GEM NEWS INTERNATIONAL 2009

COLORED STONES AND ORGANIC MATERIALS

Benitoite: Update on faceting and jewelry manufacturing. The world's only commercial source of gem-quality benitoite—the Benitoite Gem mine in San Benito County, California—was closed and reclaimed in June 2005 (see Fall 2005 Gem News International [GNI], p. 276). However, a significant stockpile of faceting material was amassed by Benitoite Mining Inc. (BMI; Golden, Colorado) while working the deposit. At the 2009 Tucson gem shows, BMI president Bryan Lees had a collection of some of the best benitoites that had been cut from this stock, consisting of 10 stones that weighed a total of 52.39 carats (figure 1). This included a matched pair that weighed ~5.9 ct each, as well as a 10.87 ct round brilliant—the second-largest cut benitoite known, after the 15.42 ct stone on the cover of the Fall 1997 *G&G*. All the gems were faceted since 2002 by Ben Kho (Decatur, Georgia).

Figure 1. Weighing a total of 52.39 carats, these 10 benitoites were mined and faceted by Benitoite Mining Inc. At 10.87 ct, the round brilliant in the center is the second-largest cut benitoite known. The matched pair of ovals weigh ~5.9 ct each, and the smallest stone pictured is 3.14 ct. Courtesy of BMI and Collector's Edge Minerals Inc.; photo by Robert Weldon.

BMI has cut all of their stock that would yield stones >0.15 ct, and Mr. Lees estimates that these goods will last 3–5 years depending on the market's recovery from the global economic downturn. In addition, according to market demand, melee-sized stones are being cut into full round brilliants that measure 1–3.25 mm in diameter (see, e.g., Summer 2002 GNI, pp. 174–175). Mr. Lees stated that supplies of this material could last beyond five years.

The market for melee-size benitoite has been enhanced by the development of new ways to showcase this material. Jewelry lines that capitalize on the stone's brilliance and color variations (i.e., colorless to deep violetish blue) were developed by Paul Cory (Iteco Inc., Powell, Ohio) and Eric Braunwart (Columbia Gem House Inc., Vancouver, Washington; see, e.g., figure 2). Some of the rings and bracelets consist of dozens of mountings that are linked together in a way that allows freedom of movement. The white gold mountings are laser manufactured in China,

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Figure 2. Jewelry designs containing melee-sized benitoite (here, 2.5 mm rounds) show the material's brilliance and range of color. The ring contains 58 benitoites set in individual mountings that are linked together so the design can move and bend, while the stones in the earrings (left and bottom) are set by conventional methods. Courtesy of Columbia Gem House Inc.; photo by Robert Weldon.

and the stones are set in the United States. Up to 400 benitoites have been set into a single bracelet, with individual stones generally ranging from 1.75 to 2.75 mm in diameter.

A chronology of the mining and processing activities by BMI, as well as many other details dating back to the discovery of the deposit, was recently published by W. E. Wilson ("The 100-year history of the Benitoite Gem mine, San Benito County, California," *Mineralogical Record*, Vol. 39, No. 1, 2008, pp. 13–42). In late June 2005, BMI sold the property to David Schreiner of Coalinga, California, who renamed it the California State Gem mine. The property was operated on a fee-collecting basis in 2007–2008 until the Bureau of Land Management closed the entire Clear Creek Management Area, due to public health concerns over exposure to asbestos that naturally occurs at several locations near the former benitoite mine.

Brendan M. Laurs

Large cat's-eye beryl from India. In February 2009, Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado) loaned three large cat's-eye beryls (75.93–282.63 ct) and donated an additional (46.76 ct) stone to GIA for examination (figure 3). All these attractive semitransparent-to-translucent oval cabochons exhibited a strong chatoyant band. According to Mr. Blauwet, the stones were obtained from near Shahpura, which is located 55 km north of Jaipur in Rajasthan State, India. He reported that there were several thousands of carats available in Jaipur, ranging from ~5 to 288 ct.

The following properties were determined on the four cabochons: color—yellow-green to brownish yellowish green; pleochroism—moderate greenish yellow to grayish green or moderate brownish yellow to yellowish green; spot RI—1.57–1.58; hydrostatic SG—2.69–2.71; and fluorescence—inert to long- and short-wave UV radiation. These properties are generally consistent with natural cat's-eye beryl (R. Webster, *Gems*, 5th ed., revised by P. G. Read, Butterworth-Heinemann, Oxford, UK, 1994, pp. 127–131). Observation of all cabochons with magnification and strong fiber-optic lighting revealed fine, iridescent, needle-like growth tubes, as well as numerous black and white needles, oriented parallel to the c-axis (figure 4); all were responsible for the strong chatoyancy. "Fingerprints" composed of transparent near-colorless crystals were also seen. Furthermore, all stones showed an absorption band of unknown origin at ~547 nm with the desk-model spectroscope.

Energy-dispersive X-ray fluorescence (EDXRF) analyses of these samples revealed major amounts of Al and Si, minor Fe, and traces of Cl, K, Ti, Cr, Zn, and Cs. The appreciable Fe content is not characteristic of beryl from India (see K. N. Babu and A. Sebastian, "On the genesis of Indian beryls," *Journal of the Geological Society of India*, Vol. 51, 1998, pp. 323–330). However, EDXRF is a bulk analysis technique that does not distinguish Fe concentra-

Figure 3. These cat's-eye beryl cabochons (46.76–282.63 ct), reportedly from Shahpura in India's Rajasthan State, show a sharp chatoyant band oriented perpendicular to the c-axis. Photo by Robert Weldon; the 46.76 ct stone (far right) is GIA Collection no. 37971.

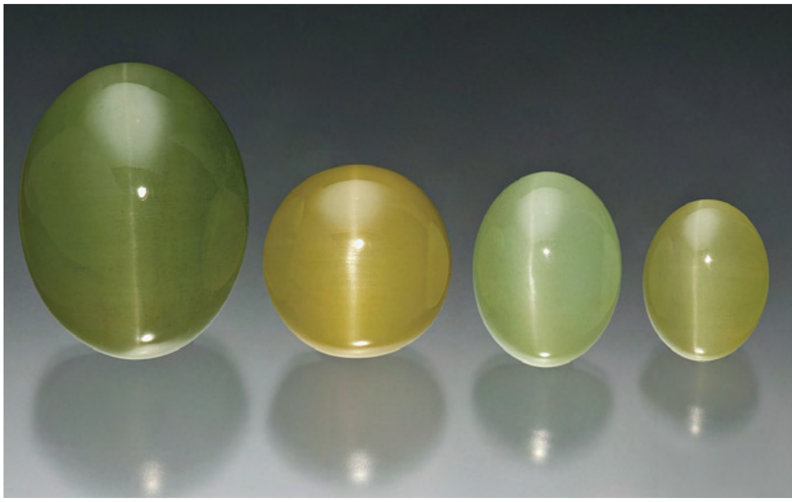

Figure 4. Abundant growth tubes and needles oriented parallel to the c-axis are responsible for the chatoyancy of the beryl. Raman analysis of the needles identified hematite (black) and siderite (white). Photomicrograph by W. L. Win; field of view 3.8 mm.

tion between the host material and inclusions. Raman analysis identified hematite (Fe_2O_3) in the black needles and siderite ($FeCO_3$) in the white ones, which explains the relatively high concentrations of Fe in these samples.

Although Rajasthan State is a known source of gem beryl, large chatoyant material has not been reported previously to this contributor's knowledge.

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Emeralds recovered using new techniques at the Kagem mine, Zambia. The Kagem emerald mine in Zambia is the largest colored gemstone mine in the world, and since June 2008 it has been 75% owned by Gemfields Resources PLC (London). The mine is worked by large-scale open-pit methods using the latest in mining and processing technologies to expose the emerald-bearing zones and sort the mined material. However, past techniques for extracting emeralds from the surrounding rock have employed the use of crowbars, hammers, and chisels, which caused damage to the valuable gem rough.

Emeralds from Kagem and other mines in Zambia are typically hosted by phlogopite schist reaction zones adjacent to quartz-tourmaline veins (see J. C. Zwaan et al., "Emeralds from the Kafubu area, Zambia," Summer 2005 *G&G*, pp. 116–148). In late 2008, an unusually thick zone of mineralized quartz discovered at Kagem was found to contain emerald crystals with intense color and unusually high luster and clarity (see, e.g., figure 5). These high-quality emeralds were "frozen" within solid masses of quartz, so Gemfields approached Collector's Edge Minerals Inc. (CEMI) for assistance with preparing and marketing them to mineral connoisseurs. In March 2009, after they formed a partnership on this venture, CEMI proposed a new method for mining emeralds based on modern techniques used to extract delicate rhodochrosite specimens from the Sweet Home mine in Colorado (see K. Knox and B. K. Lees, "Gem rhodochrosite from the Sweet Home mine, Colorado," Summer 1997 *G&G*, pp. 122–133). Specialized equipment, including a hydraulic splitter and diamond chainsaw, were shipped to Kagem, and in June CEMI's Graham Sutton trained their collecting personnel.

Although explosives are still used to excavate large areas of barren rock, the new collecting process is now employed near favorable zones for emeralds. First, a series of vertical holes are drilled 1–2 m deep along the top of benches that are 2.4-m high. Rock is then peeled away using the hydraulic splitter, which is designed to fit inside a 7-cm-diameter drill hole. Next, when emerald-rich zones are located, the diamond chainsaw is carefully used to remove the ore. Although this tool looks like an ordinary chainsaw, it is hydraulically mechanized to handle the rigors of rock cutting. The saw's blade contains sintered diamond teeth that can readily cut the rock in any direction needed, including straight into a mining face. The chainsaw has proved invaluable for extracting fragile specimens and gems.

The boulders and sawn blocks of mined material are sorted on site in a secure warehouse. Quartz-hosted samples showing potential to yield fine-quality mineral specimens are shipped to the trimming and cleaning lab at

Figure 5. At 10.7 cm tall, this specimen of emerald-in-quartz from Zambia's Kagem mine contains some fine gem-quality crystals. Courtesy of Collector's Edge Minerals Inc.

CEMI in Colorado. The first crystal specimens debuted at the Denver Gem and Mineral show in September 2009. As of early November 2009, 10 high-quality specimens and 20 moderate-value pieces had been prepared by painstakingly exposing the emeralds from the quartz matrix, revealing crystals that ranged up to 12 cm long and 2.5 cm in diameter. Processing of an additional boulder and several cobble-sized pieces is expected to yield a half-dozen high-quality specimens and 10–20 moderate-value pieces. It is hoped that more emerald-mineralized quartz lenses will be discovered as mining proceeds.

Gemfields has embraced the new collecting techniques at Kagem. In addition to greatly reducing damage to gem material and mineral specimens, these processes have improved productivity, since the workers spend less time hand chiseling the hard rock. An added benefit is security: With larger pieces being collected, less human contact with the emeralds decreases the potential for theft.

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Yellow grossular from Tanzania. New finds of grossular in yellow-to-green hues continue to be made in East Africa (e.g., Spring 2009 GNI, pp. 65–66). One of these was brought to GIA's attention in mid-2009 by Amarjit Saini (Mobu Gems, Los Angeles). According to his partner, Peter C. L. Pereira (Isle Of Gems, Arusha, Tanzania), the garnet is found in the Lelatema Mountains, ~70 km southeast of Arusha and 30 km east of Merelani. The deposit has been mined for several years, but only recently (2007–2008) has it yielded significant—although limited—production. The vast majority of the rough weighs <1 g, with ~1 g sizes uncommon and 2+ g pieces rare. The color varies from "golden" yellow to greenish yellow, and less commonly orange (i.e., "Fanta" color). Most of the facetable material is slightly to moderately included. The cut stones typically weigh <2 ct, although Mr. Pereira knew of a few that weighed ~5 ct. The garnet is sometimes sold as "Tsavo Golden."

Figure 6. These grossulars (1.51–2.29 ct) were reportedly mined from the Lelatema Mountains in Tanzania. Photo by Robert Weldon.

Mr. Saini donated three faceted samples of the yellow grossular (figure 6) to GIA, and the following gemological properties were obtained: color—light slightly orangy yellow to light orange-yellow; RI—1.738; hydrostatic SG—3.61–3.62; fluorescence—weak reddish orange to long-wave UV radiation, and weak to moderate yellowish orange to short-wave UV; and a weak absorption line seen at 430 nm with the desk-model spectroscope. These properties are consistent with grossular (R. Webster, *Gems*, 5th ed., Ed. by P. G. Read, Butterworth-Heinemann, Oxford, UK, 1994, pp. 201–202). Microscopic examination showed the stones were largely free of inclusions and growth features, except for some transparent crystals that were identified by Raman spectroscopy as apatite (figure 7).

Chemical analysis of all three stones by laser ablation–inductively coupled plasma–mass spectrometry measured average values of 4600 ppmw Fe and 3300 ppmw Mn. The chromophores Cr and V, which are often found in yellowish green to green grossular from East Africa, were present in negligible quantities (<50 ppmw). The ultraviolet-visible (UV-Vis) absorption spectra (figure 8) showed strong Mn^{2+}-related features, including a cutoff at 372 nm and peaks at 409, 419, and 430 nm. Very weak features at 504 and 690 nm were due to Fe^{2+}. The yellow coloration of these garnets is due to Mn^{2+}, as described previously for yellow to greenish yellow grossulars from East Africa (Winter 1991 Gem News, p. 258; Winter 2005 GNI, pp. 352–353).

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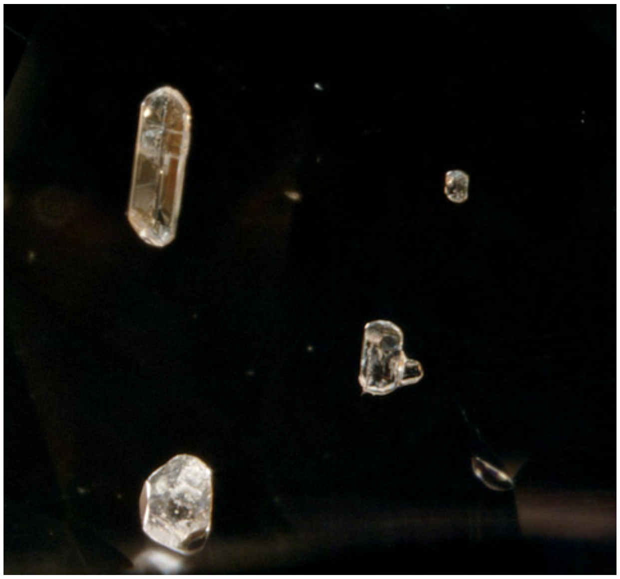
Figure 7. The only inclusions present in the grossulars were transparent crystals of apatite. Photomicrograph by D. Beaton; field of view 1.6 mm.



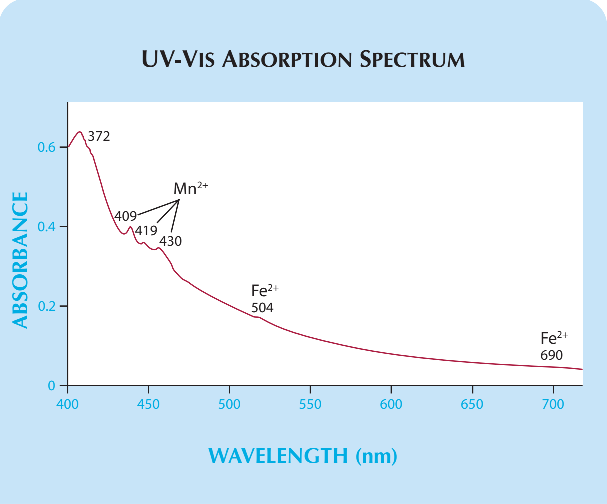


Figure 8. The UV-Vis spectra of the yellow grossulars displayed strong Mn^{2+}-related features. Very weak absorptions attributed to Fe^{2+} were present at 504 and 690 nm.

A most unusual blister pearl. A *blister pearl* is a pearl attached to the shell of its mollusk host, and may be natural or cultured. A natural blister pearl may result when a pearl that formed loosely within the mantle of a mollusk later comes into contact with the inner shell, subsequently becoming attached as further layers of nacre are laid over it. Natural blister pearls also form when parasites (worms and other organisms) attack the mollusk, often burrowing through the shell from outside. The mollusk defends itself by forming nacre around the intruder, and the resulting blister pearls sometimes resemble the original animal.

We recently had an opportunity to analyze a rare natural blister pearl in the shape of a fish or an eel that was found in a large *Pinctada maxima* oyster (figure 9). This bivalve, which originated from the Philippines, measured 25 × 22 cm; the blister pearl was 11 cm long. To investigate the origin of this sample, we analyzed it with Gemlab's "Blackbox" prototype radiography system using a high-resolution digital X-ray detector. The X-radiographs clearly showed the remains of a slender, elongated fish inside the blister pearl (figure 10). Its skull and a pectoral fin were especially detailed.

The fish was identified as a member of the pearlfish family (Carapidae), most likely the species *Onuxodon parvibrachium* (described by Fowler, 1927). This species is known as the oyster pearlfish (figure 10, inset) because of its commensalism with large bivalves such as the various *Pinctada* species (D. F. Markle and J. E. Olney, "Systematics of the pearlfishes (Pisces: Carapidae)," *Bulletin of Marine Science*, No. 47, Vol. 2, 1990, pp. 269–410). In a commensal relationship, two organisms live together and one profits while the other neither benefits nor is harmed. In this case, the fish benefits from the shelter of the mollusk's shell.

Figure 9. This Pinctada maxima *shell (25 × 22 cm) contains a fish-shaped blister pearl. Photo by T. Hainschwang.*

Figure 10. An X-radiograph reveals the remains of a fish within the blister pearl. For comparison, the inset photo shows a preserved specimen of the pearlfish Onuxodon parvibrachium *(source: National Digital Archive Program, Taiwan).*

When such a fish dies inside the host, it can be covered by nacre with the remarkable result shown here. Similar blister pearls have been reported from *Carapus dubius* (Putnam, 1874), the Pacific pearlfish.

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Myanmar cultured pearl production and new gem localities. Each year, Myanmar's eight pearl farms (joint ventures between the government and Japanese, Australian, and Thai companies) produce some 400,000 cultured pearls (table 1). The output has been restricted by limitations on the number of pearl oysters. The largest farms offered 50,000–100,000 cultured pearls in the government's Pearl Emporiums, which are held once or twice a year. The 27th emporium was held September 23–25, 2009. Yangon was the site of the first 26 emporiums, but this year's event took place in Naypyidaw (south of Mandalay). Tender and auction sales for the 424 lots of cultured pearls totaled ~US$798,000, the most in 18 years. In all, 69% of the lots were sold. This emporium also featured lectures that were open to the public on pearl farming, sorting, and other topics.

TABLE 1. Annual production of cultured pearls in Myanmar.[a]

Year	Number	Weight (momme)
2006–2007	410,791	240,596
2007–2008	443,810	235,917
2008–2009	437,181	238,744
2009 (as of August)	92,178	40,500

[a] *Source: Biweekly Burmese journals, September 4 and 25, 2009.*

A new production of spinel occurred in August 2009 at Bawma, located 9 km northwest of Mogok at coordinates 22°57′ N, 96°25′ E (elevation ~1220 m). Mostly red and purple spinel was produced, and the largest pieces weighed 1+ g. The spinel is associated with metacarbonate rocks and syenite. The deposit has been known since before World War II, but the recent finds created a gem rush that prompted the township government to stop mining activities. Nearby, colorless crystals of jeremejevite that exceeded 2 cm long were found in early 2009 at Kyauksin village (elevation ~1525 m). The jeremejevite was initially mistaken for quartz by local gem miners. In Kachin State, a new deposit of translucent "moss" green hydrogrossular was found in 2008 near Namhpu. The garnet was found in an outcrop near a stream that has produced ruby.

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Phenakite from Nigeria. Phenakite (Be_2SiO_4) is an unusual mineral that is known in gem quality from some granitic pegmatites and schist-hosted emerald/alexandrite deposits. In October 2009, Dr. Robert Lavinsky (iRocks.com, Dallas, Texas) informed this contributor about a new find of gem-quality colorless phenakite crystals from Nigeria (e.g., figure 11). In partnership with Bill Larson (Pala International, Fallbrook, California), he obtained five crystals that were selected from a parcel offered in Bangkok. In September he obtained another ~30 crystals at the Denver Gem and Mineral Show that ranged up to 5.1 × 3.8 × 3.4 cm. Mr. Larson reported the material was found in August 2009 in the Jos region of central Nigeria, where it is referred to as *okuta didan* (meaning "shining stone" in the local language). The crystals are notable for their transparency and bright, lustrous appearance; they commonly show complex surface patterns that appear to be due to chemical etching.

Although much of the phenakite is sold as mineral specimens, some of the material has been faceted into attractive gemstones. Mark Smith (Thai Lanka Trading Ltd. Part., Bangkok) reported cutting ~100 stones as of October 2009, from a 973 g parcel containing about 45

Figure 11. Nigeria is the source of this phenakite crystal (4.4 × 2.9 × 2.3 cm), which displays complex surface patterns that are characteristic of material from this locality. Courtesy of iRocks.com.

Figure 12. This Nigerian phenakite is impressive for its size (83.45 ct) and transparency. Courtesy of Herb Obodda (H. Obodda, Short Hills, New Jersey); photo by Thai Lanka Trading Ltd. Part.

pieces (typically 10–65 g each) that he obtained in late August. Most of the resulting cut stones weighed 1–10 ct, but larger gems up to 23 ct (eye clean) and 33 ct (very slightly included) were also faceted. The largest cut phenakite weighed 83.45 ct and was virtually free of inclusions (figure 12). Mr. Smith sold a 136.2 g crystal that he estimated would facet an eye-clean 200 ct gemstone.

Figure 13. The ruby mining site near the village of M'sawize, Mozambique, is located within the Niassa National Reserve. Photo by V. Pardieu.

A literature search revealed only one reference to phenakite from Nigeria: J. Malley and A. Banerjee, "Farbloser Phenakit aus Nigeria [Colorless phenakite from Nigeria]," *Kurzmitteilungen aus dem Institut fuer Edelsteinforschung der Johannes-Gutenberg-Universitaet Mainz*, Vol. 2, 1987, 3 pp. With this new find, we can add one more mineral to the list of high-quality gems produced from Nigeria, which includes tourmaline, topaz, emerald, aquamarine, various garnets, sapphire, and more (J.-C. Michelou, "Le Nigeria. Source de pierres de couleur," *Revue de Gemmologie*, No. 159, 2007, pp. 30–41).

Brendan M. Laurs

Update on rubies from Mozambique. In September 2008, rubies appeared in the Tanzanian market that came from a new mine in the M'sawize area of Niassa Province, Mozambique. Then, in February 2009, a second ruby deposit was discovered in the neighboring province of Cabo Delgado, between Pemba and Montepuez. The GIA Laboratory has described the Mozambique rubies in two reports (see V. Pardieu et al., www.giathai.net/pdf/Niassa_Mozambique_Ruby_September13_2009.pdf and S. F. McClure and J. I. Koivula, Fall 2009 GNI, pp. 224–226). In November 2009, one of these contributors (VP) visited M'sawize to document the deposit and obtain samples for GIA's research collection.

The mining site (figure 13) is located ~40 km southeast of M'sawize, in a remote area within the Niassa National Reserve. In July 2009, artisanal miners were expelled from the area by government authorities, and the Reserve continues to search for a solution to deal with illegal digging in this protected area. The area mined for rubies measured ~400 × 200 m, and the hand-dug pits were up to 12 m deep. The pits exploited the eluvium as well as the underlying primary deposit. The rubies formed in veins intruding altered gneiss, possibly of dioritic composition (Dr. Walter Balmer, pers. comm., 2009). The following minerals associated with ruby were identified by one of us (PL): actinolite, anorthite, scapolite, diopside, and epidote. Mica and red garnet were also noted on site. The rubies seen in M'sawize were very similar to those described by Pardieu et al. (2009), ranging from pink to dark red, usually with a tabular habit and weighing up to 40 g. Some showed a silky appearance.

We also attempted to visit the Montepuez deposit, but were unsuccessful due to continued tensions between the police and illegal miners. (In October 2009, the local authorities had convinced most of the miners and dealers to leave the area, while the owner of the private game farm encompassing the deposit was granted a mining license and entered into a partnership with a Thai company.) Several parcels of rubies represented as being from Montepuez (e.g., figure 14) were seen in the Mozambique cities of Nampula and Pemba. The material was similar to the stones described by McClure and Koivula (2009), and was usually a deeper red and flatter in habit than the

M'sawize rubies. Mineral inclusions (mainly amphibole) were more common, and many stones were milky.

Several fine, untreated faceted M'sawize rubies (often called "Mozambique," "Lichinga," or "Niassa" rubies in the trade) weighing up to 5 ct have appeared in the Bangkok market since late 2008, though most good-quality untreated stones have weighed <2 ct. Montepuez material, in similar sizes and qualities, appeared in Bangkok during the summer of 2009. According to Thai buyers and treaters, only ~5–10% of the Mozambique production is fine enough to be sold without heating, while the lower-quality material (~70–85% of the production) is suitable for lead-glass filling. The remainder of the rough responds to conventional heat treatment in a borax flux. Glass-filled Mozambique rubies (up to 20 ct) actually have been circulating in the Thai market since 2006—probably from elsewhere in Mozambique, such as Ruombeze (see Pardieu et al., 2009).

If mining disputes at the two new Mozambique deposits can be resolved, they could become important sources of African rubies that offer attractive alternatives to Burmese goods.

The authors thank the Niassa National Reserve and Moses Konate of Mozambique Gems (Nampula) for their support during their expeditions.

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Figure 14. Ruby from Montepuez (here, up to 17 mm) is typically deeper red and flatter in habit than the stones from Niassa. Photo by V. Pardieu.

Transparent, bright blue sodalite from Afghanistan. At the 2009 Denver Gem and Mineral show, Rob Lavinsky (iRocks.com, Dallas, Texas) had two specimens of sodalite that were remarkable for the transparency and bright color of their crystals (e.g., figure 15). The pieces were reportedly mined in May 2009 from the Kokcha Valley in Badakhshan, Afghanistan. This area also produces other intense blue sodalite-group minerals, such as haüyne and lazurite. However, the identity of these crystals as sodalite was confirmed by Dr. Robert Downs (University of Arizona, Tucson), who analyzed a fragment from one of the specimens using single-crystal X-ray diffraction analysis and Raman spectroscopy.

Figure 15. These transparent and brightly colored sodalite crystals (up to ~7 mm) were reportedly recovered from a deposit near the lapis lazuli mines in Badakhshan, Afghanistan. Courtesy of iRocks.com; photo by Joe Budd.

The sodalite occurs on a light-colored crystalline matrix with scattered small crystals of a brassy mineral that is probably pyrite. X-ray diffraction and Raman analysis of the matrix by Dr. Downs identified it as native sulfur. One of Mr. Lavinsky's specimens had sodalite crystals that were surrounded by a massive bright yellow mineral, apparently also native sulfur.

Although only a limited amount of this sodalite has been found—and the well-formed crystals are being sold exclusively as mineral specimens—the possibility exists that this attractive transparent material could be cut into brightly colored gems, which might contain unusual inclusions such as native sulfur.

Brendan M. Laurs

Pseudo-chatoyancy and pseudo-asterism in sphalerite from Spain. Sphalerite is popular among gem collectors for its extremely high refractive index and dispersion, but there have been no reports of phenomenal stones. Recently, however, we examined several sphalerite cabochons (e.g., figure 16) that exhibited sharp cat's-eyes, and two others that showed weak asterism (four- and six-rayed stars). These samples were represented as being from the Picos de Europa deposit in Spain, by far the world's most important source of gemmy sphalerite.

We identified the stones as sphalerite based on the following gemological properties: RI—over the limit of a standard refractometer, SG—4.08, optic character—isotropic, UV fluorescence—inert, and no lines visible with a handheld spectroscope. They ranged from yellow to orange, often showing both colors.

Figure 16. The cat's-eye and star effects of these sphalerites (18 and 20 mm long) are due to scratches on the base that were probably created during polishing. Photo by J. Hyršl.

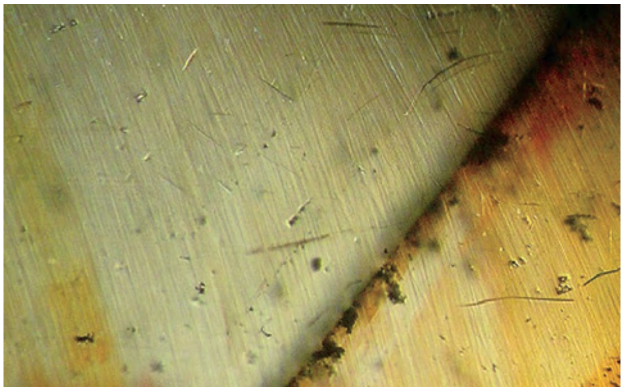

Figure 17. Polish lines on the bases of the sphalerite cabochons were responsible for the phenomena. Photomicrograph by J. Hyršl; field of view 2 mm.

With further examination, the origin of the chatoyancy and asterism became evident. When the cabochons were viewed with high magnification, tiny parallel polishing scratches were revealed on their bottom surfaces (figure 17). These scratches were usually slightly curved, resembling the striae characteristic of Verneuil synthetics. The best way to recognize the scratches was to sharpen the focus of the microscope. Because they were not three-dimensional, they could only be seen in one plane on the surface.

The cat's-eye and star effects shown by these sphalerites are very similar to the manufactured asterism described by S. F. McClure and J. I. Koivula ("A new method for imitating asterism," Summer 2001 *G&G*, pp. 124–128) and by K. Schmetzer and M. Steinbach ("Fake asterism—two examples," *Journal of Gemmology*, Vol. 28, No. 1, 2002, pp. 41–42). In this case, the phenomena probably were not intentional, because the gems were offered simply as cabochons, and not as star or cat's-eye sphalerites.

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Figure 18. At the Mozambique Gems processing plant, the washed gravels are placed on white tables for hand picking of the tourmaline. Photo by V. Pardieu.

Update on Cu-bearing tourmaline mining in Mozambique. The Mavuco area of Mozambique is famous for producing large quantities of Paraíba-type tourmaline, particularly in 2006–2007 (see, e.g., B. M. Laurs et al., "Copper-bearing [Paraíba-type] tourmaline from Mozambique," Spring 2008 *G&G*, pp. 4–31). Most of the stones have come from artisanal miners, although one company—Mozambique Gems, owned by Moses Konate—has been preparing for a major mechanized operation. In September 2009, these contributors visited the Mozambique Gems claim and documented these developments.

There were 45 people actively working at the mine, including six Brazilian technicians who constructed the washing plant. After two years in construction, this washing plant became fully functional in June 2009. Preliminary mining has taken place in open pits in three areas of the claim that were dug in June-July 2009. The laterite overburden was removed using an excavator, and the gem-bearing gravel (locally called "cascalho") was stockpiled and washed. The company's goal is to process six to eight truckloads (each about 20 tonnes) of material per day.

The processing of the gravels begins with two powerful water cannons that wash out the mud and fine-grained sediments. The muddy water is routed to a series of basins that act as settling ponds and reservoirs for the dry season. The gravels are sorted through a number of vibrating screens, each with mesh that is progressively smaller, and the sized material is spread onto white tables for handpicking of the tourmaline (figure 18). The gems are placed in secure boxes under the sorting tables.

According to production records provided by mine personnel, the first two months of operation yielded >180 kg of black tourmaline and 8 kg of colored Paraíba-type tourmaline. Most of the colored tourmaline (about 70%) was small (i.e., <2 g; see figure 19), although some fine clean pieces up to 30–40 grams were found. An average of 100–300 g of Paraíba-type tourmaline were produced daily, on a shift of 20 days per month; the best daily production has approached 2 kg. The material is sent to Brazil where it is cleaned with acid, heat treated, and then faceted.

No mechanized mining activity was seen outside the Mozambique Gems claim. Areas to the south and west of the claim were worked by independent miners from 2005 until early 2009, when the deposits were considered exhausted. These diggings, referred to as the Banco area, were the source of most of the Mozambique Cu-bearing tourmaline that entered the world markets, particularly in Bangkok and Hong Kong. After the Banco was exhausted, the miners attempted to invade the Mozambique Gems claim. In response, the police removed them from the entire area. Nevertheless, some illegal digging continues to take place at night, as revealed by a few freshly dug pits in the Banco area.

Mozambique Gems has continued its commitment to mine their claim in a professional, environmentally responsible manner that benefits the local community and minimizes impact on the area they are mining. The company will remediate the open pits by filling them with stockpiled soil and planting cashew nut trees. Their entire project appeared quite ambitious and well managed. If ultimately successful, it will serve as a positive example to follow in Mozambique and elsewhere in Africa.

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New find of pink-to-red tourmaline in Nigeria. Western Nigeria has been an important source of fine-quality gem tourmaline for several years, particularly of pink stones in the late 1990s (Winter 1998 Gem News, pp. 298–299). Recently, a significant deposit of pink-to-red tourmaline was found in the Oyo Valley of western Nigeria, according to Bill and Richard Barker (Barker & Co., Scottsdale, Arizona). In August 2009, they obtained a 20 kg parcel of this tourmaline that was notable for its high transparency and bright coloration. The largest piece weighed 7 kg and contained abundant gem-quality transparent areas (figure 20). It was so big (up to 28 cm in diameter and nearly 13 cm thick) that a large tile saw was required to make the initial cuts. As of November 2009, ~1,000 stones had been polished, weighing nearly 7,000 carats. Cutting of the stones to contain relatively few inclusions resulted in an overall yield of approximately 15%. The material fell into three main color groups: slightly purplish red (50%), darker red (10%), and "bubble gum" pink (40%). The largest stone weighed 53.45 ct, and several more were produced in the 20–40 ct range, as well as numerous calibrated goods ranging from 3 mm rounds to 14 × 10 mm ovals and cushions. The abundance of clean material showing consistent color has facilitated the creation of several necklace suites (e.g., figure 21).

Figure 19. The Cu-bearing tourmalines are recovered as waterworn pebbles in a variety of colors. Here, unheated stones are shown together with descriptions of their predicted coloration after heat treatment. Photo by V. Pardieu.

Figure 20. This 7 kg tourmaline from Nigeria's Oyo Valley contains large areas of clean, brightly colored gem material. Photo by Richard Barker.

According to Mr. Barker's supplier in Nigeria, the deposit shows good potential for yielding additional pink-to-red tourmaline for the jewelry market.

Brendan M. Laurs

SYNTHETICS AND SIMULANTS

Hydrothermal synthetic emerald sold as natural rough from Russia. Recently, the Dubai Gemstone Laboratory received an ~21.8 g intense green sample for identification (figure 22). The client who submitted the piece said it was selected from a parcel of some 800 g that had been repre-

Figure 21. The 17 Nigerian tourmalines in this necklace set (7.84–24.00 ct; total weight ~250 carats) and the other stones in the center show the bright color and transparency of this new material. Photo by Robert Weldon.

sented as natural Russian emerald. He thought the parcel might consist of assembled material because all the crystals showed a noticeable colorless layer in their centers.

Figure 22. This ~21.8 g sample, represented as natural emerald from Russia, proved to be a cleverly fashioned hydrothermally grown synthetic. The view on the right reveals the presence of a colorless seed plate. Photos by S. Singbamroong, © Dubai Gemstone Laboratory.

The sample had a hexagonal prism shape and a rough-textured surface with small patches of an off-white clay-like material on the "prism faces"; the colorless layer reported by the client was easily visible (again, see figure 22). This layer had the typical appearance of a seed plate used to grow hydrothermal synthetic emerald, rather than the separation plane that is common in assembled stones. The sample also had an uneven, undulated surface on one of the "prism faces," oriented parallel to the seed plate (figure 23). When viewed with magnification while immersed in benzyl benzoate, it displayed wavy growth patterns and planar zoning parallel to the seed plate (figure 24). All of these features are characteristic of hydrothermal synthetic emerald. Also present were stress cracks near the contact zone between the seed and the overgrowth. Fourier-transform infrared (FTIR) spectroscopy and EDXRF analysis confirmed the emerald's hydrothermal synthetic origin.

This sample had clearly been fashioned to resemble natural emerald rough. A buyer with no experience or access to laboratory expertise could make a costly mistake when presented with this material in the field.

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Figure 23. An uneven, undulated surface, such as that commonly observed on hydrothermal synthetic emerald, is present on one of the "prism" faces. Photomicrograph by S. Singbamroong, © Dubai Gemstone Laboratory.

High-RI barium-zirconium glass imitation of peridot and other gems. A 36 ct green oval modified brilliant (figure 25), thought to be peridot, was sent to Gemlab for identification. The very high brilliance and dispersion were more consistent with zircon than peridot. However, microscopic observation indicated that the sample was isotropic and free of inclusions except for a gas bubble ~25 μm in diameter, which indicated either glass or a melt synthetic.

When examined between crossed polarizers, the sample showed no strain pattern. Its RI was above the limit of the refractometer (>1.81), and the hydrostatic SG was 4.65. It was inert to long- and short-wave UV radiation, and also to the high-power UV excitation of the Gemlab UV microscope prototype (245–385 nm broadband emission, 200 W xenon source).

The sample's infrared reflectance spectrum (figure 26) did not correspond to that of ordinary lead-oxide silica glass, which would have explained the optical properties. The only matching reference spectrum belonged to a barium glass that was analyzed some time ago. EDXRF spectroscopy revealed that the sample was indeed barium rich, and it contained significant quantities of zirconium, plus some hafnium and germanium. Interestingly, this glass had almost no silicon. Barium-rich glass has been identified before (Winter 2005 GNI, pp. 362–363), but it was chemically and optically different from the high-RI glass described here. A glass with similar optical properties (RI = 2.0 and SG = 4.59) seen in green and other colors was reported in the Winter 1993 GNI section (p. 289), but no chemical composition was given.

Very seldom seen as a gem imitation thus far, this attractive barium-zirconium glass may become more com-

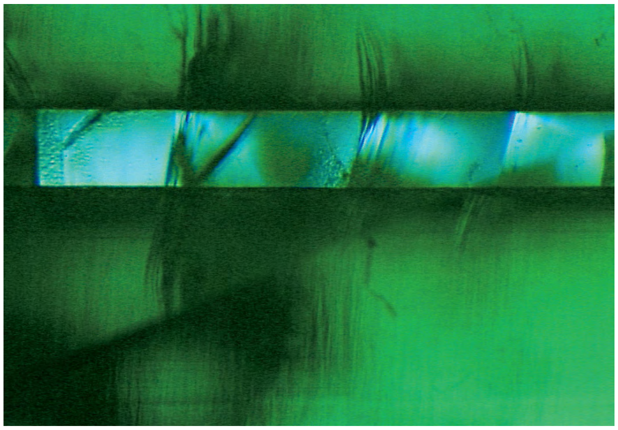
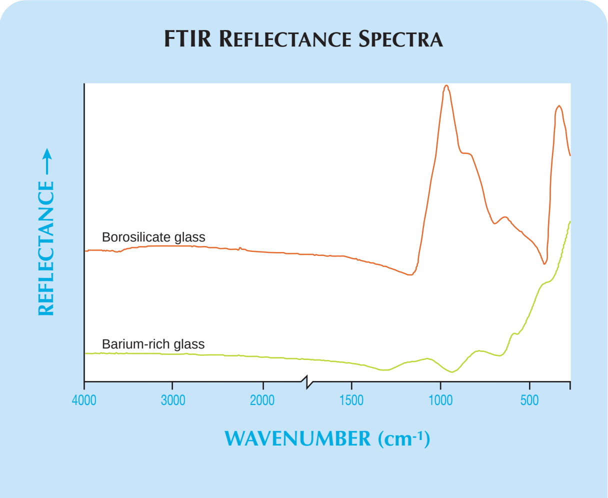


Figure 24. Immersion reveals wavy growth patterns and planar zoning parallel to the colorless seed, and also stress cracks near the seed, in the synthetic emerald "crystal." Photomicrograph by S. Singbamroong, magnified 18×; © Dubai Gemstone Laboratory.

Figure 25. This brilliant, dispersive green sample, sold as peridot, is actually a barium-rich glass. Photo by T. Hainschwang.

Figure 26. Reflectance FTIR spectroscopy showed that the barium-rich glass in figure 25 is very different from the reference sample of the more commonly seen borosilicate glass.



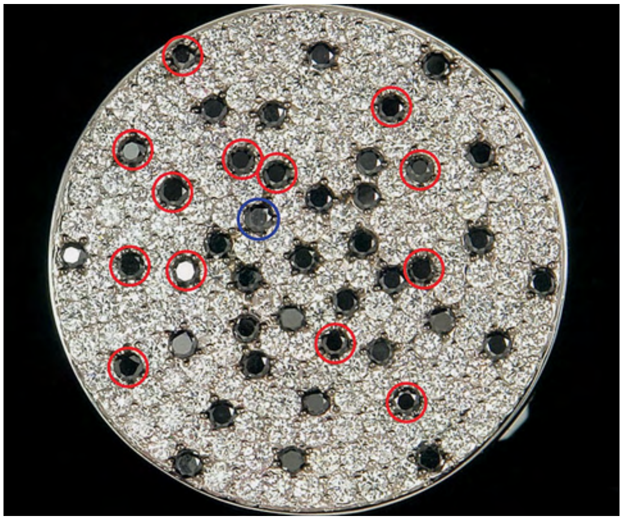


Figure 27. In this ring, the 13 red circles are black diamonds and the other 30 black stones are synthetic moissanite, one of which has crystalline silicon inclusions (blue circle). Photo by Li Haibo.

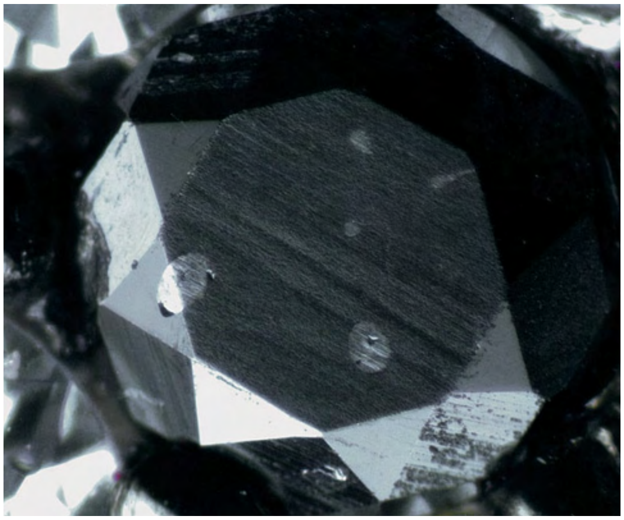


Figure 28. Five inclusions of crystalline silicon (the areas with silvery luster) are seen in the table of this black synthetic moissanite. Photomicrograph by Li Haibo; magnified 50×.

mon in the trade as an imitation of stones such as demantoid, zircon, and peridot.

Thomas Hainschwang

Silicon inclusions in black synthetic moissanite. After black-and-white jewelry became fashionable in the late 1990s, the demand for black diamonds soon exceeded supply. As a result, more treated black diamonds and black diamond simulants have entered the market. In February 2009, Japan's GAAJ-Zenhokyo laboratory issued an advisory regarding black synthetic moissanites mixed with black diamonds in jewelry (H. Kitawaki, "Lab Alert: Black moissanite," February 2, 2009, www.gaaj-zenhokyo.co.jp/researchroom/kanbetu/2009/2009_01_02-01en.html).

Recently, 21 pieces of black-and-white diamond jewelry were submitted to our laboratory by a single client for identification reports. We examined all the stones with standard gemological testing and FTIR and Raman spectroscopy. These techniques proved that 10 of the jewelry pieces contained black synthetic moissanite—229 of the 1,690 black samples we studied (see, e.g., figure 27).

Microscopic observation of genuine black diamonds with fiber-optic illumination typically reveals black needle-like inclusions of graphite scattered throughout. Black synthetic moissanite, however, is opaque even under strong light, and it also typically displays a rough surface, blunt facet edges, and various growth defects (i.e., cavities, micropipes, etc.) that are very different from diamond (Zhang Beili, *Systematic Gemmology*, Geological Publishing House Press, Beijing, 2006). Interestingly, more than 20 of the 229 black synthetic moissanites identified contained irregular-shaped surface-reaching inclusions with a silvery luster in reflected light (figure 28).

Raman spectroscopy of these inclusions identified them as crystalline silicon. To our knowledge, silicon inclusions in black synthetic moissanite mixed with black diamond jewelry have not been reported previously. They suggest that these black synthetic moissanites were not grown by the seeded sublimation process used to produce typical near-colorless synthetic moissanite for jewelry use, in which SiC is vaporized and then condensed without ever passing through the liquid state (K. Nassau et al., "Synthetic moissanite: A new diamond substitute," Winter 1997 *G&G*, pp. 260–275). Silicon inclusions have not been reported in synthetic moissanite grown by seeded sublimation, but they are known in synthetic moissanite grown by the physical vapor transport (PVT) technique in China (see Zhi-Zhan Chen et al., "Growth of large 6H-SiC single crystals," *Journal of Inorganic Materials*, Vol. 17, No. 4, 2002, pp. 685–690). Therefore, the black synthetic moissanites in this study were probably grown with the PVT technique.

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Dyed sillimanite as an emerald imitation. The Gemlab laboratory recently received for analysis three stones (figure 29, left) that had been purchased in India from a dealer who guaranteed they were natural, untreated emeralds. Ranging from ~14.5 to 43.75 ct, they were translucent and had a saturated green color. Significantly, they appeared to be filled with fibrous inclusions. Microscopic examination showed that these fibers were not inclusions; rather, the material itself had a fibrous structure (figure 29, right). Further, the green color was concentrated within this structure, indicating that the material was not emerald but a dyed imitation.

The samples were analyzed by FTIR spectroscopy, first

Figure 29. These three dyed sillimanites were represented as emeralds (left). With magnification, their fibrous structure showed green color concentrations, indicating the presence of dye (right, image width 11.5 mm). Photos by T. Hainschwang.

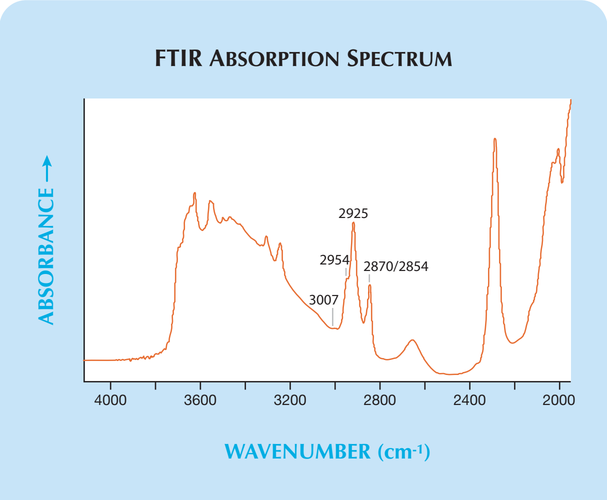


Figure 30. The FTIR absorption spectra of the sillimanite indicated significant amounts of oil, as shown by the labeled peaks.

in reflectance mode to determine the mineral species and then in transmission mode to detect any organic substances. The reflectance spectra identified all three samples as sillimanite (Al_2SiO_5). The absorption spectra showed that they contained significant quantities of oil (figure 30). Dyed sillimanite has reportedly been used to imitate a variety of materials (see, e.g., Fall 2005 GNI, p. 274). Due to its fibrous structure (which gives it the commonly used name *fibrolite*), sillimanite easily accepts dyes, allowing colored oils to penetrate deep into the stone.

Thomas Hainschwang

TREATMENTS

Dyed pink alabaster. A massive variety of the mineral gypsum ($CaSO_4 \cdot 2H_2O$), alabaster is usually colorless, white, or gray, with various shades of yellow, red, brown, or even black due to impurities. Gypsum has a Mohs hardness of 2 and is therefore too soft for use as a gem, but it has been fashioned into beads and carvings. Recently, however, a cabochon of alabaster (figure 31) was submitted to the Gem Testing Laboratory of Jaipur for identification, and it had an unexpected orangy pink color.

At first glance, the 14.32 ct specimen (17.59 × 12.86 × 8.07 mm) resembled chalcedony or opal because of its translucency. However, its luster was much too dull, and it had a distinctive waxy appearance. Fine chips on the dome revealed a powdery white composition (again, see figure 31). The powder was easily removed when wiped with a finger, indicating a very low hardness; this was confirmed by scratching an inconspicuous part of the cabochon with a fingernail. Hence, the specimen could not have been opal or chalcedony.

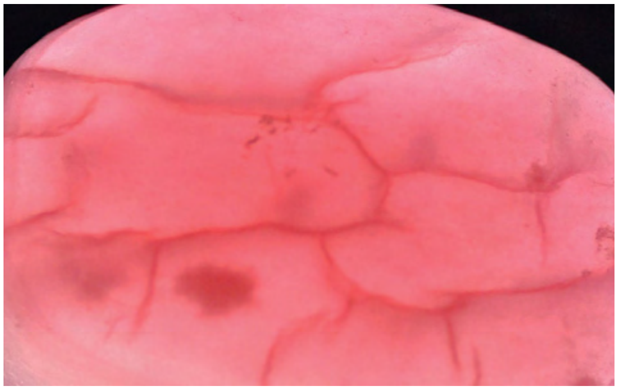
Such low hardness pointed to gypsum, which was confirmed by the spot RI of 1.52 and hydrostatic SG of 2.31. It had a patchy yellow-orange reaction to UV radiation, with a stronger reaction to long-wave. Viewed with the desk-model spectroscope, the sample displayed two closely spaced bands in the green region. This absorption pattern is associated with some red dyed quartz, supporting the

Figure 31. This 14.32 ct alabaster cabochon proved to be dyed; note its resemblance to opal or chalcedony. Also note the whitish chipped areas on the dome due to its very low hardness. Photo by G. Choudhary.

possibility that the alabaster was dyed. With magnification, the stone clearly exhibited concentrations of red and pink in surface-reaching fractures (figure 32). Color variations also were observed in the form of curved bands, with darker zones of concentrated dye in some areas and portions of the original white bodycolor clearly visible in others (again, see figure 32).

The sample's FTIR spectrum displayed complete absorption up to ~5300 cm^{-1}, and bands from 5800 to 5400 cm^{-1} and 6700 to 6300 cm^{-1}. This pattern resembled that of a colorless gypsum in our database, and it is commonly associated with other hydrous minerals. The complete absorption of wavelengths in the 3200–2700 cm^{-1} region precluded the detection of any absorption features related to organic dyes or other substances such as wax. Qualitative EDXRF analyses revealed the expected S and Ca, and traces of Sr, but no elements related to a coloring agent were detected.

Figure 32. Surface-reaching cracks in the dyed alabaster displayed concentrations of red and pink. See also the curved color banding on the lower left. Photomicrograph by G. Choudhary; magnified 10×.



Dyed gypsum was mentioned in the Summer 1963 issue of *G&G* (R. Crowningshield, "Developments and Highlights at the Gem Trade Lab in New York," p. 44) and in the Fall 1964 *G&G* (R. T. Liddicoat, "Developments and Highlights at the Gem Trade Lab in Los Angeles," p. 219); the latter report stated "A group of pieces of inexpensive antique jewelry contained green and pink colored beads that proved to be dyed-and-heavily-waxed alabaster." Although the luster of the present cabochon also suggested that wax had been applied in addition to dye, there was no evidence of wax seen when the sample was scratched, and hot point testing was not performed.

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CONFERENCE REPORTS

31st International Gemmological Conference. Approximately 70 delegates, observers, and guests participated in this meeting October 8–14, in Arusha, Tanzania. Some of the presentations are summarized here.

George Bosshart (Horgen, Switzerland) reported on the use of new 3D visualization methods in the transition from open-pit to underground mining at the Argyle diamond mine, which will extend its life beyond 2018. **Thomas Hainschwang** (Gemlab Laboratory, Balzers, Lichtenstein) compared near-colorless type Ia and IIa diamonds irradiated by neutrons or electrons, before and after annealing. The brown color in irradiated/annealed diamond is caused by a stable defect consisting only of vacancies, possibly similar to the vacancy cluster that is likely responsible for brown color in untreated diamond. Dr. **Yuri Shelementiev** (Moscow State University [MSU] Gemmological Center, Moscow) presented a hardware and software package for the objective grading of polished diamonds. He demonstrated the Helium Polish scanner for obtaining precise three-dimensional diamond models, the use of DiamCalc software for grading color and cut, and the M-Box system with Oxygen software for mapping inclusions. **Maxim Viktorov** (MSU Gemmological Center) advocated applying 3D modeling and computer analysis to improve existing classification systems of rough diamond. **Dr. Joe Yuan** (Sun Yat-sen University, Guangzhou, China) predicted that we will soon see hybrid natural/synthetic CVD diamond, produced by growing a layer of CVD material over the sawn face of a natural diamond.

Dr. Walter Balmer (Department of Geology, Chulalongkorn University, Bangkok) reported on the geology of marble-hosted ruby deposits from Morogoro, Tanzania. Their mineral inclusions resemble features in rubies from Mogok (Myanmar) and Luc Yen (Vietnam).

Thanong Leelawatanasuk (Gem and Jewelry Institute of Thailand, Bangkok) presented data on natural and heat-treated rubies from a new occurrence in Mozambique (exact locality not specified). The chemical composition appears similar to that of Winza (Tanzania) rubies, but the stones contain locality-specific internal features, such as lamellar twins and intersecting growth tubes. **Dr. Dietmar Schwarz** (Gübelin Gem Lab, Lucerne, Switzerland) compared properties of emeralds from Southeast Asia and China with those from Colombia; though Chinese emeralds may show three-phase inclusions, their UV-Vis spectra are distinctly different due to the presence of Fe^{2+}. **Julien Feneyrol** (CRPG, Nancy-Université, France) described the geology and chemical composition of tsavorite from Lemshuku/Komolo and Namalulu, Tanzania, where the garnet crystallized in veins associated with altered graphitic gneisses near dolomitic marbles. **Dr. Xin-Qiang Yuan** (Gemological Institute of China University of Geosciences, Wuhan) reported on his research into the separation of untreated from irradiated blue topaz by cathodoluminescence, using colorless topaz as a reference.

Dr. Emmanuel Fritsch (University of Nantes, France) described causes of luminescence in opal. Blue luminescence is due to the combined emission of two centers, at 414 and 465 nm; green is seen when the uranium concentration exceeds 1 ppm. Luminescence is quenched by iron; no luminescence is observed when Fe exceeds 2000 ppm. **E. Gamini Zoysa** (Institute of Gemmological Sciences, Colombo, Sri Lanka) described white opal recently found in alluvial gravels in Balangoda, Sri Lanka. **Dr. Margherita Superchi** described bright yellow danburite, recovered in 2007–2008 from central Madagascar. The properties of this material are very similar to those of yellow danburite from Tanzania. **Tay Thye Sun** (Far East Gemological Lab, Singapore) presented data on yellow beryl sold in Hanoi and Ho Chi Minh City, which is suspected to have been irradiated.

Dr. Stefanos Karampelas (Gübelin Gemmological Laboratory, Lucerne, Switzerland) demonstrated the use of Raman spectroscopy to identify various mollusks associated with natural and cultured pearls according to characteristics of their pigments (both natural and treated color). **Dr. Michael Krzemnicki** (SSEF Swiss Gemmological Institute, Basel) reported on the use of X-ray micro-tomography to identify beadless cultured pearls. **This contributor** reported on a large pearl of 2,385 grains, which was purchased at auction in Amsterdam in 1778 and has been locked away in a Dutch private collection for most of the time since then.

Post-conference field trips were organized to the Williamson diamond mine, TanzaniteOne's operation at Merelani Block C, the Lake Manyara emerald/alexandrite deposit (figure 33), and the Longido ruby-zoisite mine.

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Figure 33. IGC paticipants toured this emerald and alexandrite mine near Lake Manyara in Tanzania. Photo by Vincent Pardieu.

2009 NAG Institute of Registered Valuers' Conference. This two-and-a-half-day conference, held September 19–21 by the National Association of Goldsmiths at the Loughborough University of Technology in England, was attended by 160 participants. Now in its 21st year, the annual event covers many aspects of gemstone and jewelry appraisal through a combination of presentations, panel discussions, and workshop sessions. This year's theme was color, with many of the presentations focusing on various aspects of colored stones, particularly color communication, identification, grading, and appraising.

A number of the workshops involved a combination of lectures and hands-on practical lab time with stones, reference materials, and tools. In addition, Dr. Sally Baggott and Craig O'Donnell (Birmingham Assay Office) conducted a session on famed silversmith Matthew Boulton, providing numerous examples of his work and highlighting his involvement in the establishment of the Birmingham Assay Office, which was founded in 1773. This year marks the bicentennial of Mr. Boulton's death. Another presentation was given by David Thomas, who was England's Crown Jeweller from 1991 to 2007. Mr. Thomas described what the position meant to him, how he attained it, and his role in ceremonial occasions. The talk was illustrated with images of some of the priceless pieces in the Royal Collection.

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ERRATUM

In table 1 of the Fall 2009 GNI entry on triphylite (pp. 229–230), the major-element contents measured by LA-ICP-MS were reported incorrectly (i.e., for P, Li, Fe, and Mn). We thank Dr. Karl Schmetzer for bringing this to our attention.