DIAMONDS

Update on Diamond Trading in Sierra Leone. During the decade-long civil war in Sierra Leone, the Revolutionary United Front (RUF) rebel army committed widespread atrocities against innocent civilians, drawing global condemnation by governments, human rights groups, and concerned citizens. The RUF was partially funded by the country's diamond resources, bringing the issue of conflict diamonds in Sierra Leone to world attention in the late 1990s. Meanwhile, similar diamond-funded conflicts were being waged in other African nations, such as

Figure 1. The town of Koidu, in the Kono district of eastern Sierra Leone, was at the center of the county's protracted conflict because of the area's diamond resources. Today, the residents are working to rebuild the town and the local economy. Photo by R. Taylor.

Angola and the Democratic Republic of Congo. This situation led to the Kimberley Process for certifying diamonds from mine to market, which was implemented in 2002. With the signing of the Lomé Peace Agreement between the Sierra Leone government and the RUF earlier that year, peace has returned to the country.

In August 2006, GIA Education instructor Ric Taylor traveled through the Sierra Leone diamond mining areas of Koidu, Tongo, Kenema, and Bo, some of which were once controlled by the rebels. He saw no evidence of continuing conflict, and residents and journalists in these areas confirmed that there is no desire to return to war. In the town of Koidu (figure 1), in the diamond mining district of Kono in eastern Sierra Leone, one can still see the bare walls of buildings that were looted and burned, but many others have been rebuilt and have roofs of corrugated metal or plastic sheeting. There are several large new mosques that were built with donations from Pakistan.

Once a thriving town, Koidu is still struggling to return to normal. Today, it houses an office of the Integrated Diamond Management Program (IDMP), formerly the Peace Diamond Alliance, a group organized by the U.S. Agency for International Development (USAID) in 2002 to end the role of diamonds in funding the Sierra Leone

Figure 2. These students at the Integrated Diamond Management Program's school in Koidu are taught to grade rough diamonds by shape, clarity, color, and size. This is part of several efforts to help the miners receive fair value for their diamonds. Photo by R. Taylor.

Figure 3. Most diamond mining in Sierra Leone exploits alluvial deposits. Here, diamond-bearing gravels are screened by independent miners. Photo by R. Taylor.

conflict. According to Dr. Sahr Tongu, the head of the Koidu office, the name was changed because the organization's original purpose of ending the trade in conflict diamonds in Sierra Leone was achieved. Now, the IDMP works to develop the diamond industry for the benefit of Sierra Leone's people. The organization operates a school in Koidu that trains students to grade rough diamonds (figure 2). In a two-week course, students learn to grade diamonds by shape, clarity, color, and size. Determining value, however, is much more difficult than grading, and requires at least three to five years of experience.

Fortunately, Sierra Leone's Ministry of Mineral Resources provides a valuation service for miners in Koidu, which helps them receive fair prices for their diamonds.

While most of Sierra Leone's production comes from alluvial deposits (figure 3), diamonds are also being recovered from three small kimberlite pipes in the Kono district. The major producer is Koidu Holdings, which mines the No. 1 Pipe at Koidu by open-pit methods (figure 4). Development of the mine began in 2002, with the first production in January 2004. Approximately 20,000 tonnes of kimberlite are processed each month, yielding 6,000–10,000

Figure 4. In 2002, Koidu Holdings began mining this kimberlite in Sierra Leone (No. 1 Pipe), which today produces several thousand carats of diamonds every month. Photo by R. Taylor.

carats, depending on grade variations within the pipe. The largest rough diamond recovered to date weighed 84 ct.

According to the Sierra Leone government's Gold and Diamond Department, there has been an increase in the annual legal export of diamonds since 2000. Official figures for 2001 were approximately 222,520 carats; by 2004, reported exports had increased to nearly 691,760 carats (figures for 2005 dropped slightly to 668,700 carats). Interestingly, the value per carat has risen dramatically. In 2001, the overall value was $116.94/ct; by 2005 it reached $212.26/ct. According to Frank Karefa-Smart, diamond business advisor to the IDMP, this improvement in value and total exports is due to the fact that higher-quality diamonds that were once smuggled out of the country are now exported legally.

The possession of rough diamonds is strictly controlled, and three different types of licenses are required for their handling. A mining license allows miners to dig for diamonds but not to buy them from other miners. A dealer's license is for those who buy from the miners, but it is not sufficient to export the stones; this requires an export license, which costs Sierra Leoneans US$40,000 a year. Foreigners who purchase diamonds in Sierra Leone can export them using a local exporter's license for a fee of about 1.5% of the government-declared value.

Diamonds are evaluated for export at the Gold and Diamond Department, which assesses a 3% export tax (based on the value of the rough diamonds on the international market). The stones are then packaged and the paperwork completed according to the Kimberley Process.

Peace has been restored in Sierra Leone, and the Kimberley Process seems to have been effective in bringing Sierra Leone's diamonds into legal channels. However, further development at the mining level is an important next step in maximizing the economic benefit for the people who need it most.

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Jewelry repair damages a diamond. The SSEF Swiss Gemmological Institute recently received a mounted yellow pear-shaped diamond with a small chip on the crown (figure 5) and an associated black inclusion that was visible with a gemological microscope. It was accompanied by a grading report that did not mention the chip or inclusion, and stated the clarity as VS_1. The inconsistency of this clarity grade with such an obvious chip/inclusion suggested that these features were created after the diamond was graded. The chip was about $1.0 \times 0.5 \times 0.3$ mm and had the appearance of a cleaved depression. An SEM image (figure 6) showed a stepped crater, with the black spot at its deepest point. The client asked us to identify the black inclusion and determine the cause of the apparent damage. This was the first time we had encountered such a feature.

Chemical analysis performed during the SEM investigation (using a detector for light elements) showed that only carbon was present in the black inclusion, and a
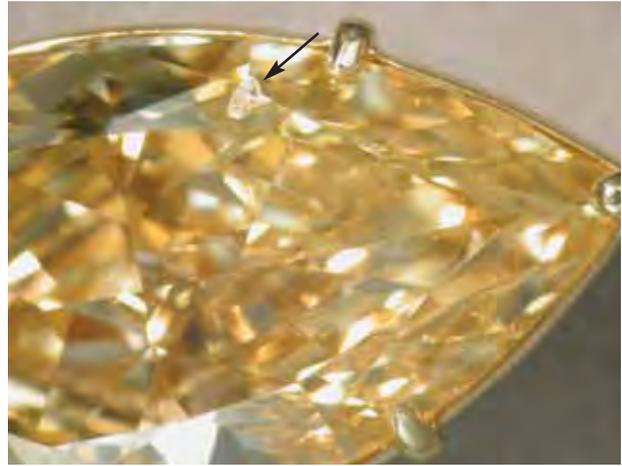
Figure 5. The chip (see arrow) on the crown of this yellow pear-shaped diamond appears to have been created by a misdirected shot from a laser soldering gun. A prong in the setting showed evidence of recent repair by laser soldering. A dark spot at the bottom of the pit was identified as graphite. Photo by H. A. Hänni; © SSEF.

Raman spectrum confirmed the presence of graphite. The association of graphite with such a crater could be explained by a pinpoint source of intense heat, causing a transformation from diamond to graphite. This would have resulted in a volume increase of ~1.6× (the density of diamond being 3.52 g/cm³ vs. 2.16 g/cm³ for graphite), creating sufficient expansion to cause the chip.

Careful observation of the setting revealed that one of the prongs on the pendant had recently been repaired by laser soldering. An accidental shot from a laser soldering

Figure 6. This SEM image of the chip in figure 5 shows the stepped shape of the crater walls and a small depression at the base of the pit corresponding to graphite. A phase transformation from diamond to graphite produced by the intense heat of a laser soldering gun would cause a sudden volume expansion, creating the chip. Image © SSEF/ZMB.
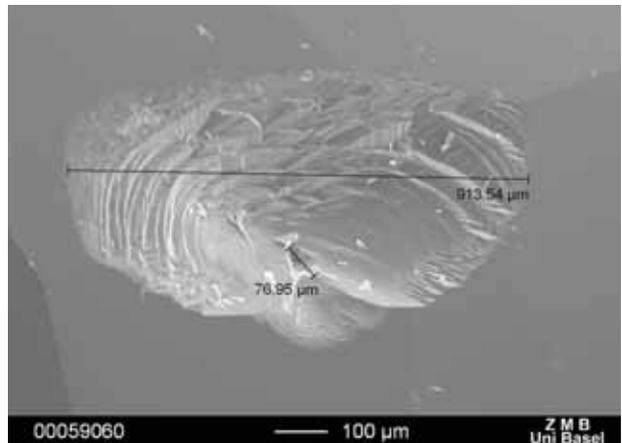
gun would have enough energy to cause the phase transition from diamond to graphite. This case shows that great care must be taken to avoid accidentally damaging a gemstone with a laser soldering gun.

HAH

COLORED STONES AND ORGANIC MATERIALS

Green augelite from Peru. Augelite, monoclinic $Al_2(PO_4)(OH)_3$, is a very rare collector's stone. Until now, the best specimens—yellow-green crystals up to 2 cm—came from Rapid Creek, Yukon Territory, Canada, where they formed within fractures in shales. And the only facetable material was from an historic andalusite deposit at the Champion mine, Mono County, California, which was worked during the 1920s and '30s. This site produced colorless crystals typically to 1 cm (exceptionally up to 2.5 cm), but faceted stones usually weighed a maximum of ~1 ct and were quite rare; the largest one known to this contributor is 4.00 ct (Patricia Gray, pers. comm., 2006).

However, a new source of gem-quality augelite appeared in early 2006, when druses of well-formed light green crystals up to 2 cm (exceptionally up to 5 cm) were discovered in a quartz vein at the small Ortega mine in Ancash Department, northern Peru (see T. P. Moore, "What's New in the Mineral World?" June 30 and October 27, 2006 updates at www.minrec.org/whatsnew.asp). Reportedly, two brothers from Lima had reopened an abandoned mine in search of quartz crystals with Japan-law twinning. They were surprised to find very fine augelite at the deposit.

The augelite crystals (e.g., figure 7) are usually milky, and only small areas near the surface are facetable. The green color is inhomogeneous, so to get the best color the rough must be carefully oriented for cutting. The faceting process is also complicated by two cleavages (perfect in the {110} direction, good in the {$\overline{2}$10} direction). Gemological properties were measured on three cut stones (0.20–1.19 ct): R.I.—n_α=1.575, n_β=1.576, and n_γ=1.590; birefringence—0.015; and fluorescence—light yellow to short-wave and inert to long-wave UV radiation. In addition, three crystals were used to measure hydrostatic S.G. values of 2.69–2.70; the Mohs hardness was determined as 5.5. These properties are comparable to those reported for augelite by M. O'Donoghue (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, p. 385). The largest cut stone seen by this contributor was 1.19 ct, but larger stones should be produced in the future.

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Bicolored beryl from the Erongo Mountains, Namibia. In mid-2006, Jo-Hannes Brunner (Pangolin Trading, Windhoek, Namibia) informed us about a new find of bicolored beryl from Namibia's Erongo Mountains. This area is famous for producing fine specimens of aquamarine, black tourmaline, jeremejevite, and other minerals (see the

Figure 7. A former quartz mine in northern Peru has produced some fine specimens of augelite; the faceted stones weigh 1.19 ct (left) and 0.94 ct (right). Photo by J. Hyrsl.

Fall 2002 GNI section, pp. 264–265 and 266–268; B. Cairncross and U. Barhmann, "Famous mineral localities: The Erongo Mountains, Namibia," *Mineralogical Record*, Vol. 37, No. 5, 2006, pp. 361–470). Only a small amount of the bicolored beryl was recovered, in early 2006, and a few stones have been cut and set into jewelry (figures 8 and 9).

Mr. Brunner donated several pieces of rough and one cut bicolored beryl to GIA for examination. The cut stone (13.68 ct; again, see figure 8) was examined by one of us (KR) and showed the following properties: color—bicolored light greenish blue and yellowish green, with a sharp demarcation between the two colors; R.I.—1.562–1.569 for the blue portion and 1.577–1.584 for the green portion; birefringence—0.007 (both colors); hydrostatic S.G.—2.68; fluo-

Figure 8. This bicolored beryl (13.68 ct) was cut from material recovered in early 2006 from the Erongo Mountains in Namibia. Gift of Jo-Hannes Brunner; GIA Collection no. 36705. Photo by Robert Weldon.

Figure 9. This necklace is set with two bicolored beryls (38 ct total weight) from the Erongo Mountains. Courtesy of Gudrun Bellwinkel, African Art Jewellers, Swakopmund, Namibia.

rescence—green portion = inert, and blue portion = inert to short-wave and very weak green to long-wave UV radiation. A weak line at 427 nm was seen in both color portions with the desk-model spectroscope. These properties are consistent with those reported for aquamarine by M. O'Donoghue (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, pp. 162–164), except that the refractive index values in that publication are slightly higher (1.572–1.590) than those recorded for the blue portion of

Figure 10. This bicolored beryl (2.9 cm tall) from the Erongo Mountains shows bluish green and brownish orange coloration. Juergen Tron collection; photo © Jeff Scovil.

this sample. Microscopic examination revealed numerous fractures and two-phase (fluid-gas) inclusions in the blue part of the stone. The green portion was more heavily included and showed parallel growth structures, opaque inclusions, and densely spaced clusters of growth tubes.

In addition to the light greenish blue and yellowish green colors described here, the bicolored beryl may also be composed of bluish green and brownish orange portions (see figure 10 and the photo on p. 393 of Cairncross and Barhmann, 2006).

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BML

Diopside from Afghanistan. "Olive" green and "chrome" green diopside reportedly from Badakhshan, Afghanistan, were brought to our attention by Farooq Hashmi (Intimate Gems, Jamaica, New York), who obtained the gem-quality rough while on a buying trip to Peshawar in January 2006. The two diopside varieties come from separate deposits that have been worked on an irregular basis for at least two years.

Mr. Hashmi obtained 3–4 kg of the "olive" green diopside from various parcels that totaled about 15 kg. The cobbed rough typically contained abundant inclusions, and the limited quantities of clean transparent pieces mostly weighed <3 grams each. The "chrome" diopside was available in larger quantities (i.e., parcels weighing up to 30–40 kg), and was reportedly cobbed from pods of material measuring up to several centimeters in diameter that were hosted by black mica schist. Extracting the gem-quality pieces was challenging due to the cleavage of the diopside.

Mr. Hashmi had a few stones faceted from each diopside variety, and loaned/donated them to GIA for examination by one of us (EPQ). Gemological testing of three "olive" diopsides (1.33–2.75 ct; figure 11) showed the following properties: color—medium to medium-dark yellow-green; pleochroism—very weak, brownish yellow and gray-green; R.I.—n_α=1.674–1.675 and n_γ=1.701–1.703; birefringence—0.027–0.028; and hydrostatic S.G.—3.29–3.30. These properties are consistent with those reported for diopside by W. A. Deer et al. (*An Introduction to Rock-forming Minerals*, 2nd ed., Longman Scientific and Technical, Essex, England, 1992, pp. 170–176). There was no Chelsea filter reaction, and the stones were inert to both long- and short-wave UV radiation. Absorption features at approximately 450, 505, and 550 nm were visible with the desk-model spectroscope. Microscopic observation revealed moderate doubling of the facet junctions, small transparent low-relief doubly refractive crystals and needles in stringers and planes, and small dark crystals. The stones also contained clouds and stringers of minute particles (which appeared dark in diffused light but white or gray in darkfield illumination); some of the clouds were planar. One of the stones displayed twinning, while another sample had partially healed fractures. EDXRF spectroscopy of two of the samples indicated the presence of

Figure 11. These yellow-green diopside samples (1.33–2.75 ct) reportedly came from Badakhshan, Afghanistan. The stone in the center (GIA Collection no. 36612) is a gift of Intimate Gems. Photo by C. D. Mengason.

Figure 12. Badakhshan, Afghanistan, was also given as the source of these "chrome" diopsides (0.57–0.77 ct). Courtesy of Intimate Gems; photo by C. D. Mengason.

major amounts of Si, Ca, and Mg; minor Fe; traces of Mn and Sr; and possibly Y and Zn.

Gemological testing of four faceted "chrome" diopsides (0.57–0.77 ct; figure 12) showed the following properties: color—medium-dark to dark green; diaphaneity—transparent; pleochroism—moderate, brownish yellow and green; R.I.—n_α=1.678 and n_γ=1.705; birefringence—0.027; S.G.—3.30–3.32; Chelsea filter reaction—none; and fluorescence—inert to both long- and short-wave UV radiation. Again, these properties were consistent with those of diopside reported by Deer et al. (1992). Absorption features at approximately 505, 550, 640, 660, and 690 nm were visible with the desk-model spectroscope; the lines in the red end of the spectrum are consistent with the presence of Cr, while the other features are probably due to iron. Microscopic examination revealed moderate doubling of the facet junctions, small low-relief doubly refractive transparent crystals and needles, and small dark crystals. The stones also contained clouds and stringers of particles and needles (which appeared dark in diffused light but white or gray in darkfield illumination); some of the clouds were planar, and the stringers had a wavy stair step–like configuration. Two of the stones had partially healed fractures and two contained larger, doubly refractive, low-relief acicular crystals. EDXRF spectroscopy of three of the samples indicated the presence of major amounts of Si, Ca, and Mg; minor Fe; traces of Cr, Ti, Mn, and Sr; and possibly V. The absorption spectra and the detection of Cr in these samples by EDXRF indicate that the intense green color of this diopside is likely due to chromium.

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BML

California jadeite with copper inclusions. The Spring 1996 Lab Notes section (pp. 46–47) reported on jadeite beads from Guatemala with inclusions of native copper. Recently, a slab of mottled gray-green jadeite containing metallic inclusions was brought to our attention by Steve Perry (Steve Perry Gems, Davis, California). The sample was sliced from a boulder that was recovered by Nancy Stinnett and Michael Humenik of Watsonville, California, from the well-known jadeite locality of Clear Creek, San Benito County, California.

The optical and physical properties of the sample were consistent with jadeite, as was the Raman spectrum obtained in the GIA Laboratory. A few "copper"-colored metallic flakes (e.g., figure 13) were the only inclusions visible at 10× magnification. Using a four-probe high-impedance conductance test on the largest inclusion (employing an ohm meter with separate probes to measure the voltage drop and current across the inclusion, and incorporating its measurements into a simple calculation), one of us (RM) determined that the electrical properties were consistent with native copper. A review of the literature found that copper was previously documented in Clear Creek jadeite by R. C. Coleman ("Jadeite deposits of the Clear Creek area, New Idria District, San Benito County," *Journal of Petrology*, Vol. 2, 1961, pp. 209–247). His description, "Native copper is present as small isolated blebs (less than 1 mm) within the jadeite . . . ," is consistent with the appearance of the inclusions in the slab we examined.

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Figure 13. The metallic inclusions in this jadeite from Clear Creek, California, consist of native copper. The largest copper inclusion measures approximately 2 mm in longest dimension. Courtesy of S. Perry; photomicrograph by R. Merk, magnified 10×.

Figure 14. Large quantities of transparent pale yellow labradorite have been mined from this remote area near Casas Grandes, Chihuahua State, in north-central Mexico. Courtesy of Barker & Co.

Labradorite from Chihuahua, Mexico. Gem-quality colorless to pale brownish yellow labradorite is known from several localities in western North America, including those in Oregon, Utah, and New Mexico (in the U.S.), as well as Mexico, among others (see J. D. Lindberg, "The source of the facet quality feldspar crystals from Rincon, New Mexico," *Lapidary Journal*, Vol. 38, No. 8, 1984, pp. 1070–1073; J. D. Lindberg, "Golden labradorite," *Lapidary Journal*, Vol. 44, No. 3, 1990, pp. 20, 22, 24; and M. O'Donoghue, *Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, pp. 263–267). Particularly large and transparent material has come from Mexico's Sierra Madre Occidental mountain range in western Chihuahua State; Lindberg (1990) reported that the largest faceted stone weighed 92 ct and that even larger ones could be cut. In early publications, such feldspar may have been erroneously referred to as orthoclase (e.g., E. M. Barron, "The gem minerals of Mexico," *Lapidary Journal*, Vol. 12, No. 1, 1958, pp. 4–16 passim). Similar labradorite has been found in the bordering state of Sonora (J. T. Gutmann, "Crystal chemistry, unit cell dimensions and structural state of labradorite megacrysts from Sonora, Mexico," *Schweizerische Mineralogische und Petrographische Mitteilungen*, Vol. 56, No. 1, 1976, pp. 55–64).

Recently, large quantities of the pale yellow labradorite from the Casas Grandes area of Chihuahua State have entered the gem market. According to a major supplier of this material, Bill Barker of Barker & Co., Scottsdale, Arizona, the feldspar is mined from weathered volcanic rock using a simple hand screening apparatus. The deposit is located in a remote area on a gentle hillside (figure 14), and the extent of the labradorite-bearing region is not yet known. Mr. Barker reported that his factory has faceted several hundred thousand carats of the material, which is notable for its uniform color, high transparency, and ability to take a good polish. A variety of shapes have been cut, including oval, cushion, radiant, trilliant, and Portuguese round. The faceted goods are typically 5–10 ct, with larger stones in the 30–60 ct range.

The gemological properties of Mexican labradorite are not well documented in the literature, so we characterized several stones that were donated by Mr. Barker and obtained from the GIA Collection. These included one sample known to be from Casas Grandes, two stones stated to be from Chihuahua State, and two labeled simply as "Mexico" (figure 15). The following properties were determined by one of us (KR): color—light brownish yellow, with weak pleochroism; R.I.—1.560–1.571; birefringence 0.009–0.010; S.G.—2.71–2.72; fluorescence—inert to long-wave and very weak orange to short-wave UV radiation; and no absorption lines visible with the desk-model spectroscope. These properties are comparable to those reported for labradorite by M. O'Donoghue (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, pp. 263–267), except for slightly lower S.G. values in that publication (2.68–2.71). Microscopic examination revealed pinpoint stringers in small discreet parallel planes, some very fine wispy clouds, small dark opaque crystals with thin-film halos, twinning, and series of very thin reflective platelets at an angle to the clouds and stringers.

All five of the faceted stones, as well as four pieces of rough Casas Grandes labradorite that were donated by Mr. Barker, were chemically analyzed by LA-ICP-MS by one of us (CMB). The use of NIST glass standards allowed for semiquantitative (rather than quantitative) analyses, but extensive LA-ICP-MS analyses of plagioclase samples of known composition from a variety of sources showed that normalizing the major-element data provides a reliable way of determining plagioclase composition with this technique. All nine samples of the Mexican feldspar showed a rather narrow compositional range that identified them as labradorite. Expressed in terms of the albite (Ab), orthoclase (Or), and anorthite (An) feldspar end-members (corresponding to Na, K, and Ca, respectively), the

Figure 15. At 1.91–18.56 ct, these samples of labradorite from Mexico were characterized for this report. The 16.15 ct oval is a gift of Barker & Co., GIA Collection no. 36692; the other samples are GIA Collection nos. 32878, 32879 (both heart and triangle), and 34467 (pear shape, gift of H. Obodda, Short Hills, New Jersey). Photo by Robert Weldon.

Mexican labradorite samples had compositions in the range of ~$Ab_{35–42}Or_{1–3}An_{56–64}$. Each stone was analyzed in two or three spots, revealing only minor variations in composition; the largest variation in anorthite content in a single stone was $An_{56–61}$. In addition to Si, Al, Ca, and Na, all the stones contained traces of K, Fe, Sr, Mg, Ti, Ba, Mn, P, Ga. It should be noted that electron-microprobe analysis of a Chihuahua labradorite at the University of Oklahoma measured a composition of ~$Ab_{40}Or_2An_{58}$ along with traces of Fe, K, Mg, Sr, and Ba (Dr. George Morgan, pers. comm., 2006). Trace amounts of Fe^{3+} in the tetrahedral site of the plagioclase causes the pale yellow color (see http://minerals.caltech.edu/COLOR_Causes/Metal_Ion/index.htm).

Although Mexican plagioclase was reported by O'Donoghue (2006) as ranging from labradorite to bytownite (a feldspar in the compositional range of $An_{70–90}$), all the samples analyzed in this study were labradorite.

BML

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Gem news from Mogok, Myanmar. In April 2006, this contributor participated in a field excursion to the Mogok area with geology students and staff from Panglong University. The information for this report was also gained from additional contacts and students in Myanmar.

- The tailings at the Kadottak ruby mine were being processed by a crushing, washing, and sorting operation for small rubies (<0.5 ct). The material is sold in bags weighing 50–100 kg that are sent to Thailand for heat treatment. The treated ruby is then sold to Thai and Indian jewelers.

- The Pein Pyit area was experiencing a boom in gem prospecting for ruby, sapphire, red spinel, zircon, and moonstone.

- Prospecting for sapphire was taking place in the Napheik and Pazunzeik areas north of Sinkwa village.

- The Kadaykada mining area (for ruby, sapphire, spinel, zircon, moonstone, and topaz) has been exhausted, and work has shifted to the nearby Lone-Cho area for ruby and spinel.

- The workings at the Bawbadan primary ruby deposit have attained a depth of 1,000 feet (328 m), and groundwater is a problem for mining. The high price of diesel fuel has restricted use of pumps, so mining has ceased at lower levels. Only small areas of corundum-mineralized marble in the upper portion of the deposit were being worked.

- Primary and secondary deposits in the Dat Taw Valley were being worked for pink sapphire, ruby, and other gems by a new influx of miners, mostly at higher levels of the deposits.

- Only small amounts of sapphire were coming from the Shwepyiaye Plot, and secondary deposits in the area have been exhausted. Permission to work a new plot in the area has been applied for, and it could yield good results in the future.

- Kwetsaung Taung in Thabeikkyin township was producing pink sapphires and pale red rubies that are opaque to translucent due to abundant parting planes. Translucent pale-to-moderate blue sapphires were also found in this area.

- Claims owned by UMEHL (Union of Myanmar Economic Holdings Limited) in the Pyaunggaung area were still producing peridot.

- Quartz and topaz were being mined in the Sakangyi area. The quartz crystals are sold in China.

- Painite production from Wetloo (a skarn deposit) and Thurein-taung (a secondary deposit) has declined, and good crystals fetch high prices.

- Prices were also high for rubellite from the Momeik area.

In conclusion, formerly insignificant gem materials in Myanmar are becoming more important and commanding

good prices. Small shops selling crystals have appeared along the roads and also in some homes. The Mogok area is full of miners, houses, and new asphalt roads, and gem prices are quite high.

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Moonstone from Madagascar. In mid-2005, we were informed about a new find of moonstone in Madagascar by Fabrice Danet (Style Gems, Antsirabe, Madagascar). According to Mr. Danet, there has been confusion among local gem dealers between moonstone and labradorite (spectrolite); the latter is abundant on the market and inexpensive. He also noted that some early reports on Madagascar's minerals by French geologists had confused the labradorescence in plagioclase with the adularescence in K-feldspar (moonstone).

Mr. Danet indicated that the new moonstone is mined from a granitic pegmatite that is located between Sahambano and Manivola, about 20 km east-northeast of Ihosy in the southern part of the island. Although the mining rights were obtained by a small French company (Tany Hafa Co.), the mine also occasionally has been worked by local people. A few kilograms of rough have been produced, mostly in small sizes, yielding cabochons that exceptionally range up to 11 ct. The cutting yield is rather low due to the orientation of the adularescence within cleavage fragments of the material.

Mr. Danet donated a parcel of the rough moonstone, along with a rectangular modified brilliant and an oval cabochon, to GIA for examination (see, e.g., figure 16). Gemological testing of the two polished stones by one of us (EPQ) yielded the following properties (those for the faceted stone are listed first; the cabochon had a flat polished back): color—very light yellow-gray and light grayish yellow, with a moderate bluish adularescence; diaphaneity—transparent to semitransparent; R.I.—1.526–1.531 and 1.525–1.530; birefringence—0.005; hydrostatic S.G.—2.57 and 2.58; Chelsea filter reac-

Figure 16. These moonstones (0.82 and 2.20 ct) are from southern Madagascar. Gift of Fabrice Danet; GIA Collection nos. 36695 (cabochon) and 36696 (faceted stone). Photo by C. D. Mengason.
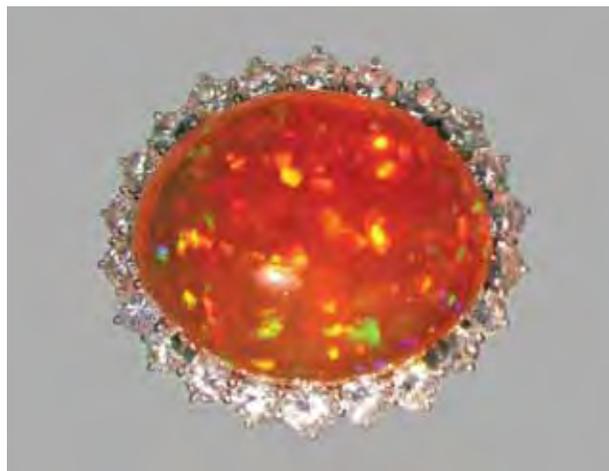

Figure 17. The 70 ct fire opal in this ring was determined to be of natural origin. Photo by T. Hainschwang.

tion—none; and fluorescence—very weak violet-blue to long-wave and weak-to-moderate orangy red to short-wave UV radiation. No absorption features were visible with the desk-model spectroscope. Most of these properties are comparable to those reported for the moonstone variety of K-feldspar by M. O'Donoghue (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, p. 270). Although the R.I. values of the Madagascar samples are higher than those provided for moonstone by this reference (1.518–1.526), they are consistent with the refractive indices given for K-feldspar in mineralogy textbooks. Microscopic examination revealed clusters of very small transparent (sometimes whitish) doubly refractive crystals and very small dark crystals, along with stringers and clouds comprised of clusters of similar but much smaller crystals. EDXRF spectroscopy showed a composition that was consistent with K-feldspar.

Elizabeth P. Quinn and BML

A large phenomenal fire opal with possible uranium-related luminescence. This contributor recently examined a high-quality 70 ct fire opal with very strong play-of-color (figure 17). The transparent bright orange opal was mounted in a ring, and was analyzed to verify its natural origin for a recent auction at Sotheby's.

The stone was identified as opal by specular reflectance FTIR spectroscopy. Although the spectra of natural and synthetic opal are similar, minor details sometimes allow them to be distinguished by this method. In this case, the spectrum matched perfectly with that of natural opal. The lack of a "snake-skin" structure during microscopic observation of the play-of-color also indicated natural origin. The opal exhibited very distinct orange net-like color zoning (figure 18, left). This zoning was also observed when the stone was exposed to short-wave UV radiation: The pale-colored zones fluoresced weak-to-moderate green, while the strongly colored "net" was almost inert (figure 18, right).

Figure 18. The color zoning of the fire opal in figure 17 (left) was mirrored in its unusual pattern of green luminescence to UV radiation (right). The luminescence was stronger in the pale-colored zones than in the intense orange "net." Photos by T. Hainschwang.
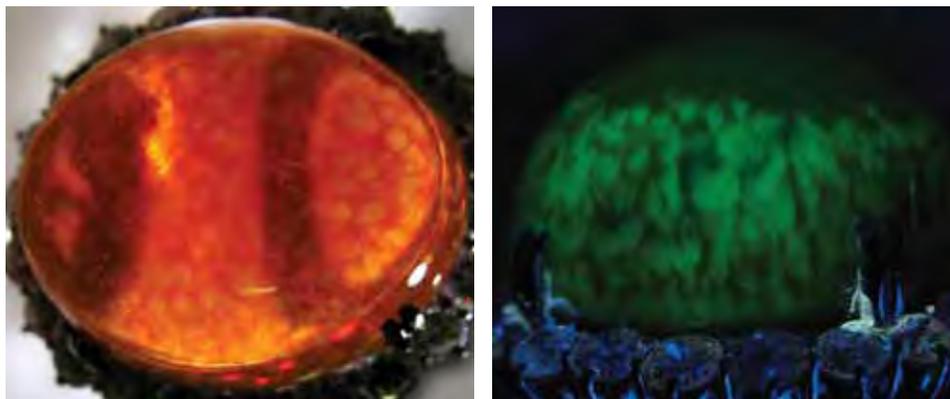
With long-wave UV, the fluorescence was much weaker but still discernable.

Green luminescence in opal has been attributed to uranium impurities in the form of the uranyl ion UO_2^{2+} (E. Fritsch et al., "Luminescence of oxidized porous silicon: Surface-induced emissions from disordered silica micro- to nano-structures," *Journal of Applied Physics*, Vol. 90, No. 9, 2001, pp. 4777–4782). Such uranium impurities can be present in very low concentrations and therefore may not be detected by EDXRF spectroscopy (E. Fritsch, pers. comm., 2006).

Indeed, EDXRF chemical analysis of this opal did not show the presence of uranium, but it did reveal trace amounts of iron. The appreciable iron concentration possibly explains why the more intensely colored zones were nearly inert to UV radiation, since yellow-to-orange color in fire opal has been attributed to nanoinclusions of an iron-containing mineral (E. Fritsch et al., "Mexican gem opals: Nano- and micro-structure, origin of color and comparison with other common opals of gemological significance," *Australian Gemmologist*, Vol. 21, No. 6, 2002, pp. 230–233). Iron is known to efficiently quench luminescence in minerals; thus, if present in sufficient quantity, it can suppress uranium-related luminescence of opal (again, see Fritsch et al., 2001), even when present within nanoinclusions (E. Fritsch, pers. comm., 2006).

Some opals contain rather large quantities of uranium. For example, a nonphenomenal yellow opal from Madagascar showing very strong green fluorescence was previously analyzed by this contributor. The presence of uranium was easily detected by EDXRF, while Fe was very low. Radioactivity was clearly measurable with a Geiger-Müller counter, and had an intensity 20 times greater than the natural background level with the detector held 9 mm from the sample.

No radioactivity was detected in this 70 ct fire opal, so the presence of uranium could not be verified by the Geiger-Müller counter. The content of uranium in this noticeably fluorescent opal is apparently less than 10 ppm, which was the EDXRF detection limit of this element for the instrument.

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"Sunset" quartz: A new gem material from Brazil. In July 2006, a new deposit of yellow-to-orange quartz was discovered in northern Minas Gerais State, Brazil. The material was found by Jean-Claude Nydegger, when he noted some quartz veins containing transparent-to-opaque areas that varied from white to yellow-orange (e.g., figure 19). Closer examination revealed a few thin bands with an attractive yellow-orange color.

Approximately 1,500 kg of quartz were extracted from the veins, but only 5 kg of this was gem quality. The first parcel of stones faceted from the material is shown in figure 20. The cut gems typically weigh 1–10 carats; the largest known to these contributors is 19.5 ct (figure 21). Due to the resemblance of the colors to those of a setting sun, these contributors suggest that the material be called "Sunset" quartz.

Initial examination with a 10× loupe revealed a number of yellow-to-orange needles in the quartz. Depending on the abundance and color of the needles, the quartz varied from pale yellow (in very slightly included samples), to yellow or orange (in samples that were more heavily included). Heating experiments done by Mr. Nydegger

Figure 19. A yellow-orange variety of quartz has been found within milky white quartz veins in northern Minas Gerais, Brazil. The orange areas of the veins, referred to as "Sunset" quartz, are relatively rare. This sample is 10.5 cm wide; photo by M. Macrì.
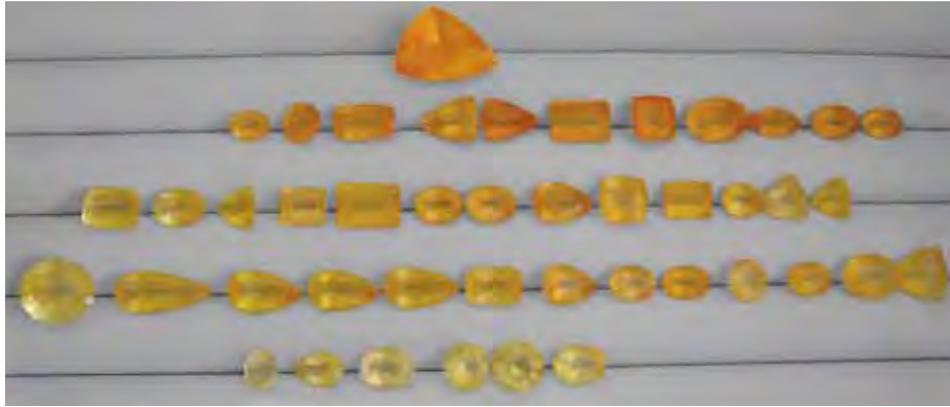
Figure 20. The stones in this first parcel of faceted Sunset quartz ranged from approximately 1 to 19.5 ct. Photo by M. Macrì.

showed that the yellow-to-orange quartz can be permanently changed to deep orange at 350°C. However, heating of the colorless and light yellow quartz resulted in no change of color. The heated and unheated quartz may show the same range of color; it is impossible to reliably distinguish them from one another by visual appearance or standard gemological testing. Some, but not all, of the heated samples contained fractures that apparently formed due to the heating process.

Standard gemological testing was performed on three faceted samples that had been heated. In addition, two samples were prepared (a doubly polished slab of unheated material and a thin section of the heated quartz) for observation using an optical microscope in both reflected and transmitted light, as well as with a scanning electron microscope (SEM). The inclusions in these two samples were chemically analyzed using a Cameca SX-50 electron microprobe (accelerating voltage of 15 kV and sample current of 15 nA) at the IGAG-CNR (L'Istituto di Geologia Ambientale e Geoingegneria—Consiglio Nazionale Delle Ricerche) in Rome.

The faceted stones yielded the following gemological properties: color—yellow, yellow-orange, orange; diaphaneity—transparent to translucent; R.I.—$n_o=1.543$, $n_e=1.552$; birefringence—0.009; and S.G.—2.65. Microscopic observations revealed a large number of randomly oriented needle-shaped inclusions in all samples (e.g., figure 22). The needles ranged up to a few millimeters long, with diameters of 1–3 μm. Their strong yellow-orange hue was responsible for the overall color of the quartz, and their abundance also resulted in the slightly milky appearance. When viewed with crossed polarizers, the inclusions showed birefringence.

Backscattered electron images of the polished slab and the thin section obtained with the SEM showed that the needles' surfaces had an irregular outline (figure 23). Suitable inclusions for chemical analysis could not be found in the unheated sample, but the needles in the heated quartz were shown by the SEM to be Al- and Fe-rich, with a lower Si content than the quartz host. Electron-microprobe analysis of the needles in this sample confirmed that they contain major amounts of Si, Al, and Fe, along with traces of K. The high iron content is probably responsible for the color of the inclusions.

While only a small quantity of Sunset quartz has been faceted, a significant amount of opaque orange material

Figure 21. This 19.5 ct Sunset quartz is the largest sample known to the authors. Photo by Federico Caprilli.

Figure 22. The Sunset quartz is colored by abundant yellow-orange needle-shaped inclusions. Photomicrograph by M. Macrì; transmitted light.
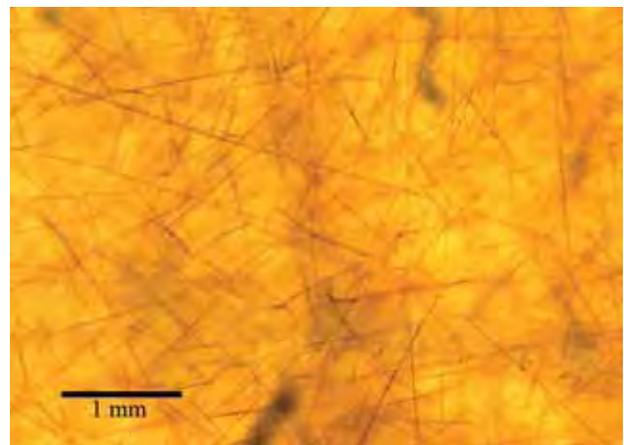
suitable for cabochons and carvings is expected to become available.

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Swedish Blue (slag) and Swedish Iron Ore. David Olson (Ingeborgs Stenar AB, Stockholm, Sweden) recently informed us about two unconventional gem products from Sweden. He reported that a blue-patterned material called Swedish Blue is cut from slag (a byproduct of smelting ore to extract metals) that was produced from the Middle Ages until about 1865, when the Bessemer process of smelting iron ore was invented. This slag comes from central Sweden, where there was once an abundance of small smelters in operation. The slag was produced when the silica-rich portions of the ore floated to the surface and were poured off as a waste product. The other material, banded iron ore, comes from a small mine near Nora, which is located 26 km north of Örebro in south-central Sweden. This mine is one of the few sources that produces a banded iron ore solid enough to cut and polish; it is sold as Swedish Iron Ore.

Mr. Olson gave GIA three cabochons of Swedish Blue and two of Swedish Iron Ore (figure 24), and these were examined by one of us (KR). The Swedish Blue had the following properties: color—finely banded, semitranslu-
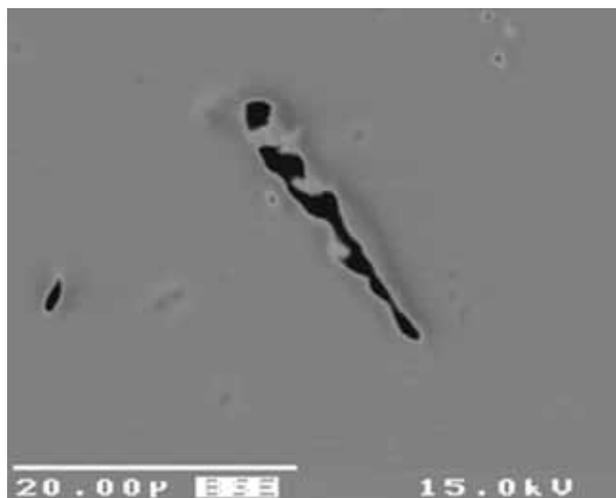

Figure 24. The blue samples are composed of slag (15.17–26.90 ct), and the banded cabochons are iron ore (16.95–34.00 ct), both from Sweden. The green areas shown by the slag correspond to areas of transmitted light. Gift of Ingeborgs Stenar AB; GIA Collection nos. 36700-36704. Photo by Robert Weldon.

cent very light gray to translucent blue with a strong yellowish green component in transmitted light; R.I.—1.58 (spot reading) or 1.583 (flat surface); hydrostatic S.G.—2.74–2.76; fluorescence—weak blue to long-wave and very weak blue to short-wave UV radiation; and no diagnostic absorption lines were visible with the desk-model spectroscope. Microscopic examination showed randomly distributed gas bubbles of various sizes and very small metallic spheres and particles. EDXRF spectroscopy performed by GIA Laboratory senior research associate Sam Muhlmeister revealed major amounts of Si and Ca; minor Mg, Al, and Fe; and traces of K, Mn, Rb, Sr, Y, Zr, Ba, and the rare-earth elements La and Ce.

The Swedish Iron Ore had the following properties: color—zebra-like, broadly banded translucent black to opaque metallic black; R.I.—1.54 from a translucent band and over-the-limits of the standard refractometer (>1.81) from a metallic band; S.G.—3.91–4.44 (variation due to different ratios of translucent and metallic material); UV fluorescence—inert; and no diagnostic absorption features visible with the desk-model spectroscope. EDXRF spectroscopy performed by Mr. Muhlmeister indicated major amounts of Si and Fe, and traces of Al and Sb. Microscopic examination showed that the black translucent areas were composed of a near-colorless transparent material that was heavily included with opaque black particles; the near-colorless areas were identified as quartz by Raman spectroscopy. The metallic bands are formed by a dense accumulation of black opaque particles that were identified as hematite with Raman analysis. At the interface of each of these layers were a few scattered very dark red particles that were only visible at higher magnification (~25×).

Mr. Olsen indicated that he sold about 1,000 cabochons (of both materials combined) into the market at the 2006 Tucson gem shows.

Kimberly Rockwell and BML

Figure 23. In this backscattered electron image, the dark spots represent the surface expression of the needle-like inclusions in the Sunset quartz. Note the irregular outline of the central needle. Image by M. Serracino.

Figure 25. This overview of the Nandihizana tourmaline mining area shows some of the workings, as well as the mining camp in the background. Photo by F. Danet.

Tourmaline mining at Nandihizana, Madagascar. In mid-October 2005, a new tourmaline deposit was discovered at Nandihizana, a village located 130 km south of Antsirabe (and only 10 km west of National Road 7). This area lies within the region known as Camp Robin, where several

Figure 26. The main pit at Nandihizana measured about 75 m long and 14 m deep. The mined material was removed in buckets using ropes and ladders. Photo by F. Danet.

tourmaline deposits have been worked over the past few years (see, e.g., Fall 2006 *G&G*, pp. 116, 156).

This contributor recorded the frenzy of mining activity that occurred when about 5,000 diggers and gem traders descended on the site (figures 25–27). The government attempted to control the influx, but this proved impossible. It is interesting to note how virtually any new gem discovery in Madagascar is followed by an immediate rush of such large proportions.

The tourmaline was mined from soil and a large underlying granitic pegmatite with a north-south strike and a subvertical dip. The pegmatite was composed of white perthite feldspar, abundant green amazonite, quartz, small amounts of black tourmaline, lepidolite, and yellow danburite (sometimes showing chatoyancy). The tourmaline production consisted of many colors, including yellow, light green, "olive" green, strawberry-like red, and violetish red. Unfortunately, most of the material was heavily included, and well-formed crystals were rare. Nevertheless, the demand for tourmaline of all qualities is quite high in Madagascar, so the production was readily consumed by African and Chinese traders for carving purposes. Only a few stones have been faceted (see, e.g., figure 28).

Tourmaline production from Nandihizana has declined in recent months. In March 2006, at a mine located near Nandihizana, several hundred kilograms of fan-shaped dark green and dark purple tourmaline crystals were recovered in groups measuring up to 20 cm long.

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Figure 27. *Miners at the Nandihizana main pit are shown here working the primary pegmatite deposit for tourmaline. Photo by F. Danet.*

Figure 28. *These tourmalines were cut from material recovered in the Camp Robin area of Madagascar. The pink stone weighs 4.75 ct. Photo by F. Danet.*

Green uvite from Afghanistan. In the Winter 2002 GNI section (pp. 357–358), we reported on some samples of brownish orange uvite from Afghanistan that were loaned to GIA by Farooq Hashmi. Mr. Hashmi has also loaned us several fragments and well-formed crystals of green tourmaline (figure 29) that are also reportedly from Afghanistan. The material was obtained in mid-2006 during a buying trip to Peshawar, Pakistan. Mr. Hashmi first noted this tourmaline in the Peshawar market in 2002. Interestingly, a single faceted stone obtained at that time by Mr. Hashmi within a small parcel of the green tourmaline crystal fragments proved to be tsavorite.

The following properties were recorded by one of us (EPQ) on four of the most intensely green crystals: color—medium-dark to dark green with some of the samples appearing darker green toward the pyramidal termination due to angular color banding oriented parallel to those faces; dichroism—moderate-to-strong greenish blue and greenish yellow; diaphaneity—transparent to translucent; hydrostatic S.G.—3.04; Chelsea filter reaction—moderate-to-strong red; and fluorescence—inert to long-wave UV radiation, and weak to moderate mottled chalky orange-yellow to short-wave UV. Although some of the crystal faces were nearly flat and fairly smooth, it was not possible to measure accurate refractive indices due to growth

features on the surfaces. UV-Vis-NIR spectroscopy of two of the crystals revealed broad absorption bands centered at 420 and 605 nm (for the o-ray) and at 440 and 600 nm (for the e-ray) together with subtle absorption features at 679, 687, and 692 nm that are most likely related to chromium. Observation with a desk-model spectroscope showed general absorption to 480 nm and a broad band centered at 600 nm, but no lines were seen in the red region. Microscopic examination revealed numerous fractures, platy low-relief doubly refractive crystals, partially healed fractures, two-phase inclusions containing a doubly refractive crystal and a liquid, two-phase inclusions containing a dark solid and a liquid, and three-phase inclusions. Two of the crystals contained clouds and one sample contained small, low-relief, pale brown inclusions that were possibly singly refractive.

EDXRF spectroscopy of two of the crystals revealed major amounts of Si, Al, and Mg; traces of Ca, Sr, V, Cr, and Ti; and possibly traces of Na, Ga, and Fe. The presence of major amounts of Mg and some Ca is consistent with

Figure 29. *These crystals of green tourmaline (6.45–14.25 mm) from Afghanistan are apparently colored by vanadium and subordinate chromium. The crystals located in the center and second from the left were among the samples that were tested for this report. Courtesy of Intimate Gems; photo by C. D. Mengason.*

the tourmaline species uvite. The EDXRF (and UV-Vis-NIR) results were comparable to similar-colored samples of "chrome" tourmaline from Tanzania and Kenya (one sample tested from each locality), but our preliminary data suggest that the Afghan material contained less Ti, Cr, V, and Sr. Notably, the tourmalines from all three localities contained more V than Cr, and did not show particularly strong Cr absorption features in the visible spectra. The intense green color of these particular tourmaline samples (typically referred to as "chrome" tourmaline by the trade) appears to be caused more by vanadium than by chromium. An early study of the Tanzanian tourmaline also indicated that vanadium is the main chromophoric element (R. Webster, "Tanganyika tourmaline," *The Gemmologist*, Vol. 30, No. 356, 1961, pp. 41–45).

Elizabeth P. Quinn and BML

SYNTHETICS AND SIMULANTS

Synthetic corundum "gem rough" in Tanzania. While on a gem buying trip to Tanzania, gem dealer Farooq Hashmi was offered some unusually transparent samples that were represented as rough spessartine and sapphire. Although he was suspicious of their authenticity due to their high clarity and the relatively low asking price, he purchased some for further examination.

In one case, a small parcel of bright orange broken fragments was sold to him as spessartine. Straight parallel stepped patterns on some of the surfaces resembled the etch features that may be seen on rough spessartine. Examination of five of these samples (1.0–3.9 g; figure 30) by one of us (EAF) showed the following properties: color—orange; hydrostatic S.G.—4.01; fluorescence—inert to long- and short-wave UV radiation; and general absorption to 500 nm and a line at 690 nm observed with the desk-model spectroscope (proving that they were not spessartine). Microscopic examination revealed no inclusions, while the surface of the samples showed conchoidal fractures as well as the straight parallel stepped areas mentioned above that had the appearance of cleavage/parting planes. Due to the unpolished nature of the samples, it was not possible to obtain R.I. readings, so the material was identified by Raman spectroscopy as corundum. The strong orange color prompted us to check for the presence of Be using LA-ICP-MS. Analysis of one sample by GIA Laboratory research scientist Dr. Andy Hsi-Tien Shen showed that it contained Fe, Cr, and Mg (besides the expected Al). The lack of Ga proved that the material was synthetic corundum.

In another case, Mr. Hashmi was offered a multicolored parcel of waterworn rough that was represented as Umba sapphire. He singled out one purple sample (figure 31) that appeared more waterworn and transparent than the others. The following properties were collected by one us (EAF): color—reddish purple; pleochroism—purple to light pink; S.G.—3.99; fluorescence—moderate-to-strong red to long-wave UV radiation, and very weak red

Figure 30. These fragments of synthetic sapphire (1.0–3.9 g) were sold as spessartine in Tanzania. Courtesy of Intimate Gems; photo by Robert Weldon.

internally and moderate chalky white on the surface to short-wave UV; and absorption lines at 470, 480, and 680 nm were seen with the desk-model spectroscope. Microscopic examination showed a rounded abraded surface with numerous small chips and fractures; no inclusions could be seen in the stone's interior. Raman analysis provided a spectral match to corundum. LA-ICP-MS analysis by Dr. Shen showed that in addition to Al, this sample contained only Cr and Ti; it had no Ga. Therefore, this sample was also identified as synthetic corundum.

Mr. Hashmi obtained these samples in Dar es Salaam, but he also reported seeing similar orange material in Arusha. According to gem dealers in Tanzania, the synthetics are brought in by Asian merchants who then use local African dealers to sell the material. Mr. Hashmi also reported that in Dar es Salaam, synthetic spinel is being sold as natural red spinel in fragments or abraded octahedral-shaped "crystals."

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BML

Figure 31. Although it has the appearance of a waterworn piece of gem rough, this 3.2 g sample was fashioned from synthetic sapphire. It was obtained in Tanzania from a multicolored parcel that was represented as Umba sapphire rough. Courtesy of Intimate Gems; photo by Robert Weldon.

Figure 32. The round brilliants in this ring (average 2.8 mm diameter) proved to be treated-color pink synthetic diamonds. With strong fiber-optic illumination (right), nine of them showed unevenly distributed green luminescence. Photos by S. Singbamroong, © Dubai Gemstone Laboratory.
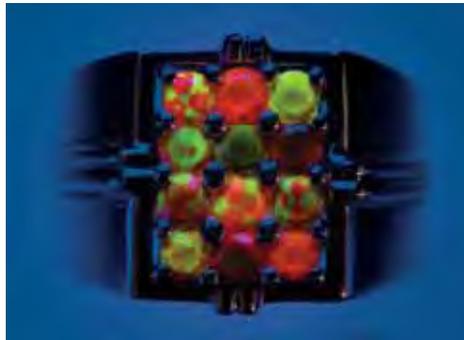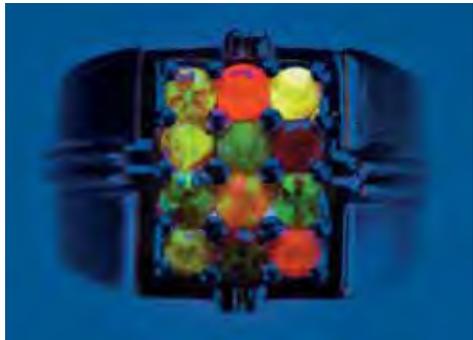

Figure 33. When exposed to long-wave (left) and short-wave (right) UV radiation, most of the treated synthetic pink diamonds revealed zones of greenish yellow to green over a red background, with cross-shaped, hourglass, or three-armed patterns. Photos by S. Singbamroong, © Dubai Gemstone Laboratory.

Small treated synthetic pink diamonds set in a ring. Recently, the Dubai Gemstone Laboratory received a yellow metal ring set with 12 pink round brilliants for identification. The round brilliants averaged 2.8 mm in diameter and exhibited a saturated color that varied from orangy pink to brownish purplish pink (figure 32, left). They gave a positive (diamond) reaction to a thermal conductivity tester.

With strong fiber-optic illumination, nine of the 12 samples showed unevenly distributed weak-to-moderate green luminescence (figure 32, right). The reaction to ultraviolet radiation was also striking. When exposed to longwave UV, all displayed a distinctive weak-to-strong yellowish orange, orange, or orangy red fluorescence, with the same nine samples also showing zones of greenish yellow to green (figure 33, left). The reaction to short-wave UV was similar but stronger, and the zoning was more clearly defined (figure 33, right). In both cases, the green fluorescing areas showed the cross-shaped, hourglass, or three-armed growth sector patterns that are typical of synthetic diamond. There was no phosphorescence reaction in any of the stones. DiamondView luminescence images of the nine samples displayed additional distinctive features characteristic of synthetic diamond.

Microscopic examination revealed metallic inclusions in six of the samples (e.g., figure 34) and a cloud of reflective pinpoint inclusions in one; among these were the three samples that did not show the green luminescence zoning mentioned above. Immersed in water and examined with diffused light, the nine samples that *did* have green zoning showed uneven color distribution, with distinct zones of yellow and pink (figure 35). Such zoning is also a typical feature of synthetic diamond.

Due to the small size of the synthetic diamonds and the nature of the mounting, it was not possible to perform UV-Vis absorption spectroscopy. However, low-temperature photoluminescence spectra recorded for two samples with a Raman microspectrometer using a 514.5 nm argon laser showed emission peaks at 575 and 637 nm, which are indicative of irradiation and annealing treatment, as well as a 658 nm band due to nickel impurities that is indicative of synthetic origin (see J. E. Shigley et al., "Lab-grown colored diamonds from Chatham Created Gems," Summer 2004 *Gems & Gemology*, pp. 128–145).

Figure 34. Needle-like metallic inclusions were seen in this treated-color synthetic pink diamond. This image also shows a cross-shaped pattern of green luminescence to visible light. Photomicrograph by S. Singbamroong, © Dubai Gemstone Laboratory; magnified 50×.
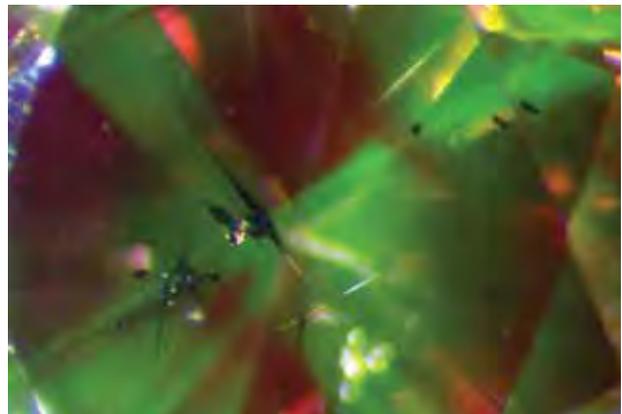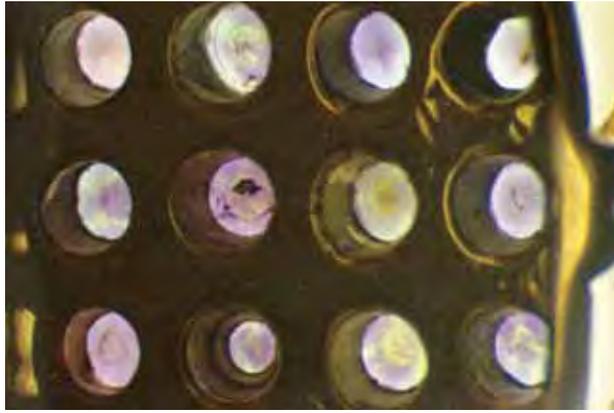
Figure 35. When viewed with diffused light while they were immersed in water, most of the synthetic diamonds in figure 32 showed distinct yellow and pink color zoning, another clue to their synthetic origin. Photomicrograph by S. Singbamroong, © Dubai Gemstone Laboratory; magnified 8×.

The infrared spectra of two samples revealed features that were a mixture of type Ib, IaA, and IaB (with IaA>>IaB, Ia>Ib). They also revealed a peak at 1450 cm^{-1}, providing additional evidence of irradiation and annealing (W. Wang et al., "Treated-color pink-to-red diamonds from Lucent Diamonds, Inc.," Spring 2005 Gems & Gemology, pp. 6–19). EDXRF chemical analysis of two samples revealed the presence of Ni and Fe.

On the basis of the color zoning, luminescence characteristics, and chemical/spectroscopic properties, we identified the 12 small round brilliants as treated-color pink synthetic diamonds.

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Figure 36. Represented as "chocolate pearls," these variously colored samples (up to 12.7 mm) were examined for this report. One of them (second from the left) proved to be silver treated, while no silver was detected in the other cultured pearls. The sample on the far left was bleached but not dyed. Slicing and/or polishing the other samples revealed narrow (~0.05 mm) concentrations of brown color at their surface. Photo by H. A. Hänni, © SSEF.
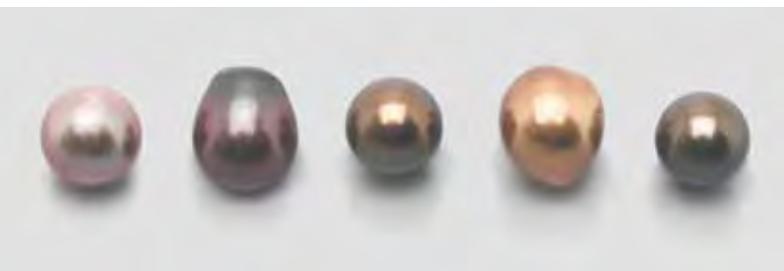
TREATMENTS

Update on "chocolate" Tahitian cultured pearls. Treated-color brown Tahitian cultured pearls were introduced a few years ago as "chocolate pearls," and there have been a number of conflicting reports about the coloration mechanism (see, e.g., "Trade raises questions about 'chocolate pearls,'" *Jewellery News Asia*, No. 241, September 2004, pp. 160–162; M. Zachovay, "'Chocolate' Tahitian cultured pearls," Summer 2005 Gem News International, pp. 183–184; "Better techniques improve brown pearls," *Jewellery News Asia*, No. 262, June 2006, p. 60). Good-quality but overly dark Tahitian cultured pearls are said to be treated to lighten the surface color. This treatment is claimed to be stable and to penetrate deeply into the cultured pearls, sometimes even turning their bead nuclei brown.

According to some of these reports, the treatment somehow affects the melanin (dark pigment) molecules in the nacre. It is not clear, though, how the surface color could be lightened by modification of the melanin, while at the same time the originally white bead in the center could turn brown. Though the color would still be considered "treated," the process is represented as superior to simple dyeing.

The SSEF Swiss Gemmological Institute has been seeking test material for some time to learn more about this mystery, and we recently received five samples represented as "chocolate pearls" from three different dealers (in England, Japan, and Switzerland) for research purposes (see, e.g., figure 36). Each sample was sawn in half, and/or a small flat spot was polished on the surface, to reveal the depth of color penetration.

The results were surprising and confirm that common sense is always helpful when facing such mysteries. One of the samples (far left in figure 36) was bleached but not dyed. The other four cultured pearls showed distinct color concentrations in their outermost layers, the thickness of which was about 0.05 mm (see, e.g., figure 37). The underlying nacre was gray to light brown (figure 38); in none of these samples was the underlying nacre darker than the surface. Furthermore, there was no apparent darkening of the bead in any of our samples. These results are nearly identical to properties exhibited by cultured pearls that have been dyed, such as those treated with silver nitrate or more modern dyes. When the samples were tested for the presence of silver using EDXRF spectroscopy, one revealed this element—indicating that it was treated by the traditional silver nitrate method—but silver was not found in any of the other cultured pearls.

Future research on a broader selection of "chocolate pearls" is necessary before we can make a better determination of the treatment process. In our experience, a nondestructive gemological test to detect this treatment is not yet available; however, polishing a tiny flat spot (e.g., around a drill hole) would show a color concentration confined to a superficial layer. The SSEF laboratory would welcome additional "chocolate pearls" for further testing.
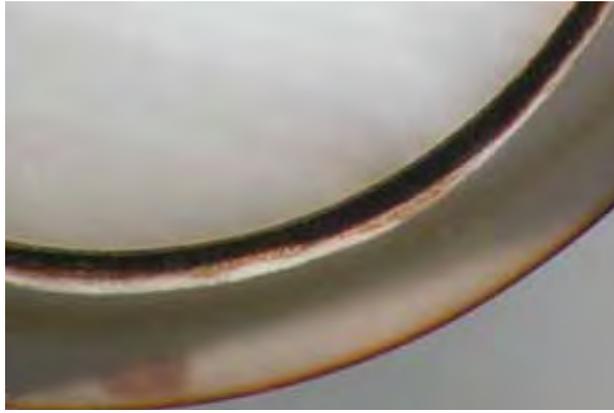
HAH

Figure 37. In this cross-section of one of the "chocolate pearls" (middle sample in figure 36), the white bead and a thin ~0.05 mm surface layer of brown coloration is clearly visible, while the nacre underlying the dark surface is lighter and predominantly gray. Photo by H. A. Hänni, © SSEF.

Treated violetish blue to violet quartz from Brazil. Blue quartz is quite rare, and the color of almost all such reported natural material is produced by mineral inclusions (see, e.g., K. Schmetzer, "Methods for the distinction of natural and synthetic citrine and prasiolite," *Journal of Gemmology*, Vol. 21, 1989, pp. 368–391). Such quartz has an orange tint when viewed in transmitted light, due to scattering by the minute particles. Thus far, the only blue quartz not colored by inclusions has been synthetic material that is colored by cobalt or heat-treated and iron-bearing (K. Nassau and B. E. Prescott, "Smoky, blue, greenish-yellow, and other irradiation-related colors in quartz," *Mineralogical Magazine*, Vol. 41, 1977, pp. 301–312).

Figure 39. The Montezuma area in Minas Gerais, Brazil, is once again being mined for amethyst (such as the 4 cm crystal pictured here). This material can be turned green by heat treatment and violetish blue to violet by subsequent irradiation. The cut stones weigh about 3–4 ct. Photo by R. S. Güttler.

Figure 38. Polishing a small flat area (1.6 mm in diameter) on one of the "chocolate pearls" revealed the shallow depth of the surface-related color concentration. Photomicrograph by H. A. Hänni, © SSEF.

A new variety of violetish blue to violet quartz (figures 39 and 40) has recently been produced through the heating and gamma irradiation of amethyst from a mine near Montezuma, in the Rio Pardo region in northern Minas Gerais. This deposit, often called the Montezuma mine, initially became famous during the 1960s for amethyst that could be turned green by heating, known today as "prasiolite" or "greened amethyst" in the trade (J. P. Cassedanne and J. O. Cassedanne, "Axinite, hydromagnesite, amethyst, and other minerals from near Vitória da Conquista (Brazil)," *Mineralogical Record*, Vol. 8, 1977, pp. 382–387; Summer 2004 Lab Notes, p. 167). One of the

Figure 40. These samples show the coloration of the Montezuma mine quartz as untreated amethyst (left, 2.40 ct), heated green quartz (center, 3.54 ct), and heated and irradiated violet quartz (right, 2.37 ct). Gift of Henrique Fernandes and Gabriel Freitas, Pinkstone International, Governador Valadares, Brazil; GIA Collection nos. 36697–36699. Photo by Robert Weldon.

veins at this deposit is now being mined again, yielding about 500 kg/month of amethyst, of which about 1–2% is gem quality.

It is well known that heat may reduce the oxidation state of iron in amethyst, and at about 300–500°C the purple color will change to colorless or yellow or green (see, e.g., E. Neumann and K. Schmetzer, "Mechanism of thermal conversion of colour and colour centres by heat treatment of amethyst," *Neues Jahrbuch für Mineralogie Monatshefte*, Vol. 6, 1984, pp. 272–282). The resulting green quartz is quite stable to heat, unlike the pale green quartz that has been produced with gamma irradiation (but no heat treatment) from colorless to very slightly green quartz from Rio Grande do Sul State. This latter quartz loses much of its green color when heated to about 150–200°C or exposed to strong sunlight. The two types of treated green quartz may be distinguished by their different responses to the Chelsea filter (see H. Kitawaki, "Green quartz," www.gaaj-zenhokyo.co.jp/index-e.html) or the Aquamarine filter (Göttinger Farbfilter, Germany). Viewed with each of these filters using incandescent light, the heated variety (derived from amethyst) appears green due to absorption in the red part of the spectrum at about 750 nm (produced by Fe^{2+}), whereas the irradiated material (derived from colorless quartz) appears red due to an as-yet-unexplained weak absorption peak at about 620 nm and efficient transmission in the red spectral region.

Gamma irradiation experiments were undertaken by one of us (HCK) to improve the green color of heated (350–450°C) Montezuma amethyst at Embrarad Ltda., a commercial irradiation facility near São Paulo. The irradiation unexpectedly produced a range of colors from violet to violetish blue to deep blue. According to the Color Atlas 5510 (Mitsumara Suiko, Shoin, Japan, 1986), the colors ranged from 4.25PB2/10 to 8.75PB4/3 (deep blue to deep purplish blue). The optical properties were typical for quartz, but with strong violetish blue and reddish orange pleochroic colors when viewed with a dichroscope perpendicular to the c-axis. Although the coloration appears to be distributed evenly in cut material, detailed microscopic examination showed color concentrations along zones parallel to the rhombohedral sectors. Preliminary experiments by HCK have shown that the stability of the coloration is comparable to that of amethyst when exposed to strong UV radiation or moderate heating (400–500°C).

The color-producing mechanism has not yet been investigated, but it may involve a charge transfer between traces of Fe^{2+} and Fe^{3+} in interstitial sites of the quartz structure (G. Lehmann, "Farben von Mineralien und ihre Ursachen" *Fortschritte der Mineralogie*, Vol. 56, No. 2, 1978, pp. 172–252), which produces absorption in the red end of the spectrum and enhances transmission in the blue-to-violet range.

About 100 kg of rough gem-quality green quartz have been stockpiled. At the time of this report, only a small amount had been irradiated to violetish blue. Research is currently being undertaken to improve the process for producing the blue color, and initial contacts are being made with gem suppliers to develop the market for this unique treated gem.

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Circular ring-like inclusions in a diffusion-treated sapphire. The Gem Testing Laboratory, Jaipur, India, recently examined an interesting 6.64 ct blue oval mixed cut. The refractive indices of 1.762–1.770, birefringence of 0.008, and hydrostatic specific gravity of 3.98 identified the sample as a natural or synthetic corundum. It was inert to UV radiation (both long- and short-wave) and displayed a weak iron-related band at 450 nm in the desk-model spectroscope.

When viewed face-up, the sample showed uneven coloration (figure 41). The cause of this became evident when it was immersed in methylene iodide: The areas of patchy coloration followed the facet outlines, and the facets around the culet appeared colorless or pale colored (figure 42). This confirmed the material as diffusion treated; the colorless areas likely resulted from repolishing after treatment.

Microscopic examination revealed straight, hexagonal zones that were slightly cloudy and whitish (figure 43, left), which were indicative of natural origin. In addition, the stone contained some irregular cloudy patches. At higher magnification, these milky zones were seen to consist of fine pinpoint inclusions (figure 43, right), as are commonly encountered in heat-treated natural corundum.

The stone displayed an interesting feature when viewed with magnification and illuminated with a fiber-optic light:

Figure 41. This 6.64 ct blue sapphire showing uneven patchy coloration owes its color to diffusion treatment. Photo by G. Choudhary.
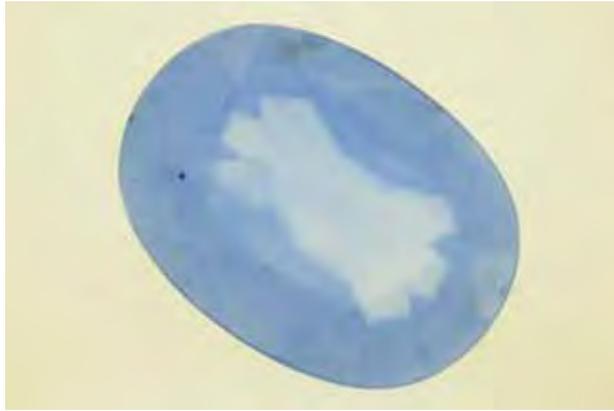
Figure 42. Immersion of the 6.64 ct diffused sapphire in methylene iodide revealed obvious color concentrations, as shown in this view of the pavilion. Photo by G. Choudhary.

groups and rows of circular rings composed of fine white particles (figure 44). Such inclusions have been reported previously in beryllium-treated corundum (Fall 2003 Lab Notes, p. 220; A. Peretti and D. Günther, "The beryllium-treatment of fancy sapphires with a new heat-treatment technique, Part C: Inclusions," *Contributions to Gemology*, No. 4, 2005, p. 54), as well as in traditionally heated sapphires exposed to very high temperatures (AGTA GTC Laboratory Update, www.agta.org/consumer/news/20060329labupdate.htm, March 29, 2006). So far such inclusions have not been encountered in unheated sapphires; it may therefore be concluded that these inclusions are likely a side effect of exposure to high temperatures, regardless of whether such conditions involved a diffusion process (using beryllium or other elements) and irrespective of the final color.

Due to a lack of sophisticated equipment such as LIBS or LA-ICP-MS, we could not test for the presence of beryllium, so the stone was simply identified as diffusion treated.

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Diffusion-treated synthetic sapphire with unusual fluorescence. Recently, the Gem Testing Laboratory, Jaipur, India, received a 5.85 ct blue oval mixed cut for identification (figure 45). Initial testing gave R.I., birefringence, optic sign, and hydrostatic S.G. values consistent with a natural or synthetic sapphire.

The specimen had a blotchy color appearance similar to that often seen in sapphires subjected to diffusion treatment. Furthermore, its hue was typical of the diffusion-treated sapphires that we commonly encounter.

When exposed to short-wave UV radiation, the specimen showed a strong patchy chalky blue fluorescence that followed the facet pattern. However, careful examination revealed that only the star and upper girdle facets showed this reaction, whereas the table and kite facets remained

Figure 43. The 6.64 ct sapphire contained straight, hexagonal, milky zones that suggest a natural origin (left). The milky zones were composed of fine pinpoint inclusions (right), which are commonly associated with heat-treated corundum. Photomicrographs by G. Choudhary; magnified 20× (left) and 40× (right).

Figure 44. The ring-like inclusions in the sapphire (left) are indicative of high-temperature heat treatment (in this case by a traditional surface-diffusion process). At higher magnification, the circular inclusions were seen to be composed of fine particles. Photomicrographs by G. Choudhary; magnified 25× (left) and 70× (right).

Figure 45. This 5.85 ct blue oval mixed cut was identified as a flame-fusion synthetic sapphire treated by a diffusion process. Photo by C. Golecha.

Figure 46. When exposed to short-wave UV radiation, the diffusion-treated synthetic sapphire in figure 45 showed an unusual pattern of symmetrical chalky blue fluorescence: The star and upper girdle facets fluoresced chalky blue, while the table, kite, and pavilion facets were inert. Photo by C. Golecha.

inert (figure 46). The pavilion was also inert, but a weak internal glow—as is commonly associated with synthetic corundum—was observed through this portion of the stone. There was no reaction to long-wave UV radiation.

This fluorescence reaction reminded us of the diffusion-treated synthetic sapphire that one of us (CG) reported previously (see Summer 2006 GNI, pp. 185–186). In that case, however, the patches were random, not following any specific symmetry. No features such as a separation plane were detected that might indicate a composite material.

Microscopic examination with diffuse illumination and immersion in methylene iodide confirmed that the specimen owed its color to a diffusion process (figure 47). However, no color concentrations were seen in the star or upper girdle facets. Also, no curved color banding or angular color zoning was present, which would have been expected if the color was inherent to the specimen. The presence of Plato lines between crossed polarizers is strongly indicative of a flame-fusion synthetic sapphire.

When we compared the color concentrations to the fluorescence reaction (figure 48), it was clear that only the facets lacking color reacted to short-wave UV radiation; those portions showing color concentrations in immersion were inert. This pattern was probably caused by "over polishing" of the star and upper girdle facets after the diffusion treatment, which removed the inert shallow coloration and exposed the untreated, colorless synthetic sapphire portion that fluoresced to short-wave UV. The same thing likely occurred to the sample reported in the Summer 2006 GNI section, although in that case the "over polishing" did not follow any specific pattern.

Chalky blue fluorescence is commonly associated with synthetic and treated sapphires. Typically, synthetic sapphires show fluorescence throughout the volume of the sample, while heat-treated natural sapphires display fluorescence corresponding to the stone's color zoning, and diffusion-treated natural or synthetic sapphires have chalky blue fluorescence in patches on the surface. Traces of Ti, combined with the high temperatures experienced during the growth of the synthetic corundum or during heat treat-

ment processes, are responsible for the fluorescence, which can be quenched by the simultaneous presence of iron or magnesium (see R. W. Hughes and J. L. Emmett, "Heat seeker: UV fluorescence as a gemological tool," www.agta-gtc.org/articles/heat_seeker_uv_fluorescence.htm). For diffusion-treated sapphires, fluorescence is typically observed in stones with low iron content as patches corresponding to the colored areas of the stone. However, for this synthetic sapphire, that behavior was reversed (again, see figure 48): The fluorescence was present in the colorless regions (i.e., those without a surface diffusion layer).

The fluorescence pattern is consistent with an insufficient concentration of a luminescence quencher (e.g., iron)

Figure 47. Viewed through the pavilion with immersion, the blue color in this 5.85 ct synthetic sapphire was concentrated on specific facets, which indicates diffusion treatment. The pale or near-colorless appearance of the star and upper girdle facets is likely due to "over polishing" after the diffusion process. Photomicrograph by C. Golecha.
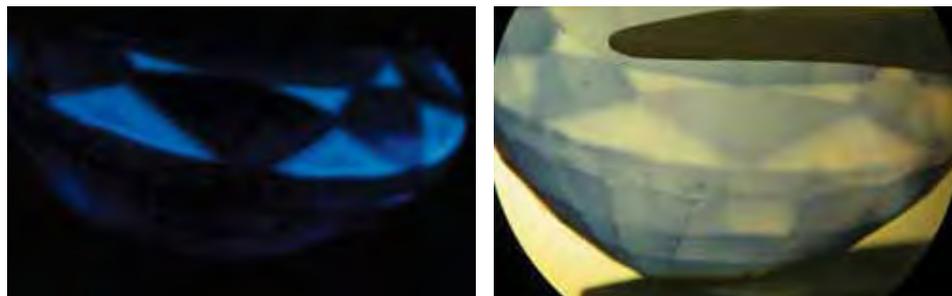
Figure 48. A comparison of the diffusion-treated synthetic sapphire viewed with short-wave UV radiation (left) and in immersion (right) shows that the colored facets are inert. This is likely caused by diffused element(s) quenching the UV fluorescence. Photomicrographs by C. Golecha.

in the synthetic sapphire, and such an element was possibly part of the surface diffusion process. We could not confirm if the quenching element was added purposely in an attempt to negate the tell-tale chalky blue fluorescence, or whether it was a contaminant that was diffused unintentionally. Traditionally, surface diffusion treatments have used titanium oxide, iron oxide, and aluminum oxide. For a detailed review of the diffusion process and chemistry, see R. E. Kane et al., "The identification of blue diffusion-treated sapphires," Summer 1990 *Gems & Gemology*, pp. 115–133.

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CONFERENCE REPORTS

32nd Annual GSJ Gemological Conference. The Gemological Society of Japan was founded in 1973 by Dr. Ichiro Sunagawa and several other gemologists. Since then, annual GSJ conferences have taken place throughout Japan. Although the official language at these meetings is Japanese, international speakers are welcome to give presentations in English. The 2006 GSJ conference was held July 22–23 at Kobe Design University. Nineteen presentations were given on diamonds, colored stone and pearl treatments, LA-ICP-MS and LIBS applications, and other topics. Abstracts from this and some previous GSJ conferences are available at wwwsoc.nii.ac.jp/gsa/index-e.html.

The 2006 conference also included a field trip to a cultured pearl bead nucleus factory on Awaji Island. The beads are made from several types of freshwater mussels, such as the washboard (*Megalonaias gigantea*), mapleleaf (*Quadrula quadrula*), ebonyshell (*Fusconaia ebena*), three-ridge (*Amblema plicata*), and the pigtoe (*Fusconaia flava*). Approximately 120,000–130,000 momme (1 momme = 3.75 g) of bead nuclei are produced annually.

Next year's GSJ conference will be held at the Tsukuba public library, Tsukuba City on June 2–3, 2007.
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International Mineralogical Association Biennial Meeting. Over 800 researchers from some 50 countries attended the 19th general meeting of the IMA in Kobe, Japan, July 23–28, 2006. The conference included a session titled "Natural and Artificial Gem Materials." **One of these con-** **tributors** (EF) discussed the several causes of brown color in diamonds, the most common being associated with brown graining resulting from plastic deformation. Recent work suggests that this brown color can be qualitatively correlated with a series of near-infrared absorption bands known as the "amber center," which possibly consists of a particular arrangement of two nitrogen and two carbon atoms in the diamond lattice. A system to classify several European fossil resins (i.e., amber) on the basis of optical, spectroscopic, and chemical properties was discussed by **Prof. Corina Ionescu** of Babes-Bolyai University in Cluj-Napoca, Romania. Her work indicates that these ambers can be divided into three chemically and structurally different categories. **Dr. Carlo Aurisicchio** of the Institute of Geosciences and Georesources in Rome described a study to establish the country of origin of emeralds using trace-element analysis determined by secondary ion mass spectrometry (SIMS) in combination with inclusion characteristics and oxygen and hydrogen isotope ratios. Unique patterns of trace elements are distinctive of at least some important emerald localities. A theoretical modeling study supported by heat-treatment experiments involving beryllium diffusion in corundum was carried out by **Dr. Jun Kawano** of the Yamanashi Institute of Gemmology and Jewellery Arts in Kofu, Japan. His work suggests that Be diffusion in corundum can occur at lower temperatures (1300 K and possibly lower) than previously thought. Several potential applications for LA-ICP-MS chemical analysis to solve identification problems in gemology were discussed by **Dr. Ahmadjan Abduriyim** of the Gemmological Association of All Japan in Tokyo. Examples included the detection of Be in diffusion-treated sapphires and the determination of the geographic source of blue sapphires and Cu-bearing tourmalines.

This same session also included several poster presentations. **Dr. Hisao Kanda** of the National Institute for Materials Science in Tsukuba, Japan, studied the broad-band luminescence (known as band-A, extending between 400 and 550 nm) in natural diamonds using cathodoluminescence spectroscopy. Two kinds of band-A luminescence were documented: (1) a band with a maximum at about 415 nm in type Ia diamonds that displays a pattern that follows the growth structure and, hence, appears to be produced by defects introduced during growth; and (2) a band with a maximum at about 435 nm in all diamond types, with a pattern that follows slip planes and is therefore produced by defects created by plastic deformation

during post-growth processes. **Prof. Norimasa Shimobayashi** of the Department of Geology and Mineralogy, Kyoto University, described iridescent andradite from Tenkawa, Nara Prefecture, Japan. The iridescence is thought to arise from a fine lamellar structure in which the layers have slightly different Al/Fe ratios.

Several presentations in other sessions were of gemological interest. **Dr. George Harlow** of the Department of Earth and Planetary Sciences, American Museum of Natural History, New York, spoke about the need for all mineralogical museums to standardize the data used to describe mineral samples in their collections in order to make this information more accessible and useful. **Dr. Satoshi Matsubara** of the National Science Museum in Tokyo described a special jade exhibit at the museum that took place in 2004–2005. **Prof. Georges Calas** of the Institut de Minéralogie et de Physique des Milieux Condensés, University of Paris, described various improved spectroscopic techniques for characterizing transition metals, such as Cr in minerals, which are important coloring agents. In a study of four highly included ("cloudy") diamond crystals from two kimberlites in Siberia, **Dr. Alla Logvinova** of the Institute of Geology and Mineralogy, Russian Academy of Sciences, Novosibirsk, found a variety of mineral and fluid phases in nanometer-sized inclusions. The similarity with the phase assemblages in analogous inclusions in diamonds from Canadian kimberlites indicates a similarity in their diamond forming environments in the mantle. **Dr. Galina Kudrayvtseva** of Moscow State University described the characteristics of gem-quality type I diamonds from the Grib kimberlite in the Arkhangelsk region in northwestern Russia. Many of the diamond crystals were colorless and of good clarity. Among the mineral inclusions identified were chromite, olivine, diopside, orthopyroxene, and Fe/Ni sulfides.

Dr. Anastasia Shuskanova of the Institute of Experimental Mineralogy, Russian Academy of Sciences, Chernogolovka, demonstrated that although sulfide melts allow the growth of diamond, they are not consistent with the inclusion suites observed in natural diamonds. Therefore, sulfide melts are at best immiscible droplets in silicate-carbonate melts during diamond growth. **Dr. Dan Schulze** of the Department of Geology, University of Toronto, Canada, studied the chemical composition of eclogitic diamonds from the Quebrada Grande region of Venezuela. These diamonds are thought to result from crystallization of biogenically derived carbon that originated in subducted oceanic crust. **Dr. Nikolai Sobolev** of the Institute of Geology and Mineralogy, Russian Academy of Sciences, Novosibirsk, reported some new trace-element data—for Ni, Mn, Ca, Co, Cr, and Al—in olivine inclusions within diamonds. Olivine is the most typical type of inclusion in peridotitic diamonds. **Dr. Makoto Arima** of the Geological Institute of Yokohama National University, Japan, discussed how various factors, such as local thermal and chemical conditions, influence both the growth and resorption of diamond crystals during their long residence in the earth's mantle. **Dr. Ben Harte** of the Grant Institute of Earth Science, University of Edinburgh, Scotland, studied majoritic (high-Si) garnet inclusions in alluvial diamonds from the São Luiz River in Juina Province, Brazil. These single-crystal inclusions appear to indicate that the diamonds formed at depths greater than 400 km.

Discoveries of blue sodalite fashioned for personal adornment as long ago as 1300 BC in the central Andes led to a study by **Dr. Masaaki Shimizu** of the Department of Earth Sciences, University of Toyama, Japan. The source of this material was identified as Cerro Sapo in Bolivia, and its distribution in archeological sites has revealed valuable information on historical trade routes across South America.

Separately from the conference, the Gemological Association of All Japan (GAAJ) organized a short field trip to the Hirayama Co. pearl nucleus factory near Kobe. The company uses 22 tonnes of freshwater mussel (*Anadonta*) shells annually to produce about 700 kg of bead nuclei. The manufacture of these beads consists of 20 steps, and the finished beads range from 1 to 15 mm in diameter. The final polish is obtained with a garnet-based powder. The best-quality beads are used for Japanese Akoya cultured pearls, while the others are sent to China.

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EF

ANNOUNCEMENTS

***G&G* online conference calendar.** A regularly updated list of conferences and museum announcements pertaining to gems is now available on the *G&G* web site at www.gia.edu/gemsandgemology.

GIA's Russell Shor wins Liddicoat Journalism Award for *Gems & Gemology* article. GIA senior industry analyst and frequent *G&G* contributor Russell Shor won the 2006 AGS Richard T. Liddicoat Journalism Award in the category of Industry/Trade Reporting for his Fall 2005 *G&G* article "A review of the political and economic forces shaping today's diamond industry" (pp. 202–233). This is the third *G&G* article so honored since the competition began in 2003.

Visit *Gems & Gemology* in Tucson. Meet the editors and take advantage of special offers on subscriptions and back issues at the *G&G* booth in the publicly accessible Galleria section (middle floor) of the Tucson Convention Center during the AGTA show, January 31–February 5, 2007. GIA Education's traveling Extension classes will offer hands-on training in Tucson with "Gem Identification" (January 29–February 2), and several free seminars will be offered by GIA staff February 3–4. To enroll, call 800-421-7250, ext. 4001. Outside the U.S. and Canada, call 760-603-4001. The GIA Alumni Association will host a dance party in Tucson on February 2 celebrating the

Association's 25th anniversary. To reserve tickets, call 760-603-4204 or e-mail events@gia.edu.

Conferences

NAJA Annual Conference. The National Association of Jewelry Appraisers is holding its 27th annual Winter Educational Conference January 29–30, 2007, during the Tucson gem shows. Visit www.najaappraisers.com.

Rapaport International Diamond Conference 2007. Scheduled for February 5 in New York, this conference will focus on the most important issues confronting the diamond industry, including conflict diamonds, the internet, and branding. Call 877-987-3400 or e-mail conference@diamonds.net.

Hasselt Diamond Workshop. Held February 28–March 2, 2007, at Hasselt University, Diepenbeek–Hasselt, Belgium, this conference will cover the physics of diamond defects and characterization of CVD synthetic diamond. Visit www.imo.uhasselt.be/SBDD2007.

PDAC 2007. The Prospectors and Developers Association of Canada convention will take place March 4–7 in Toronto. Diamonds will be featured in a session called "Diamond Facets from Exploration to Environment," and also will be included in other sessions. Visit www.pdac.ca/pdac/conv.

WJA in New York. The Women's Jewelry Association "Women In the Know" business conference will be held on March 16, 2007, at the Fashion Institute of Technology in New York City. Visit www.womensjewelry.org.

Bead Expo. The 2007 International Bead Expo will be held in Oakland, California, April 11–15. Over 60 workshops and educational lectures on bead jewelry design and manufacture are scheduled. Visit www.beadexpo.com.

BASELWORLD 2007. The BASELWORLD show will be held April 12–19 in Basel, Switzerland. GIA will host GemFest Basel on April 14, 4–6 p.m., at the Basel Convention Center, Hall Montreal. Kenneth Scarratt, director of GIA Research (Thailand), will be speaking on GIA's Pearl Classification System. RSVP by April 5 at events@gia.edu. During the show, *Gems & Gemology* editor-in-chief Alice Keller will be available at the GIA Booth in Hall 2, Stand W23. Visit www.baselshow.com, call 800-922-7359, or e-mail visitor@baselworld.com.

Sinkankas Jade Symposium. Jade will be featured at this year's John Sinkankas Memorial Symposium, held April 21, 2007, at GIA Carlsbad. A variety of experts will speak on jade localities, inclusions, treatments, appraising, lapidary work, and literature at this all-day educational event. E-mail merksjade@cox.net.

2007 ICA Congress. The International Colored Gemstone Association Congress will be held May 5–9 in Dubai, United Arab Emirates. The theme will be "Embracing Global Trends from Mine to Market." Presentations will be given by industry leaders on gem sources, manufacturing centers, marketing, branding, laboratory services, and education/ethics/economics. Visit www.gemstone.org/gem-news.

Granitic Pegmatites: The State of the Art. Held May 6–12, 2007, at the Universidade do Porto, Portugal, this workshop will focus on the study of granitic pegmatites, and will include a field trip to rare-element pegmatites in northeastern Portugal and central-western Spain. Visit www.fc.up.pt/peg2007.

2007 GAA-NSW Conference. The 2007 conference of the New South Wales Division of the Gemmological Association of Australia will be held May 18–20 at Hadley's Hotel in Hobart, Tasmania. Subjects will include the history of gems and lapidary, rare ivories, and Art Deco/Art Nouveau jewelry. Visit www.gem.org.au/conference.htm.

GAC-MAC 2007. The 2007 joint meeting of the Geological Association of Canada and the Mineralogical Association of Canada will take place May 23–25 in Yellowknife, Northwest Territories. The conference will include a special session titled "Diamonds: Exploration to Production— A Northern Canada Perspective." A "Geology of Gem Deposits" short course is also scheduled, as well as a field trip to the Ekati and Diavik diamond mines. Visit www.nwtgeoscience.ca/yellowknife2007.

Maine Pegmatite Workshop. The 5th Maine Pegmatite Workshop will be held May 26–June 3, 2007, in Poland, Maine. In addition to the in-depth curriculum, field trips to gem-bearing pegmatites in New England are planned. Visit homepage.mac.com/rasprague/PegShop.

New Diamond and Nanocarbons. Scheduled for May 28–31, 2007, in Osaka, Japan, this conference will address recent developments in the growth and characterization of synthetic diamond. The NDNC is a merger of the International Conference of New Diamond Science and Technology (ICNDST) and the Applied Diamond Conference (ADC). Visit www2.convention.co.jp/NDNC2007.

First European Gemmological Symposium: "Presence and Future of Gemmology." Honoring the 75th Anniversary of the German Gemmological Association, this international symposium will take place June 22–24, 2007, in Idar-Oberstein, Germany, and will feature numerous scientists in gemology and well-known business leaders from the gem and jewelry industry. Visit www.dgemg.com/gemmologen_eng/index.php?seite=aktuell.

30th International Gemmological Conference. Scheduled for July 15–19, 2007, in Moscow, Russia, this conference will cover new gem deposits, synthetics, treatments, gem identification methods, and markets. The talks will be given only by IGC delegates, but the conference is open to observers and students. E-mail balvlad@iem.ac.ru.

Exhibits

Colored diamonds at the Natural History Museum. On loan from Alan Bronstein and Harry Rodman, the Aurora Collection of 296 naturally colored diamonds is now on display at the Natural History Museum in London. Visit www.nhm.ac.uk/about-us/news/2006/november/news_9996.html.

Jewelry History at the Newark Museum. "Objects of Desire: 500 Years of Jewelry," an exhibition of more than 200 jewelry pieces from the collection of the Newark Museum, New Jersey, is on display through February 26, 2007. The collection covers American and European jewelry from the 1500s to the modern era. Visit www.newarkmuseum.org.

Symbols of Identity—Jewelry of Five Continents. On display through March 2007 at the Mingei International Museum in San Diego, this exhibit features examples of personal adornment from native cultures in North and South America, Africa, Asia, and Europe. Visit www.mingei.org/curex.html.

Gold at AMNH. "Gold," an exhibition exploring the historical fascination with this precious metal, is on display at the American Museum of Natural History in New York through August 19, 2007. The exhibit includes both rare natural specimens and significant cultural artifacts. Visit www.amnh.org/exhibitions/gold.

Jewelry of Ben Nighthorse. Ben Nighthorse Campbell, who was a U.S. senator from Colorado from 1992–2004, has enjoyed a successful second career as an innovative jewelry designer. This collection of his work, which debuted at the Smithsonian Institution's National Museum of the American Indian in 2004, is on display at the Colorado History Museum in Denver through December 31, 2007. Visit www.coloradohistory.org.

South Sea Pearls at the GIA Museum. "White Magic," an exhibit of South Sea cultured pearl jewelry, will be on view at the GIA Headquarters in Carlsbad January 19–May 15, 2007. The exhibit features jewelry suites by 17 of today's top designers, including Henry Dunay, David Yurman, Stephen Webster, Casa Vhernier, and Orlando Orlandini. Advance reservations are required; to schedule a tour, call 760-603-4116 or e-mail museum@gia.edu.

French Jewelry at the Legion of Honor. "Masterpieces of French Jewelry," an exhibition of notable French jewelry pieces from American collectors, will be on display at the Legion of Honor art museum in San Francisco, February 10–June 7, 2007. Among the pieces included are the Taj Mahal diamond necklace by Cartier, given to Elizabeth Taylor by Richard Burton in the 1970s, and an Art Nouveau brooch owned by Jacqueline Kennedy Onassis. Visit www.thinker.org/legion/exhibitions.

Native American Jewelry. "Shared Images: The Jewelry of Yazzie Johnson and Gail Bird" will be on display February 17 through June 2007 at the Heard Museum in Phoenix, Arizona. The exhibit includes examples of their belts, earrings, bracelets, rings, and necklaces. Visit www.heard.org.

ERRATA

1. In the Spring 2006 GNI entry on pyrope-spessartine from Tanzania (pp. 66–67), the second sentence should have indicated that the garnets came from Tanzania, rather than Madagascar.

2. In table 3 (p. 106) of the Summer 2006 LA-ICP-MS article by A. Abduriyim et al., next to the parameter "Laser line size," the GAAJ logo size should have been reported as 80×230 mm.

3. The Summer 2006 GNI section included a note on jeremejevite from Myanmar and Sri Lanka (pp. 175–176). The jeremejevite reported to be from Sri Lanka actually came from Madagascar (see Winter 2004 GNI, pp. 340–341). The rough came to Sri Lanka via dealers who purchased the material in Madagascar. We thank E. Gamini Zoysa (Mincraft Co., Mount Lavinia, Sri Lanka) for bringing this to our attention, and Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado) for confirming this with the dealer who purchased the rough in Sri Lanka.

4. In the Fall 2006 Gemological Research Conference poster session abstract on demantoid from Iran (by G. Du Toit et al., p. 131), the banded opaque material consisting of layers of apatite and calcite actually comes from a different part of Iran, rather than being associated with the demantoid deposits.

5. The Fall 2006 International Gemological Symposium poster session abstract on the Bahia sculpture (by G. Lehrer and L. Stoller, p. 158) erroneously described its source material as a rutile crystal. Bahia was carved from a rutilated quartz crystal.