



## EDITOR

Brendan M. Laurs (blaurs@gia.edu)

## CONTRIBUTING EDITORS

Emmanuel Fritsch, *IMN, University of Nantes, France* (fritsch@cnsr-imn.fr)

Henry A. Hänni, *SSEF, Basel, Switzerland* (gemlab@ssef.ch)

Kenneth V. G. Scarratt, *AGTA Gemological Testing Center, New York* (kscarratt@email.msn.com)

Karl Schmetzer, *Petershausen, Germany* (schmetzerkarl@hotmail.com)

James E. Shigley, *GIA Research, Carlsbad, California* (jshigley@gia.edu)

Christopher P. Smith, *Gübelin Gem Lab Ltd., Lucerne, Switzerland* (cpsggl2@hotmail.com)

## DIAMONDS

**Kimberley Process ratified.** After more than two years of legal and diplomatic maneuvering, 53 nations approved the Kimberley Process at a meeting in Interlaken, Switzerland, on November 5, 2002. The Kimberley Process is a system of controls on diamond imports and exports that is designed to reduce the trade in illicit and conflict diamonds. Forty-eight nations, including all major diamond producers and manufacturing centers, implemented the controls January 1, 2003. Five other nations that participated in the process, including the Czech Republic, Japan, and Sri Lanka, will implement controls later this year.

Under the Kimberley Process, which was developed by the diamond industry and backed by the United Nations, all exports of rough diamonds must be sealed in tamper-proof containers and certified by the local government that they come from legitimate sources. The paperwork must accompany the diamonds all the way through the manufacturing and sales (wholesale and retail) chain. Participating countries will no longer permit imports of diamonds that do not carry such paperwork. For more information on the details of the process, visit [www.worlddiamondcouncil.com](http://www.worlddiamondcouncil.com).

In the United States, the Diamond Manufacturers and Importers Association of America, in cooperation with U.S. government agencies and shipping companies, has established the Rough Diamond Export Mechanism for monitoring the flow of all diamonds exported from the country. European Union member countries and Canada have set up similar organizations.

The Jewelers of America has also advised its 11,000 member retailers that each time a diamond changes hands, the seller must attest to its legitimacy by means of a warranty stating the stone "has been purchased from sources not involved in funding conflict and in compliance

with United Nations resolutions." The JA also urged members to require all of their diamond suppliers to offer this warranty on every invoice, and to retain the paperwork for five years.

De Beers's director of public and corporate affairs, Rory More O'Ferrall, told sightholders at a December 2002 meeting that, even though the conflicts have ended in Angola and Sierra Leone (the original targets of the Kimberley Process), the industry must remain committed to ending trade in conflict and illicit diamonds. "First there is still a civil war and appalling human suffering in the Democratic Republic of the Congo. Second, we must accept that many governments and civil society groups are looking beyond conflicts to address the possibility that illicit diamonds are used to facilitate money laundering and, more significantly, terrorism. While no evidence of this whatsoever has been produced, the very fact that diamonds could be misused in this way is enough to ensure that governments insist on a better-regulated industry."

*Russell Shor (russell.shor@gia.edu)  
GIA, Carlsbad*

*Editor's note: Bylines are provided for contributing editors and outside contributors; items without bylines were prepared by the section editor or other G&G staff. All contributions should be sent to Brendan Laurs at blaurs@gia.edu (e-mail), 760-603-4595 (fax), or GIA, 5345 Armada Drive, Carlsbad, CA 92008.*

GEMS & GEMOLOGY, Vol. 38, No. 4, pp. 348-369  
© 2002 Gemological Institute of America

## COLORED STONES AND ORGANIC MATERIALS

**Alexandrite from Mananjary, Madagascar.** Emerald production from the Mananjary region of eastern Madagascar started in the early 1960s. Numerous emerald finds led to mining activities that continue on a small scale (see D. Schwarz and J. Kanis, "Emeralds from Africa," in G. Giuliani et al., Eds., *extraLapis English No. 2: Emeralds of the World*, 2002, pp. 52–59).

More recently, small quantities of alexandrite have been mined from the Mananjary area. The alexandrite deposit has been known for about 4 years, and is located south of Mananjary, between Mananjary and Farafangana (F. Pezzotta, pers. comm., 2002). According to A. Leuenerger (pers. comm., 2002), several hundred grams of rough material (though little of gem quality) were available from the area in 1999.

This contributor recently obtained one loose twinned crystal and one hand specimen of an alexandrite-bearing rock for examination. These samples were purchased by an intermediary from a local dealer. The rock specimen, about  $6 \times 4$  cm, was a typical biotite-phlogopite schist that showed two alexandrite crystals on the surface, with some smaller crystals almost completely covered by the matrix. Colorless to white minerals in the host rock were identified as quartz and feldspar by Raman analysis. One of the two larger crystals, about 1 cm in largest dimension, was broken. The other crystal (figure 1), of similar size, showed a thick tabular habit with dominant pinacoids  $b$  {010}, somewhat smaller pinacoids  $a$  {100} and prisms  $i$  {011}, and subordinate prisms  $s$  {120} and dipyramids  $o$  {111}. The  $a$  pinacoid was striated parallel to the  $c$ -axis.

The loose crystal weighed 70.74 ct and had a thick columnar habit with dimensions of about  $18 \times 16 \times 21$  mm (figure 2). It was twinned across {031} and showed the typical parallel striations of chrysoberyl on the  $a$  and  $a'$



Figure 1. Shown here in incandescent light, this partially transparent alexandrite crystal (approximately 1 cm wide) on biotite-phlogopite-quartz-feldspar matrix was reportedly recovered from the Mananjary area of eastern Madagascar, which is well-known as a source of emeralds; photo by M. Glas. The crystal drawing shows the faces present on this thick tabular single crystal.

{100} pinacoids. The faces listed above for the untwinned crystal were also present, but with smaller  $o$  dipyramids. The crystal showed some transparent areas from which small gems could be faceted. The  $b$  {010} pinacoids revealed a milky white area in part of the crystal that could be cut *en cabochon* to show chatoyancy. R.I.'s measured on a natural  $b$  face were 1.744–1.753. This crystal also contained inclusions of biotite-phlogopite mica platelets.

The Mananjary alexandrite samples examined by this contributor were intense bluish green in daylight with a color change to reddish or grayish purple in incandescent light (again, see figure 2). Although production figures are not known at this time, these specimens show that there is future potential for faceted and cat's-eye alexandrite from the Mananjary area. KS

Figure 2. Alexandrite from the Mananjary area shows a distinct color change, from bluish green in day or fluorescent light (left) to reddish or grayish purple in incandescent light (right), as seen in this 70.74 ct specimen. The crystal is twinned by reflection across the prism {031} and reveals the striations characteristic of chrysoberyl on the  $a$  and  $a'$  {100} faces of the twin. Photo by Maha Tannous; color corrected to show appearance in fluorescent light. The crystal drawing indicates the faces present on this thick columnar twin; the location of the twin boundary is shown by arrows.





Figure 3. Gem-quality color-change apatite was recently produced from a pegmatite in Kazakhstan. The 3.5-cm-long crystal and 2.37 ct faceted stone shown here are pinkish orange in incandescent light (left) and greenish yellow in fluorescent light (right). Photos by Jaroslav Hyrsl.

**Color-change apatite from Kazakhstan.** Apatite is a fairly common gem material, known from many localities in a variety of colors. Until now, however, color-change apatite has been documented only in synthetic form; it changes from purple-pink in incandescent light to violetish blue in fluorescent light (see Spring 2001 Lab Notes, p. 57). The Akzhailyau (or Akdzhala) pegmatite in eastern Kazakhstan recently produced gem-quality apatite that shows a distinct color change. The well-formed crystals range up to about 5 cm in length, and are dominated by faces of the hexagonal prism and basal pinacoid. They are typically recovered as loose single crystals, but a few specimens have been mined with the apatite attached to a feldspar matrix or intergrown with dark smoky quartz crystals. Many crystals have large clean areas that are suitable for faceting gemstones over 10 ct. However, little of the material has been faceted, as the well-formed crystals are valuable as mineral specimens.

For this study, two crystals and 10 cut stones up to 2.37 ct were examined. In incandescent light, the crystals

appeared pinkish orange and the cut stones were very pale pinkish orange to almost colorless. It was interesting to note two different color appearances in day and fluorescent light. In daylight, both crystals and cut stones were light brown, but in the fluorescent light used for diamond grading, both appeared greenish yellow (figure 3). Although uncommon, hue changes have been documented previously between daylight and daylight-equivalent fluorescent light in other gem materials (Y. Liu et al., "A colorimetric study of the alexandrite effect in gemstones," *Journal of Gemmology*, Vol. 26, No. 6, 1999, pp. 371–385).

The refractive indices of all samples were 1.631–1.634, with an unusually low birefringence of 0.003. The samples were uniaxial negative, and specific gravity values of 3.23–3.26 were obtained by the hydrostatic method. The apatite fluoresced pink to both long- and short-wave UV radiation, with stronger fluorescence to short-wave UV. Pleochroism was very weak (i.e., almost undetectable). When examined with a microscope, some stones revealed

Figure 4. The San Pedro mine in the Chivor region of Colombia is being worked by mechanized methods in an open cut. Photo courtesy of Kirk Bandy.



abundant two- and three-phase inclusions with an anisotropic solid phase. Tiny unidentified red crystals also were observed in some stones. The absorption spectrum seen with a hand spectroscope was a typical "didymium" type, identical to yellow apatite from Durango, Mexico (see, e.g., R. Webster, *Gems*, 5th ed., revised by P. G. Read, Butterworth-Heinemann, Oxford, 1994, pp. 315–316). However, the spectral lines seen in the Kazakhstan apatite were much sharper than those in a Mexican sample of the same thickness. This indicates that the apatite from Kazakhstan has a much higher concentration of rare-earth elements (REEs). This composition is consistent with the material's color-change behavior, which is also seen in other REE-containing minerals such as remondite and monazite.

A recent description of the Akzhailyau apatite indicated that the pink color fades on exposure to sunlight (see T. Moore, "Tucson show 2002," *Mineralogical Record*, Vol. 33, No. 3, p. 274). The color stability of the 12 samples examined was not tested by this contributor.

Jaroslav Hyrsl (hyrsl@kuryr.cz)  
Kolin, Czech Republic

#### **New emerald find from the Chivor region, Colombia.**

Recently, Colombian Emeralds Direct of Wichita, Kansas, provided this contributor with six pieces of gem-quality emerald ranging from 1.5 to 30 ct, and two faceted emeralds weighing 1.02 and 3.81 ct, from a reactivated mine in the Chivor region (figure 4). The deposit is being worked by Sociedad Minera San Pedro in an open pit and associated tunnels. From material personally examined and photos of rough taken at the mine site (e.g., figure 5), this contributor estimates that approximately 3,000 carats of rough has been mined since May 2002.

The gemological properties of the two faceted stones (see figure 6) were consistent with those for Colombian emeralds: R.I.—1.570 or 1.571 to 1.577, S.G.—2.65 and 2.70, and inert or very weak red fluorescence to long-wave UV radiation (as determined by the GIA Gem Trade Laboratory). The inclusions were also typical of those found in emeralds from Colombia. Observations by this contributor showed that both stones contained growth tubes and multi-phase inclusions that were not well defined, as well as colorless subhedral crystals (probably albite). The larger faceted gem also showed a roiled effect. The rough contained the same inclusions as the cut stones, with the addition of euhedral pyrite crystals on the surface and within several of the pieces. Two of the crystals had small areas with white calcite matrix on the surface, also typical for Colombian emeralds.

This contributor has seen about 200 carats of faceted gems, mostly in the lighter, more commercial color range similar to the 1.02 ct stone shown in figure 6; the 3.81 ct stone in that figure shows the saturated green color representative of the best-quality material from the mine. Most of the emeralds had relatively few fractures and therefore do not need clarity enhancement.

Rudy Wobito, of Wobito Gems in Ontario, Canada,



Figure 5. Weighing approximately 2,000 carats, this parcel contains some of the better-quality emeralds that were recently mined from the Chivor region. Photo courtesy of Kirk Bandy.

has faceted a number of stones from this new material with good results. He reports that he recently cut a parcel of rough weighing 185.80 carats that resulted in 13 gems with a finished total weight of 44.58 carats. Included were an 11.34 ct medium green gem from a 50 ct piece of rough and a 9.07 ct finished gem from a 30 ct piece of rough. The range of color and good clarity of these emeralds should contribute to several different levels of the market.

Edward Boehm (joebgem@aol.com)  
JOEB Enterprises  
Solana Beach, California

Figure 6. These emeralds are representative of recent production from a reactivated mine in the Chivor region of Colombia. The saturated green 3.81 ct stone was examined by the GIA Gem Trade Laboratory and found to contain no evidence of clarity enhancement. The lighter green 1.02 ct sample shows the typical color of most of the faceted material obtained from the recent production. Photo by Maha Tannous.



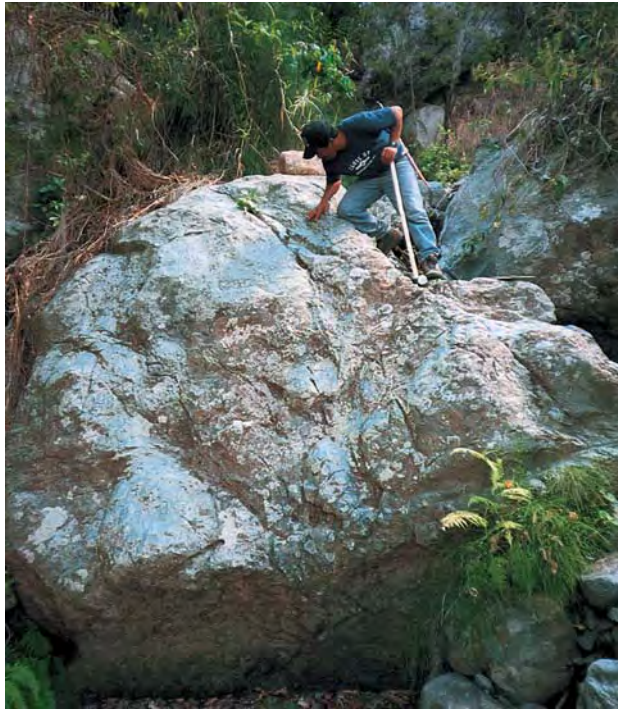


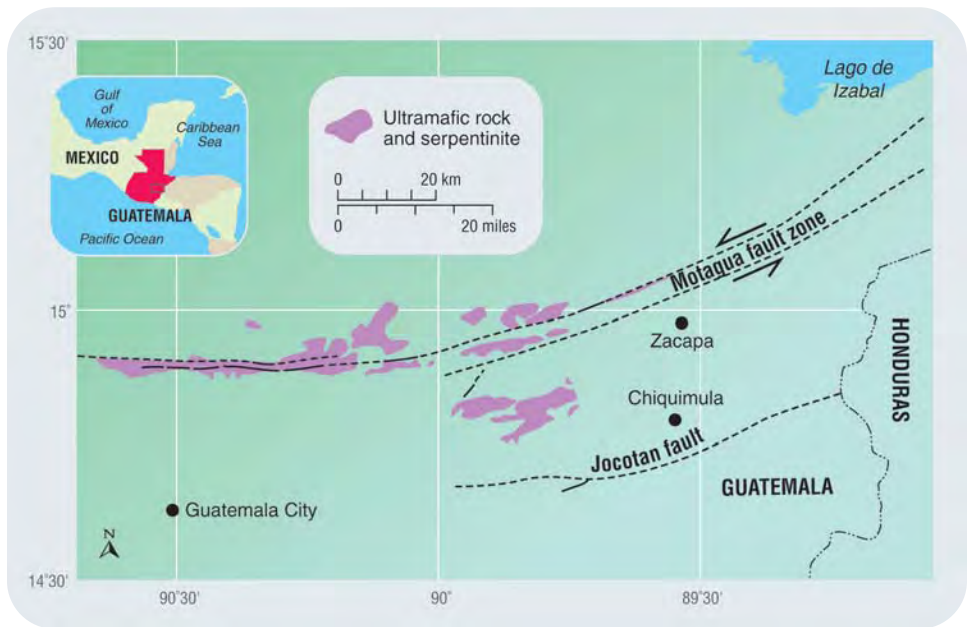
Figure 7. This large boulder of Guatemalan jadeite, estimated to weigh 340 tons, marks the discovery site of the “Olmec Imperial” material. The boulder contains 2–5 cm wide veins of green Olmec Imperial jadeite in a matrix of dark green, almost opaque jadeite. Smaller boulders containing the “New Blue” jadeite lie along the same creek. In total, the boulders are estimated to contain about 3,000 tons of jadeite. Photo by John Cleary.



Figure 8. This boulder of New Blue jadeite is cross-cut by a vein of bluish green Olmec Imperial jadeite. Photo by John Cleary.

**Important discovery of jadeite in Guatemala.** Guatemala has been the focus of significant media attention since the recent announcement of a “jade lode as big as Rhode Island” (see W. J. Broad, “Found in the Guatemalan wilds...,” *New York Times*, May 22, 2002, pp. A1, A10). This discovery is particularly significant because one of the new areas contains several large boulders of jadeite with narrow bands of bluish green and greenish blue that are jewelry quality (figures 7 and 8). Local jade hunters discovered the boulders in the mid-1990s, in rugged terrain about 40 km west of Chiquimula (figure 9). The significance of the discovery was recognized more recently, following the exposure of new jadeite outcrops and alluvial boulders by torrential rains that accompanied Hurricane Mitch in October 1998.

Figure 9. Guatemalan jadeite deposits are hosted by serpentinites located within and adjacent to the Motagua fault zone. The Motagua river valley follows the trace of the fault zone.



These contributors have been involved in field exploration for Guatemalan jadeite with Ventana Mining Co. since January 2001. The discovery area reported by the *New York Times* lies in the Motagua river valley about 80 km northeast of Guatemala City (figure 9). All of the jade deposits known in Guatemala are found within or near the Motagua fault zone (MFZ), an east-west-trending boundary between the North American and Caribbean tectonic plates; this area is active today as a zone of left-lateral faults. Along and adjacent to this zone, numerous sheared serpentinite bodies are present in an area 10–40 km wide and 100 km long (again, see figure 9). Jadeite occurs within the serpentinites as veins, lenses, and pods a few meters wide and up to tens, or even hundreds, of meters long. These primary jadeite bodies are the sources of the alluvial boulders found throughout the region. The jadeite is thought to have crystallized directly from a hydrous fluid at pressures of 5–12 kbar and temperatures of 200°–450°C (V. B. Sisson et al., "Jadeite and eclogite occurrences along the Motagua Suture Zone, Guatemala," *Programme with Abstracts*, 18th General Meeting of the International Mineralogical Association, Edinburgh, Scotland, September 1–6, 2002, pp. 221–222).

The recent finds of bluish green jadeite are similar to the type associated with royalty in the Olmec culture. As such, these contributors describe this new material as "Olmec Imperial" jadeite (figure 10). It has also been called the local term in Spanish for "green vein" in the field. From an examination of 12 polished samples, we noted that this material shows a significantly darker tone in reflected light compared to its appearance in transmitted light, and was translucent up to a thickness of 5 mm. Spot R.I. values were 1.65 to 1.68 and the S.G. (determined hydrostatically) ranged from 3.27 to 3.34.

A different material (see figure 11), termed "New Blue" jadeite by these contributors has been found for the first time in the field. This bluish green to greenish blue jadeite is called various names by local prospectors, including the terms in Spanish for "celestial blue" and "window blue." This material is entirely different from the "Olmec Blue" jade (a green jadeite, typically of low saturation) previously described in the gemological and archaeological literature (see, e.g., R. Seitz et al., "'Olmec Blue' and formative jade sources: New discoveries in Guatemala," *Antiquity*, Vol. 75, 2001, pp. 687–688).

Dr. Robert Coleman of Stanford University has confirmed from petrographic and geochemical analysis that the New Blue material is 95% jadeite with small amounts of phengite mica, sphene, albite, and zircon (pers. comm., 2002). This is consistent with our examination of five polished samples, which yielded S.G. values from 3.32 to 3.34 and R.I.'s of 1.66 to 1.68. The material was translucent up to a thickness of 12 mm. The samples were dark bluish green in reflected light, and medium-light bluish green to greenish blue in transmitted light. The blue color compo-



Figure 10. Olmec Imperial jadeite (here, 1.89–5.51 ct) is strongly saturated bluish green in transmitted light. Courtesy of Ventana Mining Co.; photo by Maha Tannous.

nent is due to  $\text{Fe}^{2+}$ - $\text{Ti}^{4+}$  intervalence charge transfer, whereas the green is produced through  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  absorptions (G. Harlow, pers. comm., 2002).

Recovery of both the Olmec Imperial and the New Blue jadeite by local jade hunters has historically been only from creek beds and alluvial terrace deposits downstream of the giant boulders. The local jade hunters sell most of their rough to the several jewelry manufacturers in Antigua, Guatemala. These manufacturers sell almost all of their jewelry to the local tourist trade.

John G. Cleary and  
William R. Rohtert  
(william.rohtert@ventanamin.com)  
Ventana Mining Company, Reno, Nevada

Figure 11. These cabochons (4.01–15.05 ct) show the typical bluish green to greenish blue color of the New Blue jadeite. Courtesy of Ventana Mining Co.; photo by Maha Tannous.





Figure 12. This 1.66 ct very light yellow cut-cornered, rectangular step cut purchased in Madagascar was identified as milarite. Photo by A. Cossard.



Figure 13. The milarite shown in figure 12 is filled with unusual very thin, elongate inclusions, which locally appear interrupted. Photomicrograph by Emmanuel Fritsch; magnified 7x.

**Faceted milarite with unusual inclusions.** A 1.66 ct very light yellow cut-cornered, rectangular step cut (figure 12) was purchased in Madagascar by Richard Lejeune, of Charleville-Mézière, France. The stone was assumed to be of Madagascar origin, but the seller did not know its identity, so it was brought to this contributor for identification. The R.I. was 1.53 and the S.G. was 2.53. The stone was isotropic on the refractometer, regardless of the facet selected for measurement. When examined between crossed polarizers, the stone showed a band of second-order interference colors (blue to yellow) along its length. With long-wave UV radiation, the stone fluoresced a medium, slightly chalky green, followed by weak phosphorescence in the same color for 30 seconds to one minute. With short-wave UV, it fluoresced a medium whitish green followed by long-lasting greenish phosphorescence (i.e., for about three to five minutes). It was not a thermal conductor and was not magnetic. Based on the perfect isotropy on the refractometer, the R.I., the S.G., and the interference colors between crossed polarizers, the logical conclusion would be pseudocubic apophyllite. However, the color of the stone, as well as the absence of the common iridescent cleavages

of apophyllite, made that conclusion doubtful.

A Raman spectrum was obtained using a Bruker RFS100 FT laser Raman spectrometer, with a resolution of  $4\text{ cm}^{-1}$ . The most intense peak was at about  $480\text{ cm}^{-1}$ , with weaker ones at about 1123, 538, and  $130\text{ cm}^{-1}$ , a strongly orientation-dependent feature at  $288\text{ cm}^{-1}$ , and minor peaks at 835, 383, 350, 324, and  $161\text{ cm}^{-1}$ . This spectrum closely corresponds to the milarite reference in the database of the gemology laboratory at the University of Nantes. The reference spectrum for apophyllite is completely different, with main Raman peaks at about 1060, 664, 585, 433, and  $211\text{ cm}^{-1}$ . These results were very surprising, as the few milarites measured previously by Yves Lulzac from Nantes always had two distinct R.I.'s, even if the birefringence was weak (about 0.003–0.004).

Milarite ( $\text{KCa}_2\text{AlBe}_2\text{Si}_{12}\text{O}_{30}\cdot 0.5\text{H}_2\text{O}$ ) is a hexagonal mineral belonging to the osumilite group. To confirm the identification, quantitative chemical analyses of the stone were performed with a JEOL 5800LV scanning electron microscope (SEM) equipped with a PGT (Princeton Gamma Tech) energy-dispersive IMIX-PTS detector. The chemical compo-

Figure 14. This water-worn spinel crystal from the Tunduru area in Tanzania has a very unusual dodecahedral shape. Approximately 6 mm across, it weighs 1.87 ct. Photo by H. A. Hänni.



Figure 15. Spinel typically crystallizes as simple octahedra, as shown by these two examples from Mogok, Myanmar (left) and Pelmadulla, Sri Lanka (right). Each crystal measures approximately 6 mm across; photo by H. A. Hänni.



sition was (in wt.%): 4.72 Al<sub>2</sub>O<sub>3</sub>, 71.73 SiO<sub>2</sub>, 4.89 K<sub>2</sub>O, and 11.18 CaO, for a total of 92.52 wt.% (beryllium and hydrogen cannot be detected with this system). This compares favorably with the analysis published by C. Palache ("On the presence of beryllium in milarite," *American Mineralogist*, Vol. 16, No. 10, 1931, pp. 469–470).

The most striking characteristic of this stone was its inclusions (figure 13). The stone was filled with randomly oriented, thread-like inclusions that were about 1 μm or less wide and typically 1–2 mm long. Their cross-section seemed somewhat rectangular. Under certain lighting conditions, some appeared as interrupted lines, although they were continuous. Attempts to identify these inclusions by Raman analysis gave no spectra other than milarite. Therefore, the inclusions were either too small to be identified by this method, or they were empty tubes. This contributor could not find any surface-reaching inclusions to study with the SEM, so their true nature remains a mystery. EF

**Spinel crystal with an unusual shape.** The SSEF Swiss Gemmological Institute received a parcel of rough stones from Tunduru, Tanzania, that contained a water-worn light violet crystal of dodecahedral shape (figure 14). From its shape and color, one might expect this crystal to be a color-change garnet; however, the stone showed no color change. One face had been polished to facilitate a refractive index reading, which was 1.718. Between crossed polarizing filters, the crystal showed no double refraction. Specific gravity (measured hydrostatically) was 3.56. From all these observations, we identified the mineral as spinel, which was further confirmed by Raman analysis. EDXRF spectroscopy showed Mg and Al as main constituents, with traces of Fe, Ti, Mn, Zn, and Ga.

All of these properties were consistent with spinel, except for the crystal's shape. According to mineralogy reference books (see, e.g., W. L. Roberts et al., *Encyclopedia of Minerals*, 2nd ed., 1990, Van Nostrand Reinhold, New York), crystals of spinel are usually octahedral (figure 15), but in rare cases they may form cubes or dodecahedra. If routine gemological properties are not taken, spinel crystals such as this one might easily be mistaken for garnet.

HAH

**More tourmaline from Warner Springs, California.** The Winter 2001 GNI section (pp. 338–339) reported on a remarkable discovery of large, well-formed pink tourmaline crystals from the Cryo-Genie mine in north-central San Diego County. The showpiece specimen from that find, a 25-cm-long (after repair) crystal of tourmaline on quartz, was purchased by the Los Angeles County Museum of Natural History.

A new gem pocket was discovered in August–September 2002 by mine owners Dana and Ken Gochenour, mine engineer Jim Clanin, and partner Dave Kalamas. The deposit has continued to be mined on a small-scale basis, via drilling and blasting tunnels into the



Figure 16. At 18.1 cm long, this bicolored, doubly terminated tourmaline is representative of some of the fine-quality crystals that were found in August–September 2002 at the Cryo-Genie mine near Warner Springs, California. Photo © Jeff Scovil.

pegmatite. The lower drift was extended approximately 4 m into barren pegmatite to reach an area lying down-dip of the large pocket found in October 2001. There, small cavities containing pencils of gemmy, bluish green tourmalines led the miners to two clay-rich areas that joined together into a large pocket measuring approximately 2.2 × 1.2 × 1 m. Numerous matrix specimens of translucent to transparent smoky quartz on cleavelandite feldspar were recovered from the sticky reddish brown clay. Less common, but more spectacular, were large (up to about 30 cm long), well-formed crystals of pink and bicolored pink-green tourmaline (see, e.g., figure 16). Several of the





Figure 17. These Nigerian tourmalines (3.43–9.65 ct) illustrate the color variety of some of the samples that were chemically analyzed and identified as elbaite and/or liddicoatite. Rossmanite also was found in portions of two of the stones (the 3.69 ct tricolored emerald cut in the lower center and the 7.50 ct pink/green cushion cut to the upper right). Courtesy of Pala International and Barker & Co.; photo © Harold & Erica Van Pelt.

crystals were doubly terminated, with flared pinacoidal terminations similar to those reported in the Winter 2001 GNI item. GNI editor Brendan Laurs witnessed the removal of one such tourmaline that was broken by natural forces into several pieces. The miners were careful to excavate all of the pocket contents so that the broken pieces of such crystals could be reconstructed. Portions of the largest crystal found were broken beyond repair, but gem-quality pink material in its interior is expected to yield several hundred carats of faceted stones and cabochons. In addition, 50 bluish green stones ranging up to about 1 ct have been cut. The polished goods will be sold individually and set in custom jewelry.

**Faceted rossmanite and other tourmalines from Nigeria.** Recent chemical analyses have shown the occurrence of liddicoatite in faceted stones and slices of Nigerian tourmaline that were produced in the late 1990s (see Gem News International, Summer 2001, pp. 152–153, and Fall 2001, pp. 240–241; “Liddicoatite tourmaline from Anjanabonoina, Madagascar,” D. Dirlam et al., Spring 2002, pp. 28–53; and the *G&G* Data Depository at [www.gia.edu/pdfs/table2.xls](http://www.gia.edu/pdfs/table2.xls)). Over the past several months, we have had the opportunity to analyze many additional faceted samples of tourmaline from the Ibadan area in western Nigeria.

A comprehensive color suite containing 100 stones with a total weight of 565 carats was loaned to GIA by Bill Larson (Pala International, Fallbrook, California) and Bill Barker (Barker & Co., Scottsdale, Arizona). This collection was assembled from rough that was produced during 1998–2000. Fifty of the stones that were representative of the entire color range were chosen for electron microprobe analysis at the University of New Orleans; some of these are shown in figure 17. The face-up colors ranged from pinkish orange to pink to purplish red, red-orange, pale yellow to yellowish green and dark green, bluish green, grayish blue, and near colorless. Some of these hues resulted from the combination of two different colors (e.g., pink and green) in stones that were cut so that the table was not perpendicular to the color boundary. Seven distinctly bicolored or tricolored stones with pink to red, green, greenish

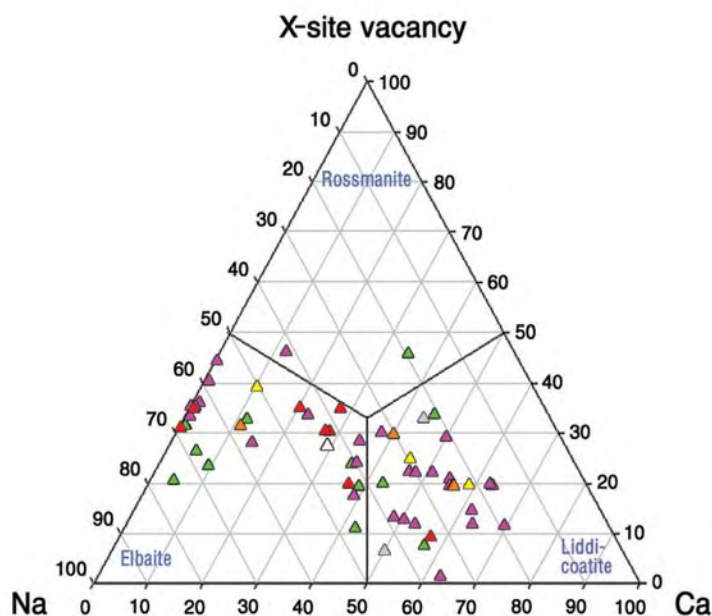


Figure 18. Electron microprobe analyses of 100 Nigerian tourmalines of various colors show that they were predominantly elbaite and liddicoatite; note also the two analyses of rossmanite. The color of each data point roughly approximates the color of the area analyzed. There is no correlation between X-site occupancy and color.

blue, bluish gray, and near-colorless zones also were analyzed. Generally, five analyses were obtained from each stone, or from each major color zone in the multicolored samples.

The data summarized in figure 18 represent averages of each stone or color zone analyzed, and show that approximately half the analyses correspond to elbaite and half to liddicoatite compositions. We were pleasantly surprised to discover that two analyses fell within the rossmanite field, making this the first time we have documented this rare tourmaline species in faceted stones. Rossmanite, named in honor of California Institute of Technology professor (and *G&G* Editorial Review Board member) George Rossman, was recognized as a new lithium-aluminum tourmaline species in 1998, and is characterized by an elemental vacancy in the X site (see Fall 1998 Gem News, p. 230). A few faceted examples of rossmanite (in colorless to pale pink) are also known from the island of Elba, Italy (F. Pezzotta, pers. comm., 2003).

As documented previously by Dirlam et al. (2002), the analyses showed no systematic correlation between color and X-site occupancy; that is, there was no correlation of color with the identification of the material as elbaite, liddicoatite, or rossmanite. The two samples containing rossmanite (again, see figure 17) were analyzed in more detail to better define the distribution of this species. Rossmanite was detected in some analyses of the green portion of a 3.69 ct tricolored (green–near colorless–pink) emerald cut, and liddicoatite was found in both the green and pink portions of this stone. The other sample containing rossmanite (in a pink area) was a 7.50 ct pink/green cushion that consisted mostly of elbaite. In both cases, the analyses fell fairly close to the border of the rossmanite field (again, see figure 18).

Some additional samples of Nigerian tourmaline from the Ibadan area—showing unusual coloration—were loaned by Mark Kaufman (Kaufman Enterprises, San Diego, California). Included were three particolored rectangular step cuts (1.39–1.70 ct) and two particolored crystals from the same parcel, as well as a bright orange 7.85 ct elongate cushion accompanied by a piece of rough of identical color (see, e.g., figure 19). Electron microprobe analysis of the orange rough showed that it was elbaite with 4.92 wt.% MnO and 0.42 wt.% TiO<sub>2</sub>; iron was below the detection limit of 0.016 wt.% FeO. All three of the particolored stones were liddicoatite, with the exception of one area with an elbaite analysis that fell very close to the liddicoatite field. Interestingly, the color zones in this tourmaline were oriented perpendicular to the c-axis, rather than being parallel to a pyramidal direction as is the case with liddicoatite from Madagascar. The colors of these five Nigerian liddicoatites also were less pronounced and showed a narrower range of hues (in colorless to pink, yellowish green, or bluish green) than their Malagasy counterparts.



Figure 19. These particolored tourmalines (1.39–1.70 ct faceted, as well as 5.82 and 10.06 ct crystals) from Nigeria show color zoning perpendicular to the c-axis. Chemical analysis of the faceted stones proved that they were liddicoatite (with the exception of one area that gave an elbaite analysis). The bright orange color of the 7.85 ct Nigerian sample in the inset is unusual for tourmaline. Chemical analysis of a rough sample of identical color showed an elbaite composition with appreciable amounts of manganese, traces of titanium, and no detectable iron. Courtesy of Mark Kaufman; photos by Maha Tannous.

**Uvite tourmaline from Afghanistan.** Beautiful gem tourmalines have been commercially available from Afghanistan for nearly three decades, typically in pink, green, and blue hues. Available chemical analyses indicate that these tourmalines are of the elbaite species (see, e.g., R. Leckebusch, “Chemical composition and colour of tourmaline from Daræ Pich (Nuristan, Afghanistan),” *Neues Jahrbuch für Mineralogie, Abhandlungen*, Vol. 13, 1978, pp. 53–70).

In July 2002, Sir-Faraz (“Faroq”) Hashmi of Intimate Gems, Jamaica, New York, sent GIA some brownish orange samples from Afghanistan that were tentatively identified as either tourmaline or bastnäsite. Included in this donation were two faceted stones (0.59 and 1.46 ct) that were cut for our research by John Bailey (Klamath Falls, Oregon), several loose crystals, and two specimens of the brownish orange crystals in a white, talc-like matrix (figure 20). Mr. Hashmi was told by Gaus-ud-din, an Afghan partner, that the material was mined from the “Wata Poore” area in Konar Province. Reportedly a few dozen kilograms of the material has been mined, although production has slowed in recent months due to the unrest in the region.

The crystals were equant and lacked the striations on their prism faces that are typically seen on tourmaline from Afghanistan and elsewhere, and the mineralogy of the matrix material indicated that it was not derived from a granitic pegmatite. Nevertheless, standard gemological

BML

William “Skip” Simmons and Alexander Falster  
University of New Orleans, Louisiana



Figure 20. These samples of brownish orange uvite tourmaline were reportedly mined from Kunar Province, Afghanistan. The equant, well-formed crystals are found in a soft, white, talc-like matrix. The two cut stones weigh 0.59 and 1.46 ct. Courtesy of *Intimate Gems*; photo by Maha Tannous.

properties obtained on the two faceted stones indicated that they were tourmaline (i.e., uniaxial negative optic character, R.I.—1.620–1.641, birefringence—0.021, and S.G.—2.99 and 3.04). Microscopic examination revealed abundant mineral inclusions of colorless to white, anhedral, birefringent particles; partially healed fractures; and “feathers.” A few dark brown (nearly black), transparent inclusions also were present. The stones were inert to long-wave UV, and showed a chalky greenish orange fluorescence of moderate intensity to short-wave UV radiation.

To better characterize these unusual tourmalines, one of the crystals was analyzed by electron microprobe at the University of New Orleans. The sample proved to be uvite, a Ca-Mg tourmaline that is uncommon in facetable quality. The six analyses revealed a rather homogeneous composition, with an appreciable dravite component (as shown by the presence of 1.35 wt.% Na<sub>2</sub>O). In addition, the analyses showed an average of 1.14 wt.% TiO<sub>2</sub>, 0.06

wt.% FeO, and 0.50 wt.% F. Polarized visible-range spectroscopy of one sample showed that the brownish orange color is due to a combination of Fe<sup>2+</sup>-Ti<sup>4+</sup> intervalence charge transfer and Fe<sup>2+</sup> (G. Rossman, pers. comm., 2003).

BML

William “Skip” Simmons and Alexander Falster  
University of New Orleans, Louisiana

## SYNTHETICS AND SIMULANTS

**An assembled agate “nodule.”** This contributor was recently shown an unusual agate that was reportedly purchased in 2002 at an agate mine near Lhasa, Tibet (figure 21). After the owner returned to the U.S., he noticed that the agate slab had separated from its matrix, revealing its assembled nature.

The thin slab of translucent agate was backed with pink tissue paper and attached to a piece of granitic rock (probably rhyolite). A clay “bezel” had been built up around the slice. The slice was apparently polished after it was assembled, since there were traces of what appeared to be chrome oxide in the porous areas of the agate and the matrix. The green color of this polishing residue resembled that shown by celadonite, a clay-like mineral that commonly forms in association with agate nodules.

This contributor has been involved with research on agates for about 40 years (see <http://csd.unl.edu/csd/programs/agateres.html>), and has never seen such a specimen before. Considering the poor quality of the agate slice, it is surprising that someone would take so much time to forge the specimen. This does point out, however, that buyers should exercise caution even when purchasing the most inexpensive stones. It is conceivable that forgers might assemble such stones from slices of finer agates such as those from northern Mexico, which can command high prices.

Roger K. Pabian ([rpabian1@unl.edu](mailto:rpabian1@unl.edu))  
University of Nebraska, Lincoln

**A glowing manufactured gem.** At the 2002 Tucson gem show, this contributor encountered a unique new manufactured material that was represented as “Nightglow Stone.”

Figure 21. The sliced agate “nodule” on the left (10–12 cm in diameter) was recently purchased at a mine in Tibet.

On the right, the assembled nature of the specimen is revealed. A thin slice (5 mm) of agate was backed by pink tissue paper, and embedded in a layer of clay adjacent to the rock matrix. Photos by Roger K. Pabian.



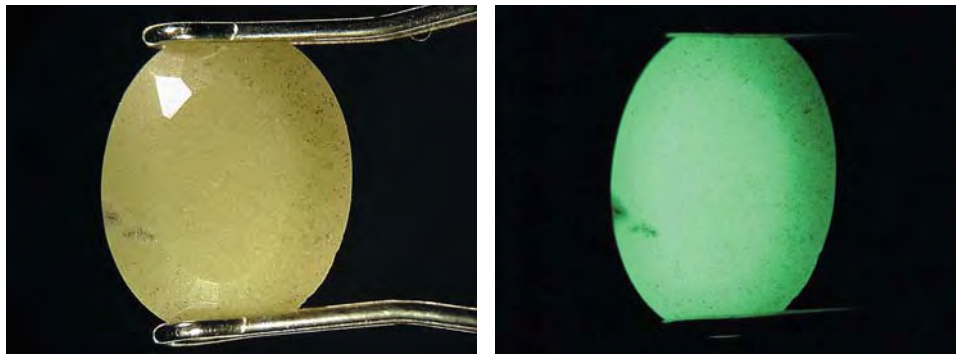


Figure 22. Marketed as “Nightglow Stone,” this new greenish yellow manufactured gem (left, 1.40 ct) displays particularly strong, long-lasting phosphorescence (right). Photos by T. Hainschwang.

The faceted samples had a greenish yellow body color and were translucent with a rather low luster. Some contained small black inclusions. Their most distinctive feature was a persistent, very strong green phosphorescence that occurred even after brief exposure to light (figure 22). According to the dealer, the material was produced by a company in China. These characteristics are consistent with the “Qinglong Luminescent Gem” reported by N. Shi and Q. Hao (“A new material for artificial stone . . .,” *China Gems*, Vol. 10, No. 3, 2001, p. 24). The dealer indicated that the chemical composition was  $\text{SrAl}_2\text{O}_4$  plus boron, dysprosium (Dy), and europium (Eu) oxides.

This contributor purchased two faceted samples and borrowed two additional ones for examination. The 1.40–2.15 ct samples contained various amounts of black impurities. For safety reasons, they were checked for radioactivity with a Geiger counter; none was radioactive. Then, phosphorescence was checked by exposing one of the samples to a strong fiber-optic light for 10 minutes and placing it in a dark safe. Amazingly, it still showed a weak green glow after 14 hours in darkness.

Standard gemological examination and hardness testing using hardness points (on three samples) gave the following properties: R.I. (average)—1.655, optic character—*isotropic*, S.G.—3.46–3.55, and hardness—5.5–6. When exposed to both long- and short-wave UV radiation, the material exhibited a strong yellowish green fluorescence, and a strong and persistent green phosphorescence.

Microscopic observation revealed that the material was granular and inhomogeneous. High magnification (up to approximately 800 $\times$ ) was used to resolve the individual grains in reflected light (figure 23). The microstructure suggested that the material was not grown by conventional methods, but was produced by sintering; this process was also mentioned by Shi and Hao (2001). In sintering, a granular or powdered substance is solidified through the application of heat and pressure.

Visible–near infrared spectra were recorded for three of the four samples in a range of 400–1000 nm. Several absorption peaks between 750 and 915 nm were present. The position and appearance of these absorptions indicated that they were caused by rare-earth elements. The phosphorescence spectrum of one sample showed a broad emission band with its maximum intensity at 524 nm.

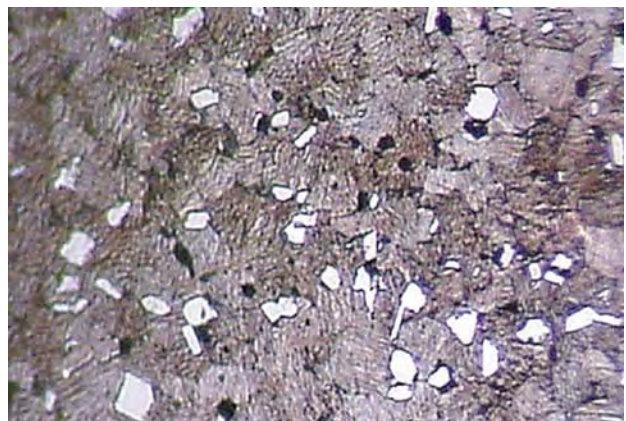
Photoluminescence spectroscopy of two samples was

performed using a Raman spectrometer equipped with a 532 nm laser. Several peaks between 650 and 735 nm were present, with a dominant peak at 693.5 nm. These peaks are similar to those shown by corundum, which are due to traces of Cr. Thus, rather low concentrations of Cr appear to be present in this manufactured material.

FTIR spectra of three samples were recorded in the range of 7800–350  $\text{cm}^{-1}$ . Weak OH-related peaks were detected at about 6200  $\text{cm}^{-1}$  and between 3500 and 2100  $\text{cm}^{-1}$ , similar to the features seen in some glasses due to hydration. However, reflectance FTIR spectra of two samples revealed several sharp peaks between 1000 and 350  $\text{cm}^{-1}$  (figure 24), which are indicative of an aggregate-like crystalline structure rather than a glass.

Semi-quantitative chemical analysis of one sample was then performed using a Zeiss SEM-EDX system. The imaging capabilities of the scanning electron microscope revealed the individual grains and the presence of several different phases (figure 25). In addition, in backscattered electron (BSE) images such as this, the quantity of electrons backscattered from a given surface is proportional to the mean atomic number of the material. Thus, the light-colored areas in figure 25 contain the heaviest elements, while those of darker color have the lightest atomic weight. Six point analyses (2

Figure 23. At high magnification (here, 200 $\times$ ), the individual grains constituting the luminescent material become visible. Photo by T. Hainschwang; reflected light.



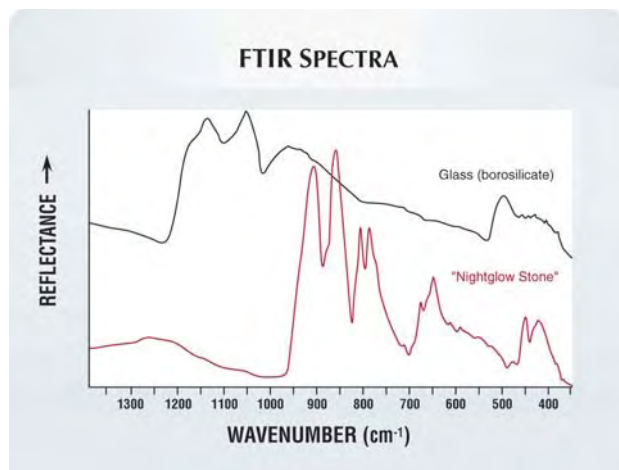
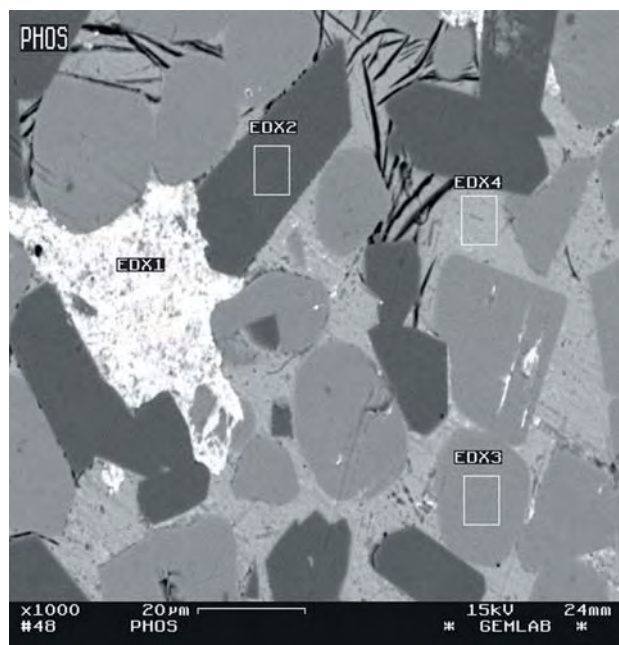


Figure 24. The reflectance FTIR spectra show obvious differences between glass and the phosphorescent material. The sharp peaks are indicative of an aggregate-like crystalline structure, rather than a glass.

μm diameter) were performed to investigate all of the apparent phases present. All of the elements in the composition stated by the dealer were verified except boron, which cannot be analyzed by this instrument. Analysis of the light

Figure 25. This BSE-SEM image (1,000×) of the phosphorescent material reveals the presence of several phases, as light and dark areas corresponding to over-all atomic weight. Light tones correspond to heavy elements, and dark tones indicate light elements. Specific areas that were chemically analyzed are labeled (see text).



areas (e.g., EDX 1 in figure 25) revealed Pb, Cr, and Sb. The black impurities (as seen in standard viewing conditions) had unusually high contents of Eu and Dy, and appear to be unmelted or exsolved additives of the rare-earth dopant. Some grains (mottled light and dark gray in the BSE-SEM images) had a high content of Zn; the origin and role of this impurity is unclear.

The majority of grains analyzed (e.g., EDX 2, 3, and 4 in figure 25) showed only Sr and Al in various proportions, representing around 90% of the ingredients detected. The color of these grains in the SEM images directly relate to the ratio of Sr to Al: the lighter the tone, the higher the Sr content.

The Nightglow Stone appears to be produced by a sintering process with a ceramic phosphor (doped with rare earths) as the main ingredient. This contributor has learned that a crystalline powder of  $\text{SrAl}_2\text{O}_4$  (strontium aluminate) doped with  $\text{Eu}^{2+}$  and  $\text{Dy}^{3+}$  has been produced (mainly in China and Japan) by the floating-zone technique. This so-called ceramic phosphor is greenish yellow, nontransparent, and exhibits a very long lasting green phosphorescence, so it appears likely that it forms the main ingredient in these manufactured gems. The addition of boron (a fluxing agent) may help transform the non-transparent powder into a translucent glassy substance during the heating process. The role of Cr, Pb, and Sb is unclear, but they may represent impurities in the ceramic or part of a flux involved in the production process.

Thomas Hainschwang (gemlab@adon.li)  
Gemlab Gemological Laboratory  
Vaduz, Principality of Liechtenstein

**“Rainbow Calsilica.”** At the June 2002 mineral show in Saint Marie aux Mines in France, we saw a beautifully colored necklace consisting of polished pieces of a fine-grained, banded opaque material called “Rainbow Calsilica.” We purchased two samples of similar material for examination, 46.11 and 36.14 ct (figure 26). The dealer claimed that the material came from the U.S. and had been around for several years. He supplied a photo of the “mine” showing a thin, near-vertical vein of colored material, as well as a letter of authenticity from a private laboratory based in Arizona. This letter stated that the Rainbow Calsilica was composed of microcrystalline calcite, with the amorphous clay mineral allophane as the binding material; the pigmentation was associated with the allophane. The U.S. distributor of this material told these contributors that it was believed to have come from Chihuahua, Mexico. The color was reportedly the result of a “copper push” that cross-cuts rhyolite.

Macroscopically, the material showed irregular bands of blue, green, light yellowish green, yellow, orangy yellow, white, black, and reddish brown, and somewhat resembled the brightly colored sands found in bottles in curio shops. The width of the bands ranged from 0.1 to 2.7 mm, with variations not only between the bands, but also

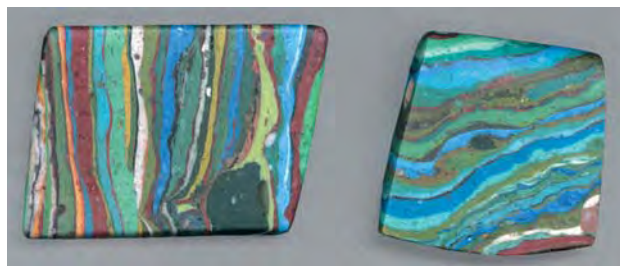


Figure 26. These two pieces of “Rainbow Calsilica” weigh 46.11 and 36.14 ct. The larger sample is 35.6 mm long. Photo by Lore Kiefert.

within a given band. In places, rounded “droplets” with the same granular texture as the surrounding bands, but of a different color, were present.

The S.G. values of the samples (measured hydrostatically) were 1.88 and 1.92. The fluorescence depended on the intensity of the color. When exposed to long-wave UV radiation, white bands fluoresced white, light green and light blue bands fluoresced a weaker white, and brown and black bands were inert. A similar, but weaker, result was observed with short-wave UV.

With the gemological microscope, we were able to distinguish broken, irregularly shaped, and sometimes rhombic white grains in all of the colored bands. Also present were grains of various colors (figure 27), the quantities and proportions of which corresponded to the overall color and intensity of each layer. Blue bands contained dark blue grains and, in some cases, thin layers of concentrated color (figure 28), along with white grains and a colorless bonding material. The green bands contained yellow as well as blue pigments. Occasionally, we observed a transparent band of a soft plastic-like material, sometimes with bubbles, between the colored bands and in irregular patches (again, see figure 28). Bands and other areas that appeared black to the unaided eye were dark grayish green with 50× magnification, and showed a multitude of different-colored grains, transparent plastic-like areas, and pigments.

EDXRF analyses with a Tracor Spectrace 5000 energy-dispersive X-ray fluorescence spectrometer showed that Ca was the major constituent (approximately 80%–90%) in two randomly chosen bands, as well as in representative layers of various colors (i.e., blue, green, reddish brown, and black). Minor constituents were Si, Ba, and Fe (similar values in all samples). In addition, there was approximately 1%–2% Sr in the blue, brown, and green bands. A black band contained over 13% Sr. Traces of Mg, Al, P, S, Cl, Mn, Cu, Zn, and As were detected in various amounts, with no obvious correlation to color.

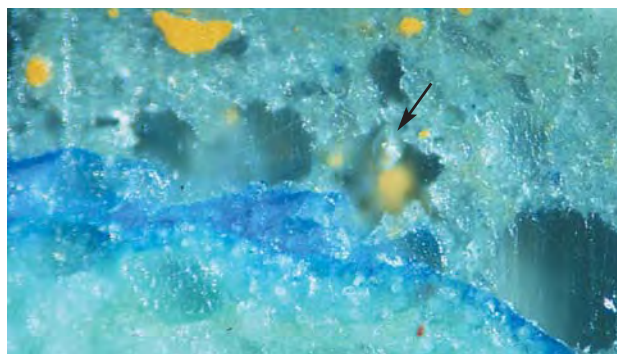
Analysis with a Renishaw Raman System 1000 microspectrometer showed that the white grains were calcite. This mineral was also a major constituent of the fine-grained groundmass. Analysis of two red layers showed the presence of hematite, which was consistent with the color of these bands. Celestine ( $\text{SrSO}_4$ ) was identified in the black areas, and is likely the cause of the high Sr content mea-



Figure 27. White grains of various sizes are present in all of the color layers of the Rainbow Calsilica, together with smaller grains of blue, green, yellow, and other colors. Photomicrograph by Lore Kiefert; magnified 50×.

sured with EDXRF. Raman analysis of concentrated blue areas within blue layers gave the strongest peaks above  $1300\text{ cm}^{-1}$  (figure 29, left), which suggests that this material is organic. When this Raman spectrum was compared to those of 20th century blue artists’ pigments, the material was identified as a copper phthalocyanine pigment called PB15 (again, see figure 29), a synthetic pigment that was developed in the 1930s. Similarly, the light greenish yellow

Figure 28. A thin layer of concentrated blue color is visible in this view of the Rainbow Calsilica, as are areas of yellow pigment and a clear plastic-like material; the arrow points to a bubble. Photomicrograph by Lore Kiefert; magnified 100×.



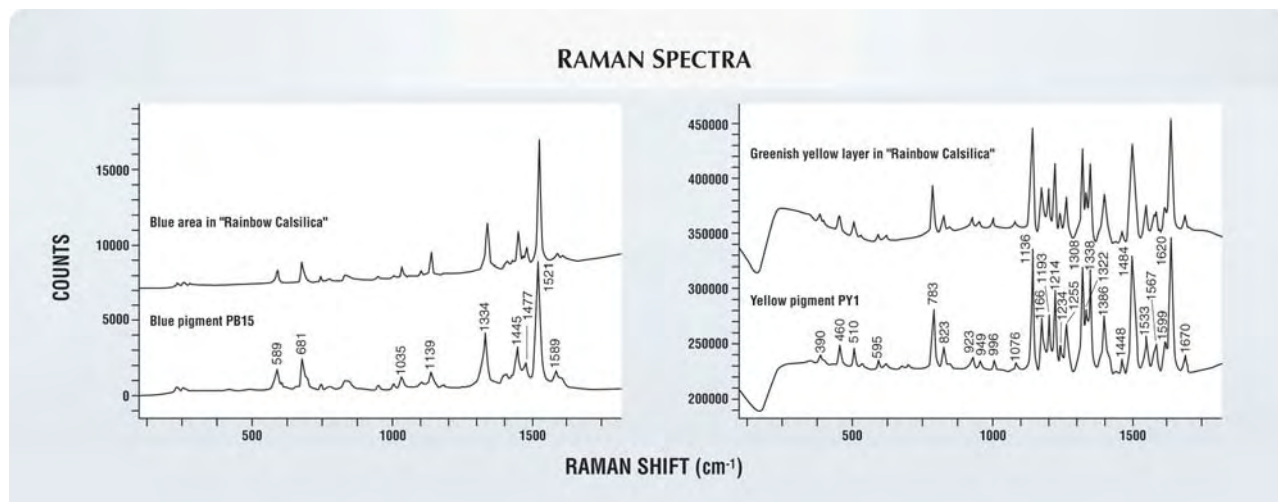


Figure 29. The Raman spectrum of the blue pigment in Rainbow Calsilica is identical to that of the blue copper phthalocyanine pigment PB15 (left), and the spectrum of the yellow pigment matches that of the yellow mono-azo pigment PY1 (Hansa Yellow; right).

areas contained the yellow mono-azo pigment PY1 (or Hansa Yellow; see figure 29, right). The other colored bands contained one or both of these pigments to produce the corresponding color. For more on the Raman spectral characteristics of artists' pigments, see P. Vandenabeele et al., "Raman spectroscopy of azo-pigments used in art," *Journal of Raman Spectroscopy*, Vol. 31, 2000, pp. 509–517.

Infrared spectra of the colorless areas and layers were taken with a Phillips PU9800 FTIR spectrometer. The spectra revealed features similar to paraffin wax, together with some additional, unidentified absorption bands. Raman analysis also showed peaks that are consistent with paraffin, with the major bands at 2928 and 2868  $\text{cm}^{-1}$ . Additional peaks were observed at 1444, 1462, and 1732  $\text{cm}^{-1}$  (paraffin), as well as at 1279, 1306, and 1352  $\text{cm}^{-1}$  (due to unknown phases). Despite the spectral similarities to paraffin, the material was more elastic and it appears that the substance is an aliphatic polymer or a paraffin derivative mixed with other compounds unknown to us.

Our examination of the two Rainbow Calsilica samples proves that this is a manufactured material. Specifically, the presence of synthetic pigments and of a paraffin-like substance precludes a natural origin. The latter substance has apparently been used to stabilize the material; samples that lack this polymer reportedly separate easily along some of the color layers (S. F. McClure, pers. comm., 2002). Our samples appear to have been made of pulverized carbonate rock that was mixed with pigments and stabilized with a polymer.

Lore Kiefert (*gemlab@sssf.ch*)  
 SSEF Swiss Gemmological Institute, Basel  
 Peter Vandenabeele, Ghent University  
 Ghent, Belgium  
 Jörg Hänni, Basel

Note: PV is grateful to the Flanders (FWO-Vlaanderen) fund for supporting his postdoctoral fellowship on Raman spectroscopy.

## TREATMENTS

**Heat treatment experiments on faceted amber.** Since the 1990s, several reports have described the effect of heat on the properties of amber (see, e.g., Summer 1993 Lab Notes, pp. 122–123; P. Hutchins and G. Browne, "New amber treatment," *Australian Gemmologist*, Vol. 19, No. 7, 1996, p. 302; and the Lab Notes entry on pp. 341–342 of this issue). These studies have documented a darkening of color with corresponding increases in R.I. values due to heat treatment, as well as orange fluorescence to long-wave UV radiation and tiny gas bubbles just below the surface. Additional studies were recently performed by this contributor on samples of faceted amber, so that detailed R.I. measurements could be obtained.

The six samples of faceted Baltic amber ranged from 3.2 to 13.8 ct. All were the same pale yellow color before the heating experiments, and infrared spectroscopy confirmed that they were amber. One of the stones was retained for reference, and the other five were heated for up to 48 hours at temperatures up to 200°C in a nitrogen atmosphere.

With increasing duration and temperature of heating, the color of the samples changed from pale yellow to orange to dark brown (see figure 30 and table 1).

A systematic increase in R.I. was measured in the darker colors, and some of the readings showed anomalous optical behavior. The untreated sample showed an R.I. value of 1.54, which is typical for amber. The highest R.I. value, at 1.62, was recorded for the darkest sample. Sample 2 showed double lines, and sample 4 showed more than 10 lines in the refractometer between 1.54 and 1.59 (figure 31). Samples 3 and 4 yielded multiple R.I.'s, but only when the stones were rotated; the R.I. variations appeared to correlate to unevenness of color. If only the polarizer was rotated, the R.I. of those samples remained constant, as expected for a singly refractive material.

To investigate the extent of the color penetration, sam-

ples 4 and 6 were cut in half. In both cases, a thin layer (i.e., less than 1 mm) of brown color was present near the surface; this layer was much darker in sample 6. Below this layer, each stone showed the original pale yellow color. The core of each sample yielded the expected R.I. value of 1.54.

In this contributor's experience, many of the so-called sun-spangled ambers, as well as ambers with an orange hue that have become increasingly popular in the market, have R.I. values ranging up to 1.555. This is consistent with the use of a heating process.

It is reasonable to infer that the organic structure of amber is modified by heat treatment. However, the exact mechanism by which the color, R.I., and other properties are changed still requires further research.

*Morley Sheng-Hong Chang*  
(perfectgem2000@pchome.com.tw)  
Perfect Jewelry Co., Taichung, Taiwan

**An update on Be-diffused corundum.** Over the past year, GIA has published several items on the gemological properties and chemical composition of the yellow to orange to orangy pink and orangy red corundum (figure 32) that is being produced in Thailand by treating sapphires from different localities (see Spring 2002 Gem News International, pp. 86–90; Fall 2002 Lab Notes, pp. 254–255 and pp. 255–256; and the *GIA Insider* [www.gia.edu/wd\_349.htm] on January 28, February 15, May 3, and November 1, 2002). The elevated beryllium concentration and its close relationship to the depth of color penetration in these sapphires demonstrated that diffusion of Be into the crystal lattice of

**TABLE 1.** Properties of unheated and heat-treated amber.<sup>a</sup>

Sample no.	Color	Long-wave UV fluorescence	R.I.	Comments
1	Pale yellow	Dull greenish yellow	1.54	Unheated reference sample
2	Pale orangy yellow	Yellowish orange	1.54–1.55	Double lines in the refractometer
3	Yellow-orange	Orange	1.54–1.56	Range in R.I. values obtained only when sample was rotated
4	Orange	Bright orange	1.54–1.59	More than 10 lines seen in the refractometer within this range; range in R.I. values obtained only when sample was rotated
5	Brownish orange	Brownish orange	1.60	Abundant tiny gas bubbles present just below the surface
6	Dark brown	Dark orange	1.62	Abundant tiny gas bubbles present just below the surface

<sup>a</sup> Note that specific gravity ranged from 1.07 to 1.09, with no systematic variation according to color. Samples were heated in a nitrogen atmosphere.



Figure 30. With increasing temperature and heating time, the color of these amber samples (left to right, samples 1 to 6 in table 1) changed from yellow to orange to dark brown. The reference sample on the far left has not been heat treated. Samples 4 and 6 were cut in half for testing purposes. The samples range from 3.2 to 13.8 ct. Photo by Morley Chang.

the sapphire could be the main cause of the color change. As part of our ongoing research into this treatment, GIA has had additional chemical analyses performed. These new data have not only supplemented the information we had on this treatment, but they also have led us to reevaluate some of the earlier analyses.

Due to insufficient calibration standards, a large uncertainty was associated with the previously published concentrations of Fe and Be obtained through SIMS analysis (see www.gia.edu/pdfs/table2.pdf and Spring 2002 Gem News International, pp. 86–90). As we indicated at that time, the uncertainty of the Be concentration, for example, could be as high as ±200%. This was because the SIMS facility that provided the analyses did not have established corundum standards for these elements. In our efforts to improve the accuracy of analysis, we worked with the facility to create new corundum standards for Fe and Be by means of ion implantation. Using the new standards, we

Figure 31. More than 10 lines were visible in the refractometer between 1.54 and 1.59 for heat-treated amber sample 4. Photo by Morley Chang.







Figure 32. These sapphires were treated by Be diffusion. Shown are a yellow (sample 45035, 1.22 ct) and an orangy red sapphire (sample 45033, 1.54 ct pear shape) that were treated in Thailand, as well as an orange sapphire (sample 48717, 0.86 ct) and ruby (sample 48878, 2.78 ct) that were treated by an unknown source. See table 2 for the chemical analyses of these samples. Photo by Elizabeth Schrader.

recalculated the concentration of Fe and Be in the previous analyses. We also reanalyzed several of the samples we had tested earlier (see table 2). Note that, in a few samples, Ti concentrations are not available because of technical problems with the original analyses. Also, Si concentrations were measured in some of our most recent analyses only.

The recalculated SIMS data indicate that although the concentrations of Fe and Be have changed, the relative relationships between the values remain the same; that is, in those sapphires that show clear color zonation from rim to center, the abundance of Be in the rim is still approximately 10 times greater than in the center. An analysis of the original (not repolished) surface of treated orange sapphire no. 48413 revealed that the Be concentration was as high as 99 parts per million (ppm). In some samples, Be had diffused through the entire crystal, so no color zoning was observed. We also conducted additional before-and-after experiments (samples 45493–45494) for which, as done previously for samples 45002 and 45031, we had an untreated natural pink sapphire from Madagascar sawn in half, and then had one half treated in Thailand using the same method as for the other treated sapphires. In both sets of samples, the treated halves showed a greater Be concentration than the untreated halves. Compared to the other elements analyzed, the Be concentrations showed the largest and most consistent changes caused by the treatment. The much smaller variations in the other elements could be due to chemical heterogeneity within the samples on a micrometer scale, the high-temperature diffusion process itself, and/or surface contamination introduced in the sample preparation for analysis.

Recent experiments have demonstrated that diffusion of about 10 ppm Be could create strong coloration in very pure originally colorless synthetic corundum (J. L. Emmett, pers. comm., 2002). We have also seen that the lattice diffusion of Be may not necessarily lead to color change in all natural sapphires. For example, a significant concentration of Be (11 ppm) was detected at the rim of one pink sapphire (sample 45082) that showed no apparent change in color after the treatment. In addition, as reported earlier, high concentrations of Be (recalculated to 73–113 ppm) were detected in a crucible we obtained in Thailand that had been used for the treatment.

The Be concentrations in natural, untreated corundum samples that we have analyzed were typically below 1.0 ppm. In most cases, diffusion of trace amounts of Be into the lattice of a corundum sample at high temperature significantly changed its color appearance. To date, we have seen end products that are yellow, orange, orangy red, or even red, depending on the properties of the original corundum and the conditions of the treatment.

On the basis of all these data and observations, we believe that our previously published findings and conclusions about the importance of Be diffusion in this new sapphire treatment process continue to be valid.

Wuyi Wang (wuyi.wang@gia.edu) and Barak Green  
GIA Gem Trade Laboratory, New York and Carlsbad

**Orange topaz with synthetic hematite coating.** Recently, the SSEF Swiss Gemmological Institute received for testing two bright orange stones that were represented as topaz. A 6.97 ct stone was donated by Peter Groenenboom of the Amsterdams Edelsteen Laboratorium in Arnhem (Netherlands), and a 2.95 ct topaz (figure 33) was submitted by another client; both parties reported that such stones have been offered recently in Nigeria. The following gemological properties, obtained on both stones, confirmed that they were topaz: biaxial, R.I.—1.610–1.619, birefringence—0.009, S.G.—3.53, and inert to long- and short-wave UV radiation. However, their bright orange color, which is comparable to spessartine garnet, is unusual for topaz.

Microscopic examination of both stones revealed a bluish green iridescence on the pavilion facets. Careful inspection using brightfield illumination also showed small, colorless chips along the pavilion facet edges (figure 34) and some colorless scratches on the pavilion facets. These features indicated the presence of a coating. Pink, orange, and red coatings on topaz have been attributed to a sputter-coating process (see Summer 1998 Gem News, pp. 143–144); the color layers deposited by that process could easily be scratched and removed.

However, the coating on these stones could not be scratched with a needle. This is the first time that orange-coated topaz with a hard and rather stable coating has been reported. In addition, the spotty appearance typical of sputter coatings was not observed on these two stones.

EDXRF chemical analyses of the pavilion surfaces of

**TABLE 2.** Trace-element composition of corundum and a crucible determined by SIMS (in ppm weight).<sup>a</sup>

Sample	Color	Color zonation	Analytical position	Na	Mg	K	Ca	Ti	Cr	Fe	Ga	Si	Be	Description
39402	Orange	Yes	Rim	0.04	132	0.05	1.55	na	975	1831	89.8	na	6.41	Treated in Thailand; ground and polished through the center
			Midpoint	0.06	128	0.04	1.26	na	797	1409	59.7	na	0.61	
	Pink		Center	0.04	92.0	0.02	0.81	na	664	1276	49.9	na	0.62	
39403	Orange	Yes	Rim	0.37	126	0.56	1.80	123	333	1697	111	na	10.6	Treated in Thailand; ground and polished through the center
	Pink		Center	0.02	129	0.06	1.65	126	330	1714	114	na	0.59	
49185	Orange	Yes	Rim	0.47	151	0.36	3.03	183	157	863	67.9	78.6	6.99	Treated in Thailand; ground and polished through the center
	Pink		Center	0.09	150	0.05	2.73	170	142	803	61.6	52.4	0.68	
39404	Orange	Yes	Rim	3.46	146	4.24	7.98	na	697	2062	137	na	10.5	Treated in Thailand; ground and polished through the center
			Midpoint	0.84	97.8	1.35	1.90	na	473	1613	95.1	na	0.60	
	Pink		Center	0.59	72.3	0.74	1.18	na	333	1179	57.2	na	0.62	
45033	Orangy red	No	Rim	0.24	93.3	0.27	1.10	na	1798	2958	66.5	na	8.44	Treated in Thailand; ground and polished through the center
	Orangy red		Center	0.31	90.9	0.35	0.95	na	1809	2882	64.6	na	7.21	
45032	Orange	No	Rim	0.58	106	1.18	2.18	na	1705	2107	123	na	6.78	Treated in Thailand; ground and polished through the center
	Orange		Center	1.80	96.6	4.75	1.50	na	1363	1660	82.9	na	10.8	
48430	Orange	Yes	Surface	0.06	56.7	0.11	0.71	62.8	379	2312	121	na	7.92	Unknown source
48413	Orange	Yes	Surface	6.37	180	3.78	5.57	513	312	429	97.7	na	99.0	Unknown source, treated stone; not repolished
48717	Orange	Yes	Surface	0.65	50.8	0.85	0.73	56.4	244	1320	112	60.0	12.2	Unknown source
48882	Orange	Yes	Surface	0.05	115	0.08	0.95	187	138	362	27.3	11.9	6.45	Unknown source
45493	Orange	Yes	Surface	2.48	159	1.28	2.66	211	1987	315	115	na	7.93	Half treated in Thailand; repolished
45494	Pink	No	Surface	0.70	198	0.23	2.70	282	2361	430	174	na	0.64	Untreated half
45002	Orange	Yes	Surface	0.60	151	0.91	1.86	na	1121.6	509	125	na	5.29	Half treated in Thailand; repolished
45031	Pink	No	Surface	0.04	125	0.04	1.22	na	744	420	77.4	na	0.53	Untreated half
45082	Pink	No	Rim	0.45	256	0.25	3.49	359	2702	955	176	na	11.0	Treated in Thailand; ground and polished through the center
	Pink		Center	0.95	232	0.77	3.69	327	2666	917	169	na	0.62	
	Pink		Center	0.43	228	0.41	3.31	328	2661	909	166	na	0.61	
45035	Yellow	No	Rim	0.07	30.1	0.09	0.44	102	10.5	9493	188	na	9.05	Treated in Thailand; ground and polished through the center
	Yellow		Center	0.03	29.3	0.07	0.42	54.0	23.3	9199	187	na	7.19	
45490	Yellow	No	Rim	0.04	6.18	0.02	0.22	46.9	9.94	4069	115	na	10.8	Treated in Thailand; ground and polished through the center
	Yellow		Center	0.03	14.1	0.02	0.24	37.1	10.0	4122	160	na	1.38	
45491	Yellow	Yes	Rim	0.19	66.2	0.06	1.16	20.1	3.71	683	93.9	na	9.52	Treated in Thailand; ground and polished through the center
	Pale yellow		Center	0.14	57.6	0.03	0.80	14.1	0.55	531	66.0	na	0.82	
48415	Red	Yes	Surface	0.49	75.5	0.46	1.05	110	10387	6613	182	na	11.0	Unknown source
48878	Red	Yes	Surface	0.13	1009	0.15	11.0	1231	8380	4766	109	220	8.71	Unknown source
45100	Crucible		White inner area	66.9	943	3.33	675	na	289	1154	83.8	na	113	Crucible that had been used for this type of treatment in Thailand
	Crucible		Blue inner area	2.59	736	1.20	35.9	na	264	951	75.6	na	73.2	
	Crucible		Convex outer surface	117	2217	9.71	702	na	138	858	75.9	na	105	

<sup>a</sup> Yellow rows correspond to previous analyses that were recalculated against new Be and Fe standards. Analyses highlighted in blue were obtained more recently, with all elements calibrated against new standards. Rows in darker yellow and darker blue refer to samples that were analyzed both before and after treatment. Abbreviation: na=not analyzed.

both samples revealed high concentrations of iron. Raman spectra of the coated surfaces revealed distinct hematite peaks, in addition to peaks corresponding to the underlying

topaz. It appears, then, that the orange color of these samples is derived from a thin coating of microcrystalline hematite applied to the pavilion surfaces. To our knowl-



Figure 33. The orange color of this 2.95 ct topaz is caused by a thin coating of synthetic hematite applied to the pavilion. Photo by Michael S. Krzemnicki; © SSEF Swiss Gemmological Institute.

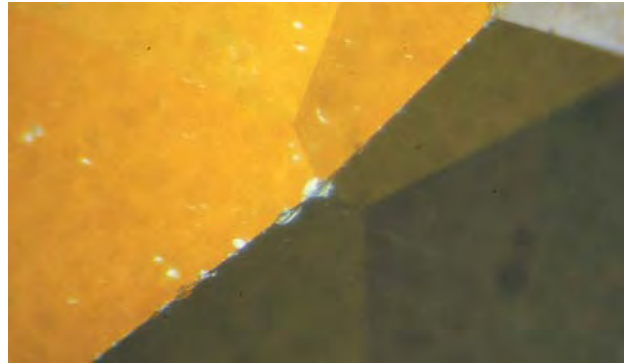


Figure 34. Minute colorless chips are visible along the edges of the pavilion facets on this coated topaz. Photomicrograph by Michael S. Krzemnicki, magnified 35x; © SSEF Swiss Gemmological Institute.

edge, this is the first time that synthetic hematite has been used as a coating on a gemstone.

This investigation reinforces the importance of carefully inspecting faceted gems from all angles. Analysis of only the crown of these stones with standard or advanced techniques would not have revealed their true nature.

Although the surface coating of topaz has been known for quite some time, such stones are often sold as “diffusion” treated. The two coated samples reported here showed no evidence of diffusion into the stone.

Michael S. Krzemnicki ([gemlab@ssef.ch](mailto:gemlab@ssef.ch))  
SEEF Swiss Gemmological Institute

## CONFERENCE REPORTS

**Diamond presentations at the annual Australian Diamond Conference.** Attendance at the annual Australian Diamond Conference, held in Perth on December 2–3, 2002, was just over 200, down from last year's 240 (see Winter 2001 Gem News, pp. 333–334). There were 26 presentations and a concluding panel discussion. The few non-Australian presenters included **Susan Shabangu** of the Ministry of Minerals and Energy, Johannesburg, South Africa, and **Nirupa Bhatt** of Rio Tinto Diamonds, Mumbai, India. Ms. Shabangu emphasized that the new South African mining law will give the indigenous people more control over mining their resources without nationalizing the industry. Ms. Bhatt discussed the enormous growth of the Indian diamond cutting and polishing industry, which now employs over one million people. Its success is due to the abundance of low-value rough produced by Australia's Argyle mine, the low cost of competent labor in India, and the marketing efforts of the Indo-Argyle Diamond Council.

Following the opening address by **Ewen Tyler** of Striker Resources, Perth, **John Hughes** of De Beers Consolidated Mines, Johannesburg, said that De Beers was committed to continuing diamond prospecting in Australia where, in 2002, it spent 8% of its global US\$40 million exploration budget. **Carl Pearson** of Econunit, London, discussed the importance of branding to promote diamonds and stated

that the diamond industry must increase its advertising budget, which is approximately one tenth of the ad budgets for other luxury goods such as watches. **Mike Mitchell** of Rio Tinto Diamonds, Perth, emphasized complete accountability “from cradle to grave” in all aspects of prospecting and mine development, awareness of socio-economic and environmental impacts on the region and its indigenous people, and involvement in downstream marketing.

Many speakers reported on the results and progress of their respective companies, the most important being **Miles Kennedy**, **David Jones**, **Nick Yiannopoulos**, and **Peter Danchin** of Kimberley Diamond Co., Perth, who were happy to announce that the Ellendale diamond mine has a higher grade (as reflected by current mining activities of 15 ct/100 tonnes) and value per carat (as indicated by the latest sales in Antwerp of US\$155/ct) than predicted by the feasibility study (see, e.g., Fall 2002 Gem News, pp. 258–259). **Max Cozijn** and **Linda Tompkins** of Elkedra Diamonds, Perth, reported on the discovery of numerous chromites of possible kimberlitic origin in Australia's Northern Territory. According to a subsequent company news release, the loam samples from which many of these chromites were recovered occurred in a 2.5-km-diameter ring-shaped structure. **Karl Simich** of Namakwa Diamonds, Perth, presented results of their bulk sampling of uplifted beaches on the coast of Namaqualand, South Africa; the production was better than the expected economic grade of 10 carats per 100 tonnes. **Phil Crab** of Thundelarra Exploration, Perth, announced the discovery of four new small kimberlite pipes, south of the large 20 ha (noneconomic) Aries pipe in the Kimberley Plateau of Western Australia. **Tom Reddcliffe** of Striker Resources, Perth, reported an unexpectedly high grade of 225 carats per 100 tonnes from a 183 tonne bulk sample taken from the Seppelt 2 pipe, located in the northern part of the Kimberley Plateau of Western Australia. Plans to drill for a deeply buried (up to 280 m) large kimberlite pipe beneath the Springfield Basin in South Australia were discussed by **Kevin Wills** of Flinders Diamonds, Perth.

Several speakers gave presentations on new exploration methods. **Richard Russell**, consulting geomorphologist to

Mt. Burgess Mining, Perth, showed that ground gravity methods had a greater success in outlining kimberlite pipes buried under Kalahari sands in northeast Namibia than ground magnetic surveys or other geophysical methods. **Stefan Schwank** of Bauer Maschinen, based in Schrobenthausen, Germany, illustrated how large-diameter (up to 3 m; see, e.g., figure 35) drill rigs are now being used to: (1) evaluate dump material at kimberlite mines, such as Koffiefontein and Jagersfontein in South Africa; (2) sample kimberlite at the Ellendale mine in Western Australia; and (3) recover ocean floor sediments off the coast of Namibia. He also described their potential for the actual mining of kimberlite from barges in deep open pits that have become flooded with water. **Phil Harman** of Gravity Capital, Melbourne, discussed the advantages of BHP's new Falcon™ airborne gravity method in finding kimberlite pipes. Gravity Capital will apply this method at their joint-venture properties, interpret the data, select prospective ground, and drill the targets to evaluate the prospects for a 50–50 equity. **Nick Lockett**, diamond exploration consultant in Perth, discussed the interpretation of satellite images and aerial photographs for locating primary diamond deposits in lateritic and glaciated terrain. **Kevin Dardis** of Fluor Australia, Perth, spoke about bringing online the new Combined Treatment Plant of De Beers mines in Kimberley, South Africa, which was designed especially to treat clay-rich material from old waste dumps and from the Dutoitspan mine.

Other presentations included one by **Tracey Rogers** of Australia's Northern Territory geological survey, based in Darwin, about developing geoscientific datasets for diamond explorers that can be downloaded free of charge; and by **Garry Holloway** of Diamond-Cut Inc., Melbourne, who emphasized that the "fourth C," cut, is the "Cinderella of the valuing process" and an increasingly important factor in the retail trade. He described a simple, small instrument that jewelry stores can use to help illustrate cut quality for their customers.

The mood of the conference attendees was subdued, but guardedly optimistic that the economic downturn was over and conditions were slowly improving. This is demonstrated by the current high number of exploration samples submitted to Australian laboratories for indicator mineral processing.

A. J. A. "Bram" Janse ([archon@space.net.au](mailto:archon@space.net.au))  
 Archon Exploration Pty. Ltd.  
 Carine, Western Australia

**Antwerp Diamond Conference.** On October 7–8, 2002, some 400 participants from major diamond producing, processing, and consuming nations assembled in Antwerp for a conference on international diamond policies and strategies. Speakers included key government and mining company executives from South Africa, Namibia, Botswana, Australia, Canada, and Russia; industry bankers; and diamond manufacturers. In addition, the president of Botswana, Festus Mogae, and former U.S. vice-president Al Gore addressed the gathering.



Figure 35. Shown at an on-shore marine diamond deposit in Namibia, this 100-ton rotary drilling rig employs a 2.5-m-diameter bucket, which has a capacity of 5 m<sup>3</sup> or 10 tons and can reach depths to 115 m. Courtesy of Bauer Maschinen.

The program, moderated by Chaim Even-Zohar (Tacy Ltd., Tel Aviv, Israel) focused on four main challenges of marketing new diamond production:

1. Expansion of production from new sources: This will inevitably lead to greater competition among producers and possible excess of supply over demand.
2. Advancing technology: In diamond exploration, more effective exploration methods will accelerate new discoveries. In diamond processing, new treatments will be developed to improve a diamond's appearance.
3. Greater scrutiny by the public, government, news media, and bankers: This includes an awareness of conflict diamonds, international finance, and a greater need to know the backgrounds of business partners.
4. Increased marketing and branding: This will be necessary to expand sales of diamond jewelry and to maintain quality assurance.

On the first two points, mining company executives discussed ongoing exploration efforts that will likely increase diamond production in the coming decades. **Gordon Gilchrist** of Rio Tinto, London, predicted that the world supply of rough diamonds will increase from US\$7.5 billion in 2002 to \$9 billion in 2007. **Robert Boyd** of Ashton Mining

Co., Vancouver, noted that mining companies are spending \$200 million annually on diamond exploration, 41% of this in North America. **Valery Kalitin** of Alrosa, Moscow, reported that his company has identified a number of new diamondiferous areas in Russia and will begin sampling next year. Offshore of Namibia, Namdeb (a joint venture between De Beers and the Namibian government) and Namco are using new technologies to extract diamonds from the seabed much more efficiently. **Greg Walker** of Namco, Windhoek, Namibia, said that as many as 3 billion carats could be lying offshore, scattered along the 1,400-mile-long Namibian coastline.

The conflict diamond issue has generated negative press and attention from Non-Governmental Organizations over the past two years. De Beers Chairman **Nicky Oppenheimer** congratulated the diamond industry on its efforts to stop such diamonds from entering the legitimate trade; however, the reputation of the industry is still at stake. He noted that diamonds can be a major contributing force to the economies of producing countries, if the governments offer a "secure, transparent, and predictable legislative environment." He singled out Botswana as an example of a nation that has used its diamond wealth to create prosperity. Botswana president **Festus Mogae** elaborated, telling the audience that his country's prosperity is rooted in the rule of law, and stating that his government is committed to the Kimberley Process of certifying the origins of rough diamonds. **Al Gore**, who addressed the closing dinner, declared that the conflict diamond issue was "largely a thing of the past" and congratulated the industry on its efforts to greatly reduce trade in such diamonds.

Governments are also demanding greater financial accountability from the industry, in the wake of allegations that money launderers and terrorists have used gems to finance their activities. **Paul Goris** of the Antwerp Diamond Bank, Belgium, stressed that bankers will more closely monitor their clients' businesses, requiring increased disclosure about their partners. **Jim Antoine** of the Government of the Northwest Territories, Canada, noted that diamond mining companies have a responsibility to protect the environments in which they operate and to ensure that development of natural resources benefits the people living in affected areas.

Most of the speakers agreed that diamond branding was still a new and largely untried concept. **Gareth Penny** of De Beers, London, told the audience that branding need not be limited to a product, but could also include service and the store selling the product. A brand, he said, must mean something to the consumer in terms of quality assurance, trust, and service. It must also be based on consumer needs. He showed how the three-stone ring promotion redressed an old concept into a new idea and captured 1% of the diamond jewelry market in 2001 and 3%–4% in 2002—with a goal of attaining 10% in the future.

Other producers focused on increasing diamond sales through strategic partnerships. Aber Resources, for example, entered into an equity arrangement with Tiffany & Co., because a significant percentage of production from

Diavik is very high quality. **Matt Manson** of Aber, Toronto, said that his company believes that growth of brands will drive future demand in the diamond market, but also that its best strategy is to partner with existing diamond jewelry and luxury goods houses.

China is the fastest growing retail diamond jewelry market. **Du Gong-pu** of the Shanghai Diamond Exchange, Shanghai, reported that in June 2002, the Chinese government enacted a new import taxation policy that removes all taxes and duties on polished and rough diamonds except at the retail sales level. Finished diamond jewelry imports are still subject to a tariff of 30%–35% plus a 17% value-added tax. The aim, he said, is to provide business opportunities for major diamond manufacturing operations to produce diamonds and diamond jewelry for domestic sale and re-export. Diamond polishing and jewelry manufacturing operations are concentrated in three areas: Guangdong Province, with 12,000 workers; Shandong Province, with 5,000 workers; and Shanghai, with 200 workers. Monthly wages average \$100 to \$200. In 2001, China imported 3.28 million carats of rough diamonds, valued at \$623 million.

*Russell Shor (russell.shor@gia.edu)  
GIA, Carlsbad*

**Antwerp Gem Conference.** On November 10–11, 2002, more than 100 people attended this conference, organized by the HRD—Institute of Gemmology. The keynote speaker, **Joanna Hardy** of Sotheby's Jewellery Department in London, offered pointers for evaluating estate jewelry, including the paramount importance of provenance. **Dr. Jeff Van Royen**, of the Antwerp Diamond High Council, reviewed the development and identification of HPHT-treated diamonds, and reported that a Russian-manufactured "BARS" apparatus has been installed near Antwerp for use by HRD researchers. **Dr. A. H. Rankin** of Kingston University, London, described how Raman analysis and LA-ICP-MS can be used to "fingerprint" gems as to their locality or natural/synthetic origin. LA-ICP-MS is a very sensitive technique, but it is also expensive and current databases are lacking. **Dr. Lore Kiefert** of the SSEF Swiss Gemmological Institute, Basel, reviewed the fillers used in emerald and ruby, which can be identified with magnification or (for emeralds) with IR spectroscopy or Raman analysis.

**Dr. Emmanuel Fritsch** of the University of Nantes, France, reported on various aspects of opal structure, including the differences between opals with and without play-of-color; the latter tend to have the most organized structure and the most perfect "spheres" of silica. **Vincent de Jaegher**, of Vincent de Jaegher S.A. in Verviers, Belgium, reviewed several methods of pearl identification, including the use of X-rays (to separate natural from cultured pearls), high-power magnification (i.e., 100×–200×, to separate genuine products from imitations), UV fluorescence (to identify bleaching), and SEM (to help identify treated black and polished pearls). **Dr. Dirk Van Dyke** of the University of Antwerp explained the usefulness of (nondestructive) X-ray microtomography

in observing inclusions and fissures in diamonds to help with cutting. **John I. Koivula** of the GIA Gem Trade Laboratory in Carlsbad concluded the conference with a description of the special tools (e.g., fiber-optic illuminators and various filters such as the first-order red compensator) and techniques (e.g., shadowing) he uses for effective gemological photomicrography.

Alice S. Keller ([akeller@gia.edu](mailto:akeller@gia.edu)) and  
John I. Koivula, GIA Carlsbad

## ANNOUNCEMENTS

**Beryllium: A known carcinogen.** The National Institute of Environmental Health Services published the 10th edition of its biennial Report on Carcinogens in December 2002. Beryllium was upgraded from a "reasonably anticipated" to a "known" human carcinogen, and jewelers were among the workers listed who should take precautions to avoid exposure to beryllium-containing dust. To see the report, visit <http://ehp.niehs.nih.gov/roc/toc10.html>.

## Conferences

**PDAC 2003.** The Prospectors and Developers Association of Canada convention will take place March 9–12 in Toronto. Diamonds will be featured in the technical program and reviewed in a "Commodities and Market Outlook" session. A pre-meeting short course on diamond exploration using kimberlite indicator minerals will be held March 8. Visit [www.pdac.ca/pdac/conv](http://www.pdac.ca/pdac/conv), phone 416-362-1969, fax 416-362-0101, or e-mail [info@pdac.ca](mailto:info@pdac.ca).

**Basel 2003.** The World Watch, Clock, and Jewellery Show will be held April 3–10 in Basel, Switzerland. GIA will host GemFest Basel 2003 from 4:00 to 6:00 p.m. Saturday, April 5. Open to the public, it will highlight trends in fancy-color diamonds and present the latest discoveries from the GIA Gem Trade Laboratory. 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](http://www.baselshow.com) or call 800-357-5570.

**Moscow gemology colloquium.** The 6th International Conference *New Ideas in Earth Sciences* will take place April 8–22, 2003, in Moscow, and will feature a section on gemology. Contact GIA Moscow at [gigia@rol.ru](mailto:gigia@rol.ru), 70-95-433-5566 (phone), or 70-95-438-1504 (fax).

**Gems and industrial minerals.** The 39th Annual Conference on the Geology of Industrial Minerals will occur May 18–24, 2003, in Reno, Nevada. Included in the program will be the session "Gemstones and Mineral Collectibles." Visit [www.nbmj.unr.edu/imf](http://www.nbmj.unr.edu/imf) or e-mail [tgarside@unr.edu](mailto:tgarside@unr.edu).

**GAC-MAC-SEG meeting.** The Geological Association of Canada, Mineralogical Association of Canada, and Society of Economic Geologists will host this large geosciences conference May 25–28, 2003, in Vancouver, Canada.

Special sessions on gem materials and Canadian diamonds will be offered. Visit [www.vancouver2003.com](http://www.vancouver2003.com), phone 604-681-5226, fax 604-681-2503, or e-mail [vancouver2003@nrca.gc.ca](mailto:vancouver2003@nrca.gc.ca).

**Maine pegmatite workshop.** Gem-bearing granitic pegmatites will be included in field studies from May 31 to June 2, 2003 that will be offered by pegmatite experts from the University of New Orleans and a local geologist and pegmatite miner. Visit <http://homepage.mac.com/rasprague/PegShop> or e-mail [rasprague@mac.com](mailto:rasprague@mac.com).

**Kimberlite conference.** The 8th International Kimberlite Conference will take place June 22–27, 2003, in Victoria, Canada. Topics will cover kimberlite geology and economics, diamonds, target area selection, and diamond exploration. Visit [www.venuewest.com/8ikc](http://www.venuewest.com/8ikc), phone 604-681-5226, fax 604-681-2503, or e-mail [8ikc@venuewest.com](mailto:8ikc@venuewest.com).

## IN MEMORIAM

**Prof. Dr. Pieter C. Zwaan, 1928–2002.** *Gems & Gemology* author and noted gemologist P. C. Zwaan passed away November 7, 2002. Dr. Zwaan was awarded a Ph.D. in geology from the University of Leiden, The Netherlands, in 1955. At the National Museum of Natural History (formerly National Museum of Geology and Mineralogy) in Leiden, he acted as both mineral curator (1951–1993) and director (1979–1988). For several years, he was also a gemology instructor for the FGA diploma course at the School of Gold- and Silversmiths in Schoonhoven, the Netherlands, and a professor of gemology at the University of Leiden. For more than four decades, he directed the Netherlands Gemmological Laboratory in Leiden. He was an invited speaker at many international geological and gemological conferences, and led numerous field trips to gem localities in Asia, Brazil, and South Africa. He authored 149 articles on mineralogy and/or gemology, including two articles on Sri Lanka's gems in the Summer 1982 (pp. 62–71) and Winter 1996 (pp. 262–269) issues of *G&G*.

## ERRATUM

In the Spring 2002 Dirlam et al. article on liddicoatite (pp. 28–53), there were some inaccuracies in references to Russian publications. First, the reference listed as Shmakin and Makagon (1999) should have been shown as:

Zagorsky V.Ye., Peretyazhko I.S., Shmakin B.M. (1999) *Miarolitic Pegmatites*. Volume 3 of B. M. Shmakin and V. M. Makagon, Eds., *Granitic Pegmatites*, Nauka—Siberian Publishing Firm RAS, Novosibirsk, Russia.

Also, in the reference to "Zagorsky et al. (1989)," the correct spellings of the author names are *Zagorsky* and *Shiryayeva*. We thank Dr. Victor Ye. Zagorsky of the Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia, for bringing these errors to our attention.