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TUCSON 2015

Once again, buyers and sellers from all over the world converged on a corner of the American Southwest for the annual Tucson gem shows. Many broad trends continued from 2014: Consuming markets are hungry for fine colored gems, and demand still outstrips supply, causing prices for some gems to reach new highs. As more buyers from Asia compete for new production of rough gemstones, the secondary market is becoming more important for domestic dealers. Many recycled gems and jewelry pieces were returning to the market through estate sales, or directly from owners lured by all-time high prices. Some sellers were showing items that had been held in inventory for years or even decades (figure 1). These included fine corundum, Imperial topaz, red spinel, and aquamarine. We noted that many of these "recirculated" goods were exceptional gems, superior to newly mined production. Many vendors are unable to source new production at prices their clientele are prepared to pay.

Cultured pearls of every type were in high demand—especially from the Chinese market. The same was true of rubellite and "watermelon" tourmaline, tsavorite, and spinel, especially red to pink material from Mahenge, Tanzania.

Overall, we observed several clear trends:

- Many gem-quality stones were cut in nontraditional shapes such as cabochons, fantasy cuts, carvings (figure 2), and even slices.
- Many jewelry pieces had an organic, natural feel. Similarly, non-round pearls—particularly large baroque shapes—were also everywhere. The freeform shapes of many opals also fit well with natural-shape trends for jewelry, lending themselves to carved flowers, animals, and abstract pieces.
- Designers were seeking out unusual colors for standard gems: fancy-color sapphires, colored diamonds, tourmalines, spinel, garnets, zoisite, zircon, and beryl (morganite was very much in demand).
- Many vendors told us they left their "traditional" inventory items at home, as they can sell those at any time. The Tucson crowd demands the unusual (figure 3), so vendors brought nontraditional items and were reportedly selling them at a good pace.
- Even though red-brown "Marsala" was named the Pantone color of the year for 2015, it did not appear to be an overall favorite, with the most observed colors being bright blues, greens, and pinks.
- The largest crowds observed at the wholesale shows were gathered at the booths selling nontraditional gem materials such as cabochons, druzy, tourmalinated and rutilated quartz (again, see fig-

Figure 1. Many sellers at Tucson were displaying very large, fine, or unusual gems that had been held in inventory for years. Photo by Duncan Pay/GIA; courtesy of Noor Gems Japan Ltd.

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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Figure 2. Rutilated quartz was a popular material at the 2015 Tucson gem shows. These examples were carved by German artist Alexander Kreis. Photo by Eric Welch/GIA; courtesy of Sonja Kreis.

ure 2), and crystal slices—material typically used in "craft" jewelry.

- Opal (figure 4) was prominent: There was an abundance of Ethiopian hydrophane opal, Australian opal, Mexican fire opal, and material from the U.S. Recent finds in Ethiopia have generated a buzz for all types, according to several vendors.

Foot traffic at the main AGTA and GJX shows appeared down from 2014, but most merchants reported brisk sales, especially of very fine or unique items. In fact, many vendors mentioned that this was their best show in recent years. Eric Braunwart of Columbia Gem House (Vancouver, Washington) said he had forgotten what a "good year was like" until this show.

Figure 3. All throughout central Tucson and along the Interstate 10 corridor, tents sprang up around hotels and other venues to host buyers and sellers from all over the globe. Photo by Duncan Pay/GIA.

Alexander Wild (Wild & Petsch Lapidaries, Kirschweiler, Germany) provided a broad-brush market update from his firm's perspective. Rough prices for many gems continued on an upward trajectory, he reported. Just a few years ago, fine-color, high-clarity rubellite tourmaline sold at wholesale for $300 to $350 per carat. These numbers reflected the asking price for superb quality, with perhaps just a few tiny inclusions. In 2015, prices for equivalent material are almost triple that figure.

As in the previous year, sourcing rough gems remains a problem, although it is by no means impossible for established companies with good connections in source

Figure 4. Opals of all kinds were prominent at this year's shows. The freeform shapes of these Mexican fire opals lend themselves to one-of-a-kind pieces. Photo by Eric Welch; courtesy of Opalos & Artesanias Mexicanas.

Figure 5. The Cruzeiro mine, the Miranda Group, and KGK work together to bring Brazil's bicolor and rubelite tourmaline to the market in China. The Cruzeiro mine provides the rough to the Miranda Group, which cuts the material. Photo by Andrew Lucas; courtesy of Miranda Group Co. Ltd.

Figure 7. Fine Brazilian rubellite tourmaline at the Miranda Group's factory in Shenzhen—most of these cut stones are larger than 10 ct. The factory needs to receive 100 kilos of rough per month to meet production goals of 25,000 to 30,000 carats. KGK markets and sells the cut stones and also mounts them into jewelry for sale, primarily in China. Photo by Andrew Lucas; courtesy of Miranda Group Co. Ltd.

countries, such as Wild & Petsch. The company is able to source quality rough, though prices are definitely higher for many goods. Since mid-2014, prices for many other commodities such as oil and copper have fallen. But gemstone rough prices continue to rise, largely due to demand from China. In Wild's opinion, such high prices are unsustainable. He wondered how long this would continue, asking rhetorically, "Is this a gem bubble?"

Asked what was in demand, he answered that it was the gemstones Wild & Petsch is known for: fine tourmaline and beryl. With their African connections, they secured a nice production of Paraíba-type copper-bearing tourmaline from Mozambique, along with good parcels of aquamarine. As a result, they were able to offer their clientele this material at what Wild considered very fair market prices. In contrast, supply of rubellite and pink tourmaline rough is quite difficult, and most of his supply has been coming from Nigeria. Brazilian rubellite is basically unavailable.

Figure 6. Rough tourmaline crystals are sliced or sawn by the Miranda Group in Hong Kong, then faceted and polished at their factory in Shenzhen. Photo by Andrew Lucas; courtesy of Miranda Group Co. Ltd.

[*Editor's note*: In a 2014 visit to Brazil's Cruzeiro mine in Minas Gerais State, a GIA team witnessed recovery of large facet-grade rubellite crystals (figure 5), which were all put aside for exclusive sale to a consortium—composed of the Miranda Group and KGK—that fashions the material at its own factory in Shenzhen, China, for the Chinese market (figures 6 and 7). Only blue to green production was available for sale to local and export markets.]

Adjusting to price fluctuations has always been part of life for colored stone merchants, Wild conceded, but not sudden, successive increases to levels that are three, four, or five times higher than the market was previously accustomed to (see www.gia.edu/gia-news-research-miranda-journey-of-rubellite-tourmaline).

Wild offered the possibility that at some point a single market will be satisfied—even one as large as China's. When that happens, suppliers will have to find other markets for these goods. Wild believes the North American and European markets are more sophisticated in terms of pricing—especially for cut goods—than China's current market. There is also the possibility that any political upheavals there could cause rough prices for certain gems to go down sharply, he said. And that could spell trouble for some miners who base their operations on today's historically high rough gem prices.

Wild said business at the 2015 show had been better than the year before. He reckoned business was a third above 2014, with some big-ticket items—including a fine aquamarine suite—spoken for prior to the show. He confirmed our impression that traffic was down slightly from last year—possibly due to fewer Asian buyers or the winter travel difficulties on the U.S. East Coast.

Wild intimated that many clients came with specific requirements in mind, particularly aquamarine or Paraíba-

Figure 8. A group of Paraíba tourmalines from Brazil's Rio Grande do Norte state. From the top: a 6.28 ct cushion, a 1.73 ct triangular brilliant, a 5.28 ct oval, three smaller ovals totaling 3.50 carats, and a 0.97 ct triangular brilliant. Photo by Robert Weldon/GIA; courtesy of Brazil Paraíba mine.

type tourmaline, and selection was good for these gems at this year's show. He mentioned they had even sold a few collectors' pieces, including a beautiful large green step-cut beryl that measured more than 200 ct. That was a surprise to him, because such items have proven more difficult to sell the last few years.

"Everyone is searching for good things," Wild concluded. "For the most part, we get what we need." Asked if the trend is still toward finer, more unique pieces, Wild responded, "Absolutely. I think quality still comes first. A lot of the trends from last year still apply, and we're still waiting to see if there's going to be any deflation in pricing for some goods."

Once again, *G&G* greatly appreciates the assistance of the many friends who shared material and information with us this year, with special thanks to the American Gem Trade Association for providing photography studio space during the AGTA show. Dr. Tao Hsu, Andy Lucas, Donna Beaton, Pedro Padua, and Dr. Jennifer Stone-Sundberg contributed to these reports.

New production of copper-bearing tourmaline from Rio Grande do Norte, Brazil. At the GJX show, Sebastian and Ananda Ferreira (Brazil Paraíba mine, Parelhas, Brazil) showed us examples of new production from their MTB mine, which a GIA team visited in April 2014. The seven principal stones we saw were a 6.28 ct square cushion, a 1.73 ct triangular brilliant, a 5.28 ct oval, three small ovals totaling 3.50 carats, and a smaller 0.97 ct triangular brilliant (figure 8).

Figure 9. Discovered in early 2014, this spray of copper-bearing tourmaline was a harbinger of new production at the MTB mine in Rio Grande do Norte. Photo by Duncan Pay/GIA.

The MTB mine is located at the northern edge of a ridge of low, rounded hills that curve to the south and west from Rio Grande do Norte toward the original copper-bearing tourmaline discoveries by Heitor Barbosa at Mina da Batalha in the state of Paraíba. The geology is very similar to the Batalha occurrences, except that the feldspars in the MTB mine's pegmatites are not decomposed.

These gems represent the first new production from the mine in several years. At the time of GIA's visit, the operation was reprocessing ore from previous mining for melee-sized rough. This produces strongly colored precision-cut gems, much in demand for the watch industry. When GIA visited the mine, miners had recently extended the workings downward and been rewarded with sprays of what appeared to be copper-bearing tourmaline in the wall rock (figure 9).

Figure 10. This exceptional 9.22 ct emerald is from Belmont's underground mine. Photo by Robert Weldon/GIA; courtesy of the Belmont mine.

The new production that furnished the cut gems seen in figure 8 came a few weeks after the GIA team's departure. For more on the MTB mine, please see www.gia.edu/gia-news-research-an-overview-of-2014-gia-brazil-expedition.

Duncan Pay
GIA, Carlsbad

New production of Brazilian emerald from Minas Gerais. At the GJX show, Marcello Ribeiro (Belmont Mine, Itabira, Brazil) showed us production from Belmont's underground mine, including one especially fine 9.22 ct stone (figure 10). As a GIA team visited Belmont in April 2014, it was interesting to see the gems from this relatively new part of the mining operation for sale at the show.

Originally the site of a cattle ranch, Belmont yielded its first emeralds in 1978 (H.A. Hänni et al., "The emeralds of the Belmont Mine, Minas Gerais, Brazil," *Journal of Gemmology*, Vol. 20, Nos. 7–8, 1987, pp. 446–457). Since then, the mine has expanded to include both open-pit and underground operations with a highly sophisticated recovery plant. Mining is supported by a comprehensive geological survey program. To date, more than 15 km (9.3 miles) of 3.8 cm (1.5 inch) diameter cores have been drilled. Geological surveys indicated that a 300-meter-thick schist layer—with emerald potential—underlies much of the property, including the recovery plant. Core sampling defined the extent and depth of the emerald ore body and proved the viability of an underground mine at Belmont. Sampling the underlying rocks also helped plan the mine's mechanical structure by showing which layers would be capable of supporting underground tunnels.

The underground mine is accessed via a 666-meter ramp that allows removal of up to 30 to 40 truckloads of ore per day using large commercial trucks (figure 11). At the time of our visit, approximately 10 to 15 truckloads per day (about 200 tonnes) were being taken to the recovery plant. The underground workings deliver a ratio of one tonne of ore to one tonne of waste. Each tonne of ore yields about two grams of rough emerald. On average, those two grams of rough produce two carats of faceted emeralds. By contrast, the ratio for the current open pit is only one tonne of ore per 11 tonnes mined. The rest is overburden or waste. There is clearly the capacity for many more years of productive mining at Belmont.

During the same April 2014 trip, GIA field gemologists visited the Montebello mine, near Nova Era. At this year's GJX show, Sergio Martins (Stone World, São Paulo) showed us new production from that mine (figure 12). These gems were in the 2–4 ct range, bright with strong color and good luster.

Figure 11. A full-size truck navigates the tunnels of Belmont's underground mine. From the outset, the operators determined this would be a high-capacity, ramp-style mine. Photo by Duncan Pay/GIA; courtesy of the Belmont mine.

Figure 12. This array of gems in the 2–4 ct range from the Montebello mine shows the bright, vivid appearance of high-quality emeralds from Nova Era. Photo by Robert Weldon/GIA; courtesy of the Montebello mine.

The Montebello mine is adjacent to the independent miners' village of Capoeirana, about 6 km (3.7 miles) from Nova Era. Capoeirana is about 26.5 km (16.5 miles) east of Itabira. Unlike the larger mechanized operation at Belmont, the area around Capoeirana hosts a variety of small-scale mining activities by these independent miners, known as *garimpeiros*. The Montebello mine is perhaps the largest, employing 15 of them.

Emeralds were first discovered near here in 1988 (D. Epstein, "The Capoeirana emerald deposit near Nova Era, Minas Gerais, Brazil," Fall 1989 *G&G*, pp. 150–158; www.gia.edu/gems-gemology/fall-1989-brazil-emeralds-epstein). The exploration that led to a mining boom in nearby Capoeirana was triggered by the discovery of emerald at Belmont. Production has dwindled in Nova Era, due in part to the 2008 global economic recession and the greater depths—often more than 100 meters—required to reach the emerald mineralization (A. Lucas, "Brazil's emerald industry," Spring 2012 *G&G*, pp. 73–77; www.gia.edu/gems-gemology/spring-2012-brazil-emerald-lucas). Emerald mineralization in the surrounding area appears to start in Nova Era and finish at the Belmont mine. Between them is another—currently unworked—mine, called Piteiras, which Martins used to operate. Mining stopped there due to ownership disputes that the parties hope will be resolved shortly.

At Montebello, the main elevator shaft descends 130 meters. At the time of GIA's visit, miners had sunk a new vertical shaft about 40 meters below the level of the existing main shaft (figure 13). It follows a new vein that dips steeply underground. Neighbors in an adjacent mine have already found a productive vein at about that level. When the miners sunk their shaft, they located a seven-meter-thick seam of soft black schist underlain by granite. Emeralds occur in the boundary where the quartz meets the schist. The dark color of the schist and the presence of quartz are good indicators for emeralds and pale beryl crystals. From this new 40-meter shaft, they are driving a new horizontal tunnel out into the schist. The miners plan to expand the shaft and install a second elevator. The miners added that Montebello's stones appear to increase in size and color with depth.

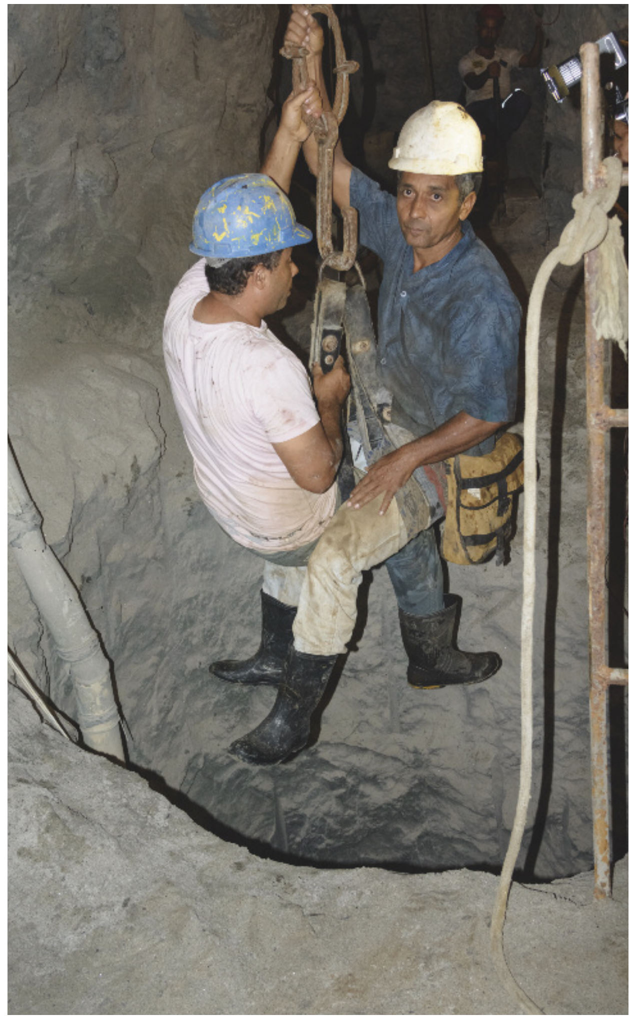


Figure 13. At Montebello, the miners have sunk a new shaft to follow a promising vein of emerald-bearing schist to deeper levels in the mine. The base of the new shaft is 170 meters below the surface. Photo by Andy Lucas/GIA; courtesy of the Montebello mine.

Duncan Pay

Exceptional red spinels and fine aquamarine. At the GJX show, Axel Henn (Henn GmbH, Idar-Oberstein, Germany) showed a superbly colored 61.29 ct Tanzanian red spinel measuring 36.49 × 18.44 × 13.55 mm (figure 14), along with two pear-shaped gems cut from similar rough. Red spinels of this size, color, and quality are exceptionally rare. Indeed, stones of such deep, rich color larger than 50 ct are almost unheard of.

According to Henn, this gem was from a find of three exceptionally large spinel crystals (one larger than 50 kg) recovered from a dried riverbed in the mid-2000s. Henn heard of the discovery through a local Tanzanian contact.

Figure 14. Superb Tanzanian red spinel marquise of 61.29 ct. Photo courtesy of Henn Gems.

Figure 15. Among the many fine aquamarines at Axel Henn's booth, the standout was this 450.08 ct square step-cut gem. Photo by Duncan Pay/GIA; courtesy of Henn Gems.

The crystals needed to be hammered and trimmed, but they still produced cuttable rough of significant size, including a suite of gems totaling 174.58 carats. In his opinion, the 61.29 ct marquise is the finest of the lot.

This is likely the same discovery as the widely reported 2007 recovery of four giant spinel crystals weighing 52, 28, 20, and 5.7 kg from a zone in the Ipanko ruby and spinel mining area known as the "Joel Box." Reported as having a "vibrant orangy, pinkish red color," the largest crystal was broken up for transportation away from the mining area. The outside portions of crystals had some superb cuttable material, but the cores were mostly lower quality. Although the eventual yield was said to be as low as 3%, the crystals had the potential to produce many thousands of carats of cut gems, including significant pieces of over 50 ct. The 61.29 ct marquise is likely part of this yield.

Henn also displayed a superb 450.08 ct rectangular (corners-on) step-cut aquamarine (figure 15). This gem possessed the coveted pure blue "Santa Maria" color, with no hint of green or yellow (this name refers to a mine near Santa Maria de Itabira in Minas Gerais, Brazil). The gem was of stunning clarity—this cutting style is very revealing of any imperfections—and was fashioned from rough recovered in 1927. Henn said he purchased the rough from an "old gemstone family," and it had been "kept in the basement" for generations.

Duncan Pay

Fine tsavorite and spinel. Bruce Bridges (Tsavorite USA Inc., Tucson) said that fine stones often return to his inventory after years in a collector's possession. At the AGTA show, he showcased a vivid, top-quality 12.46 ct cushion-cut tsavorite fashioned some 15 years earlier, which made its way back into the market in the last two years (figure 16). As tsavorite rough has a high value, gems are typically cut to maximize weight. Rough is typically recovered as long, thin asymmetrical fragments that lend themselves to pear, marquise, and trilliant shapes. This example's unusual square cushion shape, large size, color, and clarity make it a notable and rare gemstone.

After seeing the wealth and variety of gems on display at the Tucson gem shows, it might be easy to come away with the impression that fine colored stones are not particularly rare. Yet the truly magnificent stones are extremely rare and often have a memorable provenance. One such gem is the 18.21 ct triangular cut red spinel Bruce Bridges showed us at his AGTA booth (figure 17). According to Bridges, this magnificent gem was cut in 2007 in Bangkok from rough recovered in one astounding find in Tanzania's Ipanko mining area that yielded several giant spinel crystals, one of which weighed in at over 50 kg. A number of other dealers at this year's show, including Axel

Figure 16. This spectacular 12.46 ct tsavorite recently returned to Bruce Bridges's inventory after being in a collector's possession for many years. Photo by Robert Weldon/GIA; courtesy of Bridges Tsavorite.

Figure 17. This 18.21 ct Tanzanian red spinel was fashioned from material recovered from one of four enormous multi-kilogram crystals reputedly found in the Ipanko ruby and spinel mining area near Mahenge, Tanzania. Photo by Robert Weldon/GIA; courtesy of Bridges Tsavorite.

Figure 18. This unheated 8.56 ct intense pink sapphire represents the very best of recent production from Madagascar. Photo by Robert Weldon/GIA; courtesy of B&B Fine Gems.

Henn, also displayed fine gems from this one extraordinary discovery.

Donna Beaton
GIA, New York

Fine corundum, demantoid garnet. At the AGTA show, Dave Bindra (B&B Fine Gems, Los Angeles) showed us some exceptional corundum, especially fine untreated yellow and pink sapphires.

The first standout piece Bindra showed us was an 8.56 ct unheated, intense pink sapphire of extremely high clarity from Madagascar. Under the lights of our photo studio, it showed an intense pink hue (figure 18). A gem of this quality might expect to realize a wholesale price in the region of $10,000 to $15,000 per carat. Bindra noted that Madagascar is producing some superb fancy sapphire, including pink, violet, and "padparadscha" colors.

Although this pink gem represented recent production, Bindra explained that the secondary market has become an extremely important source for many dealers now that competition for freshly mined goods is so intense, particularly from buyers serving Asian markets. These recirculated gems coming back onto the market offer a way for dealers to procure stones that often surpass current production in size and quality, or are simply unobtainable today. As an example, Bindra cited an 89.55 ct unheated golden sapphire from Sri Lanka (figure 19), remarking that he had not seen material of this color emerge from the ground in Sri Lanka for more than 10 years. Originally this gem was somewhat larger, over 100 ct. Modern cutting reduced the weight slightly but produced a dramatic improvement in color and brilliance. Bindra described this gem's appearance and stature as "world class." As such, it would likely command a wholesale price in excess of $3,000 per carat.

Bindra next showed us a blend of new production and recirculated stones: a graduated suite of 12 perfectly matched Russian demantoid garnet round brilliants. Each gem contained a classic "horsetail" inclusion. Weighing in at 20 carats total, the suite took Bindra four years to complete. He described it as a special item, with the stones from the secondary market selected and recut to perfectly match the newer gems.

For Bindra, Mozambique is the future of ruby production. He illustrated this with three fine heated gems from the Montepuez deposit weighing 7.05, 7.92, and 9.35 ct (figure 20). Although all three stones represented beautiful, clean material, he considered the 7.92 ct gem the finest, due to its superior brilliance and intense red hue. Due to the ongoing trade embargo with Myanmar, classic "Burmese" ruby is unobtainable for U.S. dealers. Fine Mozambique rubies like these in the 7–9 ct range are in high demand and exceptionally rare. Gems larger than 4 or 5 ct are increasingly hard to find, Bindra pointed out.

Figure 19. This exceptional unheated 89.55 ct golden sapphire from Sri Lanka is an example of a recirculated stone. Photo by Robert Weldon/GIA; courtesy of B&B Fine Gems.

Figure 20. Left to right: These heated rubies from Mozambique weigh 7.05, 7.92, and 9.35 ct. Photos by Robert Weldon/GIA; courtesy of B&B Fine Gems.

Unlike Myanmar, Mozambique does not carry the stigma of human rights abuses. The heat treatment of these rubies is not an issue with consumers, either. As Bindra explained, the market for top natural unheated ruby has now reached such rarified levels that buyers are very receptive to high-quality heated rubies. (The current auction record is held by an unheated 8.62 ct Graff ruby, of Burmese origin, which sold for $8,372,094—or $994,040 per carat—at a Sotheby's Geneva auction in September 2014.) Purchasing such expensive stones is a stretch even for the top 1% of consumers. By contrast, stones like the three Bindra showed us wholesale in the region of $35,000 to $50,000 per carat. He said gems like these are "quite consumable" and can be the centerpieces of wearable jewelry, meaning they will occasionally be seen outside of safe deposit boxes.

Bindra faces the same issue as many other colored stone dealers in Tucson: scarcity of new rough production due to intense competition between the U.S. market and buyers purchasing for Chinese consumers. This is the major driver for dealers looking for alternative sources of gems such as recirculated goods, he said.

The new wealth in China has created a different dynamic. For more than 50 years, American and European consumers have been the main buyers of fine gemstones, he explained. Now these established markets have competition, and Bindra and many of his colleagues in the business supply gems to these competitors as well. Besides China, other cultures—India, for instance—have a rich jewelry heritage, and consuming gems is ingrained. This trend is not going to change, so there will be more wealthy consumers in emerging markets that desire colored gems, and current producers will struggle to meet demand.

In terms of demand at the show, Bindra reported that rubies and unheated sapphires were quite strong. There was demand for anything rare and exotic, goods that the average consumer would not find elsewhere. He also saw renewed demand for emerald. In the past, he noted a "certain favoritism" toward Colombian emerald, but increased supplies of quality gems from Zambia have made it a much more popular source and established the "Zambian brand" in people's minds.

Duncan Pay

High-end colored gems. At GJX, Constantin Wild (W. Constantin Wild & Co., Idar-Oberstein, Germany) showed us a remarkable multicolored suite composed of 12 gems from all over the world. The total weight was 290 carats, with each gem weighing approximately 25 ct and measuring 19–20 mm. The suite included aquamarine and an unheated purple copper-bearing tourmaline from Mozambique; rubellite, yellow beryl, green tourmaline, and Imperial topaz from Brazil; peridot and kunzite from Pakistan; mandarin (spessartine) garnet from Nigeria; tanzanite from Tanzania; green sphene from Sri Lanka; and "canary" tourmaline from Zambia (figure 21).

Figure 21. Constantin Wild displays a unique 290 carat multicolored gem suite. Photo by Duncan Pay/GIA.

Figure 22. 26.18 ct and 19.83 ct "canary" tourmalines from Zambia. Photos by Duncan Pay/GIA; courtesy of Constantin Wild.

Figure 23. This superb 339.42 carat suite of 10 rubellite tourmalines contains Brazilian gems with a Nigerian center stone. The gems in the suite range from 39.61 to 77.16 carats (center stone). Photo by Duncan Pay/GIA; courtesy of Constantin Wild.

Wild specifically highlighted canary tourmaline (figure 22). He remarked that its intensity of color is reminiscent of Paraíba tourmaline. Found intermittently in the 1980s and marketed since the early 2000s, this typically yellow-green material is rich in manganese (up to 9.18 wt.% MnO). Wild had two significant oval-cut gems of 19.83 and 26.18 ct, both unheated. For more information on this unique gem, see www.gia.edu/gems-gemology/winter-2007-yellow-tourmaline-zambia-laurs.

Another standout at Wild's booth was a superb suite of rubellite tourmaline totaling 339.42 carats (figure 23). Wild called it a suite "from two continents," as it contained both South American and African gems. The suite featured a spectacular cushion-cut 77.16 ct Nigerian rubellite centerpiece from new production, measuring 28.30 × 24.87 mm, framed by nine perfectly matched Brazilian rubellites from previous inventory weighing 262.26 carats.

Besides his higher-end single gems and suites, Wild also displayed some mixed-color sets, which he described as more "fashion-oriented" combinations (figure 24). Intended as concepts for jewelry designers, they included color combinations such as opal with pink tourmaline and morganite beryl with red tourmaline, tanzanite, tsavorite, and treated blue topaz, along with more unusual arrangements: demantoid and "Mali" garnet with fire opal, or yellow beryl and mandarin garnet.

Another trend was the use of facet-grade rough for cabochons. These were often of large size and superb color. Of particular note were a 104.83 ct tanzanite and a 140.95 ct kunzite spodumene (figure 25).

Duncan Pay

Tsavorite garnet and Mahenge red spinel. At GJX, Daniel Assaf (The Tsavorite Factory, New York City; figure 26) explained the current market situation for tsavorite garnet, Tanzanian red to pink spinel, and yellow danburite. According to Assaf, the recent recession and the ensuing disruption in supply had less of an impact on his business

Figure 24. Constantin Wild's selection of mixed-color sets for jewelry designers included some interesting combinations. Photo by Duncan Pay/GIA; courtesy of Constantin Wild.

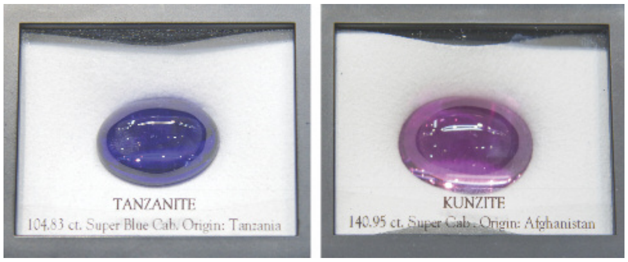


Figure 25. Left: A 140.83 ct tanzanite cabochon with superb color and clarity. Right: Kunzite is rarely seen in cabochon cuts. The color and clarity of this 140.95 ct example make it noteworthy. Photos by Duncan Pay/GIA; courtesy of Constantin Wild.

than increasing demand from China. For him, current rough scarcity and high prices relate more to the growth in the Chinese jewelry market, which 5 to 10 years ago was a fraction of its size today.

Assaf explained that both tsavorite and spinel are rare stones, and even minor changes in the market might have a considerable impact. If just a fraction of one percent of Chinese consumers becomes interested in tsavorite, this has a measurable consequence for supply, especially if production in mining areas is static or even showing slight declines. According to Assaf, the biggest tsavorite purchasers at the source in Arusha, Tanzania, are Sri Lankans buying for the Chinese domestic market. These buyers are prepared to pay very high prices for tsavorite rough.

To illustrate the sporadic nature of current supply, Assaf cited a bright, light-toned green grossular garnet. This material has become popular and is sold as "Merelani mint" garnet. It is usually recovered as a byproduct of tanzanite mining. Every so often, he related, miners find a productive pocket and buyers fly in within a couple of weeks.

According to Assaf, the stones on the tray in front of us (figure 27) were from the latest small pocket and had been in the ground just a few months earlier. After the initial flurry of buying activity, Assaf said, it might be another year or two before a similar discovery. In the meantime, the miners might bring buyers the occasional stone—at much higher prices.

In Assaf's opinion, today's tsavorite rough prices in Arusha are almost "out of control." In effect, there is a disconnect between the Arusha prices and the prices in Tucson, which will likely take several years to readjust.

His company stops buying before the Tucson show because the clientele here will not pay the high asking prices. He cited an instance several weeks earlier in which buyers were offering him top-quality rough for approximately $10,000 per stone, in sizes sufficient to cut 3 ct finished gems. A stone cut from this rough would have a per-carat price well above what the market at the Tucson show would pay. Besides the high asking price, Assaf said there is a significant element of risk in buying rough: "You never know what kind of unpleasant surprises you might find."

He pointed out that there are places in the world where such high prices are accepted—China and possibly parts of Europe—which is why the few fine rough tsavorites that become available every month are snatched up. Assaf had just heard of a 7-gram piece of tsavorite—perhaps suitable for a 10 ct finished gem—that sold for $200,000 in Arusha.

Assaf showed us two examples of the finest tsavorite col-

Figure 26. Daniel and Andre Assaf of the Tsavorite Factory explained the current market for tsavorite. Photo by Duncan Pay/GIA.

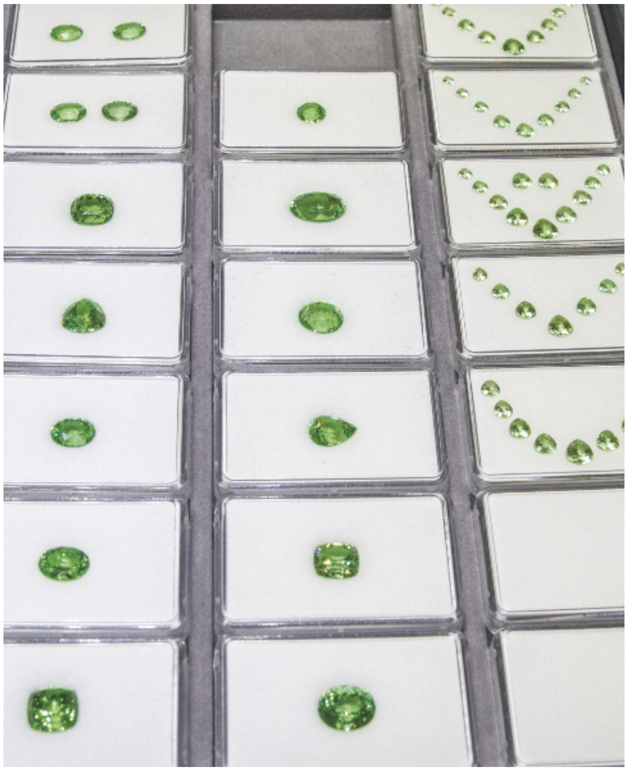


Figure 27. These light-toned Tanzanian grossular garnets—termed "Merelani mint"—were mined just a few months prior to the Tucson show. Photo by Duncan Pay/GIA; courtesy of Tsavorite Factory.

ors. In his opinion, both are of equal merit (figure 28, left). Some clients love the deeper, darker color, while others prefer a brighter, lighter-toned green. In either case, he said, the most important consideration is to have a blue color component rather than a yellow one. As long as the gem is not overly dark, and has a bluish cast to the green, it is a quality stone. If it is pale but still has a bluish component to the green, he would classify it as a "mint" garnet.

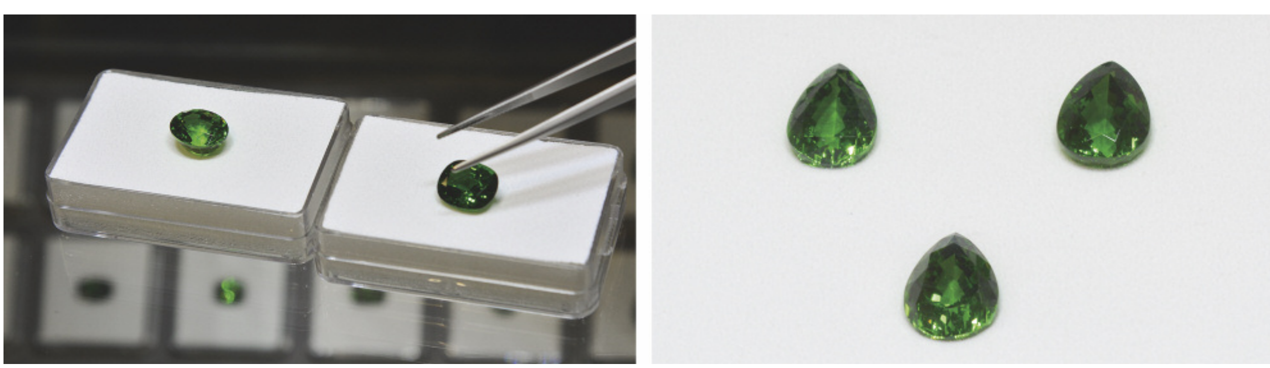
We asked Assaf how recent Chinese demand has affected tsavorite prices. He said that for sizes under 2 ct, prices have increased as much as 30–40%. The impact has been most dramatic in larger stones: For gems larger than 3 ct, prices have tripled. He felt that prices for large tsavorites have gone up in relation to emerald and other gems due to scarcity of supply and high demand.

To emphasize the point, Assaf chose a suite of three tsavorite pear shapes totaling 37.79 carats (figure 28, right). Each gem was above 10 ct and of the highest clarity, so they constituted exceptionally rare material. Aside from these standouts, Assaf admitted he had few stones of such size—large stones are typically a Tsavorite Factory specialty—due to the prohibitively high price of rough. He lamented that with today's stratospheric prices, he would have to pay around $200,000 to obtain another 7-gram piece to cut another 10 ct gem. And very few clients—likely none at this show—would accept the resultant high per-carat prices for the finished gem. That leaves two possibilities: Either the prices will adjust in Arusha, or they will become accepted in the U.S.

Assaf recounted that some of the same market factors apply to red spinel. His company does not carry spinel from Myanmar, focusing instead on Tanzanian material. This year, he said, a specific color people were calling "Mahenge"—deep pink with a touch of orange, almost like a padparadscha color—was in extremely high demand (figure 29). Assaf had sold all of his "Mahenge" spinel but none of the other colors. While these lavenders, blues, and mauves are quite beautiful and competitively priced at around 10% of the pinks, the red to pink spinels are what his clients seek. Assaf also mentioned that buyers looking for something unusual picked yellow danburite from Tanzania, and that this gem had sold quite well for him at the show (Summer 2008 GNI, pp. 169–171).

Duncan Pay

Figure 28. Left: Some prefer tsavorite garnets with a brighter color, while others prefer a darker appearance. The stone on the left weighs 9.50 ct. Right: This suite of three pear-shaped tsavorites totals 37.79 carats. The approximate asking price for such fine gems would be about $15,000 per carat. Photos by Duncan Pay/GIA; courtesy of Tsavorite Factory.



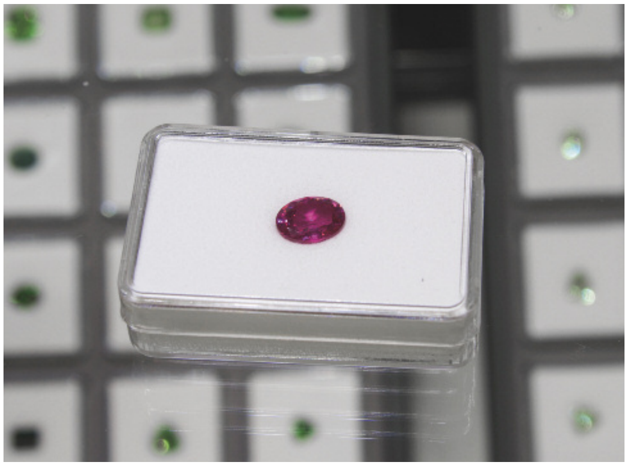


Figure 29. An example of "Mahenge" spinel from Tanzania. This was one of the few examples left at Daniel Assaf's booth at the time of our interview. Photo by Duncan Pay/GIA; courtesy of Tsavorite Factory.

Figure 30. Fashioned by lapidary Jean-Noel Soni, this 35.50 ct mixed-cut sunstone is reportedly from a mine on Eagle Butte, in Oregon's remote Harney Basin. Photo by Robert Weldon/GIA; courtesy of Suncrystal Mining.

Oregon sunstone update. At the GJX Show, Nirinjan Khalsa (Suncrystal Mining, Lake and Harney Counties, Oregon) showed us a remarkable 35.50 ct rich orangy red Oregon sunstone fashioned into a modern mixed-cut cushion by lapidary Jean-Noel Soni (Top Notch Faceting). This stone (figure 30) resembled a fine ruby under the showcase lights and was one of the most exquisite examples we had seen.

At Khalsa's request, we followed up with Soni after the show. He told us the original rough weighed 198.82 ct. As is typical with Oregon sunstone, the rough contained spots of strong red or green color in the cores of otherwise yellow or near-colorless crystals. This crystal had two color spots, so he divided it, and this gem was the first of two he intended to cut. Rather than using CAD software to design his gems' faceting styles, Soni treats each rough as unique and individual, cutting to maximize color and luster. He explained that the pavilion had to be deep, due to sunstone's relatively low RI (1.563–1.572). This produced a 63.00 ct preform, from which he faceted the 35.50 ct gem we saw. The asking price for this gem—reportedly from one of the mines on Little Eagle Butte (in Harney Basin, near Plush, Oregon)—was in the region of $60,000.

Also at the GJX show, Don Buford and Mark Shore (Dust Devil Mining, Plush, Oregon) gave an update on their operations. They said 2014 was a good year at Dust Devil. They uncovered a former dried creek bed where the basalt was extensively decomposed, which has allowed easier recovery of the sunstones. Buford hopes to have the mine's optical sorter operational for the 2015 mining season.

Shore showed us an exceptional 156.00 ct "watermelon" sunstone from recent production (figure 31). The stone has a red center surrounded by a greenish "rind." Shore has made arrangements to have it carved by Dalan Hargrave, winner of multiple AGTA Spectrum Awards.

At the 22nd Street show, Terry Clarke, co-owner of the Dust Devil mine, explained a recent initiative to maintain the integrity of natural, untreated Oregon sunstone and promote it to retailers and consumers as a rare and desirable "all-American" gemstone. Called the Oregon Sunstone Miners Association (OSMA), the organization includes most of the miners with working claims or mines in Lake and Harney Counties (figure 32). OSMA also offers an associate membership for sellers of loose gems or jewelry. Anyone purchasing sunstone from an OSMA member can be assured they are getting the natural, untreated Oregon product. The intention is to expand the marketplace for this unique gem and maintain stability and consumer confidence in the event of an influx of treated material from another source. The association's website is www.oregonsunstonema.com.

At the AGTA show, John Woodmark (Desert Sun Mining & Gems, Depoe Bay, Oregon) provided an update of his

Figure 31. This 156.00 ct rough sunstone belongs to the Dust Devil mine's Mark Shore and will likely become a fine carving. Photo by Duncan Pay/GIA; courtesy of Mark Shore.

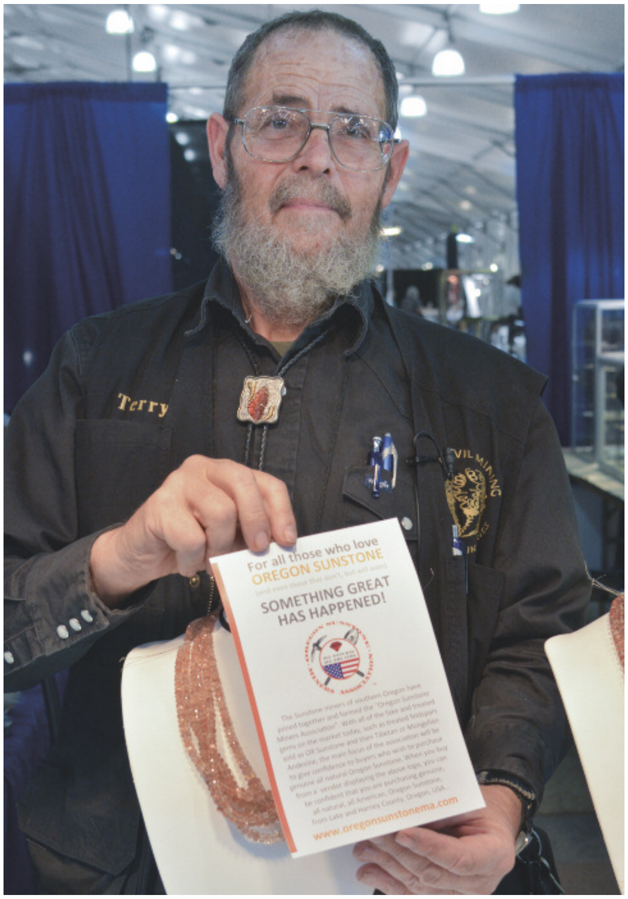


Figure 32. Dust Devil Mining's Terry Clarke holds a flyer promoting the Oregon Sunstone Miners' Association. Photo by Duncan Pay/GIA; courtesy of Dust Devil Mining.

operations at the Ponderosa mine and summarized the current market for his goods. He showed us a striking 2.77 ct "spinel red" gem from recent production (figure 33).

According to Woodmark, 2014 saw heightened interest in Oregon sunstone. He received requests for rough from clients in Australia and for finished stones from Brazil and Europe (principally the UK and Germany). At this particular show, Woodmark said he had received many more inquiries from domestic jewelers for samples and information, all following customer requests due to growing public awareness of the gem. He cited a TV shopping channel's recent promotion of production from the Sunstone Butte mine and the growing reach of his Internet business. For more information on the Sunstone Butte mine, see www.gia.edu/gia-news-research-butte-sunstone.

Woodmark observed that Internet merchandising, often by TV jewelry shopping channels, has been transformative for low-volume, one-of-a-kind products like Oregon sunstone. Web marketing frees traditional TV merchandisers from the production costs of on-air hosts and studios, and allows the cost-effective presentation of a spectrum of Oregon sunstone from "bargain parcels" to unique designer

Figure 33. This 2.77 ct "spinel red" sunstone, measuring 10.5 × 8 mm, is from Oregon's Ponderosa mine. Photo by Robert Weldon/GIA; courtesy of Desert Sun Mining & Gems.

cuts costing several thousands of dollars per piece. According to Woodmark, one buyer for a major TV jewelry retailer at the Tucson shows said that Internet business was now 40% of the company's total sales volume.

Woodmark estimated the total volume of fashioned Oregon sunstone on the market in 2014 was approximately 70,000 carats. By his calculations, that would be sufficient to supply one large U.S. retail jewelry chain with 10 carats per store per month over the course of a year. If demand picks up in 2015, that volume will not meet the industry's needs. Woodmark reported that business was up 25% on the previous year's show, which was up one-third on the year before.

In the 2014 mining season, Woodmark employed up to five pickers working the screens. He worked the mine for a total of 20 days and produced almost 2,000 kg of rough in all grades. Woodmark plans to work for 40 days in 2015 and expects to recover 4,000 to 5,000 kg of rough. To start the upcoming mining season, Woodmark will bring in heavier machinery and extend the pit back into the hillside. He will also bring in a bulldozer with a ripper to tear up the pit floor and start moving downward, too. Late 2014 saw recovery of larger rough, some pieces up to 70 grams (figure 34). In addition, the pit's "red zone," with a higher proportion of red-cored rough (up to 20%), remained productive. Woodmark expected the trend of bigger, better stones to continue as the miners work deeper into the deposit. This is similar to the situation at Sunstone Butte, he remarked.

Anticipating higher demand, he also planned to cut more frequently in 2015. Rather than cutting two to three times per year, he will cut 2,000 to 4,000 kg per month (new production plus stockpiled rough), depending on his needs. As 4,000 kg equates to approximately 2,000 carats of finished stones, Woodmark expected his production to significantly increase market availability of Oregon sunstone in 2015.

Like all the Oregon sunstone mines, Ponderosa pro-

Figure 34. The 2014 season saw some larger rough sunstone from Ponderosa mine in the 20–70 gram range. As operations go deeper, stone size seems to increase. Photo by Duncan Pay/GIA; courtesy of Desert Sun Mining & Gems.

duces a substantial quantity of yellow and near-colorless labradorite—material with little or no pink or red and no visible coppery reflections. One of the things Woodmark has learned at this show is the importance of cutting style and quality on a gem's perceived value. He sold 2 kg of yellow rough to another vendor at the AGTA show—Ken Ivey (Ivey Gemstones, Prescott, Arizona)—and was astonished at the result.

Ivey's use of concave cutting styles (figure 35) presented the feldspar's bright yellow color far more effectively than conventional cuts. With conventional cutting, Woodmark struggled to get a few tens of dollars per carat for yellow goods. With only a modest investment in extra cutting costs for concave faceting—perhaps twice the expenditure—the same material can sell for up to five times as much. As the yellow rough sells for a couple hundred dollars per kilogram, this is a potentially significant value addition in the finished product.

Another encouraging trend Woodmark sees is that designers and jewelers are mixing calibrated sunstones of different shapes and colors in the same jewelry piece. The casting is standardized, but because every combination is unique there is no longer the need to match them. Volume business with sunstone jewelry has always been hampered by the perception that every stone in a piece has to match and every piece must be uniform.

In Woodmark's opinion, even home shopping channels like QVC are moving away from that concept, in essence marketing the uniqueness of the gem rather than a uniformity it can never provide. He cited a piece for which he supplied 3.0, 4.0, and 5.0 mm calibrated gems. One was a top-quality red sunstone, and the others were paler pink. In this way, the manufacturer does not have to match the stones and can use larger volumes.

Duncan Pay

Figure 35. The concave cutting style used on these Oregon feldspars accentuates their yellow color and raises the market value of the material. Photo by Duncan Pay/GIA; courtesy of Ivey Gemstones.

Figure 36. Noor Gems showcased afghanite from Badakhshan Province, Afghanistan. Photo by Duncan Pay/GIA; courtesy of Noor Gems Japan Ltd.

Large and unusual gems. The inventory of Noor Gems Japan Ltd. at the GJX show was characterized by large and unusual gems, including a fine selection of rare blue and pink gemstones: afghanite, hauynite, hemimorphite, and pezzottaite. Bright blue afghanite (figure 36), which the company has been selling for three years, was available in gem quality in the 0.3–1.5 ct range, priced at approximately \$500–\$700 per carat. It has been especially popular with Noor's Japanese clientele. Afghanite is a relatively soft stone for jewelry, with a hardness 5.5 to 6, best suited for pendants and earrings. While near-colorless material can be found in Italy and Germany, the recent production of blue afghanite is from Badakhshan Province, Afghanistan.

Figure 37. Another attraction at the Noor Gems booth was pinkish purple copper-bearing tourmaline from Mozambique, which they labeled as "Paraíba." Photo by Duncan Pay/GIA; courtesy of Noor Gems.

Figure 38. Marketed as "ginger" garnet, these four garnets range from 8.33 to 35.54 ct. Photo by Robert Weldon/GIA; courtesy of Advanced Quality.

Mehraj Uddin exhibited two large topaz of exceptional pink to red color (6.38 and 12.08 ct). As with virtually all pink topaz, he acknowledged that these fine stones were heat treated. Debuting at Noor's GJX booth was pinkish purple copper-bearing tourmaline from Mozambique (figure 37).

For some large and exceptional gemstones, such as a 254.50 ct peridot cabochon from Pakistan, Uddin admitted they hold on to these stones for 10 or 20 years. The company is reluctant to sell them because of the difficulty in replacing such inventory. They will only sell when they feel the market is high.

Donna Beaton

Ginger garnet, "fancy" tanzanite. Kobi Sevdermish (Advanced Quality, Ramat Gan, Israel) showed us large fine "ginger" garnets and discussed the cutting of natural-color tanzanite crystals. The garnets are from a new find in Tanzania, discovered in late 2014. In large sizes, the stones have a pleasing "open" pinkish orange or orangy red hue (figure 38). By "open," Sevdermish meant the tone is not too dark, remaining lively and relatively bright even in sizes above 30 ct. He noted that many red garnets cut in large sizes have a tendency to become very dark, and this material avoids that pitfall. If fashioned correctly, it "pops." Along with the virtues of lighter tones and relatively large sizes, it possesses high clarity.

Supply has been limited—Sevdermish had only seen a few parcels of larger rough suitable for cutting gems up to 40 ct—and some of this material was of lower clarity. Standard gemological testing revealed an RI of 1.74 and an SG in the range of "Malaya" garnet (3.78–3.85).

As in 2014, Sevdermish reported that "natural-color" tanzanite remained a very successful item for Advanced Quality. He showed us a selection of unheated gems in a range of subtle secondary colors (greens and pinks) behind the predominant "typical" blue to purple tanzanite colors (figure 39). Sales have been strong in Europe and particularly Asia. According to Sevdermish, this is because no two

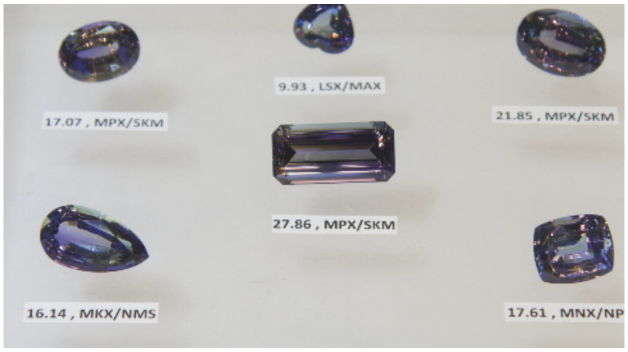


Figure 39. A selection of reportedly natural-color, unheated tanzanites ranging from 9.93 to 27.86 ct. Photo by Duncan Pay/GIA; courtesy of Advanced Quality.

are exactly alike. To demonstrate, he showed us a large suite of mixed fancy colors (figure 40).

He explained that rough of "odd" colors—unheated pinks and greens—did turn up over the years, but in the last year and a half, material from Block B of the tanzanite mining area has provided some "magnificent" natural colors: lavender, cognac or golden colors, and very rare pink and yellow and green.

Sevdermish noted that buying suitable tanzanite rough in these colors is a painstaking business, even though the company has cultivated connections in Africa that locate this material for them. Some purchases take time, he said, and require him to extend buying trips to obtain a few special, unique pieces. He added that it takes persistence to negotiate with miners and their representatives. And if no other buyers outbid you, you succeed. Sevdermish said that many of the stones at his booth were cut about a week and a half earlier.

Advanced Quality documents, through video recording and photography, each rough piece as it goes through the planning, sawing, and faceting process—in essence, the mine-to-market story of each significant gem. In this way, Sevdermish asserted the company can show—to the best of its knowledge—the unheated nature of its gems to clients. Many of the stones promoted as "unheated" in the market are actually the products of less-than-successful heating, he explained.

Just a couple of weeks earlier, he managed to obtain a few large pieces of rough with unique light yellow colors, one of which yielded a 27.59 ct antique cut (figure 41). The gem came out predominantly greenish yellow, but with flashes of lilac pink, which is what Sevdermish initially expected from the rough. The company debated whether to cut the original rough, as it was such a spectacular piece, but ultimately decided to fashion it because the crystal was not quite perfect enough to be a specimen.

Sevdermish described buying and cutting rough as a lottery. Certain gems—some spinels or even regular tanzanite—are more or less predictable. But with others, especially the rough for this "fancy-color" tanzanite, the results are less foreseeable. The rough for the 27.59 ct gem promised a "kaleidoscope of colors" blending pink, yellow, and green, so Sevdermish expected to see an interplay of colors inside the fashioned gem. Instead, he was dismayed to find the gem was colorless. Fortunately, Sev-

Figure 40. Kobi Sevdermish of Advanced Color shows off natural-color tanzanite, including a remarkable multicolor necklace of almost 170 carats total. Photo by Duncan Pay/GIA.

Figure 41. This 27.59 ct unheated, natural-color zoisite or "fancy" tanzanite shows a subtle tint of lilac pink against a greenish yellow bodycolor. Photo by Robert Weldon/GIA; courtesy of Advanced Quality.

dermish reported, the hoped-for greenish yellow color returned after the gem had "rested" for two days in its parcel paper.

Duncan Pay

Gem artistry in smaller sizes. At GJX, we caught up with gem artist Alexander Kreis (Sonja Kreis Unique Jewelry, Niederworresbach, Germany). It is a family business, with his father buying the rough, his mother designing the jewelry, and Alexander cutting the gems. Kreis had placed their best Oregon sunstone and their largest rutilated quartz pieces prominently in the booth to achieve a "wow" effect. Immediately beneath those signature pieces, Kreis had positioned more accessible gems that customers could use to make more affordable jewelry items. Although smaller than his trademark pieces, these were invested with the same precision and beauty. He produces pairs that would be ideal for earrings or even men's cufflinks. Kreis spoke about three of these more accessible lines, involving tourmaline, citrine, and blue topaz.

For Kreis, green and pink tourmaline symbolize the colors of the rainforest, so their design evokes the vivid foliage and blooms of that environment. The curves provide a fluid elegance, and the cuts on the underside capture the veins and structure of tropical leaves.

Among Kreis's new product designs for this year are citrines cut in a more angular style, with very detailed carvings on the back representing sunrays (figure 42). To Kreis, citrine's color represents the heat of the sun, while the carvings channel its intense slanted rays.

Figure 42. Gemstone artist Alexander Kreis holds a sun carving, one of his new designs in citrine. Photo by Duncan Pay/GIA; courtesy of Sonja Kreis.

In striking contrast, another new design he called "frozen topaz" (figure 43) uses the icy hue of treated blue topaz to evoke arctic waters. The carving in the center is smoothly polished; the light rays, which are reflected from the polished carving, produce pinpoints of light on the gem's frosted sides. The design and the material combine to produce an icy brilliance. As the wearer moves the gem, Kreis said, it produces "a harmony of light points dancing through the stone."

Duncan Pay

Figure 43. In these examples of "frozen topaz," the smooth carvings contrast with the frosted textures and lend an icy brilliance to the finished gems. Photo by Duncan Pay/GIA; courtesy of Sonja Kreis.

Figure 44. This edge-on view of the "wheel of light" reveals its construction. Photo by Duncan Pay/GIA; courtesy of Nature's Geometry.

Figure 45. Seen end-on, the larger disk displays the spectrum as concentric colors. Photo by Duncan Pay/GIA, courtesy of Nature's Geometry.

Larger optic disks. At the 2014 GJX show, Brian Cook (Nature's Geometry, Graton, California) showed us innovative optical disks made of colorless quartz featuring a drilled tube containing pieces of brightly colored gem and mineral rough. The tube is subsequently sealed with clear quartz. When the disk is viewed face up, the insert's reflections permeate the disk with bright color.

For this year's show, Cook's "wheel of light" design evolved into larger sizes with more intriguing reflective effects. Seen front-on, the new disks produced concentric colored reflections. The first we saw measured approximately 4 cm (1.57 in.) in diameter and featured Brazilian emerald, Paraíba tourmaline, and haüyne insets (haüyne is a brittle sodium calcium sulfate that provides rich blues). One innovative feature is that the viewer could see different colors depending on the viewing direction. From various directions the disk was suffused with bands of rich green, electric blue, or royal blue color.

According to Cook, this new product takes the color and amplifies it. There is a chamber within the quartz, which he polishes before inserting the colors he wants. Because no faceting is involved, all the colors are blended together. Cook said his passion for Paraíba tourmaline was the starting point.

Cook unwrapped a larger disk, approximately 8 cm (3.15 in.) in diameter. Viewed edge-on, the chamber's pattern of colored rough gems and minerals was revealed (figure 44). Cook had arranged a complete spectrum of rainbow colors in sequence: ruby, spessartine garnet, a gold nugget, Paraíba tourmaline, and haüyne (figure 45).

Cook also showed us a smaller optic disk set in a handmade platinum pendant set with diamond and melee-size Paraíba tourmaline from the Brazil Paraíba mine in Parelhas, Rio Grande do Norte. This piece combined the unusual optic effects of the center, which featured more Paraíba tourmaline and haüyne, with a conventional suite, which besides the pendant included a pair of earrings set with similar optic disks.

Duncan Pay

Figure 46. This unique 303 carat "Snow White" tourmaline suite was reportedly carved in Idar-Oberstein in the 1970s. Photo by Duncan Pay/GIA; courtesy Jan Goodman Co.

Unusual carved tourmaline suite. Jan Goodman (Beverly Hills, California), had an exquisite 303 carat suite of carved, particolored tourmaline depicting Snow White and the Seven Dwarfs (figure 46). In most depictions of the dwarfs in a line, the lead figure is "Doc" carrying a lantern. In this series, in a nod to the jewelry industry, the lead dwarf is depicted carrying a beaded necklace. Goodman recalls that the set was carved in Idar-Oberstein in the 1970s and came to him mounted in the presentation case. The suite had been in his personal collection for more than 30 years. Goodman told us "demand and price are finally in such a place as to justify parting" with it.

Donna Beaton

Figure 47. A carved agate and leaf pendant featuring diamond and tsavorite accents. Photo by Robert Weldon/GIA; courtesy of Jeff Bilgore, LLC.

Figure 48. A platinum pendant featuring 13 natural colored diamonds (6.31 carats total) with an 18K yellow gold and platinum chain featuring 36 oval fancy color diamonds (4.23 carats total). Photo by Robert Weldon/GIA; courtesy of Jeff Bilgore, LLC.

Gemstones and jewelry inspired by nature. Jeff Bilgore has 18 AGTA Spectrum Awards to his credit in both the cutting and design categories. His booth in the AGTA GemFair featured two pieces that departed from the norm of colored stones: an exquisitely carved leaf brooch of moss agate, highlighted with diamonds (figure 47), and a platinum pendant panel and chain featuring natural-color fancy diamonds that appeared to float within the frame (figure 48). The cut-corner rectangular panel, reminiscent of a classic Cartier design, featured 11 natural colored diamonds (5.68 carats total, all with GIA reports confirming Fancy, Fancy Vivid, or Fancy Intense hue), paired with a chain featuring 36 additional oval fancy colored diamonds (4.23 carats total).

After viewing the selection of carefully curated gemstones, one becomes aware of the entwined themes of art and nature. Bilgore espouses the principle of biophilia, the belief that humans intuitively respond positively to nature. Rather than viewing gemstones as inanimate objects, Bilgore sees them as part of nature, and he displays many of the gemstones and jewelry pieces with a tiny easel featuring an associated image (figure 49). A 5.69 ct Australian crystal opal, exhibiting play-of-color in all hues, was displayed with an image of the aurora borealis. Some of the other images are Bilgore's own photos, taken in his garden or while hiking. In a further nod to nature, the design of the colored diamond panel pendant was inspired by the Golden Mean and the Fibonacci series, mathematical relationships often found in nature and incorporated into manmade creations as diverse as music and architecture.

Donna Beaton

Rare stones in demand. For Brad Wilson and John Bradshaw (Coast-to-Coast Rare Stones International, Kingston, Ontario), their inventory of corundum and other familiar

Figure 49. A 5.69 ct Australian crystal opal is accompanied by an image of the aurora borealis on a tiny easel. Photo by Towfiq Ahmed; courtesy of Jeff Bilgore, LLC.

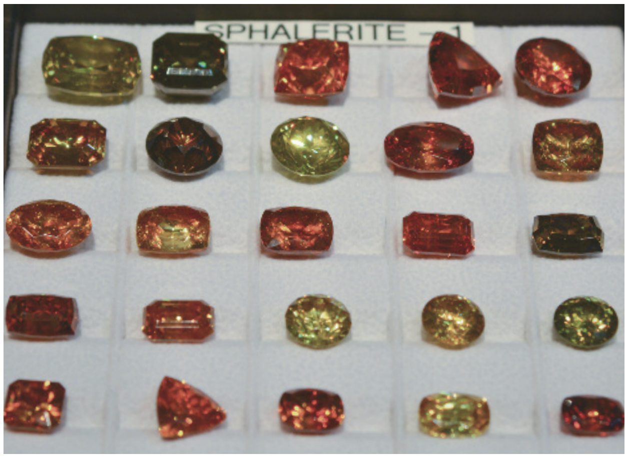


Figure 50. Brightly colored sphalerite is one of the most popular "unusual" gems sold by Coast-to-Coast. Photo by Duncan Pay/GIA; courtesy of Coast-to-Coast Rare Stones International.

gemstones never makes the trip to Tucson. Instead, their showcases are filled with rarities such as afghanite, bastnaesite, beryllonite, clinohumite, celestite, hambergite, magnesite, montebrasite, pargasite, sphalerite, violane, and zincite. These stones often are soft and near-colorless and have cleavage, making them less desirable for jewelry. But for a collector or a designer looking for the unusual who understands how to work with such challenging stones in jewelry, Coast-to-Coast at GJX is a worthwhile destination.

Some of the lesser-known stones available at Coast-to-Coast included datolite, cobaltocalcite, faceted aragonite, and tenebrescent scapolite. Fluorescent opal was a noteworthy new find. Under ordinary interior lighting, this opal is near colorless to very pale yellow. It can fluoresce bright green in response to the small UV component in ordinary daylight. Placed under an ultraviolet light or 405 nm laser, the fluorescent effect is spectacular.

With unfamiliar collectors' stones, colorful varieties usually sell best. Wilson's more popular items for this show included sphene, sphalerite (figure 50), and apatite. He told us that other stones rise and fall in popularity. One example is tugtupite, a rosy-pink mineral, usually found in aggregate form, that exhibits both interesting fluorescence and tenebrescence. It sold out on the first day in previous shows, according to Wilson, but in 2015 only a few had sold by the third day.

Donna Beaton

Color-change garnets from Tanzania. At the Riverpark Inn (Pueblo) show, Todd Wacks (Tucson Todd's Gems, Tucson and Vista, California) showed us interesting color-change or color-shift garnets from Tanzania (figure 51). According to Wacks, they were mined in Morogoro, Tanzania, back in 1988, and documented the same year (see C.M. Stockton, "Pastel pyropes," Summer 1988 *G&G*, pp. 104–106). The material resembled rhodolite rough and contained fine needle-like inclusions—most likely rutile.

The gems were pinkish purple in daylight and showed a color change from intense pink in warm incandescent light to purple—almost like a fine amethyst—in cool LED light. Wacks said the larger stones display the most pronounced color change. Very similar color change phenomena have been reported for other purple "pastel pyropes" from Tanzania, Sri Lanka, and Madagascar.

The rough had been stuck in a safe deposit box for years, he said, because most potential buyers assumed it was rhodolite, saw the inclusions, and lost interest. Wacks recently acquired the 2–4 kg of rough, cut a few pieces, and discovered the color change. He has been promoting the gem since then.

He sent samples to Dr. George Rossman (California Institute of Technology, Pasadena), San Diego gemologist Kirk Feral, and GIA. According to Wacks, the gems are approximately 80% pyrope, 10% spessartine, and 10% almandine, with an RI of 1.736. (This material will be the subject of a more detailed paper in the Summer 2015 *G&G*.)

Sharing booth space with Wacks was colleague and jewelry designer Mary van der Aa (vdAaco, Vista, California). She produces jewelry designs for many of the gems he cuts, including pastel pyropes and pink tourmalines from some

Figure 51. This 7.61 ct "pastel pyrope" shows a strong pink color in warm incandescent light and a strong purple in cool LED light. Photos by Duncan Pay/GIA; courtesy of Tucson Todd's Gems.

Figure 52. This hand-fabricated 14K rose gold and yellow gold pendant by Mary van der Aa features a 6 ct "hot pink" tourmaline from the Stewart mine, cut by Todd Wacks. Photo by Duncan Pay/GIA; courtesy of vdAaco.

of the mines in San Diego County (figure 52). Her jewelry also features stones cut by renowned gem artist Meg Berry.

Duncan Pay

Bold color combinations. For retailers and designers overwhelmed by the endless rows of gemstones lined up in trays, inspiration could be found at the booth of Stephen M. Avery (Lakewood, Colorado). Avery presented "statement"-sized gemstones in suites of bold color combinations (figure 53). His company has mainly sourced African stones but is now traveling to Asia to add brightly colored sapphire and spinel to its design palette. Avery, an expert cutter as well as buyer, fashioned all the gemstones in his inventory. The combination of craftsmanship and creative inspiration appeared to have paid off, as he reported the company's best show ever.

Donna Beaton

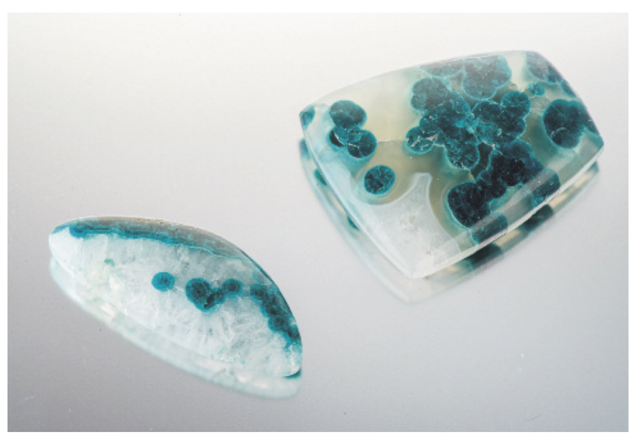
Figure 53. Top: This vibrant 2.08 ct oval pink sapphire flanked by a pair of warm-hued spessartine garnets totaling 3.41 carats strikes a tropical note. Bottom: This bold pendant and earring suite features three marquise-shaped tanzanites totaling 6.73 carats, with modified trilliant rubellite tourmalines of 14.20 carats total. Photos courtesy of Stephen M. Avery.

Chrysocolla in quartz. The Rare Earth Mining Company (Trumbull, Connecticut) booth at the AGTA show displayed a specialized inventory of unique and rare materials available as finished gemstones, mineral specimens, and fossils. Curt Heher, Rare Earth's president of sales, reported more than 300 companies placing orders in finished stones alone: "We enjoyed our biggest Tucson show in 40 years."

We obtained two cabochons of blue-spotted clear and near-colorless quartz (figure 54) that were reminiscent of "K2 stone" or "Raindrop azurite" seen in previous years (Spring 2012 GNI, pp. 55–56). Heher's father bought the rough, which was crystallized around blue stalactites, at auction in the 1980s. It remained in storage until recently. The material was reportedly mined in Globe, Arizona, in the 1970s.

Gemological examination of the 19.16 and 52.96 ct cabochons revealed an RI of 1.54 to 1.55 in most areas, but approximately 1.5 in the blue area, and a 1.46 spot reading in transparent areas. Specific gravity ranged from 2.36 to 2.47. The fluorescence reaction to long-wave UV was weak white in fractures and the transparent areas. Raman analysis confirmed that the blue material was chrysocolla, the transparent to whitish areas were quartz, and the transparent cryptocrystalline areas were chalcedony. Raman analysis also indicated the presence of a hardened glassy polymer (polymethyl methacrylate). FTIR also confirmed the polymer, corroborating the stabilization that Heher indicated

Figure 54. 52.96 ct and 19.16 ct chrysocolla in quartz, obtained from Rare Earth Mining Company at the AGTA show. Photos by Jian Xin (Jae) Liao.



was needed to prevent crumbling or fracturing during the cutting and polishing process. The treatment conclusion on a GIA report would be "impregnated" or possibly "composite" if the polymer occupied significant volume or surface area.

Chrysocolla in quartz is not uncommon, but it is rare to see such defined stalactites resulting in a distinct orbicular pattern. This material often remains as mineral specimens rather than being cut for jewelry purposes.

Donna Beaton and Akhil Sehgal

PEARLS

Cultured pearl market update. At the 2014 AGTA show, Fran Mastoloni (Mastoloni Pearls, New York City) provided a market summary from his own business perspective. He emphasized surging demand in the Chinese domestic market for all cultured pearl types, plus the need to introduce innovative styles and pearl combinations in contemporary jewelry. Since then, overall supply of fine cultured pearls of every type has become even more challenging.

This year, Mastoloni reported that Chinese demand for Philippine golden cultured pearls continues unabated, and the domestic market there is absorbing nearly all available production, effectively pricing them out of the North American market. Although never a high-turnover item in the U.S., any such pearls sold in the American market will likely come from suppliers' existing inventory. And once sold, they will not be replaceable given current market prices. Mastoloni predicted an eventual downward correction, once the Asian market's appetite for golden pearls is sated.

Supply of quality Tahitian cultured pearls (figure 55) is also becoming problematic. Mastoloni said the Tahitian government has ceased support of pearl farmers, with a resulting decline in colors, sizes, and overall product quality.

Figure 55. Mastoloni described this fine 16.4–16.7 mm Tahitian cultured pearl with natural color and luster as his "new favorite pearl." He added that top-quality examples like this are increasingly hard to find. Photo by Duncan Pay/GIA; courtesy of Mastoloni Pearls.

Figure 56. Top-quality Australian South Sea baroque cultured pearls 15.5 × 19.0 mm and larger grace this spectacular necklace. Photo by Duncan Pay/GIA; courtesy of Mastoloni Pearls.

Exceptional pearls are particularly scarce. He was very concerned about pearl production over the next 10 years. Prior to 2008, he said, Tahitian pearl farmers were very conscientious about quality. Today, in Mastoloni's words, "Farmers are producing to turn over."

[*Editor's note*: On October 1, 2008, the Tahitian government abolished the pearl export tax, which had largely supported the GIE Perles de Tahiti industry association. This removed the funding for the promotion of Tahitian cultured pearls, leading to GIE Perles de Tahiti's collapse in 2012. The 2008 global economic downturn drastically curtailed pearl sales and stressed many Tahitian pearl farmers (see A. Müller, "A brief analysis of the global seawater cultured pearl industry," European Gemmological Symposium, Bern, Switzerland, June 5, 2009, pp. 7–10). Since the collapse of GIE Perles de Tahiti, producers have increasingly looked to China as a promising export market, which is also likely to affect availability for U.S. and European markets.]

Mastoloni noted that white South Sea cultured pearls remain the standard by which fine pearls are judged. Although fine quality is still difficult to find, supply is good. He showed us a spectacular Australian South Sea necklace composed of white to pink 15.5 to 19 mm-plus baroque pearls with excellent luster and unblemished surface (figure 56). Weighing in at an "extraordinary" 46.1 momme

Figure 57. Left: Long necklaces are in style. This "Wave" necklace features multicolored Tahitian cultured pearls ranging from 7 to over 14 mm. Right: This close-up of the necklace shows its repeating color and size patterns in a succession of "waves." Photos by Duncan Pay/GIA; courtesy of Mastoloni Pearls.

(172.88 grams), this necklace took more than two years to complete. There is always the temptation to keep improving a piece, to make it "bigger and better." As an example, he showed us a large baroque specimen that measured 23.3 × 28.6 mm and weighed 4 momme (15 grams), with superb luster, that he would like to make the centerpiece of the necklace. Prices for baroque cultured pearls are stable with moderate demand, he noted, but sourcing high-quality goods is somewhat difficult.

Mastoloni said fine akoya cultured pearls are also in high demand. Once again, he faces competition from Chinese buyers purchasing for their domestic market. According to Mastoloni, pearl farmers in China are no longer concentrating on smaller round pearls. They are not producing enough 5, 6, or 7 mm diameter goods in sufficient quality, in either akoya or freshwater types, to satisfy demand. The result is increased competition, with Chinese buyers competing at the source in Japan for akoya. This demand is driven by the emerging wealth of Chinese consumers. Their purchasing power and the sheer quantity of consumers in the Chinese domestic market is fueling unprecedented demand. They are looking for better quality, and fine Japanese akoya pearls meet that need.

In terms of trends, Mastoloni noted that "long is in." Double- and triple-length necklaces from 32 to more than 50 inches are very popular, he said. He has also noticed that basic necklaces are making a comeback, and more retailers are asking him to supply "regular" necklaces for their inventory. Mastoloni showed us a double-length necklace that made clever use of soft-colored round Tahitian cultured pearls in a variety of sizes. He called it the "Wave" necklace (figure 57). "Swells" graduating from 7 to over 14 mm form waves in repeating color patterns along the length of this necklace (approximately 36 inches), creating a layered look. The repeating size and color patterns lend a sense of movement and drama.

Duncan Pay

Chinese freshwater pearl culturing, overall market summary. Also at the AGTA show, Jack Lynch (Sea Hunt Pearls, San Francisco) offered his perspective as a pearl entrepreneur (figure 58). Over the years he has introduced many trends in cultured pearls and pearl culturing techniques to

Figure 58. Jack Lynch of Sea Hunt Pearls displays strands of baroque bead-nucleated Chinese freshwater cultured pearls at his AGTA booth. Photo by Duncan Pay/GIA.

Figure 59. This spectacular strand of Chinese freshwater cultured pearls is graduated from 15.4 to 19.3 mm. Lynch described it as the best of four such strands available when he purchased it from his supplier. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

the market, including soufflé pearls: large baroque Chinese freshwater cultured pearls with fine luster, interesting colors, and light heft (Spring 2010 GNI, pp. 61–63, www.gia.edu/gems-gemology/spring-2010-gem-news-international).

Lynch's reputation for introducing new products and styles leads to the same question at his Tucson booth every year: "What's new in the pearl business?" Typically the question centers on freshwater cultured pearls from China. This year, he noted, the emphasis of Chinese pearl culturing innovation was on size. As evidence, Lynch showed us a remarkable necklace composed of round freshwater cultured pearls graduating from 15.4 to 19.3 mm (figure 59). He had never seen a necklace of this size and quality, with beautifully matched, top-quality round pearls. His supplier only had four available, and this necklace was the finest.

Rather than producing baroque pearls, like the soufflé, the drive is now toward bead nucleation and large, spherical pearls. As producers initially sell by weight, there is a financial imperative to produce bigger pearls.

Although producers are ultimately striving for quality, quantity is still the most important factor. Lynch felt that the goal of Chinese freshwater pearl culturing has always been the production of "large white round pearls" and that success to date has been limited, with extremely small volumes of fine-quality product available. Certainly, Lynch knows of no more than a handful of examples like the necklace he showed us at his AGTA booth.

Lynch was uncertain which kind of nuclei or culturing process is used for these larger spherical pearls, but he said the results speak for themselves. He believed it might be similar to the proprietary process used by Chinese producer Grace Pearl for its "Edison" pearls. In this method, genetically selected mussels are implanted using tiny beads instead of mollusk tissue. "Edison" is a backhanded tribute to American inventor Thomas Edison.

Lynch noted that producers are continually hybridizing the mussels used for cultivation, and that they remain very tight-lipped about their methods. Without drilling, sawing, or X-raying the pearls, it is difficult to fully understand the processes or growth methods used.

He mentioned that some of the top producers in China have become increasingly "bullish" about their products, comparing them very favorably with the best South Sea cultured pearls. Because the Chinese domestic market is so strong, its consumers are prepared to pay higher prices than consumers in countries like the U.S. The producers are, in effect, pricing their products out of these markets. According to Lynch, the message from these producers is that the traditional stature of their product vis-à-vis other pearl types must change. In the meantime, they will not consider lowering their prices to satisfy traditional export markets in the U.S. and Europe.

We noticed he had a comprehensive selection of baroque freshwater cultured pearls. Lynch said that while there is moderate market demand for baroque pearls, much of the production originates from cultivators striving for spherical pearls, because "that's where the money is." In his opinion, much of the current Chinese production is similar to "Kasumiga pearls" with textured skins that display very strong orient over natural colors (figure 60).

Known as "ripple" pearls for their textured surface, they are highly regarded for their prismatic effects, near-metallic luster, and organic shapes. As a strand wholesales for just a few hundred dollars, they present a "big look" for a modest outlay. For example, a very rough estimate on the

Figure 60. These 16 × 13 mm bead-nucleated baroque Chinese freshwater cultured pearls have impressive heft along with striking orient and warm natural colors. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

Figure 61. These slightly larger, higher-quality baroque cultured pearls have smoother skins than those in figure 60. As a consequence, they are priced two to three times higher. Natural-color goods are in the foreground, while the white pearls have been bleached for a more uniform appearance. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

15.4–19.3 mm round necklace shown in figure 59 would be $10,000 per strand, whereas these baroque multicolor necklaces cost just a few hundred dollars per strand.

Lynch's higher-quality baroque Chinese freshwater pearls are larger and have smoother skins (figure 61), so the price rises accordingly. The next examples he showed us cost two to three times more. According to Lynch, they are very fashion-forward and still represent a tremendous value for the size.

The higher-quality baroque strands Lynch showed us were also bead nucleated, but the bead had been positioned more conventionally, in the gonad of the mollusk. This technique produces a different type of pearl, known in the trade as a "fireball" (D. Fiske and J. Shepherd, "Continuity and change in Chinese freshwater pearl culture," Summer 2007 *G&G*, pp. 138–145, www.gia.edu/gems-gemology/summer-2007-continuity-change-chinese-freshwater-pearl-culture-fiske).

All the peach to pink colors in these strands are natural, Lynch told us. Bleaching produces the white product. Unlike the soufflé pearls, which are typically hollow after being drilled, these bead-nucleated pearls have impressive heft. They sell very well, according to Lynch, and no two necklaces are quite the same due to the uniqueness of every pearl. As an aside, he told us that the weight of the pearls he shipped to the show was around 489 pounds (about 221 kg), much of that consisting of bead-nucleated freshwater cultured pearls.

Next, he showed us some tissue-nucleated (non-beaded) round freshwater cultured pearls (figure 62). These 5–6 mm spherical pearls were impressively uniform with high luster and crisp reflections from smooth skins, making them an excellent substitute for an akoya strand. Finding this sort of quality is very difficult these days, Lynch told us. These also cost a few hundred dollars per strand.

Although Lynch carries a wide stock of Chinese freshwater pearls, most of his resources go into purchasing Tahitian, South Sea, and akoya cultured pearl products. All in all, he said, supply of every top-quality cultured pearl type is very limited, and competition for available product is very high. The increase in Chinese consumption has drastically affected supply for U.S. and European wholesalers. Fortunately, Lynch told us with a sense of relief, he has been a "pearl hoarder" for many years, so he has a significant inventory to draw upon.

Lynch suggested that the Chinese domestic market does not know what the market value of many products might be elsewhere. The Chinese have a different mindset

Figure 62. These tissue-nucleated Chinese freshwater cultured strands resemble fine akoya cultured pearls. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

Figure 63. Fine Tahitian and South Sea cultured pearl singles and pairs are in high demand with designers for one-of-a-kind custom jewelry pieces. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

than consumers in the West, he told us, citing a fashion example: "You'll pay more for couture items in Shanghai than in Paris… If it's expensive, it's better." Although many commentators insist the Chinese economy is slowing down and no longer enjoying double-digit percentage growth, Lynch said that the emergence of a large middle class that wants all the trappings of wealth is driving up the market prices for gems and pearls. He noted that the tChinese like to display their wealth, and jewelry is an obvious way to do that.

Asked what was selling this year, Lynch explained how his business has changed. He used to sell more volume at the Tucson show, especially freshwater items wholesaling for $300 to $600 apiece. Today he handles fewer transactions, but the average transaction has increased dramatically. Lynch's perception is that spending habits have changed as the middle class in the U.S. has shrunk. He finds fewer consumers looking for $1,000 items. Instead, he sees purchasers from a higher income bracket looking for a $20,000 or $30,000 piece.

Lynch now sells far more round white South Sea and Tahitian goods, along with fine single pearls and pairs (figure 63). The first piece he showed us was a superb, exceptionally large round South Sea cultured pearl of 18.2 mm (figure 64). Lynch said he buys with designers in mind, as items like this are far more affordable than a strand and make excellent centerpieces for custom jewelry pieces. The price for such a piece would be approximately $6,000, whereas a necklace of this quality would cost many tens of thousands of dollars.

Finally, Lynch pulled out a uniquely shaped Tahitian baroque cultured pearl (figure 65). Its flattened shape would allow it to sit especially well as a pendant. At 19.7 mm, it was large. Even though the pearl was very baroque, its color was exceptional. This piece had the style and substance to really make a statement at a reasonable price (a couple of thousand dollars).

Duncan Pay

CONFERENCE REPORTS

GILC 2015. The International Colored Gemstone Association (ICA) sponsored the invitation-only GILC (Gemstone Industry & Laboratory Conference) on February 2, during the Tucson gem shows. Participants represented primarily gemological laboratories, educational institutions, gemstone buyers and wholesalers, and retailers (figure 66).

Shane McClure of GIA began with an update on the activities of the Laboratory Manual Harmonization Com-

Figure 64. This superb spherical South Sea cultured pearl measures 18.2 mm in diameter and weighs 8.25 grams. Photo by Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

Figure 65. This 19.7 mm Tahitian Sea cultured pearl weighs 2.45 momme (9.19 grams). It would make a fine centerpiece for an item of custom jewelry. Duncan Pay/GIA; courtesy of Sea Hunt Pearls.

Figure 66. Laboratory representatives at the GILC in Tucson spoke on a wide range of topics related to colored gems, including nomenclature, treatment, and clarity enhancement. Photo by Duncan Pay/GIA.

mittee (LMHC). The LMHC establishes consistent nomenclature among international lab reports but does not address standardization of criteria and testing procedures. The committee consists of seven international gemological laboratories, whose representatives meet three times per year by teleconference or in person. Information sheets that are under development include hydrophane opal, along with "pigeon's blood" and "royal blue" designations for corundum. Topics under discussion include light sources, tanzanite/zoisite nomenclature, and the problem of stones being treated soon after a laboratory report is issued.

McClure also presented additional color designations for ruby that will be featured on GIA reports. He noted that "pigeon's blood" would designate vivid red color on rubies with high fluorescence and low iron content, as typified by high-quality Burmese rubies. "Scarlet" and "crimson" would be used for fine-colored iron-bearing rubies with low fluorescence, in the slightly orangy to slightly purplish ranges, respectively. "Deep red" will be used for rubies of darker tone. There appeared to be different opinions among the participants about the definition of pigeon's blood, and no clear agreement about the proposed new terms. This provoked a lively discussion as to whether "romantic" terminology belonged on lab reports, and whether the use of advantageous vocabulary was a move by some labs to gain market share.

Chris Smith of AGL spoke on the detection of low-temperature heat treatment of corundum. Smith defined "low temperature" as less than 1300°C, a treatment range where rutile (including silk) would still remain intact. The treatment has a long history and is still used to improve the color of pink, red, yellow, and orangy corundum, typically by removing purplish or bluish components. Characterization of non-rutile mineral inclusions and IR spectroscopy are keys to detecting the treatment.

Gabriel Angarita, ICA ambassador to Colombia and president of the Emerald Exporters Association, gave a presentation on residues in emeralds caused by the cutting process. He presented visual evidence that "dust" from the emeralds, laps, or abrasive powders can enter fractures during cutting and polishing, and he was concerned that they might be interpreted as clarity enhancement residues. It emerged during the discussion that although the stones might not have been intentionally clarity enhanced, the lubricating oil used in the cutting process, or the wax or nail polish used on rough to seal the fractures from dust, could be the source of the clarity enhancement being detected by gemological laboratories.

In the open session forum, participants pointed out that confidence in lab reports was waning for two reasons: (1) the inconsistency in country-of-origin and treatment determinations, and (2) the increasing prevalence of stones being altered or treated after receiving a favorable report (for instance, the re-oiling of emeralds).

The issue of hydrophane opal was revisited, with a call for nomenclature and comments, and perhaps a standardized method of assessing and communicating the degree of absorption and its impact on durability and color stability.

While trade in elephant ivory is prohibited in the U.S., the trade in extinct mammoth ivory has been severely restricted in New York and New Jersey, and on eBay. Nomenclature to distinguish the two types needs to be developed, along with awareness of treatments to disguise modern ivory as mammoth or antique to circumvent restrictions.

Another issue raised was the treatment of spinel, once considered a gemstone that was not treated. Participants confirmed the routine heating of spinel from Myanmar and Tanzania, as well as the colored (red) oiling of both spinel and corundum in Mogok. While microscopic examination does little to detect heating, photoluminescence and Raman spectroscopy are useful.

Donna Beaton

International Diamond School. In late January 2015, nearly 100 scientists (figure 67) gathered in the northern Italian town of Brixen to attend the Second International Diamond

Figure 67. Attendees from countries including Australia, Botswana, Russia, Brazil, and the United States learned the latest tools and techniques for diamond research at the Second International Diamond School. Photo by Fabrizio Nestola.

School (IDS). The program, titled "The Nature of Diamonds and Their Use in Earth's Study," was designed so that attendees from varied educational and professional levels could learn from leaders in the field of natural diamond research.

The school successfully blended student and professional perspectives, as well as the cross-disciplinary nature of the participants and speakers. Over four days, IDS attendees from a wide range of backgrounds—including experimental researchers, petrologists, mineralogists, crystallographers, isotope geochemists, and diamond industry experts—were treated to a wide scope of lectures and workshops. Presentations provided insight into diamond exploration, advanced research-level analysis, diamond morphology, inclusion chemistry, and geologic occurrences.

George H. Read (Shore Gold Inc., Vancouver) presented a recent history of diamond exploration, culminating with his company's new Canadian diamond mine: Star-Orion in Saskatchewan, a $2.5 billion project. He provided context on production history, sources, and trading centers. He outlined future diamond mining projects in Botswana, Canada, Lesotho, and India, concluding that the small number of viable projects might signify a shortfall in rough supply. The complexity and financial risks involved with bringing new diamond mines online was made evident.

Bruce Kjarsgaard (Geological Survey of Canada, Ottawa) reviewed kimberlite eruptive models based on 1970s and 1980s research in South Africa. He explained the revision of these models after new kimberlite discoveries in the 2000s in Canada's Slave craton. He defined kimberlite as a strongly homogenized and "mixed-up" hybrid rock, representing a blend of crystallization out of the magma with country rock, that is often highly variable from place to place. In a second presentation Kjarsgaard examined the major techniques used for exploration for diamondiferous kimberlites, focusing on the Canadian experience and its applicability to glaciated shield areas such as Canada, Russia, the northern United States, and Finland. These techniques have been remarkably successful, partly because of the solid scientific research behind them.

Jeff Harris (University of Glasgow, UK) reviewed the characteristics of lithospheric diamonds based on his experience as a De Beers research director and his access to an unparalleled proportion of run-of-mine diamonds. He showed how different pipes produce distinct diamond size ranges and morphologies. He covered the age relationships between inclusions and host diamond, inclusion chemistry, formation pressures and temperatures, fluid inclusion chemistry, and the abundance of different carbon and nitrogen isotopes in diamond.

Michael Walter (University of Bristol, UK) discussed the super-deep carbon geodynamics of Earth's mantle along with information provided by analysis of lower-mantle fluids found as inclusions in "superdeep" (sublithospheric) diamonds from Brazil's Juina field. He explained how new thinking over the past five to six years has provided a model for diamond formation by subduction of carbonate-bearing hydrated oceanic crust in the transition zone of the mantle at depths of 440 to 600 km.

Paolo Nimis (University of Padua, Italy) discussed thermobarometry, a technique that uses mineral phase diagrams to discover the original formation conditions (pressure, temperature, and therefore depth) of rocks in the mantle. He also related the possibility of applying similar techniques to inclusions in diamonds to help determine their formation conditions. His talk explored the accuracy and precision of the different thermobarometers and where future improvements are likely to occur.

Ross Angel (University of Padua) discussed elastic barometry for inclusions in diamonds. This new field uses Raman shift or X-ray diffraction (lattice distortion) to measure decompression effects on the surrounding diamond crystal caused by inclusions formed at high pressure to estimate pressure of diamond formation.

Fabrizio Nestola (University of Padua) explained the advanced X-ray diffraction methods used in their laboratory, which permit very rapid crystal orientation and data collection. This work has shown that some olivine inclusions cannot be syngenetic, as they share no preferred orientation with the host diamond.

Graham Pearson (University of Alberta, Canada) overviewed the petrology and geochemistry of cratonic mantle roots. He explained the effects of melt depletion (removal of clinopyroxene and orthopyroxene) to produce very magnesium-rich melts in the sub-continental mantle, which removes rhenium (Re) to "freeze in" the osmium (Os) isotopic system to allow radiometric dating. This gives very different mean Re/Os model ages for "on-craton" (>2.5 billion years) and "off-craton" (<2.0 billion) mantle xenoliths (potential diamond host rocks) for the Kaapvaal craton, which underlies southern Africa.

Steven Shirey (Carnegie Institution of Washington) reviewed the topic of age-dating diamonds, beginning with work in the 1980s using rare-earth element ratios in silicate mineral inclusions within the diamonds. He covered rhenium/osmium dating techniques devised in the late 1990s and perfected in the 2000s, finishing with recent Re/Os dating work on zoned diamonds from Yakutia, which showed two-billion-year-old cores surrounded by younger rims of one billion years.

Oded Navon (Hebrew University of Jerusalem) presented on silicic and low-magnesium carbonatitic fluids in fibrous diamonds and their relationship to fluids in gem-quality diamonds. He explained how new work on inclusions along the twin planes of otherwise gem-quality diamonds—macles—revealed fluids of very similar compositions. One can generalize from previous studies of fibrous diamond that most diamonds form under similar growth conditions most of the time.

Thomas Deining (WITec Instruments Corp., Ulm, Germany) introduced WITec's confocal Raman spectrometer system and described its ability to map three-dimensional fields of features at very high resolution. This instrument is ideally suited to looking into diamond, and his talk set the stage for the Raman workshops the following day.

Maya Kopylova (University of British Columbia) discussed fluid inclusions and volatiles in monocrystalline, octahedral diamonds, with a focus on nitrogen (N_2) and carbon dioxide (CO_2). She related this new work to previous studies on fibrous diamonds, showing it has wider relevance than previously thought.

Wuyi Wang (GIA, New York) covered diamond treatment and synthesis. He introduced the various causes of color in natural diamonds and explained how combinations of irradiation and high-pressure, high-temperature (HPHT) treatment might alter or remove color. He also reviewed improvements in synthetic diamond size and quality due to advances in HPHT and chemical vapor deposition (CVD) synthesis technology.

Frank Brenker (Goethe University, Frankfurt) outlined the latest findings on ultra-high pressure mineral phases in diamonds. Much of this work is nanostructural in nature and requires removing exceptionally thin wafers of diamond by focused ion beam lithography, a technique borrowed from the electronics industry. Brenker dealt specifically with the idea that some of the inclusion minerals thought to have grown in the lower mantle (e.g., Mg perovskite and ferropericlase) might actually have formed at the shallower depths of the mantle transition zone or even the upper mantle.

Dan Frost (University of Bayreuth, Germany) presented on the experimental petrology of the mantle, using state-of-the-art multi-anvil presses capable of achieving pressures of 250,000 bar at 1,800°C. This work demonstrates the possibility that at certain temperatures and pressures, a system may exist where carbon dioxide (CO_2) and methane (CH_4) produce carbon (C) plus water (H_2O). He presented this as a new model for diamond formation in the deep mantle.

Pierre Cartigny (Institut de Physique du Globe de Paris) showed how carbon and nitrogen isotopes are used to characterize the fluid sources and fractionations that can occur with diamond growth. One of his long-standing conclusions is that even though subduction of C and N can occur and is thought to be a major process for introducing fluids into the mantle, the signatures of subduction are not as clear as one would expect. The possible isotopic changes that can occur between the diamond and its host fluid during diamond growth need much further study.

Andy Davy (Rio Tinto Plc., Bristol, UK) drew upon his experience as a consulting geologist to discuss the role of engineers and natural diamond scientists in evaluating diamond deposits. His talk covered the exploration and evaluation of prospective deposits, improvements in recovery methods to prevent diamond breakage, and assessing the performance of deposits through time. He left the audience with a realistic picture of the complications in establishing diamond grade, price, and hence the viability of any given diamond project. He further showed how exceedingly rare good diamond-producing kimberlites are.

The school was a fantastic opportunity for attendees to learn about diamond exploration, advanced research-level analysis, diamond morphology, inclusion chemistry, and geologic occurrences in a way that will inspire their future studies and career choices. GIA's contribution directly benefited these up-and-coming research scientists by reducing the attendance fees for the conference, permitting many students to attend who otherwise would have been unable to do so.

IDS was organized by Fabrizio Nestola, Graham Pearson, and Steven Shirey, under the auspices of the Diamonds and Mantle Geodynamics of Carbon (DMGC) consortium, part of the Deep Carbon Observatory (DCO). The school was sponsored by GIA, the DCO, the Italian Society of Mineralogy and Petrology (SIMP), and the University of Padua. The IDS website is at www.indimedea.eu/diamond_school_2015.htm.

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REGULAR FEATURES

COLORED STONES AND ORGANIC MATERIALS

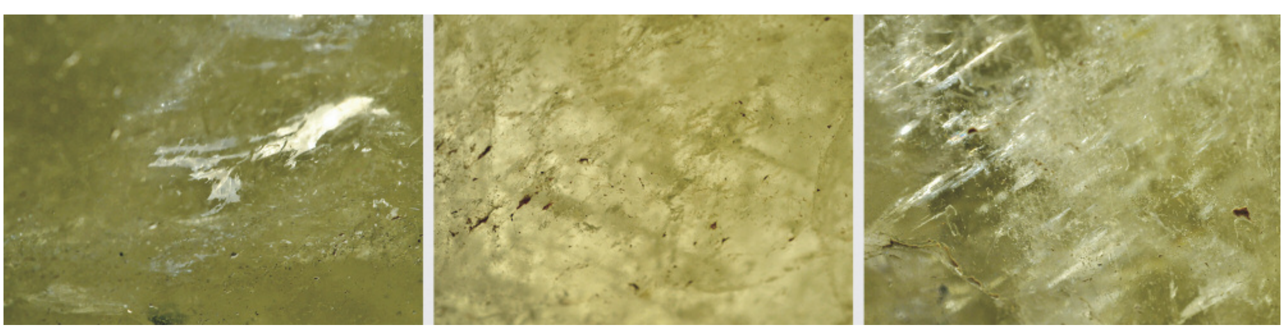
A remarkably large amblygonite-montebrasite carving. Recently the Gem Testing Laboratory in Jaipur had an opportunity to examine an unusually large yellow, semitransparent to translucent carving (figure 68). This 1,871 g (9,355 ct) piece measuring approximately 18.50 × 15.10 × 7.30 cm was fashioned after Lord Mahavira, one of the ancient Indian sages who established the tenets of Jain Dharma. Initial observations suggested beryl due to the color, medium heft, and cloudy liquid inclusions visible to the unaided eye. Gemological testing ruled out that possibility, however. Spot RI was approximately 1.61, with a small but distinct birefringence blink, while hydrostatic specific gravity measured 3.00. The carving was inert to UV radiation.

Examination with a hand loupe revealed reflective liquid films (figure 69, left), fingerprints composed of phase droplets, elongated phase/short tubes oriented in one direction, aligned in planes intersecting at approximately 65/115° angles (figure 69, center). Also present were parallel reflective films that appeared to be incipient cleavage (figure 69, right). The overall inclusion pattern was typical of gems found in pegmatitic bodies such as beryl, tourmaline, and topaz.

Figure 68. This 1,871 g amblygonite-montebrasite carving (18.50 × 15.10 × 7.30 cm) is unusual for its size and transparency. Photo by Gagan Choudhary.

The carving was identified as amblygonite-montebrasite by Raman spectroscopy in the 200–2000 cm^{-1} region, which revealed distinct peaks at ~297, 425, 481, 600, 643, 797, 1011, 1058, 1107, and 1186 cm^{-1} (figure 70). Amblygonite and montebrasite are both lithium phosphates with a common chemical formula of (Li, Na)$AlPO_4$(F, OH), forming an isomorphous series between F-rich amblygonite and OH-rich montebrasite. The two minerals can be colorless, yellow, or green. High-quality crystals are prized by collectors but rarely seen in the gem trade (R. Webster, *Gems: Their Sources, Descriptions and Identification*, 5th ed., rev. tby P.G. Read, Butterworth-Heinemann, Oxford, UK). The amblygonite and montebrasite end members can be differentiated on the basis of peaks at ~600 and 1060 cm^{-1} and a peak at ~3370 cm^{-1}. With an increasing percentage of fluorine, the 600 cm^{-1} peak shifts from 599 to 604 cm^{-1} while the 1060 cm^{-1} peak shifts from 1056 to 1066 cm^{-1} (B. Rondeau et al, "A Raman investigation of the amblygonite-montebrasite series," *The Canadian Mineralogist*, Vol. 44,

Figure 69. Examination of the carving with a hand loupe revealed reflective liquid films (left), elongated phase/short tubes oriented in one direction and aligned in planes intersecting each other at approximately 65/115° (center), and parallel reflective films that appeared to be incipient cleavage (right). Photos by Gagan Choudhary; image width 25 mm.



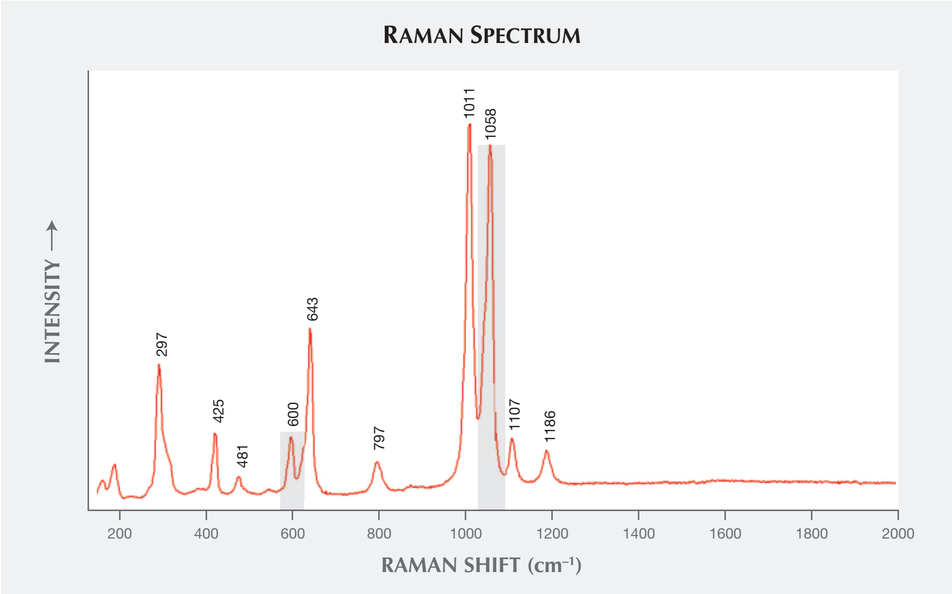


Figure 70. The carving's Raman spectrum showed major peaks at around 297, 425, 481, 600, 643, 797, 1011, 1058, 1107, and 1186 cm^{-1}. The peaks at approximately 600 and 1058 cm^{-1} suggest an intermediate member of the amblygonite-montebrasite series.

No. 5, pp. 1109–1117). According to the RRUFF database, however, the peak for montebrasite is at 1047 cm^{-1} while amblygonite's is at 1060 cm^{-1}. This is possibly due to different instrument settings. Although the ~3370 cm^{-1} peak was not studied here, the 600 and 1058 cm^{-1} peaks in this carving suggested that it belongs to an intermediate state in the amblygonite-montebrasite series.

Amblygonite-montebrasite is known from many localities, especially the United States and Brazil, but the client did not know the source of the carving. A few faceted samples have been examined at this laboratory, but the carving documented here was exceptional for its large size and transparency, despite its brittleness and tendency to crack.

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Amethyst from Morocco: An update. Most major sources of fine amethyst are located in Africa. Yet African amethysts on the market, especially Zambian material, tend to be dark and difficult to find in sizes larger than 10 ct. Since the late 1980s, there have been additional discoveries in Malawi, Tanzania, Namibia, Nigeria, and the Democratic Republic of Congo. The most recent African source is Morocco (see Spring 2009 GNI, pp. 62–63), which has produced gem-quality amethyst with an appealing purple color and sizes larger than 10 ct.

GIA's Bangkok laboratory recently examined several parcels of gem-quality Moroccan amethyst (figure 71) received from Tom Banker, a colored stone dealer. Gemological properties obtained from the crystals and faceted stones were similar to those reported in the 2009 GNI entry.

Figure 71. These Moroccan amethyst crystals, which weigh 2.87 and 6.24 grams, display an attractive purple zoning conforming to the rhombohedral faces. Photo by Nuttaphol Kitdee.

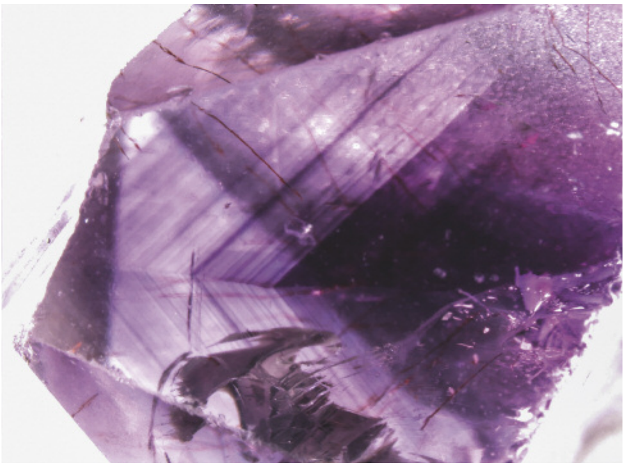


Figure 72. A closer view of the amethyst shows alternating bands of darker and lighter purple color zoning. Photo by Charuwan Khowpong; magnified 10×.

Common characteristic internal features were intense color zoning conforming to the rhombohedral faces (figure 72), reddish brown needle-like hematite inclusions (figure 73, left), and fingerprints consisting of two- and three-phase inclusions (figure 73, center). Dolomite and anhydrite inclusions were also found (figure 73, right).

A thin wafer with a thickness of 1.28 mm was prepared for FTIR and UV-Vis-NIR spectroscopy. The wafer plane was oriented parallel to the c-axis. The FTIR spectra were recorded using a Thermo Nicolet 6700 spectrometer with a resolution of 4 cm^{-1} and 200 scans, while the UV-Vis spectra were collected using a Hitachi U-2910 spectrometer at 1.5 nm slit width and 100 nm/min scan speed, integrated with a polarizer accessory controlled by Thorlabs APT.

FTIR spectroscopy revealed typical features of amethyst. The absorption peaks at 3585 and 3613 cm^{-1} were related to vibrations caused by Al substitutions. The absorption shoulder at 3595 cm^{-1} is common in natural quartz and rarely seen in synthetic quartz. The cause of this feature remains unknown (S. Karampelas et al., "Infrared spectroscopy of natural vs. synthetic amethyst: An update," Fall 2011 *G&G*, pp. 196–201). Areas of dark, medium, and light purple zoning had very similar FTIR patterns.

Amethyst owes its purple color to color centers associated with Fe^{2+} or Fe^{3+} impurities (A.J. Cohen, "New data on the cause of smoky and amethystine color in quartz," *The Mineralogical Record*, Vol. 20, No. 5, 1989, pp. 365–367). The UV-Vis-NIR absorption spectra showed bands in the visible range at 545 nm caused by Fe^{4+} charge transfer (E.H.M. Nunes, "Spectroscopic study of natural quartz samples," *Radiation Physics and Chemistry*, Vol. 90, 2013, pp. 79–86; E. Neumann, "Mechanism of thermal conversion of color and color centers by heat treatment of amethyst," *Neues Jahrbuch für Mineralogie, Monatshefte*, 1984, No. 6, pp. 272–282). The complexity of absorption bands in the ultraviolet region is related to the presence of Fe^{3+} in more than one environment in the α-quartz structure (F. Hassan and A.J. Cohen, "Biaxial color centers in amethyst quartz," *American Mineralogist*, Vol. 59, Nos. 7–8, 1974, pp. 709–718).

Further chemical analysis using advanced techniques such as EDXRF and ICP-MS will be conducted to summarize the characteristic chemical profile of the Moroccan material.

Ratima Suthiyuth
GIA, Bangkok

Dumortierite in rock crystal quartz. Dumortierite, which commonly occurs as a blue borosilicate mineral, is of gemological interest when present in quartzite, making an attractive blue ornamental material. Recently examined by GIA's Carlsbad laboratory were several examples of dumortierite inclusions in rock crystal quartz (figure 74) provided by Luciana Barbosa (Asheville, North Carolina). According to Mrs. Barbosa, the material is reported to be from the Brazilian state of Bahia, in the Serra do Espinhaço Range near the Vaca Morta quarry.

Much of the material examined by the authors showed phantom planes and clusters of acicular needles with a vibrant blue coloration (figure 75). Polarized light revealed

Figure 73. Microscopic examination of the Moroccan amethyst samples revealed reddish brown hematite (left), two-phase inclusions (center), and dolomite crystals (right). Photomicrographs by Charuwan Khowpong; magnified 50×, 5×, and 80×.

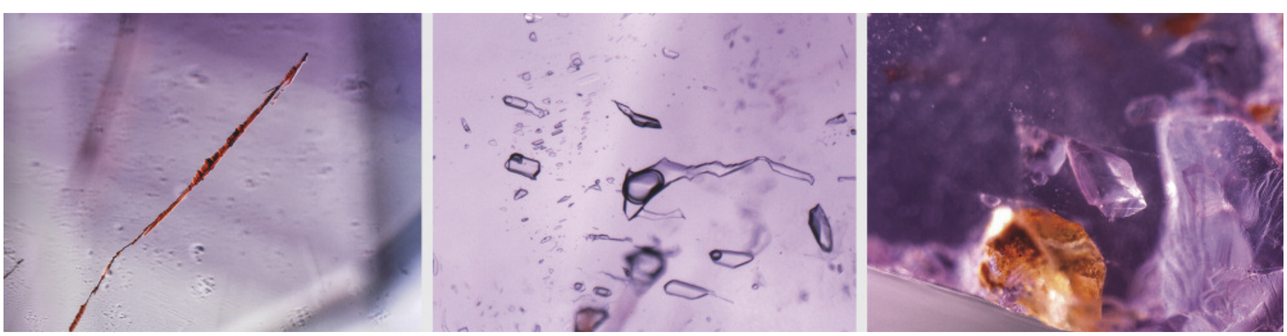


Figure 74. This group of rock crystal quartz from Brazil shows vibrant blue dumortierite inclusions. The largest rough crystal weighs 139.79 ct, and the faceted stone weighs 15.47 ct. Photo by Kevin Schumacher.

very strong blue to colorless pleochroism in the blue mineral inclusions. Raman analysis confirmed the identity of the needles as dumortierite. Also observed in one sample were colorless acicular crystals on a phantom plane, which were also identified by Raman as dumortierite (figure 76).

Blue color in dumortierite has previously been reported to be caused mainly by Fe^{2+}-Ti^{4+} charge-transfer (see http://minerals.gps.caltech.edu/FILES/Visible/dumortierite/Index.htm). The chemical composition of the blue and colorless dumortierite inclusions was analyzed by LA-ICP-MS to look for any prominent differences that might explain the variance in observed color. The most significant difference was in the magnesium content, which was almost 10 times higher in the colorless dumortierite inclusions (1070 ppma, compared to 127 ppma Mg in the blue dumortierite). While more research is needed to fully understand the role this higher magnesium content has on color, the authors speculate that the titanium preferentially charge-compensates with magnesium instead of iron. If there is not enough excess titanium relative to magnesium, it may not be possible for titanium to pair with divalent iron, and this would prevent the formation of blue color.

Figure 75. Clusters of vibrant blue acicular dumortierite were observed in this rock crystal quartz. Note that some dumortierite crystals are brownish due to epigenetic mineral staining along the interface of the quartz host and the dumortierite inclusions. Photomicrograph by Nathan Renfro; horizontal field of view 7.38 mm.

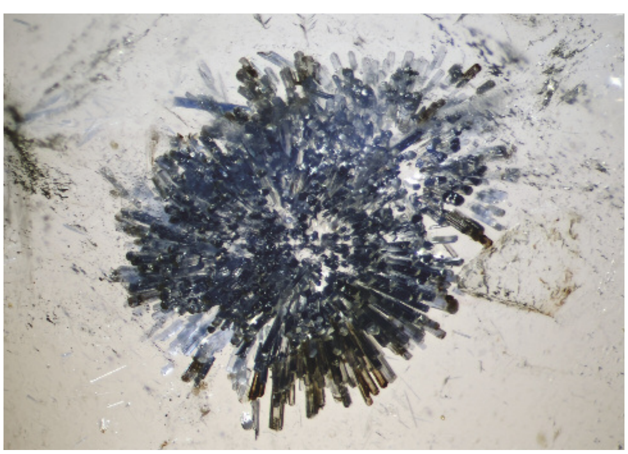
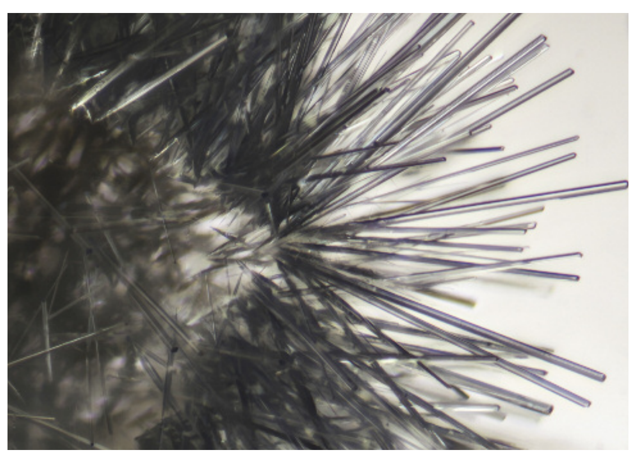


Figure 76. Unusual pale blue to colorless needles of dumortierite were also observed in the rock crystal quartz. Photomicrograph by Nathan Renfro; horizontal field of view 2.24 mm.



These are the first examples of prismatic blue and colorless dumortierite inclusions in rock crystal quartz we have encountered.

Nathan Renfro, Ziyin Sun, and John Koivula
GIA, Carlsbad

Jadeite with high albite content. With high prices and demand from Chinese consumers for jadeite jade (or *fei cui*), correctly identifying samples is a major challenge for gemological laboratories. Jadeite's complex mineral composition and its nature as a rock rather than a mineral further complicate this problem. While jadeite is the main mineral in jadeite jade, other pyroxene minerals such as kosmochlor, omphacite, amphibole-group minerals, plagioclase (especially albite), and even some iron oxides may also be present. Recently, the National Gold & Diamond Testing Center (NGDTC) lab tested 29 bangles submitted as jadeite jade (figure 77). The results again raised the issue of nomenclature.

The samples could be separated into two groups, one group with finer texture and color (shown on the left in figure 77). Standard gemological tests were applied to all of the samples, and the surface features were observed using a standard gemological microscope. The samples showed the characteristic 437 nm line with a handheld spectroscope. Ten randomly chosen spot RI readings were recorded on each bangle, and the results offered interesting insights. Two different readings of 1.52 and 1.66 were observed, indicating the presence of two major components. The SG ranged from 2.99 to 3.34, while the referenced SG for jadeite jade is 3.34 (+0.06–0.09). The low SG indicates a significant amount of light minerals in these samples. Another observation was that the group of lesser luster and color (shown on the right in figure 77) tended to have lower SG than the higher-quality samples. Overall, most of the samples were inert to UV, though six showed weak to moderate unevenly distributed bluish fluorescence. Under 30× magnification and brightfield illumination, two major mineral groups with contrasting color, crystal shape, and luster were revealed (figure 78).

Figure 77. These 29 bangles were submitted to NGDTC by a wholesaler as jadeite jade. The bangles in the left column are slightly finer and of better color. Photo by Li Jianjun.

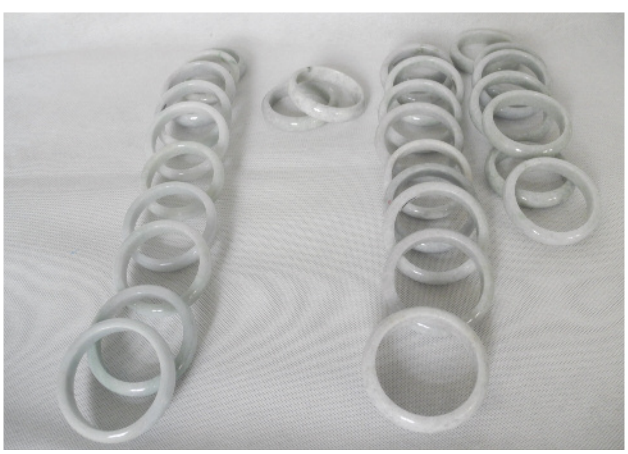


Figure 78. Two groups of minerals were observed on the surface of this sample under brightfield illumination. One group is composed of the pale whitish subhedral to euhedral grains, the other of the creamy minerals in between. Photomicrograph by Li Jianjun; magnified 30×.

Transmission infrared spectra collected from the positions that fluoresced weakly to moderately showed no polymer-related features. To confirm the composition of the two major minerals, we collected micro-infrared reflectance spectra from them (figure 79). The spectrum of the pale whitish mineral indicated jadeite, with the presence of the featured 1050 and 744 cm^{-1} bands in addition to the four bands between 400 and 600 cm^{-1}. The IR spectrum of the creamy mineral matched that of albite, with the characteristic peak at 1040 cm^{-1} band assigned to the Si-O stretching vibration in the SiO_4 tetrahedral structure. The multiple peaks in the 800–700 cm^{-1} region can also help to distinguish albite from jadeite.

The spot RI readings around 1.52 were consistent with albite's published RI of 1.528–1.542. The SG of albite is 2.60–2.65, considerably lower than that of jadeite. The presence of albite as a major mineral component in this material could account for the much lower SG in most of the samples. Although albite is one of the common minerals in jadeite jade, the amount is usually very minor and cannot be easily detected by standard gemological tests. Because the lab could not destroy the samples, no quantitative data were achieved.

Identifying these materials is not easy, especially when the concentration of certain components cannot be quantitatively determined and there is no trade standard on the boundaries for the different varieties. This study serves as a reminder that in addition to the omphacite issue, the high concentration of albite in some goods is a potential problem facing laboratories. To better protect consumers, the NGDTC recommends a clear statement regarding the pres-

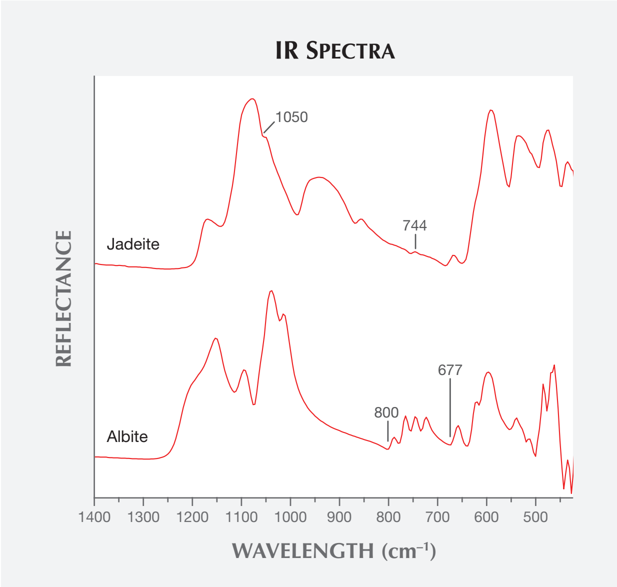


Figure 79. IR reflectance spectra collected from the two main minerals in the samples identified one as jadeite and the other one as albite.

ence of albite on laboratory reports once the albite is identified by the standard gemological test especially according to refractive index, even by the FTIR spectrometer.

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National Gold & Diamond Testing Center, Jinan City, China

Moldavites: natural or fake? Tectites are members of a large group of impact glasses, formed by the collision of a meteorite on the Earth's surface and the subsequent melting of surrounding rocks. The most famous tectites used as gemstones are moldavites from southern Bohemia in the Czech Republic. These were formed by a meteorite's impact in the Ries crater in southern Germany 14.7 million years ago, about 500 km from their occurrence (V. Bouška, *Moldavites: The Czech Tektites*, Stylizace, Prague, 1994). Moldavites are popular for their pleasant green color, enigmatic origin, and interesting etched texture. They are used in jewelry, in either faceted or natural form. The price of moldavite has risen in the last few years, and as a logical consequence imitations have become more widespread.

In fact, moldavite imitations are nothing new. Faceted moldavites were very popular in Czech jewelry during the second half of the 19th century, often with Czech garnets (chrome pyropes) or small river pearls. Their use diminished in the beginning of the 20th century when imitations made from green bottle glass began to appear. Nevertheless, the author's recent study of five moldavite sets (bracelet, brooch, and earrings) from the second half of the 19th century in the collection of the Museum of Decorative Arts in Prague revealed an unexpected result. Only one set contained moldavites—a donation to the museum by Olga Havlova, the first wife of Vaclav Havel, the late Czech author and statesman. All of the stones in the other four sets proved to be glass imitations. This means that glass imitations have been around decades longer than previously thought (figure 80).

Figure 80. Glass in a silver brooch, hallmark from 1866. Private collection, photo by Jaroslav Hyršl.

Fortunately, the identification of faceted moldavite is simple. Besides their flow texture and abundant bubbles (almost always much more abundant than in an artificial glass), moldavites contain "wires" of lechatelierite, a high-temperature form of SiO_2. Lechatelierite is very easy to see with a loupe due to its lower RI.

The identification of moldavite with a natural-looking surface is much more difficult. Rumors of moldavite imitations from China have been circulating among Czech dealers for many years, but only recently has the author been able to study some examples (see figure 81). Two large moldavite imitations were seen in a high-end jew-

Figure 81. Two moldavites from southern Bohemia, Czech Republic (top row) and two recent imitations from China (bottom row). The natural specimen on the top right measures 44 mm across. Photo by Jaroslav Hyršl.

Figure 82. One of two huge moldavite fakes seen in Hanoi. Photo by Jaroslav Hyršl.

elry shop in Hanoi during the 2013 International Gemmological Conference (figure 82). Their size was astonishing, because very few real moldavites weigh more than 100 g. Their shape was also too perfect, making them easy to recognize.

Chinese producers are now manufacturing small stones weighing just a few grams that are very realistic. The surface feature of natural moldavite is caused by natural etching, and an almost identical feature can be created artificially, likely in hydrofluoric acid. If the stone in question has a polished surface, the presence or lack of lechatelierite "wires" (figure 83, top and bottom) is the best diagnostic tool, along with refractive index (table 1). For rough, immersion in water or especially oil with a similar RI is very helpful to reveal lechatelierite. Imitation moldavite also has a different density, UV-Vis absorption spectrum (figure 84), and fluorescence (again, see table 1). The color of natural moldavites is caused by very low concentration of iron; all other tectites are more Fe-rich and therefore black. Fluorescence is particularly helpful because it may be used on large mixed lots. Some imitations are not fluorescent, however. One imitation seen by the author several years ago was not fluorescent, but its very high specific gravity of 3.60 immediately ruled out natural moldavite.

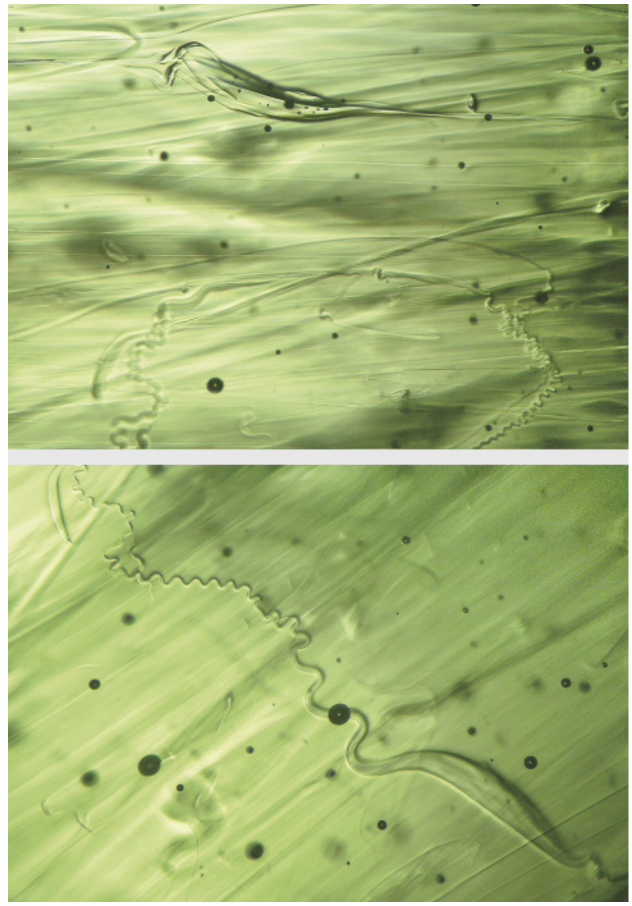

Figure 83. Typical bubbles and inclusions of lechatelierite in natural moldavite; image width 5 mm. Photomicrograph by Jaroslav Hyršl.

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Prague

Iridescent scapolite. GIA's Carlsbad laboratory recently examined two cabochons from L. Allen Brown (All That Glitters, Methuen, Massachusetts) that exhibited prominent

TABLE 1. Characteristics of natural and imitation moldavite.

	Moldavite	Chinese imitations	19th-century glass imitations
Color	Light green to brown	Light green	Light green
RI	1.490 (1.480–1.510)	1.520	1.545–1.580
Density	2.35 (2.27–2.46)	2.52–2.53	n.a.
Fluorescence	Inert in UV	Chalky in short-wave UV	Inert in UV
Absorption spectrum	Minimum at 550 nm	Maxima at 460 and 640	n.a.

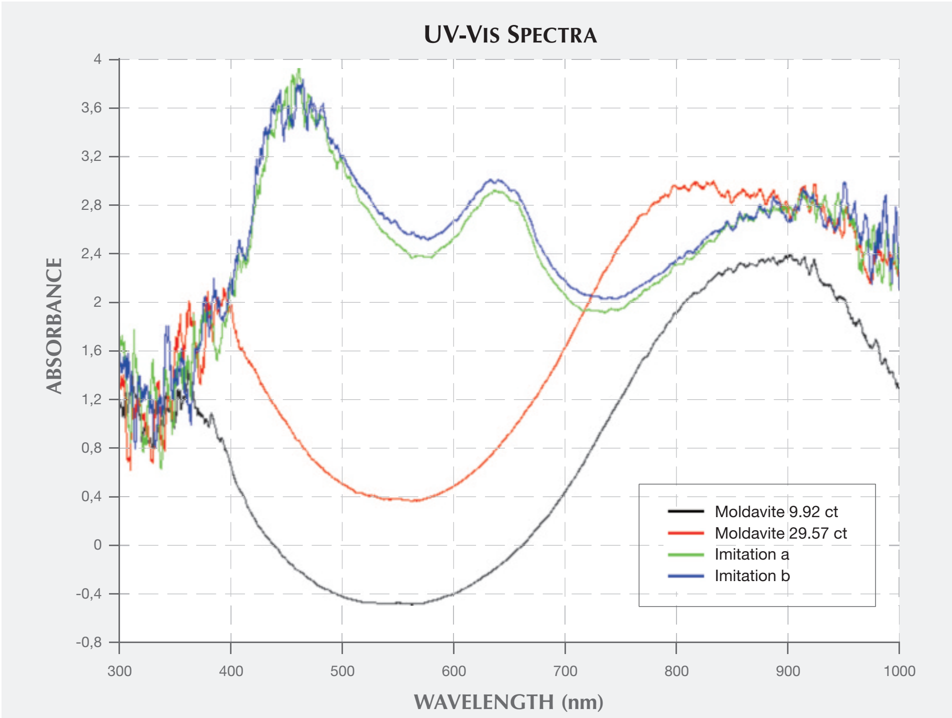


Figure 84. Absorption spectra of natural moldavite (black and red lines) and imitations (green and blue lines).

iridescence in reflected light (figure 85). Standard gemological testing of the 7.30 and 32.22 ct specimens revealed a spot RI of 1.55 and a hydrostatic specific gravity of 2.67. Fluorescence was inert to long- and short-wave UV light. The stones also showed a very weak reaction to a strong magnet.

Under magnification, the most distinctive internal characteristic was the presence of dark brown exsolution stringers of a secondary mineral. Larger tabular dark brown crystals were also observed (figure 86, left). Under reflected light, these exsolution stringers proved to be the source of the iridescent colors (figure 86, right). Similar material has been reported to occur in India, by G. Choudhary (Spring 2013 GNI, pp. 58–59), but the identity of the phenomenon causing inclusions was not determined.

Raman spectroscopy confirmed that the stones were scapolite. To identify the color causing inclusions, the smaller stone was selected for destructive testing. Windows were polished to expose some of the inclusions to the

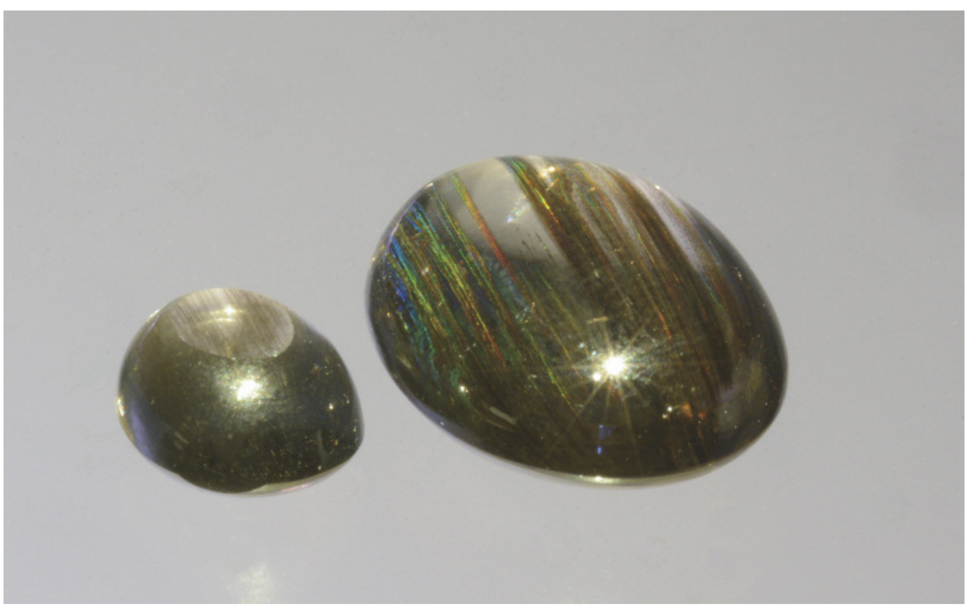


Figure 85. These two scapolite cabochons (7.30 and 30.22 ct) displayed prominent iridescence in reflected light. Photo by Don Mengason.

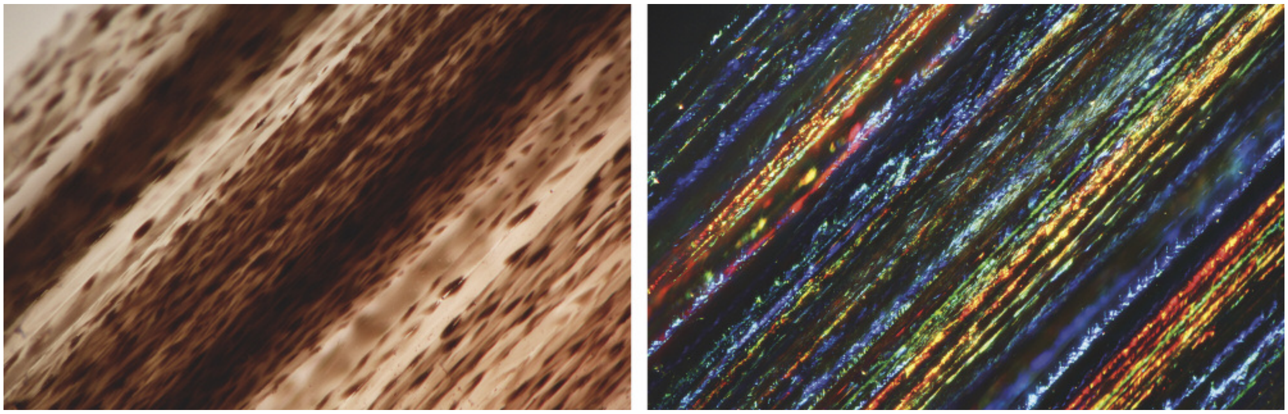


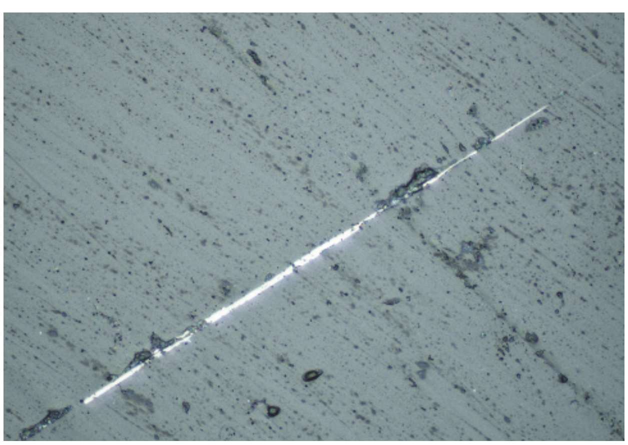
Figure 86. Dark brown exsolution stringers of magnetite (left), also viewed with oblique fiber-optic illumination (right), were the source of iridescence in this scapolite. Photomicrographs by Nathan Renfro; field of view 4.37 mm.

surface of the stone. The exposed surface of the inclusion showed a metallic luster (figure 87), which was identified as magnetite by Raman spectroscopy, and was explanatory of the magnetic reaction observed.

Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) analysis was used to further support the identity of the inclusions. While the exposure of the inclusions on the stone's surface was too small for a clean analysis without a contribution from the scapolite host, the results showed a significant increase in iron as the laser ablated through the brown inclusion and decreased afterward.

Scapolite occurs in a number of rock types as a product of regional metamorphism or metasomatism. The close association of magnetite with scapolite has been noted before, particularly in some skarn deposits and some hydrothermally altered volcanic formations (J.A. Naranjo et al., "Subvolcanic contact metasomatism at El Laco Volcanic Complex, Central Andes," *Andean Geology*, Vol. 37, 2010, pp. 110–120). Choudhary reported similar material, but the inclusions that caused the iridescence were not identified.

Figure 87. Under reflected light, the exposed surface of the inclusion showed a metallic luster. Photomicrograph by Ziyin Sun; field of view 0.25 mm.



This scapolite with iridescence, also known in the trade as rainbow scapolite, is a very interesting example of a phenomenal gemstone.

Ziyin Sun, Nathan Renfro, and Aaron C. Palke
GIA, Carlsbad

Attractive composite quartz beads. The Gem Testing Laboratory in Jaipur recently received a 145.70 carat string of attractive blue and golden brown spherical beads (figure 88) measuring approximately 7.91–8.48 mm in diameter. The beads were readily identified as artificial by their appearance, which consisted of metallic golden brown veining and concentrations of blue color against a whiter body. Further tests were performed to identify the blue areas.

The measured RI was approximately 1.54. The beads displayed a patchy chalky blue reaction to short-wave UV

Figure 88. This string weighing 145.70 carats consists of attractive blue and golden brown beads measuring approximately 7.91–8.48 mm in diameter. The beads were identified as composites fashioned from pieces of dyed quartzite held in a polymer matrix. Photo by Gagan Choudhary.

Figure 89. Color concentrations of blue dye were easily visible along the fractures against a white background, while the golden brown areas were composed of copper-zinc based fine flakes. Also note the greenish polymer along the edge of the golden brown and blue areas. Photomicrograph by Gagan Choudhary; magnified 48×.

and were inert to long-wave UV. Their Chelsea filter reaction was red, and under the desk-model spectroscope they displayed a band at approximately 650 nm. Under magnification, the blue areas displayed fluid inclusions that gave the beads a cloudy effect. In addition, the abundant fractures showed the presence of dye (figure 89) that was responsible for the beads' blue color. Such features are commonly observed in dyed quartzite, but these were not sufficient to prove its identity. The golden brown areas, which consisted of fine flakes (again, see figure 89) held in a soft polymer, were later identified by EDXRF spectroscopy as copper and zinc composites. Similar composites in which the components are held together in a polymer matrix have been known in the trade for several years now (see G. Choudhary, "A new type of composite turquoise," Summer 2010 *G&G*, pp. 106–113). Also present were thick layers of polymer along the edges of the blue and golden brown areas, which appeared green due to the overlap of the blue dye with the golden flakes. Raman spectroscopy confirmed that these blue portions were quartz.

Recognizing these beads as composites was straightforward, but identification of the components required Raman and EDXRF spectroscopy. Although these beads were obviously created to offer something fancy and attractive to consumers at a low price, clear and complete disclosure remains imperative.

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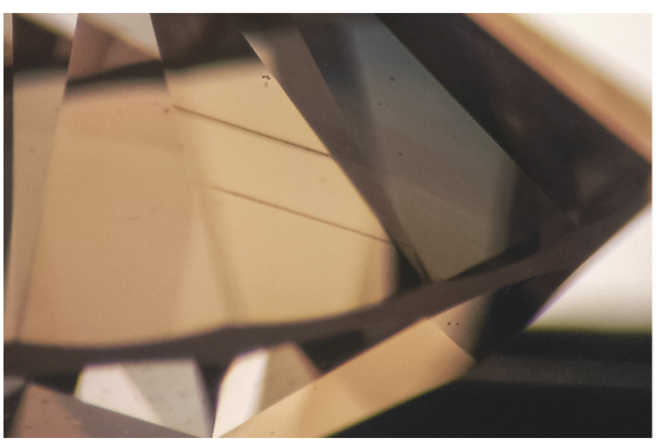
SYNTHETICS AND SIMULANTS

CVD synthetic diamond with unstable color centers. The Indian Gemological Institute – Gem Testing Laboratory, New Delhi recently examined a 1.42 ct (7.06–7.08 × 4.49 mm) round brilliant. Viewed perpendicular to the pavilion facets with its table down, the sample displayed a grayish yellow color, but a slight rotation changed the color to pinkish. On viewing the specimen parallel to the direction of the growth planes, the sample appeared grayish yellow; viewing perpendicular to these same planes, the sample appeared pinkish.

Infrared spectroscopy showed features typical for type IIa diamond. Magnification revealed no internal features except for a feather on the girdle and the two growth planes, which appeared textured. There are very fine pinpoint-like inclusions lying just along the planes (figure 90, left). These planes of pinpoints were also visible from the table (figure 90, right). Examined in the DiamondView

Figure 90. Left: These growth planes were observed in a CVD synthetic diamond; fine pinpoints were found along the growth planes. Photomicrograph by Meenakshi Chauhan; magnified 30x. Right: Pinpoints along the growth plane were also visible from the table. Photomicrograph by Meenakshi Chauhan; magnified 10×.



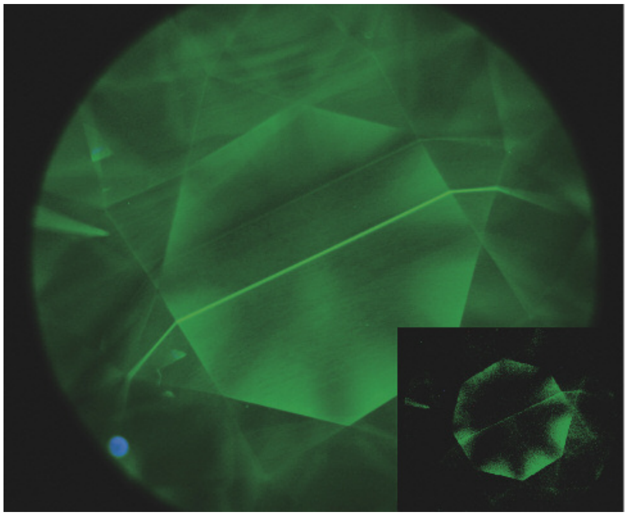


Figure 91. In the DiamondView, the 1.42 ct round showed striations typical of CVD growth. Notice the two parallel planes fluorescing stronger than the bulk of the crystal. The sample also showed moderate phosphorescence (inset), another indication of CVD growth. Images by Meenakshi Chauhan.

(using less than 225 nm short-wave UV radiation) to reveal its growth patterns, the round brilliant showed parallel striations indicative of CVD growth (figure 91). It also exhibited moderate phosphorescence under the UV lamp for approximately 20–25 seconds. (figure 91, inset), confirming synthesis by a CVD process.

Upon removal from the DiamondView after approximately two minutes of exposure time, it showed a distinct grayish blue color. After exposure to a 100-watt halogen bulb for about three minutes, the synthetic diamond regained its initial color (figure 92).

This process was repeated, and the sample turned a grayish blue color after a single minute of exposure to the short-wave UV radiation of the DiamondView and regained its initial color in approximately one minute under the halogen light.

UV exposure produced unstable color centers in this CVD synthetic diamond, which gave it a grayish blue color. Heat removed the color centers, restoring the CVD synthetic diamond to its initial grayish yellow color.

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Indian Gemological Institute – Gem Testing Laboratory

INSTRUMENTS AND TECHNIQUES

The Foldscope and its gemological applications. The Prakash Lab of Stanford University, a small team of graduate students led by bioengineering professor Manu Prakash, has created a portable paper microscope called the Foldscope. Originally conceived for disease detection in remote areas, it was later expanded for educational use. The concept of the Foldscope won a $100,000 grant from the Gates Foundation in 2012 and a $50,000 first prize from the 2014 Moore Foundation Science Play and Research Kit Competition, which challenges participants to reinvent scientific tools of the past to attract a new generation of scholars. Speaking at the annual TED Conference in March 2014, Dr. Prakash announced that the concept was prototyped, functional, and could be manufactured for less than $1 each.

Submissions were accepted for a beta test group (now closed) named the "10,000 Microscope Project." The goal was to get a Foldscope in the hands of 10,000 users worldwide, in medical and non-medical fields. The project requested users who understood microscopy and agreed to write detailed scientific studies based on their own research, to be collected and published to show the variety of potential uses. Seeing a major application in field gemology, this author requested and received a Foldscope.

Beta testers received Foldscope components and instructions in December 2014. The body is made of a mate-

Figure 92. The CVD synthetic diamond before (left) and after exposure (right) to the short-wave UV radiation of the DiamondView. Photos by Meenakshi Chauhan.

Figure 93. A fully assembled Foldscope measures approximately 7 × 2.5 in. A toggled LED light source is tucked into tabs on the back, and the bottom center slit accommodates standard glass microscope slides. Photo by Kate Pleatman.

rial more like plastic than paper, to prevent tearing. Pieces are punched out of perforated sheets and assembled like origami (figure 93). The kit also contained interchangeable low-magnification (140×) and high-magnification (400×) lenses, a 3V LED toggled light source, and a surprise: a coupler to connect to a cell phone for photomicrography. Due to its complexity, assembling the Foldscope may take an hour or two. The device was ingeniously constructed, but would it work with gems?

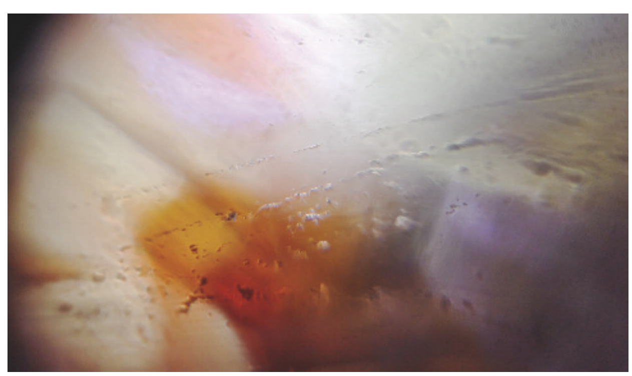
Stones between 1 and 3 mm could be mounted onto glass slides for study. Larger stones were held with gem tweezers in the slide opening, to test whether the Foldscope would work with loose stones as well. Stones that were transparent and relatively small produced impressive results. The use of a binder clip to hold the slide or tweezers in place freed the hands to manipulate the focus more precisely. Focusing was the biggest obstacle, and late in the research the author inadvertently scratched a lens while trying to focus on a 1 mm corundum culet.

It was possible to clearly distinguish between natural and synthetic stones, because the magnification levels were exceptional (figures 94–96). Yet the small fixed size of the slide opening made it difficult to use with loose stones in tweezers, and gems more than 8 mm in depth could not pass enough light to view. Opaque material was not visible at all.

Research details, photos, and feedback were sent to the Prakash Lab, along with design recommendations for making the device more ideal for gemological use. Suggestions included protection for the lens to prevent scratching

Figure 94. This photomicrograph of synthetic opal, taken using the high-magnification lens (400×), shows the characteristic cellular mosaic appearance. Photomicrograph by Kate Pleatman.

Figure 95. These fluid inclusions in quartz were taken using the Foldscope's low-magnification lens (140×). Photomicrograph by Kate Pleatman.



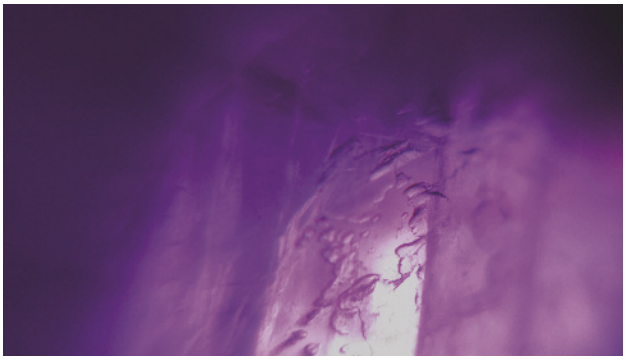


Figure 96. These liquid inclusions in ruby are seen using the low-magnification lens (140×). Photomicrograph by Kate Pleatman.

and a larger gap for examining non-slide materials such as loose stones held with tweezers. An optional three- or four-inch fiber-optic light attachment would offer illumination from any angle, even for mounted stones. The Foldscope team has been very attentive to the feedback, although they have not committed to any alterations. Time will tell if the suggested modifications are feasible. No public release date or final price for the existing version has been announced. For more on this tool, visit www.foldscope.com.

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Sri Lankan heat treater Master Simon displays his copy of the Fall 2014 G&G. *The issue's cover featured him heating a star ruby using an old-fashioned blowpipe technique. Photo by Vincent Pardieu.*

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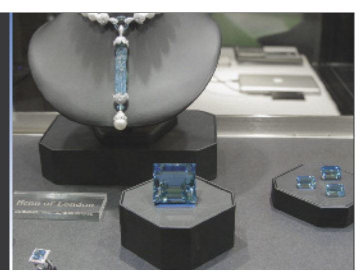

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