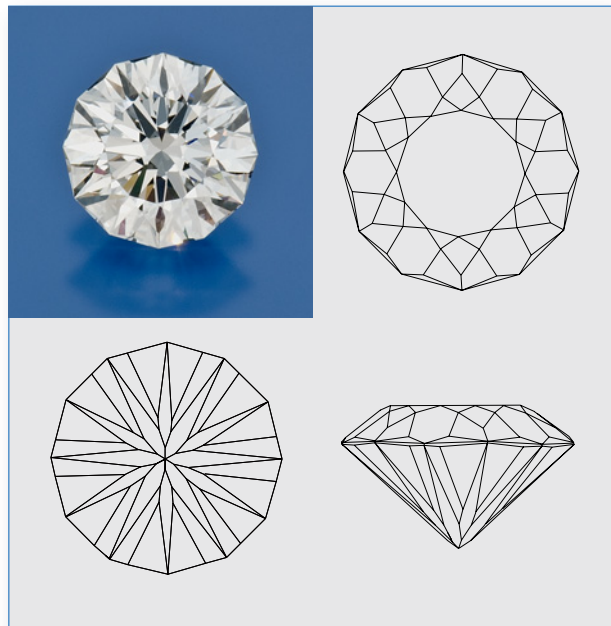


## DIAMONDS

**Unusual facet arrangement produces scalloped appearance in diamond.** Facet arrangement can have an important impact on a diamond's appearance. We recently had the opportunity to examine a stone cut by independent diamond cutter Zev Weitman (New York) that creates an interesting optical effect.

*Figure 1. In this unusual diamond cut, the stone has a scalloped appearance due to light leakage from the small crown facets adjacent to the upper edge of the girdle (1.19 ct, photo by Robert Weldon). The drawings of the stone's crown and profile show the placement of the triangular crown facets. Note in the profile view that the girdle facets are uneven in size.*



*Figure 2. Setting the diamond in figure 1 in a ring with the six prongs placed at alternate facet junctions emphasizes the scalloped-edge pattern. Photo by Robert Weldon.*

Mr. Weitman's bright and lively 12-sided modified round brilliant design appears to have a scalloped outline (figure 1). This visual effect is due to the presence of small, steep triangular crown facets near the girdle edge (figure 2). These facets are tilted to provide a direct light path through the stone. Since they "leak" light, they appear dark, which creates the scalloped appearance seen face-up.

This cut variation provides a challenge for jewelry designers: Four prongs upset the apparent six- or 12-fold symmetry, and bezels or heavy prongs hide the girdle and

*Editor's note: Interested contributors should send information and illustrations to Brendan Laurs at blaurs@gia.edu or GIA, The Robert Mouawad Campus, 5345 Armada Drive, Carlsbad, CA 92008. Original photos will be returned after consideration or publication.*

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Figure 3. These chrysocolla chalcedony samples (13.68–31.25 ct) were recently produced from the Acari mine in southern Peru. Photo by Robert Weldon.

this optical effect. Prongs set along the flat face of a facet can also hide the effect, but they can enhance it if carefully placed at specific facet junctions (see, e.g., figure 2). The optical effect is easiest to see when lighter prongs can be employed (as with pendants or earrings).

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## COLORED STONES AND ORGANIC MATERIALS

**Chrysocolla chalcedony from Acari, Peru.** The Acari copper mine in the Arequipa region, southern Peru, has become an

important source of gem materials such as “Andean” pink and blue opal and chrysocolla chalcedony (Summer 2006 Gem News International [GNI], pp. 176–177). During the past two years especially, the mine produced a significant amount of high-quality chrysocolla, ranging from green to blue, according to Hussain Rezayee (Rare Gems & Minerals, Beverly Hills, California). In April 2008, he received an initial rough parcel of 5 kg, from which he cut ~500 carats of cabochons weighing up to 5 ct; ~20% were translucent. Five months later, he obtained an additional 300 kg of “mine run” material in Peru, from which he cut an additional 4,000 carats of good-quality cabochons that ranged up to 30+ ct. The stones reportedly were mined by hand methods and have not undergone any treatments.

Mr. Rezayee loaned five cabochons (13.68–31.25 ct; figure 3) to GIA for examination, and the following properties were collected: color—green-blue and blue-green; diaphaneity—translucent; spot RI—1.54–1.55; birefringence—0.01; hydrostatic SG—2.63; and inert to both long- and short-wave ultraviolet (UV) radiation. The desk-model spectroscope showed a 650 nm cutoff, and no absorption lines indicative of dyeing. Microscopic examination revealed subtle spotty green inclusions, along with small fractures in some of the samples. These properties are consistent with those given for chrysocolla in the literature, except for the relatively high SG (compare to 1.93–2.40; R. Webster, *Gems*, 5th ed., revised by P. G. Read, Butterworth-Heinemann, Oxford, UK, 1994, pp. 399–400) and their homogeneous overall color appearance.

Chemical analysis by energy-dispersive X-ray fluorescence (EDXRF) indicated major amounts of Cu and Si, as well as traces of Pb and Fe in two of the samples. Infrared and Raman spectroscopy were performed to further characterize the samples. The IR spectra showed absorption

Figure 4. A kunzite crystal (the dark-appearing object) is carefully extracted from a gem pocket at the Oceanview mine in Pala, California (left). Illuminated by a miner’s lamp, this just-extracted kunzite crystal shows fine color (right). Photos by M. Mauthner.



peaks at  $\sim 7077$ ,  $5234$ ,  $4440$ , and  $2502\text{ cm}^{-1}$ , plus broad saturation at  $\sim 3708\text{--}2546$  and  $2405\text{--}800\text{ cm}^{-1}$ , as are typical of chrysocolla. The Raman spectra matched those of quartz in our database.

Ultraviolet-visible–near infrared (UV-Vis-NIR) spectroscopy can be used to detect dyed chrysocolla chalcedony (see A. Shen et al., “Identification of dyed chrysocolla chalcedony,” Fall 2006 *G&G*, p. 140) by calculating the ratio of the integrated intensity of the  $\text{Cu}^{2+}$  band to that of the structurally bonded OH band. Natural chalcedony colored by chrysocolla has a ratio between 7 and 44, while samples dyed with a copper solution have ratios from 0.5 to 3.0. The samples we examined had ratios from 33.5 to 54.7, confirming that they were not dyed.

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**Recent finds of kunzite in Pala, California.** California’s Pala pegmatite district, the type locality for kunzite (“lilac”-colored gem spodumene), still occasionally produces fine gem material. In December 2009, workers at the Oceanview mine (owned by Jeff Swanger, Escondido, California) broke into a significant spodumene-bearing pocket. Other mines in the district have produced gem spodumene since its discovery there in 1903, but this was the first such find at the Oceanview mine after nearly 10 years of regular part-time operation. The Elizabeth R mine, located nearby on the same pegmatite dike, produced small quantities of kunzite on several occasions during the 1980s and as recently as two years ago (Winter 2008 *GNI*, p. 373).

Shortly after the discovery of the aquamarine- and morganite-bearing 49er Pocket in September 2007 (see Spring 2008, *GNI*, pp. 82–83), workers found traces of pale kunzite in the footwall below the 49er stope. In November 2009, they recovered a few gem-quality kunzite crystals up to several centimeters long. Further mining entered a roughly  $2 \times 1.5 \times 1\text{ m}$  zone in December that produced 7+ kg of kunzite, more than a quarter of which was clean, deep-colored gem material (e.g., figure 4)—including a very limpid and well-developed crystal weighing over 300 g (figure 5). Some of the production has been sent to cutters, and a few dozen gems have been faceted so far (e.g., figure 6). More cutting material is in the possession of local dealers, and additional gems will undoubtedly find their way to the market in the future.

Just before this issue went to press, on June 28 the miners opened another kunzite pocket. However, this one was larger and contained spodumene ranging from “lilac” to pale blue-green to green, as well as some gem-quality green, pink, and bicolored tourmaline. The largest spodumene crystal uncovered so far measured  $\sim 20 \times 10 \times 1.5\text{ cm}$ . More information and photos from this pocket are available in the *G&G* Data Depository ([gandg.edu/gandg](http://gandg.edu/gandg)).

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Figure 5. These kunzite crystals (the largest is 11.2 cm tall) were recovered from the Oceanview mine in December 2009. Photo by M. Mauthner.

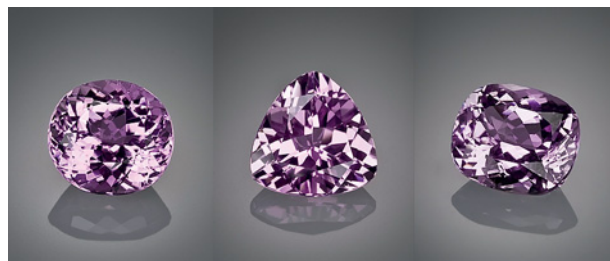


Figure 6. These kunzites (6.0, 7.5, and 6.5 ct) were faceted from material found recently at the Oceanview mine. Photos by M. Mauthner.

**Natural pearls of the Pectinidae family: Review and origin of color.** Interest in non-nacreous natural pearls has been growing recently, mainly because of the attractive structures they can exhibit (e.g., “flame” structures found in the *Strombus gigas* “queen conch” pearls). The Pectinidae (classified by Rafinesque, 1815) bivalves have been used for food and adornment since ancient times, and they are still harvested for their meat. Natural Pectinidae pearls can be found in *Placopecten magellanicus* (Gmelin, 1791), *Argopecten spp.* (Monterosato, 1889), and *Nodipecten spp.* (Dall, 1898); they are also known as “scallop” pearls (*The Pearl Book: Natural, Cultured & Imitation Pearls—Terminology & Classification*, CIBJO, Milan, Italy, 2010, 53 pp.). However, the best-known “scallop” pearls are those from *Nodipecten spp.* These bivalves are found mainly in Baja California and in the eastern Pacific. To our knowledge, no cultured pearls from mollusks of the Pectinidae family have been reported.

Scallop pearls range from white to “cream” white to light gray to yellow to brown, as well as pink to brownish purple (figures 7 and 8); the interior of the Pectinidae



Figure 7. These natural “scallop” pearls display a variety of colors, shapes, and qualities. The largest sample is 12.4 × 9.7 mm (8.45 ct). Courtesy of K. C. Bell; photo by Evelyne Murer.

shell can show similar colors. The pearls commonly measure up to 6 mm, and those larger than 12 mm are rare. They exhibit a variety of shapes; buttons, ovals, and drops are most common, sometimes circled. These shapes appear to be due to the pearls’ rotation during formation. Sometimes they vary in color along their rotational axis (e.g., figure 8, left).

Some scallop pearls present interesting macroscopic and microscopic structures (e.g., figures 8 and 9). These structures have been described as a segmented patchwork of cells, with each cell comprising three differently oriented subsegments (K. Scarratt and H. A. Hänni, “Pearls from the lion’s paw scallop,” *Journal of Gemmology*, Vol. 29, No. 4, 2004, pp. 193–203). This is probably because of their prismatic calcite microstructure, similar to that observed in some pearls from the Pinnidae family (“pen shell” pearls; see Fall 2009 GNI, pp. 221–223).

Raman spectroscopy of the scallop pearls in figure 8 (left) and several shells showed that their colored regions

contain a mixture of unsubstituted polyenic (polyacetylenic) compounds. UV-Vis-NIR reflectance spectra of samples of various colors showed a gradual absorption from the UV to the NIR region, with the polyenic pigments absorbing in the blue and green portions of the spectrum. The specific color of each pearl seems to be due to the relative intensities of these absorptions. To the best of our knowledge, colored Pectinidae are the only gem-quality natural pearls that consist of calcite and contain polyenic pigments. Similar pigments with calcitic structures are observed in *Corallium spp.* corals.

*Acknowledgments:* The authors are grateful to Thomas Hochstrasser (Hochstrasser Natural Pearls, Dörflingen, Switzerland) and K. C. Bell (KCB Natural Pearls, San Francisco) for supplying pearls for this study.

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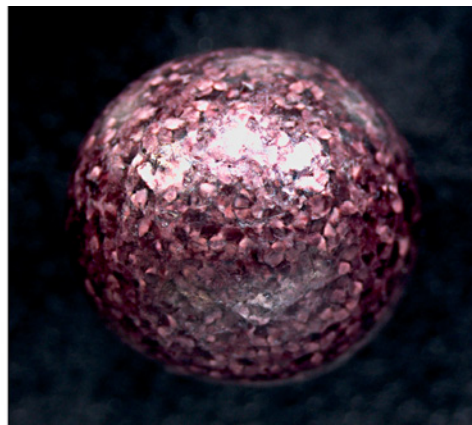


Figure 8. Scallop pearls are non-nacreous and exhibit a range of colors. The yellowish brown sample in the left photo is 6.8 × 4.1 mm, and the brownish purple pearl in the right image is 7.5 × 7.2 mm. Courtesy of Gübelin Gem Lab, K. C. Bell, and Gemlab; photos by Evelyne Murer (left) and T. Hainschwang (right).

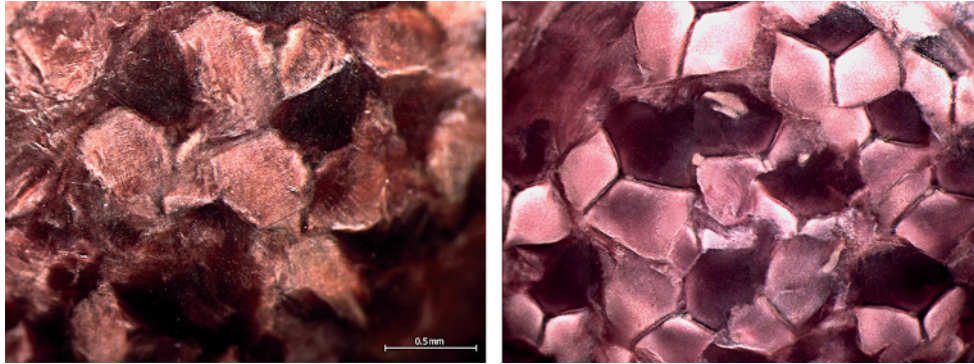


Figure 9. The structures observed in these scallop pearls are due to the arrangement of the calcitic prisms. Photomicrographs by T. Hainschwang; width of right image is ~2 mm.

**More on ruby from Cabo Delgado, Mozambique.** In April 2010, these authors visited the ruby mining site in Cabo Delgado Province, east of Montepuez, in northern Mozambique (see Winter 2009 GNI, pp. 302–303). Our associates in the evaluation of the deposit were Trevor Robson (Lusaka, Zambia) and Jeremy Rex (Transglobe, London). Located on a private game farm, the concession has been granted to Mwiriti Mining, based in Pemba. We were hosted and guided by Mwiriti's Carlos Asghar. Mwiriti employs 15–20 people and has an active exploration and mining program under way, but the deposit has been overrun by illegal miners. In fact, we saw several shafts (up to 20 m deep) they had sunk. As many as 4,000 illegal miners have been evicted in recent months, with several arrested while we were at the deposit. A number of foreigners have also been arrested while attempting to smuggle the rubies out of Mozambique.

Our exploration activities revealed that the rubies are hosted by eluvial material as well as the underlying weathered bedrock. The bedrock consists of the Montepuez Complex, a Neoproterozoic suite of metamorphosed sedimentary rocks (amphibolite-grade schists and gneisses) that were intruded by granite, granodiorite, and tonalite. In the deeply weathered area we examined, the eluvium appeared to lie directly on Montepuez gneisses, which were crosscut by light-colored veins (now mostly weathered to clay; figure 10). These veins ranged up to 20 cm thick, and probably originally consisted of syenitic (silica-deficient) pegmatites and aplites. Ruby was seen in these veins and also in the overlying boulder-rich eluvium. The miners dig pits in the lateritic soil to search for light-colored, sand-rich layers that are indicative of underlying boulder beds (figure 11). We recovered the crystals in figure 12 from the eluvial deposits. Their tabular euhedral form is characteristic of the ruby crystals from this area.

The Montepuez deposits appear to extend over a large region. Mwiriti's concession includes licenses for six contiguous properties that cover an area of 11,060 hectares. Additional ruby finds have been reported nearby, but outside of the concession. Reliable local sources told us that rubies of similar color and character were being recovered 10–20 km from the site we visited.

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**Ruby, sapphire, and spinel mining in Vietnam: An update.** After intense activity during the 1990s (see, e.g., R. E. Kane et al., "Rubies and fancy sapphires from Vietnam," Fall 1991 *G&G*, pp. 136–155; R. C. Kammerling et al., "Update on mining rubies and fancy sapphires in northern Vietnam," Summer 1994 *G&G*, pp. 109–114), gem mining in Vietnam slowed considerably in the 2000s. During three expeditions, in January and May of 2009 and April 2010, these authors were accompanied by Philippe Ressigeac (France), Jean Baptiste Senoble (Switzerland), Lou Pierre Bryl (Canada), Kham Vannaxay (Thailand), Tracy Lindwall (USA), Jazmin Amira Weissgärber Crespo (Germany), and David Bright (USA), to visit most of Vietnam's ruby, sapphire, and spinel mines (figure 13) and collect specimens on-site for the GIA reference collection.

Today, most gem mining is performed by independent miners and local farmers who dig for gems when agricultural activity is low (generally March–June and October–January in the north, and December–March in

Figure 10. At the Montepuez ruby deposit, tabular crystals of corundum are hosted by deeply weathered light-colored veins that crosscut metasedimentary rocks. A clay-covered ruby crystal is being pointed out here, still in situ within a vein. Photo by L. W. Snee.





Figure 11. In the eluvial areas at Montepuez, the miners dig pits through dark gray/red overburden to reach the boulder-rich layers containing the ruby. These beds are usually found beneath light-colored sandy layers. Photos by L. W. Snee.

the south) using simple hand tools. In northern Vietnam's Yen Bai Province, ruby (mainly cabochon quality), star ruby, and dark red spinel are recovered sporadically around Tan Huang and Truc Lau, and on some islands in Thac Ba Lake. In addition, as of April 2010, an estimated 500 miners were working near the town of Yen The (e.g., figure 14), as well as the villages of An Phu and Minh Tien, in the Luc Yen district. Besides ruby, the main production consists of spinel of various colors, blue sapphire, and green tourmaline; blue spinel (figure 15) has become increasingly popular with buyers since 2007. Luc Yen's production of fine gems is limited, however. Its output consists predominantly of small gems and specimens destined for use in decorative items, such as marble carvings

Figure 12. These ruby samples were washed from a 1 kg concentration of corundum and mica that was excavated from eluvial material at Montepuez. Photo by L. W. Snee.



and gem paintings, which are popular in Asian markets. These goods provide a steady income for most miners, enabling them to keep working the area and hopefully find fine gems from time to time.

Beginning in 2010, some new operations were initiated in the Luc Yen district. Near An Phu, an Indian-Vietnamese joint venture (Vietnam Alliance Minerals Ltd.) secured an exploration license for the Cung Truoi and Mai Thuong areas, known for their ruby and spinel matrix specimens. At Truc Lau, an area known for large rubies and spinels, a private Vietnamese company (Doji Cie) is preparing for a mechanized operation.

Further south, around Quy Hop in Nghe An Province, some rubies and sapphires are being recovered from the Chau Hong area as a byproduct of tin mining. Gem mining around Quy Chau is limited to nighttime digging by a few illegal miners. Nevertheless, the Doi Thy ruby mine could reopen at the end of 2010.

In southern Vietnam, we witnessed small-scale mining of basalt-related blue, yellow, and green sapphires at Hong Liem near Phan Thiet (Binh Thuan Province), and also at Dak Nong (Dak Lak Province). In other areas around Di Linh (Lam Dong Province), former jungle-covered sapphire mining areas have been replaced by coffee plantations.

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**Sphene from northern Pakistan.** Attractive gem-quality sphene has been known from Pakistan's North West Frontier Province since mid-2004 (see Spring 2006 GNI, pp. 67–68). At this year's Arizona Mineral & Fossil Show (Hotel Tucson), Syed Iftikhar Hussain (Syed Trading Co., Peshawar, Pakistan) had some faceted sphene from a new locality in Pakistan: the Shigar Valley area, which is



Figure 13. Vietnam's main ruby, sapphire, and spinel localities are shown on this map. Adapted from Kane et al. (1991).

already famous for its production of aquamarine, topaz, black tourmaline, and other minerals. The sphene deposit is reportedly located near Niesolo in the Basha Valley, which is situated within Pakistan's Gilgit-Baltistan territory (formerly known as the Northern Areas). Sphene was initially found there in 2008, and Mr. Hussain knew of ~7 kg of crystal fragments containing gem-quality areas. Although stones weighing 25–30 ct could be cut, they appeared too dark above 6–7 ct. The ~160 faceted stones



Figure 14. This small ruby mining operation is located in Khoan Thong Valley, west of Yen The town, in the Luc Yen district. This area was worked by Thai companies during the 1990s. Photo by V. Pardieu, April 2010.

that Mr. Hussain had in Tucson showed fairly consistent color (figure 16), appearing yellowish green in daylight and brownish green in incandescent light.

Brendan M. Laurs

Figure 15. These blue spinels were mined in Vietnam's Luc Yen district. The largest faceted stone weighs ~2 ct. Photo by V. Pardieu, January 2009.





Figure 16. These spinels (up to ~1.7 ct) are reportedly from a new locality in northern Pakistan's Shigar Valley area. Photo by Jeff Scovil.

**Spinel from Bawma, Myanmar.** Fine-quality spinel has been known from Myanmar for many years, especially in bright red hues. Recently Hussain Rezayee informed us about a new find of orangy red to purplish red spinel near the village of Bawma in the Mogok area of Myanmar. He

Figure 17. These spinels (0.35–3.52 ct) were cut from a piece of rough that was recently found at a new deposit in the Mogok area of Myanmar. The 0.59 ct stone is GIA Collection no. 38203; photo by Robert Weldon.



was told that a total of 1–2 kg of facetable rough were produced in October–November 2009 before the mine was closed by the government. Although transparent pieces up to 20 g were found, most of the material was too dark for cutting attractive stones in large sizes.

From a 6.8 g piece of rough, Mr. Rezayee cut five spinels weighing 0.35–3.52 ct (figure 17), which he supplied to GIA. The following properties were recorded: color—red; RI—1.718; hydrostatic SG—3.60; fluorescence—weak-to-moderate red to long- and short-wave UV radiation; and a broad absorption observed in the green region along with a sharp absorption line at 684 nm visible with a desk-model spectroscope. Microscopic examination revealed “fingerprints” composed of minute octahedral negative crystals. All properties and observations were consistent with natural red spinel. Raman photoluminescence spectra showed no indications of heating (see background on this technique in the Lab Note on pp. 145–146 of this issue).

During a recent trip to Myanmar, Mr. Rezayee was told that the Burmese government may be planning to mine the deposit in a joint venture with private companies, so additional production seems likely.

*Editor's note:* Consistent with its mission, GIA has a vital role in conducting research, characterizing gemstones, and gaining knowledge that leads to the determination of gemstone origins. The gemstones studied in this report are not subject to the Tom Lantos Block Burmese JADE Act of 2008, and their import was in accordance with U.S. law.

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**Tsavorite and other green garnets reportedly from Afghanistan.** In December 2008, Farooq Hashmi (Intimate Gems, Jamaica, New York) loaned GIA some green gem material that was sold to him as garnet in Peshawar, Pakistan. He purchased it several years ago, and was told it came from Kala, Kunar Province, Afghanistan. He reported seeing several parcels over the years in Peshawar, although the pieces tended to be small, mostly suitable for cutting melee stones.

Examination of the 18 rough samples (0.08–0.21 g) and three faceted stones (0.09–0.20 ct; figure 18) revealed the following properties: color—medium-light to medium-dark yellowish green to green; RI—1.74 to 1.77 (spot readings of the rough samples fell within this range); hydrostatic SG—3.43–3.64; fluorescence—inert to long-wave UV radiation, and inert to very weak orange to short-wave UV; and absorption bands or cutoffs at 440 nm visible with the desk-model spectroscope. These properties are consistent with those reported for grossular to grossular-andradite garnet, although some of the SG values are somewhat low (as compared to the 3.57–3.66 range reported by C. M. Stockton and D. V. Manson, “A proposed new classifica-





Figure 18. These samples of grossular to grossular-andradite are reportedly from Afghanistan. The faceted stones weigh 0.09–0.20 ct, and were cut by Matt Dunkle; the two darker green ones are tsavorite. Photo by Jian Xin (Jae) Liao.

tion of gem-quality garnets," Winter 1985 *G&G*, pp. 205–218). EDXRF spectroscopy of all the samples revealed major amounts of Ca, Al, and Si, with minor Mn, Fe, Ti, Cr, Cu, and Zn. Microscopic examination revealed needles, liquid inclusions, partially healed "fingerprints," dark crystal inclusions, and iron staining.

Some of these samples of grossular to grossular-andradite were green enough to be considered tsavorite. We are unaware of tsavorite from Afghanistan being previously produced.

*Erica Emerson and Jason Darley*

## SYNTHETICS AND SIMULANTS

**An unusual lab-grown garnet: Calcium niobium gallium garnet.** There are two species of green laboratory-grown garnets that gemologists sometimes encounter: yttrium aluminum garnet (YAG) and gadolinium gallium garnet (GGG). Occasionally, though, a less familiar manufactured garnet will come through the laboratory.

A 5.43 ct green stone resembling tsavorite (figure 19) was submitted to AGL for an origin report. The following gemological properties were recorded: singly refractive with weak anomalous double refraction; RI—over the limits of the standard refractometer; hydrostatic SG—4.73; and no reaction to long- or short-wave UV radiation. When examined with a desk-model spectroscope, it showed general absorption to 470 nm, with bands centered at 585, 625, and 670 nm. Microscopic examination showed no inclusions or growth structures. Although the client believed it was demantoid, this was not supported by the SG value or spectrum.

EDXRF spectroscopy revealed major amounts of gallium and niobium, with minor Ca. (Oxygen, a light element, is not detectable with this instrument.) The FTIR spectrum



Figure 19. This 5.43 ct green sample proved to be calcium niobium gallium garnet, a lab-grown product with no natural counterpart. Photo by Bilal Mahmood.

showed one distinct peak at  $3532\text{ cm}^{-1}$  and a smaller, broader peak at  $3448\text{ cm}^{-1}$ ; it had some similarities to other lab-grown garnets in our database, but did not match any of them precisely. Based on these properties, we identified the sample as calcium niobium gallium garnet.

Like YAG and GGG, calcium niobium gallium garnet has industrial use as a lasing material. Since this lab-grown garnet has no known natural counterpart, it would not be considered a "true" synthetic, which is also the case with YAG and GGG.

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**Glass imitations of emerald with straight zones.** For centuries, glass has been the most widely used gem simulant. This versatile substance is capable of imitating almost any gem material—organic or inorganic, transparent or opaque, in any color—and possessing phenomena such as chatoyancy, sheen, adularescence, opalescence, orient, and color change. Gas bubbles, swirl marks, or devitrification effects are useful for identifying glass.

Recently, the Gem Testing Laboratory of Jaipur, India, received for identification the two green specimens in figure 20 (17.05 and 1.79 ct), which were submitted as emeralds. Although the stones' appearance initially suggested emerald, their exceptional color and clarity raised doubts regarding their origin.

Both specimens displayed anomalous double refraction in the polariscope, ruling out emerald. The 17.05 ct specimen had an RI of 1.730 and a hydrostatic SG of 4.36, while the 1.79 ct gem had an RI of 1.630 and an SG of 3.03. Both were inert to long- and short-wave UV radiation and displayed no absorption features in the desk-model spectroscope. These properties indicated glass.



Figure 20. These 17.05 and 1.79 ct specimens, represented as emerald, were identified as glass imitations. Photo by G. Choudhary.

Striking features were observed with magnification. Both specimens displayed a series of sharp, straight lines along their lengths (figure 21, left), which were visible with darkfield illumination but were much clearer when the stones were observed under immersion. Such straight lines are often associated with growth lines or zoning in natural gemstones. Viewed from different angles, some of these lines were revealed to be planes with sharp edges (figure 21, right). In addition, a few scattered gas bubbles were present in the 1.79 ct specimen.

These glass imitations were readily identified with classical gem testing instruments, but they may pose a problem for jewelers or field gemologists who attempt to identify them with only a 10× lens.

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**“Nanogems”—A new glass-ceramic material.\*** Glass-ceramic is a class of manufactured materials that consists of glass matrix and nanometer-size crystalline particles (oxides and silicates) that are grown within the matrix. It

has unusual physical properties—such as negative thermal expansion—that make it useful for specialized industrial applications. Glass-ceramic became known to the general public during the 1970s, when it was first used as a surface for cooking ranges. Until now, though, we have not seen glass-ceramic materials produced as gem simulants. One Russian manufacturer, Formica LLC (Moscow, with a factory in Bangkok), has developed a new glass-ceramic material that it calls “Nanogems.” According to the company, the material is available in a variety of colors, has a Mohs hardness of 7–7½, and its high thermal shock resistance makes it suitable for a variety of jewelry manufacturing processes.

At the 2010 Tucson show, Formica LLC donated four samples to GIA, consisting of two blue and two green brilliants ranging from 2.59 to 3.15 ct (figure 22). Standard gemological testing yielded the following properties: RI—1.621 (blue) and 1.629 (green); no dispersion evident; hydrostatic SG—3.02–3.07; aggregate reaction in the polariscope; fluorescence—inert to long-wave UV and inert (green samples) or weak white (blue samples) to short-wave UV, with no phosphorescence; spectroscopy spectrum—three distinct bands in the green, yellow, and red regions (blue samples) and two distinct bands in the orange and red regions (green samples). Microscopic observation revealed only a few pinpoint inclusions and conchoidal fractures in the green samples. However, all four showed prominent graininess, in most cases throughout the entire specimen (figure 23). When illuminated with a fiber-optic light source, all also had a somewhat milky appearance, as would be expected for light scattering from nano-crystals.

Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) of all samples indicated a mainly Mg-Ti-Zn-Zr alumino-silicate composition. The blue samples contained ~80 ppm Co and the green samples ~7000 ppm Ni. We believe these two elements are the

\*The original title read “Nanogems’—A new lab-grown gem material.” This was an improper use of the terms lab-grown and gem material. —Eds,

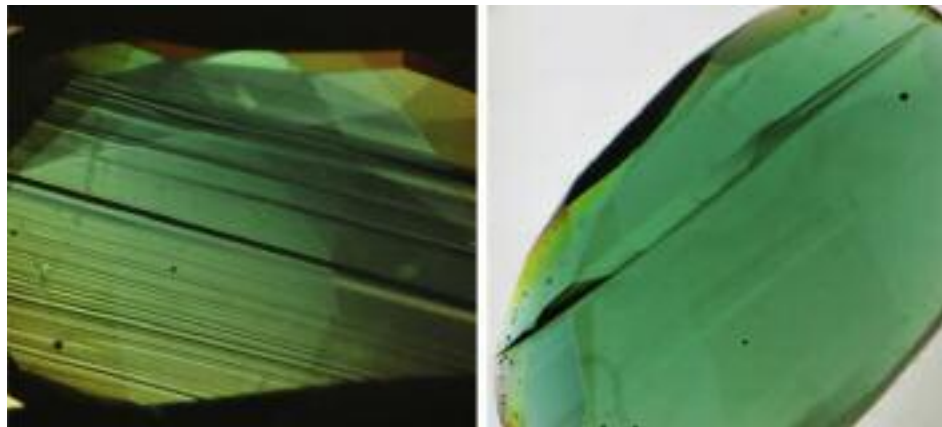


Figure 21. Both specimens in figure 20 displayed sharp, straight lines along the length of the gem, reminiscent of growth lines and zones in natural gemstones (left). Viewed from various angles, some of the lines were actually planes with sharp edges (right). Photomicrographs by G. Choudhary; magnified 45×.

main coloring agents. UV-Vis spectroscopy showed results equivalent to those seen with the desk-model spectroscope: three obvious bands in the blue samples (545, 583, and 624 nm) and two in the green samples (593 and 633 nm). The infrared spectra of all samples displayed a general absorption edge at  $2150\text{ cm}^{-1}$  and two distinct bands at  $3641$  and  $3394\text{ cm}^{-1}$ , probably related to the hydroxyl group. Four additional minor absorption bands were observed, at  $4521$ ,  $4252$ ,  $2677$ , and  $2244\text{ cm}^{-1}$ . Raman spectroscopy indicated a broad hump typical of an amorphous material (i.e., glass), with some sharper bands (most prominently at  $656$  and  $415\text{ cm}^{-1}$ ) that matched those of gahnospinel. Therefore, the properties of this material are consistent with a glass-ceramic.

The aggregate polariscope reaction and strong graining should allow separation of this material from glasses typically used as gem simulants. However, it is possible that not all faceted glass-ceramics will exhibit these features, making them more difficult to distinguish from glass—despite their unusual chemical composition. The most definitive separation criteria would be provided by X-ray diffraction, but this technique is not available in most gemological laboratories.

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**Serpentine doublets, sold as pietersite, from Arizona.** At the 2010 Tucson gem shows, one of these contributors (PH) purchased a few samples represented as pietersite that reportedly came from Globe, Arizona. The sample group contained rough pieces as well as cabochons (doublets) consisting of “pietersite” attached to black resin bases. Pietersite is composed of chatoyant silicified crocidolite (a fibrous asbestos mineral)—in the form of brecciated dark blue hawk’s-eye and/or brownish yellow tiger’s-eye. It was discovered in 1962 in northern Namibia (see *Gem News*, Summer 1988, pp. 117–118, and Spring 1992, p. 61), and a similar rock was found in 1993 in Xichuan, Henan Province, China. Considering the rarity of pietersite deposits, a U.S. locality for this material would be noteworthy.

The following properties were obtained from five of the Arizona cabochons (9.40–87.85 ct; e.g., figure 24): color—very light yellow to brownish yellow; spot RI—1.54–1.55; and fluorescence—inert to long- and short-wave UV radiation. Specific gravity measurements would not be meaningful because of the resin backing. Microscopic examination revealed that the gem material consisted of parallel fibers oriented perpendicular to the chatoyant bands, and those fibers were thus responsible for the tiger’s-eye effect. The fibers varied from white to light yellow, and some were brownish red as expected for staining by iron oxides/hydroxides.

Three pieces of rough (45.16–420.12 g) also were examined. They were composed of white to light yellow fibers with crosscutting deep green and brown crystalline



Figure 22. These four glass-ceramic samples (2.59–3.15 ct) were manufactured by Formica LLC. Photo by Robert Weldon.

aggregates. Their structure consisted of asbestiform parallel fibers oriented normal to the surfaces of fracture veins that were hosted within a massive brown-black matrix. Hydrostatic SG measurements of the three samples yielded values of 2.43–2.46. Powder X-ray diffraction data identified the major mineral as serpentine, formed by an admixture of chrysotile and lizardite. The samples also contained minor amounts of quartz and calcite.

This Arizona material is quite different from pietersite. Although its refractive index overlaps that expected for pietersite, its SG values are lower (cf., 2.50–2.58 from Namibia and 2.67–2.74 from China), which is consistent with serpentine. In addition, the Namibian and Chinese pietersite consists of fibers that are oriented in an irregular fashion, unlike this serpentine from Arizona.

Figure 23. This green glass-ceramic specimen contains a few pinpoints, as well as prominent graining when viewed in certain orientations. Photomicrograph by A. Shen; field of view 1.8 mm wide.

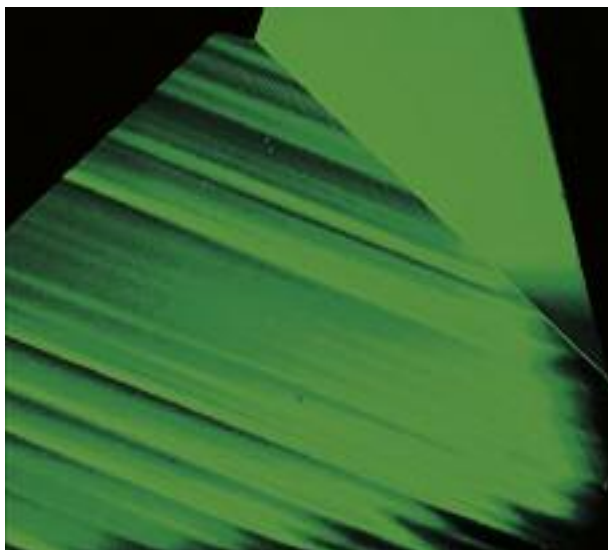




Figure 24. This stabilized Arizona serpentine doublet (here, 87.85 ct) bears a resemblance to *pietersite*, and has been marketed as such.  
Photo by K. Hu

According to Bruce Barlow (Barlow's Gems, Cave Creek, Arizona), from whom the Arizona material was purchased, it is impregnated with resin to stabilize the fibers and create a polishable mass. Although this gem exhibits an attractive chatoyancy that is the hallmark of material from Namibia and China, its mineralogy is very different.

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## TREATMENTS

**A composite coral bangle.** With China's economic growth, more enhanced gem materials are being seen in that country's jewelry markets. One of them is red coral, which has a long history as an ornamental gem. Because most corals are dendritic (branch-like), they are usually fashioned as carvings or sculptures that suit this form, or as smaller cabochons and beads. Recently, the National Gemstone Testing Centre in Beijing received for identification a bangle that was represented as red coral (figure 25). While the piece showed a uniform appearance in general, our suspicions were immediately raised because coral could not have been carved into such a shape due to the limitations nature imposes on its size and form.

The outer surface of the bangle appeared uniform (figure 26, left), but close examination of the inner surface revealed discontinuities in the pattern, as well as a layered structure (figure 26, right). Such features indicate an assembled piece. Closer examination showed that the bangle consisted of more than 250 sections. Each individual piece was elongated and approximately the same size. Detailed microscopic examination revealed distinct junc-

tions between the sections, as well as impregnation in some areas by a filling material that resembled wax (figure 27). Unfortunately, we were unable to study the filler with IR spectroscopy because the client did not give us permission to take the powdered sample necessary for the analysis.

Further examination revealed properties typical for natural coral: the distinctive red color; a refractive index of 1.58–1.60; and ribbed, pitted growth structures. Raman analysis of five spots on the outside of the bangle gave peaks at 1520, 1123, 1087, and 714  $\text{cm}^{-1}$ , a typical combination of bands associated with both the coral matrix and the natural compounds responsible for its color (see C. P. Smith et al., "Pink to red coral: A guide to determining origin of color," Spring 2007 *G&G*, pp. 4–15).

This is the first coral assemblage we have encountered in our laboratory. According to the client, such bangles have been on the Chinese market since 2009. Often referred to as "salmon coral," they are manufactured primarily by a Taiwanese-Italian joint venture. Based on conversations with the client, we believe that the pieces were assembled with an adhesive and cut into a bangle shape, which was then polished and carved with decorative patterns.

Although this coral bangle is a manufactured composite, its fine craftsmanship is remarkable.

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and Zhonghua Song  
National Gemstone Testing Centre, Beijing

Figure 25. This bangle (74 mm diameter) proved to be an assemblage of more than 250 pieces of coral.  
Photo by Jun Su.





Figure 26. The outer surface of the bangle (left, 15 mm wide) appears smooth and uniform, belying its composite nature. However, the layered structure is clearly visible on the inner surface (right). Photos by Jun Su.

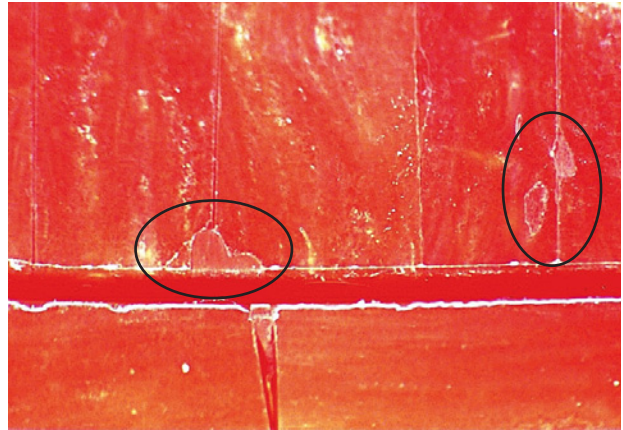


Figure 27. Magnification reveals distinct junctions between some of the individual coral pieces, discontinuities in the pattern, and areas containing a filling material (circled). Photomicrograph by Jun Su; magnified 15 $\times$ .

**Lead glass-filled ruby in antique jewelry.** Treated rubies have recently been a hot topic for both the trade and mainstream news organizations, particularly the heavily lead glass-filled rubies that are widely available in the gem trade and can even be found in retail stores, jewelry websites, and TV shopping channels. AGL has adopted the term *composite ruby* to better distinguish this material from traditional heated rubies, while recognizing that it is neither an imitation ruby nor a synthetic. This treatment significantly impacts the original corundum's appearance (perceived transparency and color), and it also requires special care to avoid damage to the stone. We know that the lead-glass filler can be etched by common household cleaning products and a jeweler's pickling solution, and the application of a jeweler's torch can cause it to degrade.

Despite the prevalence of this material in the marketplace, we were still surprised by the piece in figure 28, which was submitted for identification. This antique pendant was set with old-mine-cut diamonds and seed pearls, but the center stone was identified as a composite ruby (using microscopy and EDXRF spectroscopy) that was estimated to weigh 7.5 ct. The pendant did not appear to be a replica, and the workmanship was indicative of an older piece. The composite ruby had been carefully reset, as the milgrain around the bezel was in good condition, and we saw no degradation of the glass in the stone that could be caused by the jeweler's torch.

The fact that this material has started showing up in antique jewelry is representative of how far it has penetrated the market and reinforces the importance of proper disclosure.

*Elizabeth Quinn Darenius*

**Tanzanite and other gems set with colored adhesive.** In March 2010, GIA was informed by goldsmith Ed Barker (Artistry in Gold, Yountville, California) about various gemstones he had encountered in bezel-set rings that were mounted with colored glue. The rings were pur-

Figure 28. This antique pendant contains an approximately 7.5 ct lead glass-filled ruby. Photo by Bilal Mahmood.





Figure 29. This 1.87 ct tanzanite was mounted in a ring with a colored adhesive. Residual adhesive is still present on some of the crown facets, particularly at the corners. Photo by Robert Weldon.

chased during 2009 from a customer who had obtained them from a TV shopping network. When he removed the stones from their mountings, Mr. Barker noted that an adhesive—colored to enhance the appearance of the ruby, amethyst, or tanzanite gems—was present along the bezel area.

Mr. Barker sent one of the stones, a 1.87 ct tanzanite, to GIA for examination (figure 29). A purple-colored flexible adhesive was visible on some of the crown facets, particularly at the corners (e.g., figure 30). The material was slightly tacky, making it attractive to dust particles. After the adhesive was removed, the color of the tanzanite appeared very slightly lighter. Mr. Barker indicated that the other stones he removed from the rings became noticeably lighter (particularly the amethyst). The colored adhesive was obviously intended to enhance the appearance of the stones, as well as help hold them in their mountings . . . buyer beware!

Brendan M. Laurs

## CONFERENCE REPORTS

**1st Italian Conference on Scientific Gemology.** Organized by Dr. Eugenio Scandale (University of Bari Aldo Moro), Drs. Adriana Maras and Michele Macri (Sapienza University of Rome), and Dr. Giancarlo Della Ventura (Roma Tre University), this conference took place June 15–16, 2010, in Rome. There were ~120 registrants.

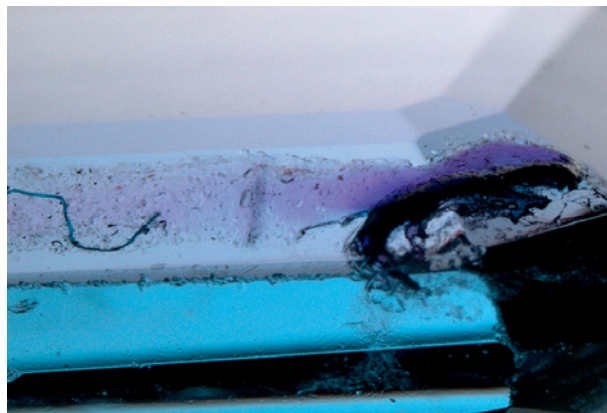
In the plenary lecture, **this author** explored scientific gemology through several case studies: country-of-origin determination for ruby and sapphire, characterization of the Wittelsbach-Graff and Hope diamonds, and identifying new coated gems and CVD synthetic diamonds. **Dr. Ilaria Adamo** (University of Milan) reviewed the growth of synthetic gem materials, with an emphasis on beryl; Tairus and Malossi are currently the main producers. **Dr. David Ajò** (CNR - Institute of Inorganic Chemistry and

Surfaces, Padova, Italy) discussed the chemistry and physics of gem treatment, focusing on tanzanite. In a presentation delivered by **Dr. Cristiano Ferraris** (National Museum of Natural History, Paris), **Dr. François Farges** (National Museum of Natural History, Paris, and Stanford University, California) hypothesized that the original piece of rough that yielded the Tavernier Blue/French Blue/Hope diamonds was naturally or manually cleaved from a rhombicuboctahedral crystal that could have weighed ~300 ct.

**Dr. Gioacchino Tempesta** (University of Bari) reviewed the application of X-ray diffraction topography to imaging growth striations, dislocations, and subgrains in crystalline materials. These features may be optically invisible but are useful for fingerprinting individual gemstones. **Dr. Giancarlo Della Ventura** (Roma Tre University) examined applications of micro-FTIR spectrometry to gemology, including analysis of H<sub>2</sub>O and CO<sub>2</sub> in opal to differentiate various localities. **Dr. Alessandro De Giacomo** (University of Bari) reviewed the use of laser-induced breakdown spectroscopy in gemology, and noted that the technique allows for 10–15% accuracy in a range from ~2 to 800 ppm. **Dr. Davide Bleiner** (University of Berne, Switzerland) discussed LA-ICP-MS, and briefly mentioned a case study that documented higher Cu contents and heavy Cu isotope depletion with increasing temperature in Cu-diffused labradorite from Oregon.

**Dr. Caterina Rinaudo** (University of Eastern Piedmont, Alessandria, Italy) differentiated sapphires from various localities (metamorphic and magmatic) using micro-Raman spectroscopy of inclusion suites. **Ron Ringsrud** (Ronald Ringsrud Co., Saratoga, California) conveyed the romance and science of emeralds, noting that highly saturated stones from Colombia's La Pita mine can be effectively cut as shallow cushions since abundant light return is not necessary to best display their color. **Dr. Stella**

Figure 30. With magnification, the colored adhesive is plainly visible on these crown facets of the tanzanite. Photomicrograph by Nathan Renfro; magnified 20×.



**Nunziante Cesaro** (Sapienza University of Rome) studied archeological emeralds from Oplontis, Italy, and determined that their origin could be Egypt, Austria (Habachtal), or Russia (Ural Mountains). **Dr. Alberto Paleari** (University of Milan - Bicocca) used UV-Vis, EPR, and PL spectroscopy to determine that  $Mn^{3+}$  is the cause of iolite's strong pleochroism. **Dr. Cristiano Ferraris** used high-resolution transmission electron microscopy to investigate the origin of color in blue apatite from Bahia, Brazil. He found strained microdomains of fluorine- and hydroxyl-rich apatite with dimensions in the violet-to-blue range of visible light (400–470 nm).

Extended abstracts of the presentations will be published in a future issue of *Rivista Gemmologica Italiana*. The conveners hope to hold a similar event next year in Italy.

*Brendan M. Laurs*

**Sinkankas Symposium 2010—Gem Feldspars.** The eighth annual symposium in honor of John Sinkankas took place April 17 at GIA in Carlsbad. Co-hosted by GIA and the San Diego Mineral and Gem Society, the sold-out event was attended by 144 people.

After opening remarks by convener **Roger Merk** (Merk's Jade, San Diego, California), GIA's **Robert Weldon** provided a photographic exploration of gem feldspar varieties, noting that feldspars show more types of phenomena—including chatoyancy, schiller, labradorescence, and adularescence—than any other gem species. **Dr. William "Skip" Simmons** (University of New Orleans) reviewed the mineralogy of feldspars and described an important gem orthoclase deposit in southern Madagascar. He obtained typical pale yellow as well as colorless and pale green samples from local Malagasy dealers; X-ray diffraction analysis showed they consisted of sanidine as well as orthoclase.

**Si Frazier** (El Cerrito, California) recounted the discovery of spectrolite (gem-quality labradorite) at Ylämaa, Finland, which was found during the Winter War (1939–1940) when Lieutenant Peter Laitakari had a rocky outcrop blasted for boulders to be used as tank traps. **Lisbet Thoresen** (Beverly Hills, California) described the archaeogemology of amazonite and the ancient Egyptian mining sites surveyed by geologist Dr. James A. Harrell (University of Toledo). One of the oldest known gem materials, amazonite was used for beads by prehistoric tribes in northern Africa and the civilizations of Mesopotamia and the Indus Valley (ca. 5200–3000 BC); however, it was most popular in Dynastic Egypt (3000–332 BC), especially for amulets and jewelry inlays.

**Meg Berry** (Mega Gem, Fallbrook, California) described the challenges and rewards of cutting gem feldspar. With Oregon sunstone, considerations include fractures/cleavages, the distribution of the schiller-causing particles, and the best direction to view the schiller phenomenon.

**Rock Currier** (Jewel Tunnel Imports, Baldwin Park, California) conveyed his experiences with amazonite—mining at Pikes Peak, Colorado, and buying in Ethiopia. In both cases, the crystals had considerable iron staining, which was removed by soaking for several days in oxalic acid or Waller solution (sodium dithionite dissolved in water). **Bill Larson** (Pala International, Fallbrook, California) showed beautiful examples of gem feldspars from deposits around the world. He indicated that Sri Lanka has produced the best moonstones with strong blue adularescence, while Myanmar's moonstones include a rare variety with orangy yellow adularescence and a four-rayed star.

**John Koivula** (GIA Laboratory, Carlsbad) illustrated the "microworld" of gem feldspar, featuring inclusions in feldspar, feldspar as inclusions in other gem minerals, and structures and zoning in feldspar. **Dr. George Rossman** (California Institute of Technology, Pasadena) indicated that the wide variety of colors in feldspar are created by impurities or structural variations.

**Shane McClure** (GIA Laboratory, Carlsbad) addressed the controversy about whether the red and green andesine reportedly from Tibet is naturally colored. The composition (i.e., anorthite content) of Tibetan andesine overlaps that of Mongolian material, but not Mexican or Oregon labradorite. There are no obvious differences in the internal features of Mongolian, Mexican, and Oregon material, except for larger copper platelets and potential differences in color zoning seen in some untreated Oregon stones. Material from all three locations has overlapping UV fluorescence. Currently GIA knows of no way to reliably separate Tibetan from treated Mongolian stones. In a second presentation, **Dr. George Rossman** provided convincing evidence that all the samples of red/green feldspar he has analyzed so far that were represented as being from Asia and the Congo were treated.

The theme of next year's Sinkankas symposium (date to be determined) will be diamond.

*Brendan M. Laurs*

## MISCELLANEOUS

**Gem news from Myanmar.** On January 29, 2010, the *Myanmar Times* reported that Max Myanmar Co. recovered a jadeite boulder weighing 115 tonnes from the Phakant (Hpakan) mining area. It reportedly measured 21 m long × 4.8 m wide × 10.5 m high, and was found 12 m below the surface near Sai Ja Bum village (plot no. Mupin 1).

In March 2010, the 47th Gem Emporium realized sales of ~US\$500 million from nearly 7,000 lots of jadeite and other gem materials. The 29th Pearl Emporium was held in Naypyidaw on May 13–15, 2010, offering 350 lots by tender and 31 lots by auction. Merchants from 27 companies attended, and the 174 lots sold comprised a total of 39,835 cultured pearls weighing 16,905 mommes. Some previous Burmese gem sales data are compiled in

**TABLE 1.** Yearly Burmese gem sales.

Year	Sales (kyats)
2000–2001	363,000,000
2001–2002	127,000,000
2002–2003	249,000,000
2003–2004	357,000,000
2004–2005	616,000,000
2005–2006	1,359,000,000
2006–2007	2,236,000,000
2007–2008	3,559,000,000

table 1, and additional information can be found at [www.palagems.com/gem\\_news\\_burma\\_stats.php](http://www.palagems.com/gem_news_burma_stats.php).

At Mong Hsu, miners are working an extension of the old deposit on the east side of the Thanlwin River, to the northeast of Mong Hsu. The quality of the rubies is reportedly the same as the material from the old deposit.

On three occasions—in 2005, 2008, and 2010—this author has encountered African rubies (with no glass filling) being sold in Myanmar.

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## ANNOUNCEMENTS

**Updated CIBJO Blue Books released.** The World Jewellery Confederation (CIBJO) has released updated versions of its guides for gemstones, pearls, and precious metals, and will soon release a Gemmology Laboratory Book. These publications can be downloaded from [www.cibjo.org](http://www.cibjo.org).

The Gemstone Book includes a new coding system for gem treatments developed in cooperation with the American Gem Trade Association and the International Colored Gemstone Association. The codes are listed as part of the nomenclature guide in Annex A. The Precious Metals Book was revised to prohibit the use of rhodium coating on yellow gold and require disclosure of any metal coating that changes the color of the base material. Also new is an annex listing national standards for precious metal marking. The updated version of The Pearl Book contains only minor revisions.

The Gemmology Laboratory Book will be released later in 2010, as a guide for the management and technical operations of gemological laboratories. It will outline best practices and general requirements for testing and grading colored stones, diamonds, and pearls.

## In Memoriam Roy E. “Chip” Clark: 1947–2010

Scientific and studio photographer Chip Clark of the Smithsonian Institution’s National Museum of Natural History passed away June 13. In photographing the museum’s exhibits, Mr. Clark captured some of the world’s most famous gems. Several of his photos have appeared in *G&G*—including the shots of the Wittelsbach-Graff and Hope diamonds in this issue—as well as in numerous other publications and on Tucson Gem and Mineral Show posters.

A native of Newport News, Virginia, where he was a member of the Junior Gem and Mineral Society, Mr. Clark earned a bachelor’s degree in biology from Virginia Tech University. He worked for NASA and taught high school biology and physical sciences before joining the Smithsonian in 1973. In addition to gems, he photographed rainforests, caves, and deep-sea environments around the world. He also shot freelance assignments for the National Geographic Society, the National Wildlife Federation, and *Scientific American*. Mr. Clark is survived by his wife and his daughter by a previous marriage. He and his talent will be sorely missed.

