bringing the crystals to tourist shops in the villages nearby. Seven years ago, a geologist and a cofounder of Geostone Group finally had the stones analyzed by GIA and confirmed that they are amethyst. Mining started in 2011–2012 and has continued on a small scale since then. From 2011 to 2015, the miners mainly used hand tools to remove the earth and extract the crystals. As the wall has gotten pushed further back, excavators have been used since 2015 to move earth. The miners are still hand picking crystals out of the removed earth.

Rough amethyst crystals are transported to the company's warehouse in Casablanca for washing and grading. Washing is done with water and acid. Rafei explained the four grades of Moroccan amethyst. The topmost grade consists of double-terminated single crystals, which are extremely rare. Rafei explained that only 1% of the production is gem quality (figure 27), of which only 2% are the double-terminated crystals. Next come the AAA grade, which refers to the deep purple stones, and the slightly less purple AA grade. The AA grade is the most common on the market. The fourth grade is a category called Rose du Maroc. Amethysts falling to this grade have an even lighter purple color than AA stones.

Marketing these amethysts is an even greater challenge. As people can imagine, the rough amethyst market is very competitive, since there are many sources in different countries. In 2013, when Geostone's founders brought their Moroccan amethysts to Tucson to test the market, they went home deflated by the feedback. Large colored stone cutting companies see little value in these amethysts. Luckily, the founders got connected with

Figure 26. These amethyst crystals from Morocco show the strong zoning characteristic of stones from this location. Photo by Eric Welch/GIA, courtesy of Geostone Group.

world-renowned gem carver Glenn Lehrer, who became their marketing advisor and took Moroccan amethyst in a completely different direction. Lehrer saw the unique features in these stones and applied his cutting styles and award-wining patented cuts to show off their beauty. The special cuts also better use the rough. The yield of Moroccan amethysts at a normal cutting factory is only about 8%. When Lehrer's special cuts are applied, the yield was increase to an average of 20% for top-quality stones. He also introduced these amethysts to Gems TV. Instead of selling the rough to gem cutters, the company now offers faceted stones and finished amethyst jewelry directly to consumers through multiple TV programs in different countries.

As a result, Moroccan amethyst is not just another amethyst. It is now a brand and trademark of Geostone Group. The mine-to-market story is sold with the gems. The story even landed Moroccan amethyst in the Rio Grande catalog. In return, the company is actively involved in community building in the mining area. It only hires

Figure 27. Morocco produces deep purple amethyst with red hematite "finger" inclusions that can cause red flashes of color. Photo by Eric Welch/GIA, courtesy of Geostone Group.

local Berbers to work in the mine, offering them a good salary and health care. During the past several years, Geostone Group has kept production quite stable and limited mining crew sizes to around 20 people. Wells, roads, electricity, and designated vehicles for schoolchildren and villagers are all provided using profits from the amethyst mine. In 2016, Geostone Group received an award from the Moroccan government to highlight its contributions to social responsibility and gem mining in Morocco.

Andrew Lucas and Tao Hsu

Emerald dealing in Afghanistan. Dealing rough gemstones is never easy. This is true even for gemstones dealers with decades of experience such as Arthur Groom of Eternity Emerald (Ridgewood, New Jersey). Groom has traveled all over the world to purchase emerald rough, and his current focus is Afghanistan. In Tucson, he demonstrated to us the art of rough purchasing and the critical decisions that must be made during this process.

Groom started by opening a parcel of about 260 g of rough emerald (figure 28), which he valued at a minimum of $600,000. He recounted the decisions he had to make in the field in Afghanistan when buying this parcel from miners. Just as with individual colored gemstones, the first thing buyers need to look at is the color of the whole parcel. Tip number one: Always spread out the stones after you get the first impression of the parcel. This is important, because colors always look better when stones are clustered together; spreading out the stones helps the buyer see the appearance of individual stones and better sort them into several groups. Next, do a quick estimation of the percentage of each group relative to the whole parcel. For example, a parcel may contain about 20% lighter-colored emeralds.

Since evaluation is the most critical step in rough purchasing, there are several aspects buyers must pay extra attention to when estimating the value of a certain piece or group. The color, the model (shape) of the crystal, and the clarity features are the three key observations that determine your decision. When looking at color, it is especially important to consider the crystal's core. This is essential for Afghan emeralds, because many of them have a lighter core (figure 29). Stones like these will lose color after faceting, which demands extra planning and often results in a higher weight loss. For emeralds, darker rough is more likely to maintain its color after cutting. The lighter rough tends to lose color, especially when cut into melee.

The rough dealer must visualize how the finished stone can be placed inside the rough based on the model, as it dictates the final yield of the rough. Groom demonstrated the types of emerald that achieve high weight retention and others that do not. There is a large quantity of pencil-shaped rough coming from the mountains of Afghanistan, material once regarded as waste by some miners and buyers. Groom said that with today's technology, these stones can be cut into melee that command on average $500–$1500 per carat. Old Soviet ammunition from the war three decades ago is still used to blast the emerald-bearing rocks due to the shortage of mining dynamite in Afghanistan. This is a problem for emerald mining, since many larger stones are broken during the blasting. The broken crystals also limit the weight retention. For instance, a perfectly preserved rough crystal can reach a yield of 60%, compared to only 10–15% for a broken one.

Figure 28. This 260 g rough emerald parcel was used to demonstrate the methodology in grading and negotiating the purchase of rough gemstones in the field. Photo by Eric Welch/GIA.

The "Four Cs" of colored gemstones are generally the same as for diamonds; however, a fifth "C" is crucial for emeralds. This is clarity enhancement, a common practice in the emerald trade. Imperfections are removed by cutting them out or treating fissures to lower their visibility. In the case of emerald, the latter is more common if higher weight retention and better proportions are desired. The buyer must find the emerald's fractures and make a decision on the possibility of enhancing them and leaving them in the stone. The essence of rough evaluation is to comprehensively consider all the factors and find the balance between them. Mastering the process requires years of

Figure 29. Upon close examination of this emerald crystal, sorted out of a large parcel during a buying trip to Afghanistan, Arthur Groom found the crystal core to be much lighter in color. Photo by Andrew Lucas.

Figure 30. Buying rough emerald in the field under less than ideal conditions, like a miner's office in Kabul, requires discipline and a systematic approach. Photo by Andrew Lucas.

practice and familiarity with both the rough and the finished stone markets.

After evaluation comes the art of negotiation. If the buyer is enthusiastic about purchasing the parcel, the negotiation takes off from there. Based on Groom's experience, buyers need to stay cool and offer reasonable prices to get what they want. The key takeaway here is that as a buyer, you need to know the value of the parcel and show the miners that you know what you are doing. Ridiculously low offers should be avoided, since that would immediately cast doubts on your capability and reputation. Once both sides realize that a fair deal is going to happen, the "sweet spot" for the price can be reached quickly.

Dealing with gemstones is ultimately about dealing with people. Afghan emerald miners (figure 30) are a very strong-willed group. They always come together to sell their stones. These miners do not owe banks money, so there is no pressure for them to sell the goods. In this situation, winning their trust is the key to motivating them to bring in more stones that fit the buyers' needs. Groom reminded us that respecting the locals and bringing value and benefit to them will guarantee good business and long-lasting friendship.

Andrew Lucas and Tao Hsu

Magnificent sapphires from Montana's Rock Creek mine. Potentate Mining marketing director Warren Boyd presented two magnificent sapphires (figure 31) and a suite of fancy sapphires extracted from the company's Rock Creek operation in Montana in 2016. He also updated the authors on this past mining season.

The larger of the two stones is the 12.61 ct blue sapphire, one of the largest of its kind from Montana. It was faceted from a 6.37 g rough that had been heated. The rough showed strong blue color before heating but had a core with heavy silk inclusions. Heating dissolved the silk and enhanced the blue color. The 7.9 ct orange oval is the largest of this color ever recovered from Montana, to Boyd's knowledge. This stone was faceted from a 5.2 g rough of pale greenish color with a dark brownish core. While the rough was of very low transparency, the results of heating were better than expected. The heated rough showed a royal blue rim surrounding a bright orange core. Both stones were faceted by Jeff Hapeman (Earth's Treasury, Westtown, Pennsylvania).

Most of the Rock Creek sapphire is small, and larger stones with spectacular colors are very rare. Because the bulk of the production comes out of the ground with greenish pastel colors, natural stones with bright colors are also very valuable. Boyd and his clients from Americut showed us a suite of natural fancy sapphires (figure 32) recovered in 2016. The company had produced sapphire rough from its Rock Creek deposit for two consecutive mining seasons and gradually built up a large inventory. Potentate is not planning to increase production but to keep it stable in the near future. The company installed a new water clarifier in its washing plant at Eureka Gulch, which recycles the water used in ore washing. The company will keep its focus on building inventory and bridging the gap between supply and demand.

Andrew Lucas and Tao Hsu

Magnesio-axinite from Merelani, Tanzania. Colored gemstone dealer Bill Vance (Vance Gems, Newark, Delaware) showed us some transparent examples of magnesio-axinite, a rare magnesium-dominant member of the axinite group of minerals. Axinite has a general formula of $H(CaFe^{2+}MnMg)_3(Al_2BSi_4O_{16})$. Gem-quality magnesio-axinite—also known as axinite-(Mg)—is transparent to

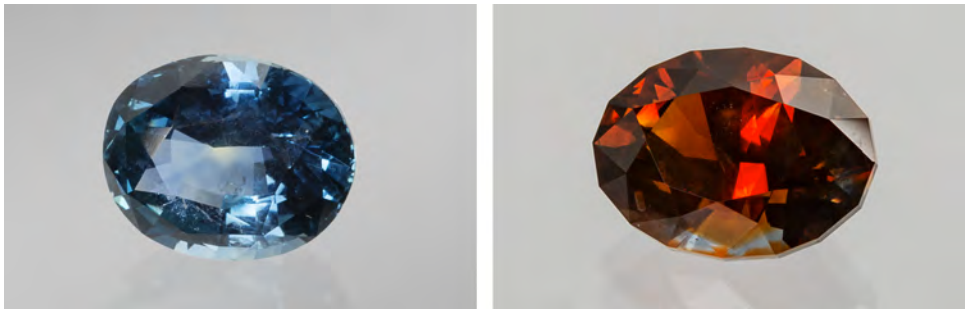


Figure 31. This 12.61 ct blue sapphire and 7.90 ct orange sapphire recently mined by Potentate show that large material still comes out of Rock Creek, Montana. Photo by Eric Welch/GIA, courtesy of Potentate Mining.

Figure 32. As displayed by these rough and cut sapphires, Potentate's sapphire production includes a wide variety of colors. Photo by Eric Welch/GIA, courtesy of Potentate Mining.

translucent, with pale blue to pale violet, light brown to light pink, or yellow to golden yellow or orange color (figure 33, left). More intensely colored bluish violet to purple magnesio-axinite tends to have a higher RI (1.659–1.681) than lighter-colored pink, purple, or yellow material (1.652–1.668). Magnesio-axinite has a birefringence of 0.010–0.016, strong dispersion, and a Mohs hardness of 5.5. Stones with a blue color component display pale blue to pale violet and pale gray pleochroic colors. Fluorescence is one of the material's most striking properties—the gem shows a dull red under short-wave ultraviolet light and a vibrant "merthiolate flame color" red under long-wave UV (figure 33, right). We intend to report on the chemistry of this interesting material at a future date.

Vance said he's attempting to name the gem "vanceite." Besides the fluorescence, pink to blue-violet stones display a color shift: If you view it under a fluorescent light, you're going to see a blue stone, he says, under incandescent, it's more of a pinkish color. Yellows don't show a color shift.

Because of the material's color shift and strong fluorescence, Vance believes it appeals to a wide audience. According to Vance, these examples come from a very limited occurrence in the Karo pit "D" block, Merelani Hills, Tanzania, where the chemistry and formation conditions were just right, and new material is very hard to get. It comes from the same rocks as green garnet, tanzanite, and chrome tourmaline. He remarked that while cutting of magnesio-axinite is straightforward, the biggest problem is getting clean pieces to cut as almost all have inclusions. In terms of size, he said, anything over four carats is a "monster."

Vance also showed us a heart-shaped 10.46 ct Tanzanian "Merelani mint" garnet. He noted that it displayed a very strong response to both long-wave and short-wave ultraviolet light (figure 34). Although such vanadium-bearing grossular garnet can come from Kenya or Tanzania, most of the Kenyan material displays no long-wave UV reaction. According to Vance, a strong long-wave UV reaction from a green grossular garnet is strong evidence of a Tanzanian stone from D block. Vance explained that supply of this material is now dwindling. In the beginning, prices ranged from $400–$500 per carat up to $800 per carat. Today's prices for equivalent material are in the range of $2,500 per carat. For a particularly fine example over six carats, prices might be as high as $10,000 per carat. Demand is really strong, especially in China.

Duncan Pay

Figure 33. Left: A suite of eight magnesio-axinite faceted gems and one rough stone. Clockwise from top right:1.21 g orange-yellow rough, 2.72 ct. yellow-orange pear shape, 1.14 ct bicolor marquise, 1.51 ct pair of pale pinkish blue princess-cut stones, 1.43 ct pink-blue oval, 1.83 ct light pink to light blue triangle, and at center in the pendant, a 4.22 ct. oval pink-blue gem. Right: The same magnesio-axinite gems under long-wave ultraviolet fluorescent lighting. Photos by Eric Welch; courtesy of Vance Gems.

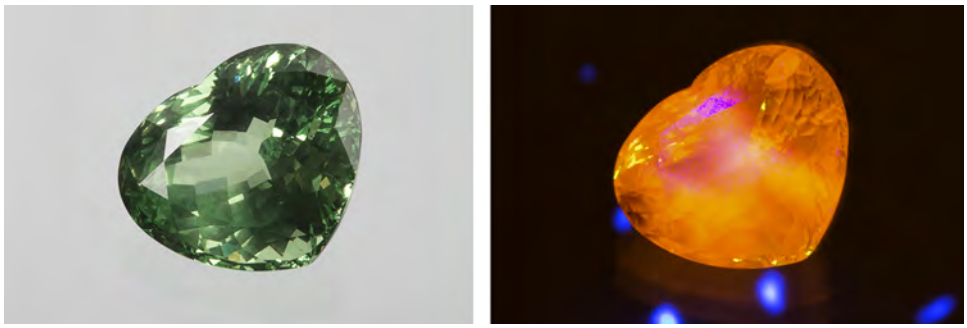


Figure 34. Left: A 10.46 ct heart-shaped green grossular garnet of the color known as "Merelani mint" in the trade. Right: The same grossular garnet displays a strong orange reaction to long-wave ultraviolet light. Photo by Eric Welch; courtesy of Vance Gems.

Ethical and sustainable vertical integration in the sapphire market. When the recession of 2008 struck, Sheahan Stephen (Sheahan Stephen Sapphires, Inc., San Francisco, California) had been dealing in Sri Lankan gemstones for two years. He saw his monthly cash flow drop to a third of what it had been when he first started traveling to Sri Lanka to buy stones for resale in the United States. During the recession he decided to borrow money and become vertically integrated. Stephen created a transparent supply chain and an ethical supply model by becoming directly involved in mining. His new business also included heat treatment, cutting, and sales.

Sustainable practices tie directly into Stephen's beliefs in how businesses should strive to operate. He sees lack of sustainability as a major cause of many of society's problems. He works with his customers in what he calls "customized" vertical integration. He fills specific orders for his customers directly from mines and brings the sapphires to market in a controlled manner, meaning they are always in his hands or an employee's hands until they reach the final customer. Stephen guarantees the entire supply chain and strives to provide full documentation, including the mine the sapphires (figure 35) came from and the name of the treater and the cutter.

He focuses on education and training in Sri Lanka to obtain the quality and traceability his customers expect. Training and complete trust in his Sri Lankan staff allow him to buy stones unseen that will fill his customers' specifications. Stephen also believes in providing education and other assistance for his employees' families in Sri Lanka.

Stephen finds that customers today want more information about their jewelry. They want to know where a piece came from, who was involved in manufacturing it and bringing it to market, and the corporate social responsibility practices of the company involved. With many of his customers today willing to pay 30% more for documented ethical sapphires and sapphire jewelry, he focuses on growing his sales with sustainability-minded clients. At the same time, he strives to be close to other wholesalers in his pricing to stay competitive and grow his business.

A major part of his business investment is the time he spends growing relationships with miners and cutters in Sri Lanka that can take years. That is an essential element of developing a sustainable business model for artisanal mining. Stephen hopes that building long-term relationships with his employees and suppliers in Sri Lanka and perfecting the processes throughout the supply chain will allow for slow but sustainable business growth. His vision is to take this model to other gem mining countries, especially in Africa, where he is currently working in Madagascar.

Tao Hsu and Andrew Lucas

Exceptional freeform tanzanite and Oregon sunstone rings. At the Gem and Jewelry Exchange (GJX), we caught up with gem artist Alexander Kreis (Sonja Kreis Unique Jewelry, Niederworresbach, Germany). As we've noted in previous Tucson reports, theirs is a family business: father Stefan buying the rough, mother Sonja designing the jewelry, and Alexander cutting the gems. Alexander and Sonja showed us a new ring (figure 36) set with a spectacular 27.20 ct vivid blue freeform tanzanite (figure 37). He explained that he had recently traveled to East Africa seeking a singular piece of gem rough to inspire an exceptional jewelry piece. He found his inspiration in Tanzania with a 65 ct rough tanzanite of remarkable color and clarity.

Even with such a top-quality piece, Alexander cautioned that success is never guaranteed. Unlike baseball—where you get three chances—with cutting, it's "one strike and

Figure 35. Untreated yellow sapphires such as this 12.18 ct gem command a premium in the marketplace, especially when a transparent chain of custody and sustainable mining practices can be documented for the customer. Photo by Eric Welch/GIA, courtesy of Sheahan Stephen Sapphires.

you're out!" He added that the gem can never be its best if the cutter misjudges and makes it too flat. For this one-of-a-kind rough, classic cutting styles such as oval or cushion shapes might be counterproductive if too much weight is lost getting proportions right or if the deep blue color is lost.

For Alexander, cutting is an "intuitive adventure" in which it might take months to place the first facet. The finished stone is a nonsymmetrical shield shape with a mixture of large and small facets that catch the light and create a strong sense of movement. According to him, cutting a freeform allows more reflections so that the gem will exhibit maximum sparkle and display the best possible color from the rough.

The facet dimensions govern the size of the reflections from the gem's surface, and a series of grooves on the base of the gem running at right angles to the facets on the top create sharp angles, heightening the sense of movement and drama (figure 38). For Alexander, this represents not just the movement of the earth, but also the volume of material the workers had to shift to recover the gems.

He reminded us that mining in Merelani is a challenge, taking place at depths of up to 3,900 ft (1,189 meters). Miners can only work for short periods due to temperatures reaching 122°F (50°C), and they must take regular breaks in designated cooling areas.

As a goldsmith and jewelry designer, Sonja follows a 500-year family tradition. She explained that it's not just attributes like size, shape, and color that drive the design of a jewelry piece to complement the stone. She normally starts thinking about the jewelry design when Alexander completes the stone, noting that it can change substantially from the rough crystal to the finished piece.

When Sonja saw the finished cut tanzanite, still wet from the wheel, she held it and examined it from every angle in front of a mirror to get a feeling for the gem and for the best type of jewelry mounting to accompany it. It's not just the size and shape that influences the gem, she noted, but the story behind it, too. This aspect is increasingly important for clients who like to buy into the romance and unique attributes of a jewelry piece. In this case, the rose gold on the mounting represents the heat the miners endure to recover the gems at depth in the mine, while the white gold cradling the tanzanite stands for the designated cooling areas where the workers have a chance to recover. The diamonds along the edges of the center gem symbolize the many stones that have been moved out of the way to reach the tanzanite. The branching metalwork in the galleries at each end of the mounting represents the air that must be pressed into the mine depths to sustain the miners. The little trail of melee diamonds around the curve of the ring's shank adds a final touch of elegance to a significant piece with a large center stone.

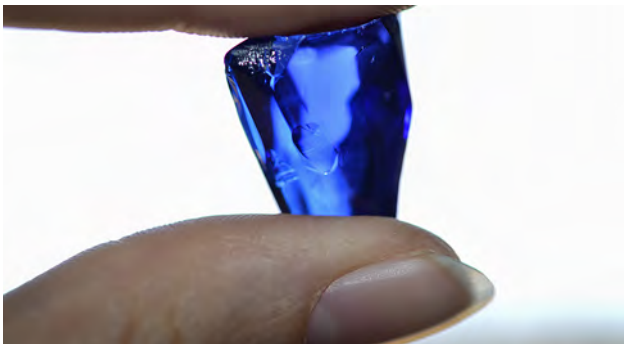


Figure 37. The gem was cut from a 13 g rough tanzanite of remarkable color and clarity. Photo courtesy of Sonja Kreis Unique Jewelry.

Figure 36. This ring is set with a spectacular 27.20 ct vivid blue freeform tanzanite. Photo courtesy of Sonja Kreis Unique Jewelry.

Figure 38. Angled grooves on the base of the 27.20 ct freeform tanzanite create a dramatic sense of movement. Photo courtesy of Sonja Kreis Unique Jewelry.

Sonja also shared with us a striking ring centered on a 28.21 ct freeform Oregon sunstone from the Dust Devil mine (figure 39). The organic outline of the mounting complements the smooth contours of the gem, which rests in an 18K rose gold "cup." The cup is highly polished to reflect light back through the gem and amplify its rich orange color. The gem itself is shot through with an array of glittering copper particles that catch the light and add to the piece's allure.

Duncan Pay

Figure 39. A 28.21 ct freeform Oregon sunstone from the Dust Devil mine is the centerpiece of this ring. Photo courtesy of Sonja Kreis Unique Jewelry.

Gem paintings from Thailand. The 2017 GJX show hosted a new vendor that manufactures and sells gem paintings, merchandise not typically seen in international gem and jewelry shows. Only a handful of companies around the globe are active in this market segment. Than Thong Arts operates its own factory in northern Thailand. Owner Wanlaya Suwannapirom is from a family that has been in the jewelry industry for over 70 years. She started her gem painting business more than a decade ago and gradually became the industry leader, with both international and domestic clientele (figure 40).

These paintings are handmade by highly skilled artisans in Thailand, using natural uncut gem fragments sourced from all over the world. The fragments come from either mining operations or cutting factories. The paintings' bright colors are generated by colored gem fragments, while the background and skin tones are created by dyed quartz or calcite powder. Artists also use extremely thin 24K gold leaf to color human hair and other details (figure 41). Unlike many other gem paintings, the gemstones are not glued to paper or canvas but attached to the glass and then framed.

The process includes several steps: sketching the painting on paper, a reverse transfer to glass, gluing the gem fragments and the dyed quartz or calcite powder, drying the glue, and framing the artwork. The middle steps are the most critical for the quality of the final product. The fragments are sorted into different sizes. Painters need to follow the order to apply the coarser grains first and then gradually go down to smaller sizes to fill the holes in between the fragments. This step continues until no space left between any fragments and the motif is completely colored by gems. Another challenge is to accurately and naturally reflect the human skin tone (again, see figure 41). To achieve this, painters grind quartz or calcite into very fine powder and dye them to slightly different tones for a very gradational transition of skin tone.

To cater to a wide range of customers, paintings are produced in many sizes and framed in various ways (figure 42). Besides wall and desk decor, the paintings are framed in jewelry boxes and wearable jewelry. According to Suwannapirom, smaller paintings require more attention to detail. In addition, crystal glass that contains a higher concentration of lead is used on the wearables to give them a glossier look than the pyrolytic glass used for decor. Therefore, the price range of the jewelry is similar to some of the larger desk decor pieces.

Customized gem paintings based on photos can also be specially created. At the booth, we saw some photo-based portraits made by Suwannapirom and her team. Some

Figure 40. While her family had been involved in different sectors of the gem industry for more than 70 years, Wanlaya Suwannapirom found a passion for gem paintings such as the one in this pendant. Photo by Albert Salvato/GIA, courtesy of Than Thong Arts.

Figure 41. By dyeing ground quartz or calcite in slightly different tones, a realistic gradation of skin tones can be achieved. Here, 24K gold leaf is used to create a beautiful hair color for the mother. Photo by Eric Welch/GIA.

Figure 42. Than Thong Arts' gem paintings are offered in a variety of sizes, frames, and styles. Photo by Tao Hsu/GIA.

prominent figures have hired her to produce their portrait in gems, including the kings of Saudi Arabia and Thailand. The finished products look very accurate and natural. The gems in the paintings offered at the show came with a certificate of authenticity issued by a Thai gemological lab.

Andrew Lucas and Tao Hsu

New designs from Paula Crevoshay. Paula Crevoshay came to Tucson some new designs that once again showcase her unique talent.

The "Queen Thai" bracelet (figure 43) contains five large freeform fire opals. Accompanying the opal are micropavé brilliant tsavorite accents and blue zircons connecting the bracelet sections. Four of the fire opals are from Mexico, and one is from Brazil. Crevoshay pointed out that the four Mexican fire opals have better transparency, while the Brazilian one has a more saturated orange color. All of them show some green and blue play-of-color, which complements the tsavorite and blue zircon accents. In return, the strong blue and green color of highly refractive tsavorite and zircon accentuates the opals' play-of-color. The intense orange color of the Brazilian fire opal forms a dramatic contrast with the Mexican stones and adds another layer to draw viewers' attention. The mounting of the bracelet follows the profile of the freeform opals, giving the jewelry its own personality.

Crevoshay expressed her love of nature in two new pieces from the collection. The "Swallowtail" butterfly (figure 44, left) combines yellow diamond, black diamond, blue Yogo sapphire, yellow sapphire, and red spinel. She informed us that this swallowtail is modeled specifically

Figure 43. In the "Queen Thai" bracelet, the contrast in orange color between the more intense Brazilian fire opal (left) and the Mexican fire opals leads the eye directly to the Brazilian stone. All of the opals are complemented by the green tsavorite. Photo by Eric Welch/GIA, courtesy of Paula Crevoshay.

after those found in Montana, a state whose natural beauty and sapphires she admires. She noted that she always tries to find an excuse to involve Montana sapphire in her artworks. The various stones are mounted over a large surface area, which allows them to optically interact with each other. The colors of the stones accurately reproduce the colors on the wings of these butterflies. When people move the piece in their hands, it vividly reflects the whimsical look of the real butterfly. The elephant head in figure 44 (right) evokes Crevoshay's memories of visiting an elephant orphanage in Sri Lanka. Captured in this pendant is the extinct East African forest elephant, which is smaller and less aggressive than most other species. A special texture was generated on the gold to depict the elephant's skin. A sapphire and spinel headdress shows the royalty of this creature. The eyes are tsavorite, while the tasks are carved mother-of-pearl.

Last but not least is the cuff bracelet featuring a large Australian boulder opal accented with sapphire (figure 45). To Crevoshay, "all opals are created by Monet," since each is a striking blend of colors. The play-of-color pattern of this opal reminds viewer of a spectacular cityscape at night. There is a subtle red linear play-of-color across the middle of this piece. This long marquise-shaped boulder opal has blue as its deepest play-of-color, and Crevoshay selected the blue sapphire to go with it. According to color theory, blue is a color that recedes. The blue sapphire and the blue play-of-color seem to dominate the cuff bracelet but then recede to the background to allow the other colors such as the green and the red to take center stage.

Andrew Lucas and Tao Hsu

Tourmaline and sapphire from Nigeria. Zoe Michelou, marketing manager for a Nigerian mining company, gave an update in Tucson on the production of gemstones, particularly tourmaline. She primarily handles sales and marketing of rubellite from Oyo State, where there are around 350 pits. There are usually 10 to 15 miners per pit. The miners descend 10 to 20 meters by ladder to the bottom of a pit, and then the pegmatites are blasted and tunneled before extraction. Some tunnels are linked for better air circulation. Pits can be very close together, although some larger open-pit operations have excavators in the pits and carts to remove the ore. Rubellite is concentrated in pockets within the pegmatites. There are plans to increase mechanization, and new pockets are being discovered.

Figure 45. The blue play-of-color from the boulder opal and the blue color from the sapphires dominate one's initial impression of the cuff bracelet. Photo by Eric Welch/GIA, courtesy of Paula Crevoshay.

Miners are paid a salary and provided with food and tools, as well as a bonus based on the value of the production. Sometimes miners can recover one ton of rubellite from a large pocket. Large single crystals can easily reach 18 kg. The rubellite is kept in a safe and then transported to the city of Ibadan for grading every two to three weeks, depending on production. Currently there are three to four quality categories. Most of the material is now shipped to Bangkok for final grading and sale. A new facility is planned to per-

Figure 44. Left: The yellow diamond, black diamond, blue Yogo sapphire, yellow sapphire, and red spinel in this swallowtail brooch create a stunning color combination. Right: This brooch was inspired by a visit to an elephant orphanage in Sri Lanka, which adds an extra touch of humanity to the piece. Photos by Eric Welch/GIA, courtesy of Paula Crevoshay.

form the final grading in Nigeria, with training of locals to create parcels for international clientele. Many of the rubellite crystals sent to Bangkok weigh 1 kg or more.

There is also an alluvial deposit where rubellite pebbles can be recovered without moving too much earth. In Kwara State there is important production of indicolite and green tourmaline, including some pink and bicolor. Most of the mining is still near the surface, with a few deeper pits. The first production of indicolite tourmaline sent to Bangkok had crystals of 2–34 grams ranging from commercial to very high quality.

Currently, the Nigerian is focused on selling rough rubellite (figure 46) through the Bangkok office and trade shows to the international market, especially in East Asia. The clients are mainly rough dealers and manufacturers from China, Hong Kong, and Thailand. This year, the company will start a training program for grading at the mining site in Nigeria. In the future, rough will be sorted and graded prior to shipment to Bangkok.

The interests Michelou represents just bought 180 square kilometers of land in the Mambilla Plateau area of Taraba State for sapphire mining. Nigeria has produced large quantities of fine-quality basalt-related sapphires. Extraction will start in the spring, with sales expected by the end of 2017 or beginning of 2018. They will only sell rough sapphires in Bangkok. Both primary and secondary deposits will be mined, with an initial focus on the secondary deposits. The washing plant will be able to handle 50 tons of ore per hour. Good-quality material weighing 3 to 5 grams is already being recovered. Security will be tight, and dealers from the Cameroon side of the border currently buying from unlicensed miners will be restricted from the commercial mining area. Transparent supply from the mine to Bangkok is an important part of the marketing strategy. The company is working out its grading system for rough sapphires.

The company primarily sells rough but also sells some cut stones to manufacturing jewelers in Europe and the United States. Michelou sees an increase in manufacturing jewelers buying rough, including tourmaline and sapphire, and having it cut instead of just purchasing finished stones. By doing so they can guarantee mine-to-market custodianship and meet strict supply chain compliance regulations.

Andrew Lucas and Tao Hsu

Figure 46. High-quality rubellite rough is highly sought after in the Asian market. Photo by Eric Welch/GIA, courtesy of Zoe Michelou.

"Boldly go" with a Southwest-inspired Starship Enterprise. At the Pueblo (Riverpark Inn) show, David Freedland (David R. Freedland Jr. Designs, Tucson) showed us some unusual pieces that stood out at his booth. Normally, you expect Southwest-style jewelry to embrace nature or Native American influences for pieces featuring detailed inlays of Arizona turquoise and other materials. Although Freedland had these in abundance, what really caught our eye was this handmade, sterling-silver rendition of the Starship Enterprise from the cult science fiction television series *Star Trek*. The piece measures 6.5 cm in length and stands 4.5 cm high. It rests on a sterling silver stand inlaid with Arizona turquoise (figure 48).

The iconic starship's saucer section is also inlaid with Arizona turquoise and a concentric band of purple spiny oyster centered on a lab-grown white opal representing the bridge. Other oval lab-grown opal cabochons grace the ends of the engine nacelles, and a turquoise cabochon represents the ship's shuttle bay. The starship portion has a loop and can be detached and worn as a pendant, if desired. Freedland also has another handmade starship available: the "Reliant" from the 1982 motion picture *Star Trek II: The Wrath of Khan* along with an array of cyberpunk—or steampunk—ray guns that are redolent of classic U.S. science fiction films of the 1950s.

Freedland told us there's no other reason behind the considerable time and effort required to hand fabricate these unique pieces except that he's always liked the idea

Figure 47. A sampling of Nigerian indicolites after fashioning. Photo by Eric Welch/GIA, courtesy of Zoe Michelou.

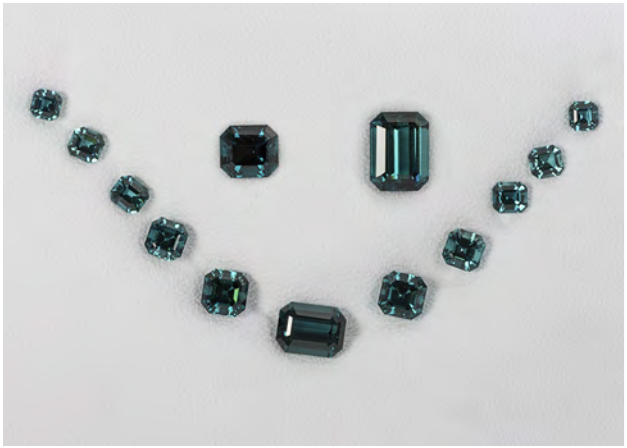


Figure 48. This handmade piece fuses Southwestern style and its characteristic inlay techniques with a science fiction icon: the Starship Enterprise from Star Trek. *Photo by Kevin Schumacher; courtesy David R. Freedland Jr. Designs.*

Figure 49. The remote Brazilian mining community of Remedios is the site of the Bahia golden rutilated quartz mines. The town is developing a sustainable collective of artisanal miners. Photo by Brian Cook.

of space and the unknown—"what's out there," as he says. And he thought they would be a lot of fun to make. We hope these designs live long and prosper.

Duncan Pay

Golden rutilated quartz artisanal mining community. At the January 2017 Jewelry Industry Summit held in Tucson, Brian and Kendra Cook (Nature's Geometry) discussed their efforts to promote sustainable mining in Brazil's Bahia State. In cooperation with 2,500 miners from the region, the Cooks are developing a collective in Remedios, Novo Horizonte (figure 49). Plans to brand the region's unique golden rutilated quartz will be supported by a warehouse and cutting facilities, as well as a visitor center. To provide food security for the population, the Cooks also intend to bring organic community farming to the area.

Brian Cook first visited the remote site, located in Chapada Diamantina bordering the Atlantic Rain Forest and the Serrado and Caatinga ecological communities, in 1983 as a geology student. The trip from Salvador, Bahia's capital, took 2½ days, and he was shown an example of golden rutilated quartz (figure 50), which was relatively rare on the gem market at the time. He later became an exporter of the quartz and helped raise its profile. The Cooks have since become landowners in Remedios, and their property includes a successful golden rutilated quartz mine. Over the years they have visited with their children from their home in Salvador (now a ten-hour journey thanks to improved infrastructure) and become trusted members of the community.

The Cooks have already helped locals formalize their land and mining rights, and now they are turning their attention to other initiatives. Their agenda includes mine safety, certificates of origin to ensure transparency and consumer satisfaction, and teaching cutting and polishing gemstones. They especially seek to empower local women, who already sell rough gems at the local markets, through lapidary and beadmaking training. The community's proximity to the Atlantic Rain Forest makes it an ideal location for ecotourism, a concept that can be combined with gemological study and buying expeditions.

Figure 50. A local miner holds up an example of the golden rutilated quartz found in the Remedios area. Photo by Robert Weldon/GIA.

Brian and Kendra Cook are seeking investors and corporate sponsorship for their community. Learn more about their work at bahiainitiative.com.

Jennifer-Lynn Archuleta
GIA, Carlsbad

Jewelry Industry Summit. The second Jewelry Industry Summit was held in Tucson, Arizona, January 29–30. The meeting was a continuation of the first summit, held in New York in March 2016, though new initiatives emerged from the Tucson gathering.

Opening remarks by Doug Hucker and Jeff Bilgore (AGTA) were followed by three speakers from outside the gem and jewelry industry. Lisa Manley (Sustainability Strategy and Cone Communications, Boston) discussed exploring a company's strengths, opportunities, and aspirations, calling sustainability "a team sport." Thea Polancic (Conscious Capitalism, Chicago) spoke on imagining the industry's future, citing specific companies that have used their leverage in their industries to make a difference in the world. Bob Mitchell (Electronic Industry Citizenship Coalition, Washington DC) presented on pinpointing possibilities for successful and sustainable business practices.

The majority of the summit was focused on committee updates from the first meeting and creating new initiatives to be worked on. Carried over from 2016:

- Brian Cook (Nature's Geometry, Tucson) is developing a model community for golden rutile miners in Bahia State, Brazil. A construction site has been chosen, and negotiations with the municipal government for lapidary equipment have begun. See p. 136 for more information.
- The education committee, headed by Christina Miller (College Corner, Ohio) is creating a glossary that can help members of the industry and consumers understand the language of sustainability, ethical sourcing, and responsible practices.
- The chain of custody and due diligence committee drafted guidelines for suppliers seeking responsible sources.
- The harmonization team is charged with establishing best practices among the existing standards across industries. Under the lead of Mark Hanna (Richline, Providence, Rhode Island) and Richard Nehls (LA Rocks, Los Angeles), the team has collaborated with other organizations to learn from their challenges and successes.
- #ResponsibleJewelryStories, the marketing arm of the summit, is led by Cleo Zancope Gnatek (Jane Taylor Jewelry, New York), Dana Bronfman (Dana Bronfman Fine Jewelry, New York), and Cecilia Gardner (New York). This team has created a website to share stories of responsible sourcing, ethical practices, and sustainability. Industry members interested in sharing their stories on this topic should contact responsiblejewelrystories@gmail.com.
- Members of the sales associate and consumer education team, led by Kevin Reilly (Platinum Guild International, New York), have developed an outline for training purposes and a proposal for content providers and potential sponsors.
- The sustainability in jewelry committee, headed by Mike Pace (New York), has distributed a survey about perceptions of sustainability to 800 fine jewelry buyers who identify as "millennials."
- The team working to fight silicosis and industrial diseases among gemstone cutters, led by Eric Braunwart (Columbia Gem House, Portland, Oregon), is creating pilot programs with three NGOs as well as the AGTA.

Among the new initiatives proposed at the summit were an effort to find a safe, affordable alternative for mercury in gold mining; a development index to measure the positive and negative effects of the gem and jewelry industry on a nation's economy; and a plan to build an agro-geo-ecotourism movement in Thailand.

The location and dates of the next Jewelry Industry Summit will be announced later in 2017.

Jennifer-Lynn Archuleta

REGULAR FEATURES

COLORED STONES AND ORGANIC MATERIALS

Pyrope-spessartine color-change garnet with a high grossular component. During the 2016 Tucson Gem and Mineral Show, Jeff Aylor provided several transparent rough garnets, reportedly from Sri Lanka, to GIA for scientific examination. We noticed that the rough garnets showed obvious color change from yellow-green under daylight equivalent lighting to orange under incandescent illumination. Three rough garnets were polished into wafers and analyzed to fully understand the chemistry and color behavior of the material.

Standard gemological testing of three garnet wafers revealed an RI from 1.76 to 1.77; hydrostatic SG ranged from 3.93 to 4.00. Fluorescence was inert to long-wave and short-wave UV light. The stones did not show any pleochroism when utilizing the dichroscope. Using a hand-held spectroscope, absorption lines in the blue and violet section, and very weak absorption bands at 520 and 573 nm, were observed. Microscopic examination showed intersecting long and short needles throughout. Graphite and quartz inclusions were also observed. All of these properties are consistent with garnet.

The chemical composition for each wafer was obtained

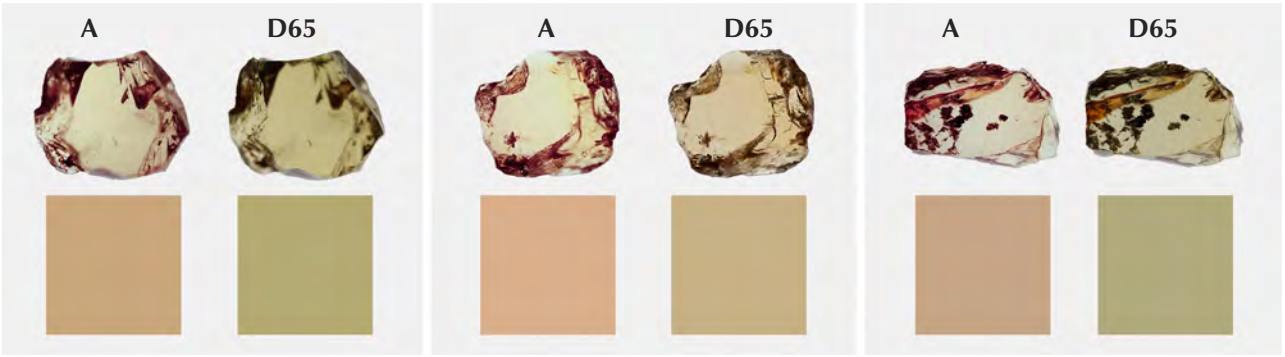


Figure 51. Top: Photos of three garnet wafers under incandescent light and fluorescent light (a daylight-equivalent imitation). Bottom: Calculated color panels of three garnet wafers under CIE A illumination and CIE D65 illumination. Photos by Ziyin Sun.

with a ThermoFisher iCAP Q ICP-MS coupled with a New Wave Research UP-213 laser ablation unit. We concluded that this type of material contains 39.79%–52.66% spessartine, 21.71%–32.03% pyrope, 3.17%–7.28% almandine, 16.87%–22.46% grossular, 0.38%–0.72% goldmanite, and 0.11%–0.19% uvarovite (see detailed table at https://www.gia.edu/gems-gemology/spring-2017-gem-news-pyrope-high-grossular-component). Based on the garnet classification from Stockton and Manson ("A proposed new classification for gem-quality garnets," Winter 1985 *G&G*, pp. 205–218), this material should be classified as pyrope-spessartine. The V_2O_3, MgO, and MnO oxide wt.% are similar to the group 5 color change garnets previously reported (K. Schmetzer et al., "Color-change garnets from Madagascar: Variation of chemical, spectroscopic and colorimetric properties, *The Journal of Gemmology*, Vol. 31, No. 5–8, 2009, pp. 258–259). However, these garnets contains much higher grossular component (16.78%–22.46%) than those reported by Schmetzer et al. (3.02%–10.23% grossular). To our knowledge, the chemical composition of this type of color-change garnet has never been reported before.

The color of the three wafers was quantitatively calculated by using the visible spectra (Z. Sun et al., "Vanadium and chromium bearing pink pyrope garnet: characterization and quantitative colorimetric analysis," Winter 2015 *G&G*, pp. 348–369). The color of each wafer can be presented by using CIE L*a*b* and RGB color coordinates, as seen online in table 2. The calculated color panels of three wafers under daylight-equivalent lighting (CIE D65 illumination) and incandescent lighting (CIE A illumination) were shown in the bottom row of figure 51. The three wafers were also photographed under both fluorescent light and incandescent light to compare with the panels in the top row of figure 51.

One way to judge the quality of a color-change stone is to plot the color pair in the CIE 1976 color circle. Good color-change pairings show a large hue angle difference, small chroma difference, and large chroma values (see table 2). The color coordinates of the three wafers were plotted in the CIE 1976 color circle found online. The color change of this material is not very significant, but is definitely observable.

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SYNTHETICS AND SIMULANTS

Plastic amber imitation in a rosary. The Dubai Central Laboratory (DCL) receives almost all types of ambers, natural and treated (e.g. heated, dyed, reconstructed) as well as amber imitations for identification. Amber rosaries (prayer beads) are increasingly popular in Middle East countries, especially the United Arab Emirates and Arabian Gulf countries.

Recently DCL received a rosary for amber identification. The yellow and yellowish brown color, structure, and size of the 102 beads were identical (figure 52, left). At first glance, even with a well-trained eye, this rosary could easily be misidentified as exclusively natural amber. Testing revealed that the rosary was strung with 71 heat-treated amber beads and 31 Bakelite plastic beads.

Spot RIs of the amber beads were 1.53; observation between crossed polarization of most beads revealed anomalous double refraction with strained colors. Stress spangles and brown thread-like substances are the most noticeable inclusions in these beads; these features are commonly seen in heat-treated amber. The spot RIs of the plastic beads was around 1.64. Aggregate and anomalous double refraction reaction was observed under the polariscope and gas bubbles and swirl marks were the main inclusions.

The most interesting aspect of the specimen was its reaction under long-wave UV. The amber showed moderate to strong chalky greenish blue and yellow fluorescence, but the plastic appeared brown (figure 52, right).This reaction was very useful for differentiating between the two materials.

Figure 52. Left: The rosary shows yellow to yellowish brown color in daylight-equivalent lighting (left). Right: The rosary under long-wave UV. The amber shows a moderate to strong chalky greenish blue and yellow reaction, but the plastic appears brown. Photo by Nazar Ahmed Ambalathveettil.

To confirm the identity of each material, we analyzed their infrared spectra with attenuated total reflectance (ATR) mode (figure 53). Spectrum A displayed main peaks at 1716.4 and 1161.1 cm^{-1}, consistent with amber. The main peaks of Spectrum B were at 1650.8, 1600.7, and 1218.8 cm^{-1}. After comparison with spectrum A and the spectra of other plastics, spectrum B confirmed the spot RI's identification of this sample as Bakelite plastic.

This rosary is an excellent example of the importance of testing and disclosure, because even an experienced person could not differentiate between the amber and Bakelite beads with the unaided eye.

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Mixed-type treated red HPHT synthetic diamond. A multiple-treatment process involving irradiation and HPHT annealing can produce pink to red color in natural and synthetic diamonds; specimens treated by this process have been on the market for over 10 years. To the best of our knowledge, nearly 95% of the studied red HPHT synthetic diamonds treated by the multi-treatment process are classified as type Ib or type IIa. Recently, we examined a treated red HPHT-grown synthetic diamond which was confirmed to be mixed type (IaA + IaB + Ib).

The 0.27 ct round brilliant sample, graded as Fancy Dark red (figure 54), had a metallic inclusion under the table. The DiamondView image showed strong red fluorescence and cuboctahedral growth structure; the latter is a typical feature of HPHT-grown diamonds (figure 55). Ni-related defects at 883.1/884.8 nm and 793.6 nm were revealed by a photoluminescence (PL) spectrum at liquid-nitrogen temperature with two different laser excitations (532 and 785 nm). The H2 defect corresponding to a sharp peak at 986.2 nm and the NV center associated with a strong peak at 637 nm were also found. In addition, the Fourier-transform infrared (FTIR) absorption spectrum (figure 56) confirmed the material was an uncommon type of IaA + IaB + Ib, with absorptions at 1282 cm^{-1} (A center), at 1175 cm^{-1} (B center), and at 1131 and 1344 cm^{-1} (C center), respectively (again, see figure 56). This mixed type is similar to that observed in treated natural diamonds. A moderate 1450 cm^{-1}

Figure 53. IR spectra of the two specimens, with ATR method applied. Spectrum A represents natural amber, with typical peaks at 1716.4 and 1161.1 cm^{-1}. Spectrum B's main peaks at 1650.8, 1600.7, and 1218.8 cm^{-1} indicate that it is Bakelite plastic.

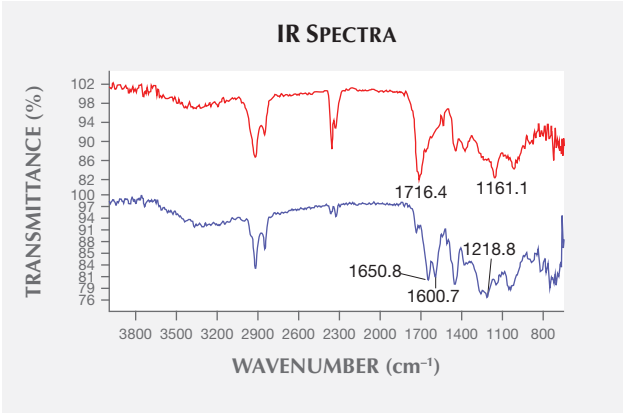
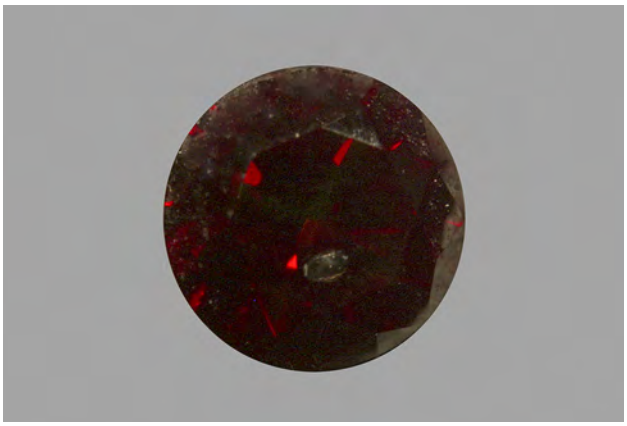


Figure 54. This 0.27 ct Fancy Dark red specimen is a multi-step treated HPHT synthetic diamond. Photo by Meili Wang.



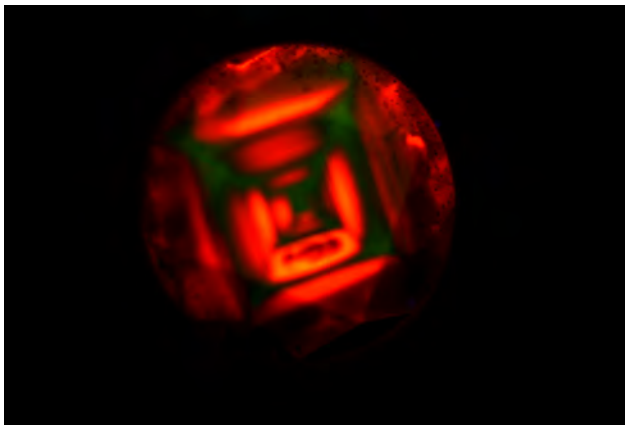
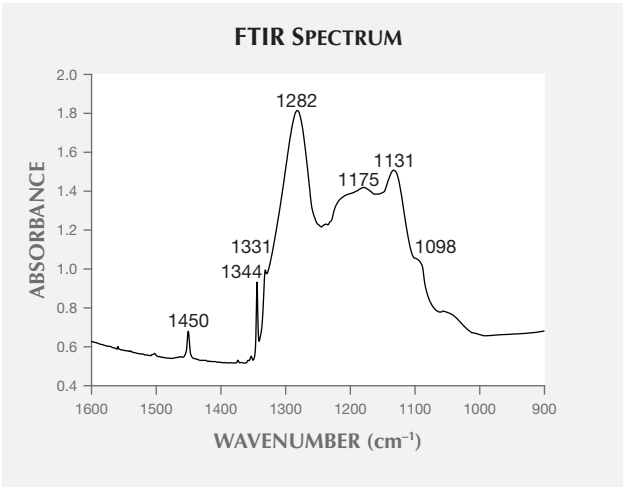


Figure 55. The DiamondView fluorescence image shows cuboctahedral growth structure, a typical feature in HPHT-grown diamonds. Photo by Wen Han.

absorption (H1a), which correlates with irradiation and subsequent annealing (Clark et al., "Absorption spectra of natural and irradiated diamonds," *Proceedings of the Royal Society of London A*, Vol. 234, 1956, pp. 363–381), was also present. Thus, this diamond was identified as a multi-step treated HPHT synthetic diamond, with irradiation and HPHT annealing indicated as treatment processes.

Although most of the recent treated red HPHT synthetic diamonds are reported to be type Ib or type IIa (e.g, Fall 2016 Lab Notes, pp. 308–309; C.M. Breeding and J.E. Shigley, "The 'type' classification system of diamonds and its importance in gemology," Summer 2009 *G&G*, pp, 96–111), such diamonds with mixed type Ia + Ib are available in the jewelry market, as exemplified by this study. Therefore, caution is still needed to distinguish such treated synthetic diamonds from treated stones of natural origin, as they may show similar characteristics.

Figure 56. FTIR spectroscopy reveals that this diamond is type Ia + Ib, with the existence of aggregated nitrogen atoms (A center at 1282 cm^{-1} and B center at 1175 cm^{-1}) and isolated nitrogen (C center at 1131 and 1344 cm^{-1}) impurities. The H1a absorption at 1450 cm^{-1}, correlating with irradiation and subsequent annealing, is also observed.



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TREATMENTS

Filled calcite with pronounced phosphorescence. Asterism, chatoyancy, color change, and play-of-color are phenomena that are caused by the interaction of light with the host's structure or from its inclusions. Fluorescence, on the other hand, is the emission of light by a substance that has absorbed light or other electromagnetic radiation. Fluorescent materials immediately cease to glow when the radiation source is turned off; phosphorescent specimens continue to emit light for variable periods after the radiation ceases. Previous studies (Spring 2005 Lab Notes, pp. 46–47; Summer 2012 Lab Notes, pp. 139–140) have reported on the misnomer "night glowing pearls," which are in fact not pearls at all but round rocks of mineral species that exhibit phosphorescence. Most of this material in the Chinese market has been treated in a variety of ways and in fact does not phosphoresce naturally.

A partially carved white ovoid with a greasy luster and golden paint within the low-relief carved features (figure 57, left) was submitted for identification to the Lai Tai-An Gem Lab. The submitting client claimed it was a "night glowing pearl." The object weighed 796.71 ct and measured 48 mm in diameter. A spot RI reading of 1.59 and an SG of approximately 2.66 indicated that the object was most likely calcite. This was later confirmed by FTIR and Raman (figure 58) analysis. Initial exposure to short-wave (254 nm) and long-wave (365 nm) UV light (cabinet and lamp respectively) failed to elicit any initial visible reaction; however, both short-wave and long-wave UV did initiate some fluorescence after about 15 minutes. When observed in a dark environment, moderate green phosphorescence lasting more than 10 minutes was noted, with strong whitish phosphorescence concentrated in one area (see figure 57, right).

Microscopic inspection of the area showing the white phosphorescence revealed that the reaction originated from within the object, and did not emanate from the entire outer surface. The microscope revealed a few tiny bubbles comprised of solid epoxy resin (figure 59, left). This translucent epoxy acted as a plug to an opening into the (assumed

Figure 57. The calcite object (left, in daylight-equivalent light) showing a moderate green overall phosphorescence after short-wave UV exposure (right). The object emits a very strong whitish phosphorescence from one area, as seen in the center of the right image. Photos by Lai Tai-An Gem Lab.

hollowed out) interior, where a highly phosphorescent material was placed to create the calcite's glowing effect. It was therefore understandable why this small capped area showed the strongest reaction (figure 59, right).

The trade name "night glowing pearl" used in Asian markets mostly refers to natural fluorite, but some fluorite is treated with a coating containing rare earth elements (REE) such as europium (Eu), dysprosium (Dy), or neodymium (Nd) to add or enhance phosphorescence. The sample submitted was calcite, consisting mainly of calcium, as confirmed by energy dispersive X-ray fluorescence (EDXRF). However, no Eu, Dy, Nd, or any other REE were detected, proving the material was not luminiferous. It therefore seems more logical that the phosphorescence originated from material below the ovoid's surface.

It is interesting to note that the same client also submitted a jadeite jade sphere that was fashioned and treated in a similar manner. The cap on the jadeite piece used to plug the void was itself a piece of jadeite. Since destructive testing was not permitted on either item, analysis of their interiors was not possible. This technique of placing a phosphorescent material inside a hollowed-out stone object appears to be applicable to any material, so those in the trade should be aware when examining similar objects.

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ERRATUM

In the J.C. Zwaan et al. Winter 2015 article on alluvial sapphires from Montana, in the lower right corner of the Mg-Fe-Ti ternary plot (p. 385), the label "Ti × 100" should be "Ti × 10."

Figure 58. Raman analysis identified the material as calcite (peaks at 279 and 1086 cm^{-1}, blue trace). Cavities were filled with epoxy resin (peaks at 638, 1112, and 1608 cm^{-1}, pink trace).

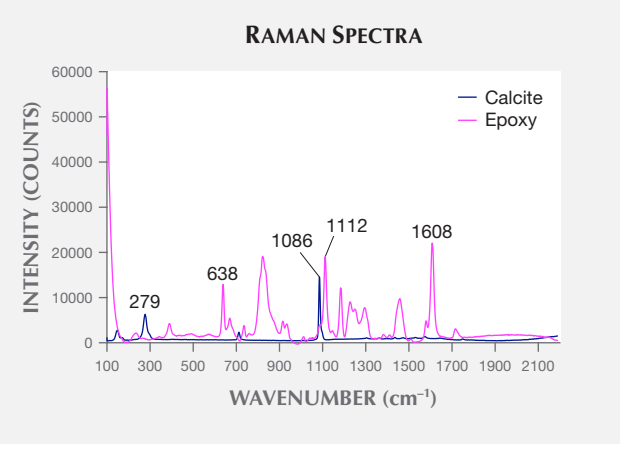

Figure 59. Left: Tiny bubbles were observed in the cavity under magnification. Field of view 6.2 mm. Right: The filled cavity showed stronger phosphorescence because the epoxy resin is more transparent than its calcite host. Field of view 11.6 mm. Photos by Lai Tai-An Gem Lab.