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DIAMONDS

A greenish yellow diamond with glass filling and HPHT treatment. Diamond treatments are now routine, and stones with multiple forms of treatment have been reported. These include diamonds that have been clarity enhanced by laser drilling and glass filling (R. C. Kammerling et al., "An update on filled diamonds: Identification and durability," Fall 1994 *G&G*, pp. 142–177), and others that were color enhanced by a combination of high-pressure, high-temperature (HPHT) processing, irradiation, and/or annealing (see, e.g., Winter 2005 Lab Notes, pp. 341–343). Recently, we examined a diamond that had been subjected to both color and clarity enhancement.

The 1.02 ct greenish yellow heart-shaped brilliant mounted in a ring (figure 1) was submitted to the National

Gemstone Testing Center in Beijing for grading and identification. Preliminary visual inspection of the stone raised suspicions about the origin of its color, which appeared quite similar to that seen in HPHT-treated diamonds. In addition, the stone fluoresced a strong yellow-green to long-wave UV radiation and a weak yellow-green to short-wave UV. No phosphorescence was observed.

The Fourier-transform infrared (FTIR) spectrum showed a strong platelet-related peak (1371 cm^{-1}) and a large, saturated absorption band between 1350 and 1050 cm^{-1} , typical of type Ia diamond with a small concentration of hydrogen. The ultraviolet-visible (UV-Vis) absorption spectrum, recorded at room temperature, showed a strong N3 center, a strong broad absorption band between 450 and 500 nm, and two weak but distinct absorption lines at 503 nm (H3) and 494 nm. The Raman photoluminescence (PL) spectrum (figure 2), recorded at liquid-nitrogen temperature with a 514.5 nm laser, showed a very strong peak at 637 nm related to the $(\text{NV})^-$ center; three moderate-intensity peaks at 575 $[(\text{NV})^0]$, 588, and 679 nm; two weak peaks at 612 and 773 nm; and two broad peaks at 604 and 659 nm. Features such as the strong yellow-green luminescence to long-wave UV, the distinct absorption lines at 494 and 503 nm, and the strong photoluminescence peak at 637 nm proved that the stone was HPHT treated (A. T. Collins, "The colour of diamond and how it may be changed," *Journal of Gemmology*, Vol. 27, No. 6, 2001, pp. 341–359).

Microscopic examination revealed signs of additional

Figure 1. This 1.02 ct greenish yellow diamond proved to be both color- and clarity-treated. Photo by Zhonghua Song.



Editor's note: Interested contributors should send information and illustrations to Brendan Laurs at blairs@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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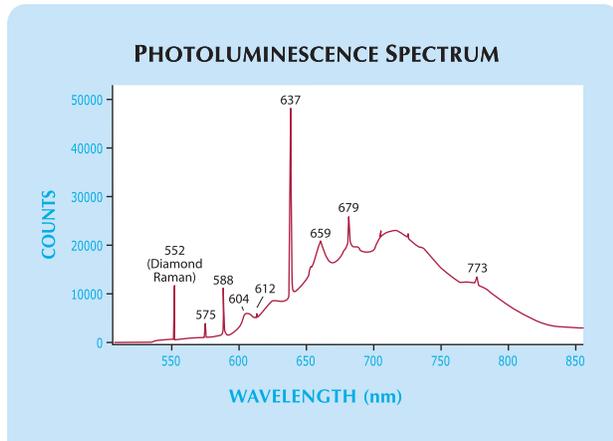


Figure 2. The 637 nm peak in the Raman PL spectrum of the diamond was one feature that indicated HPHT treatment.

treatment. Two large fractures displayed flash-effect colors typically associated with glass filling (figure 3). In darkfield illumination, distinct purple and green flashes were visible in one fracture, and subtle purple flashes were seen in another. Usually, one predominant color (violet, purple, or pink) was noted, though sometimes we saw a flash that was simultaneously purple and green. No distinct flow structure or trapped bubbles were visible. Because the diamond was mounted, we could not test for the presence of Pb that would be expected in the glass filling.

Based on these results, we concluded that the diamond was both color enhanced by HPHT processing and clarity treated by glass filling. Since glass fillers are unstable at high temperature (see Kammerling et al., 1994), the diamond likely underwent color enhancement first.

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Figure 3. Purple and green flash-effect colors can be seen in this filled fracture in the greenish yellow diamond. Photomicrograph by Zhonghua Song; magnified 32x.

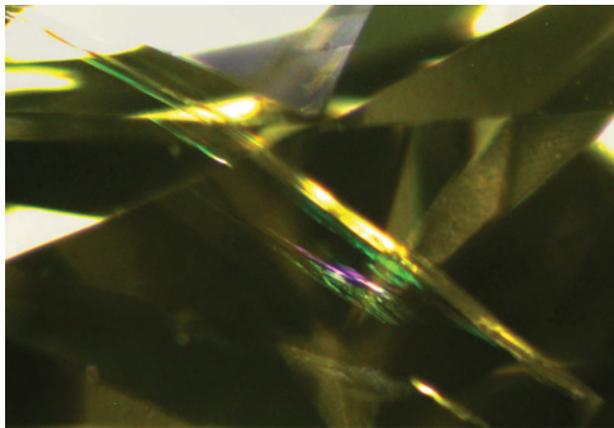


Figure 4. This aquamarine crystal (80.9 mm long), reportedly from Pakistan, proved to have an interesting inclusion scene. Photo by Jian Xin (Jae) Liao.

COLORED STONES AND ORGANIC MATERIALS

Aquamarine with ocean-themed inclusions. Recently, this contributor had the opportunity to examine an unusual aquamarine crystal (figure 4), reportedly from Pakistan, that was brought to our attention by Jordan Bogel, a gem collector from Oregon. The specimen, 80.9 mm long and 140.8 g, was readily identifiable as aquamarine from its color and crystal structure, though this was confirmed by standard gemological testing.

The crystal displayed an interesting growth pattern along one of its faces, but the most striking feature of this aquamarine was its inclusion scene, which gave the impression of exploring the ocean's depths. Transmitted light revealed "fingerprints" composed mostly of two-phase inclusions. The image of an irregular ocean floor was evoked by yellowish green moss-like inclusions, close to the crystal's surface, which resembled seaweed at higher magnification (figure 5). Despite several attempts to identify these inclusions, they proved too thin for Raman microanalysis.



Figure 5. Seaweed-like forms contributed to the oceanic scene in the aquamarine crystal. Photomicrograph by R. Befi; image width 3.0 mm.

Small crystals visible in different areas of the aquamarine resembled stingrays composed of tapered crystals partially surrounded by tension fractures (see, e.g., figure 6). One “stingray” was exposed at the surface, and the crystal was identified as zircon by Raman spectroscopy. Zircon inclusions have been previously documented in aquamarine from Pakistan (E. J. Gübelin and J. I. Koivula, *Photoatlas of Inclusions in Gemstones*, Vol. 2, Opinio Publishers, Basel, Switzerland, 2005, p. 322), but we could find no report of zircon inclusions with this unusual morphology.

No other name is better suited to this ocean-themed crystal than *aquamarine*.

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“Smoky” gray beryl. Recently, the Gem Testing Laboratory in Jaipur, India, examined the 71.57 ct step-cut stone in figure 7. It had a gray color with moderate saturation and slightly brownish gray reflections near the corners, which were stronger in one corner than the other three. When the stone was tilted in standard lighting against a white background, subtle zones of pale brown color were observed at some angles.

The color appearance and brown zones were reminiscent of smoky quartz. However, although the specimen displayed a uniaxial optic figure, it did not show the characteristic “bull’s-eye” pattern of quartz. This did not rule out quartz, but it did raise sufficient doubt to warrant further testing. The results were surprising: The refractive indices were 1.590–1.598, with birefringence of 0.008, values that are consistent with beryl. Although beryl occurs in a variety of colors—green, blue, red, pink, yellow, orange, brown, and colorless are all known—gray is quite unusual.

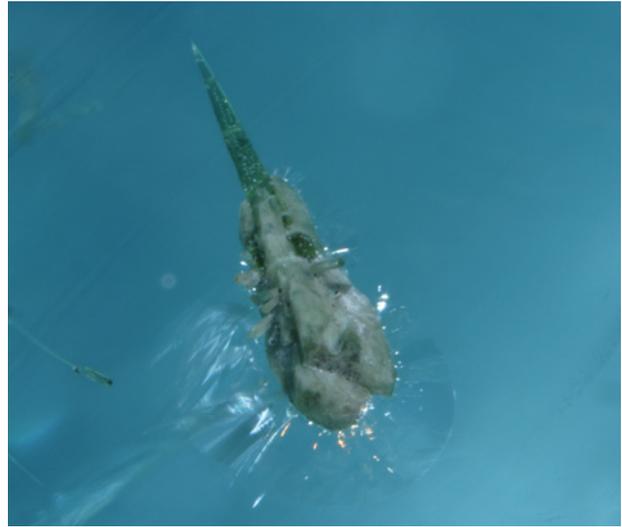


Figure 6. This striking stingray-shaped inclusion in the aquamarine crystal proved to be a zircon that is partially surrounded by a tension fracture. Photomicrograph by R. Befi; image width 2.3 mm.

The stone had a hydrostatic SG of 2.81, which is high for aquamarine but low for pink beryl (e.g., 2.66–2.80 and 2.80–2.90, respectively; see M. O’Donoghue, Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, pp. 163–164). No absorption features were visible with the desk-model spectroscope, and the sample was inert to long- and short-wave UV radiation. It displayed weak gray and pinkish brown dichroism (figure 8). No features were observed with the microscope, other than some angular and planar growth zones. The presence of these growth zones indicated the stone was natural.

FTIR spectra were typical for natural beryl, while qualitative energy-dispersive X-ray fluorescence (EDXRF) analysis revealed the presence of Al, Si (major), Ca, Mn, Fe (trace),

Figure 7. This beryl specimen ($32.90 \times 20.52 \times 12.14$ mm) is unusual for its gray color. Photo by G. Choudhary.



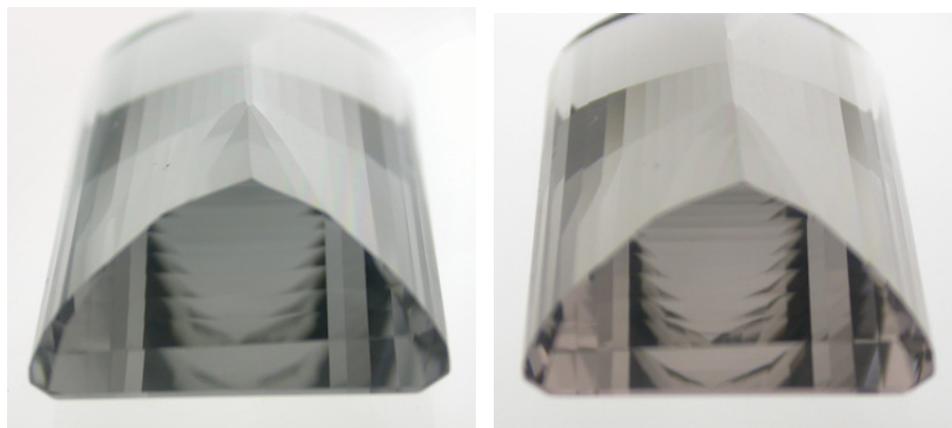


Figure 8. The beryl displays weak dichroism; the gray component (left) turns pinkish brown (right) when the polarizing filter is rotated 90°. Photos by G. Choudhary.

and Cs (minor). The presence of Cs would explain the relatively high specific gravity compared to aquamarine.

The cause of color in this unusual specimen remains unknown. John Sinkankas's *Emerald and Other Beryls* (Chilton Book Co., Radnor, Pennsylvania, 1981) noted that a beryl that had been previously heated in oxidizing conditions turned deep gray when subsequently heated in reducing conditions, although the cause of color was not determined.

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Chalcedony from Oregon with pyrite and cloud-like green areas. In June 2008, Steve Perry (Steve Perry Gems, Davis, California) informed GIA about an attractive green gem material from Oregon. He believed that it consisted of a mixture of gray chalcedony with green uvarovite and pyrite or marcasite. It was sold to him as “old material” from the Applegate Valley in Jackson County, southern Oregon. From a small parcel of rough, Mr. Perry has cut about two dozen cabochons, ranging from 0.54 to 13.38 ct.

The following properties were determined on four cabochons (2.31–13.38 ct; see, e.g., figure 9) that Mr. Perry loaned to GIA: color—variegated green and dark gray; spot RI—1.54 (from both green and gray areas); hydrostatic SG—2.70–2.80; Chelsea filter reaction—none; and fluorescence—inert to long- and short-wave UV radiation. These properties are generally consistent with those reported for chalcedony by M. O'Donoghue, Ed. (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, pp. 306–307), except for the lower SG values reported by that source (2.57–2.64). Two absorption lines, at ~680 and ~690 nm, which are related to the presence of chromium, were visible with the desk-model spectroscope.

The chalcedony contained discrete areas of cloud-like bright yellowish green to green material, as well as surface-reaching metallic “golden” yellow crystals that appeared to be pyrite (figure 10), but no other significant inclusions. Raman spectroscopy confirmed the metallic yellow inclusions as pyrite, but no Raman signals other than those of chalcedony were detected from the green clouds, which suggests they are probably not in a crystalline form. Laser

ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) analysis of the surface-reaching green areas showed Si, Na, Mg, Al, and Cr as the main components. This composition is not consistent with uvarovite, and the identity of the green material remains unknown.

This is the first time that we have encountered chalcedony with this combination of inclusions.

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Figure 9. These attractive chalcedony samples (2.31–6.01 ct) are reportedly from southern Oregon. Photo by Robert Weldon.



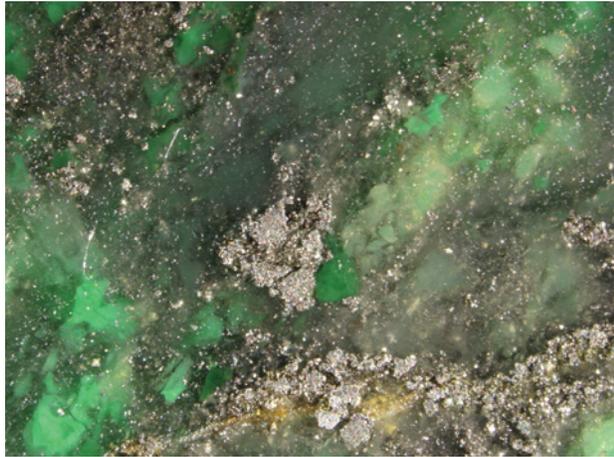


Figure 10. Microscopic examination of the cabochons revealed patches of pyrite and massive green cloud-like areas, while the host chalcedony appeared light gray. Photomicrograph by W. L. Win; field of view 5.2 mm.

Demantoid from Ambanja, Madagascar. In mid-2008, crab fishermen in northern Madagascar reportedly found some green stones in a mangrove swamp. These were brought to Antananarivo, where they were identified as demantoid. Eventually, sapphire diggers from Ambondromifehy heard the news and started to work the area. Beginning in April 2009, rumors of a new find of expensive green “sapphire” spread from cell phone to cell phone, and several hundred miners, buyers, and brokers—both Malagasy and foreign—rushed to the site (figure 11). As of late May 2009, when this contributor initially visited the deposit, about 2,000 miners were digging and 5,000–10,000 people were living in the nearby village of Antetetzambato. The deposit is

Figure 11. Thousands of miners have descended on a new demantoid deposit that was found in mid-2008 in a mangrove swamp near Ambanja in northern Madagascar. Photo by F. Danet.



located 22 km northeast of Ambanja, and the eastern border of the main workings has coordinates 13°30.426' S, 048°32.553' E.

Using hand tools (crowbars, buckets, etc.), the miners dig pits 6–11 m deep in the mangrove swamp at low tide. Pumps and dikes are employed by some miners to keep the pits from flooding, while others have explored the dry land adjacent to the swamp. The deposit measures ~500 × 500 m, and observations by this contributor suggest that the demantoid is hosted by an altered whitish skarn layer, surrounded by clays and crystalline rocks. The crystals are found lining fractures or cavities (of decimeter dimensions). The host rock can be quite hard, although it is typically completely weathered. According to the miners, some pockets have yielded a half-bucket of crystals.

The demantoid crystals are sharp and lustrous, and some faces are striated. They form truncated rhombododecahedrons or trapezohedrons (e.g., figure 12), ranging up to 25 mm. Their green hue commonly has a blue or yellow component in day or fluorescent light; the latter stones appear “olive” green in incandescent light. Also recovered are yellow and brown andradite crystals, with gem-quality areas weighing up to 2 g. Quartz is associated with the garnet, and consists of thin opaque crystals up to 4 cm long. Many other minerals were seen in the Antetetzambato market, but the dealers may have brought them from other deposits in northern Madagascar.

This contributor examined 16 pieces of rough demantoid (23.6 g total weight; again, see figure 12) weighing up to 3.1 g, with the largest clean stone weighing 1.2 g. The following properties were recorded: RI—over the limits of the standard refractometer; hydrostatic SG (five stones)—3.79–3.88 (the lower measurements were due to abundant impurities); strong anomalous birefringence in the polariscope; and spectroscopy spectrum—cutoff in the blue region, diffuse bands at 621 and 640 nm, but no lines in the

Figure 12. The Madagascar demantoid is recovered as well-formed crystals. The largest shown here weighs 3.1 g and measures 16.5 × 12.3 × 8.6 mm. Photo by F. Danet.



red region (i.e., those due to Cr at 693 or 701 nm). Microscopic examination revealed fractures and fingerprint-like inclusions, as well as a few isometric crystals. Although no “horsetails” were seen in these samples, this contributor has noted some curved acicular inclusions in a few stones examined subsequently.

While it is difficult to estimate the production, this contributor suspects that at least 20 kg of mine-run demantoid is recovered each week (probably much more), with several kilograms in the 1–3 g range. Larger sizes are rare, as are eye-clean stones weighing >1 g. About 5% of the material is facetable. Initial cutting of the demantoid has yielded some attractive stones weighing 1–3+ ct, while more-included gems range up to 7 ct. Eye-clean stones of good “emerald” green color are scarce above 2 ct, while those with “olive” green coloration are more frequently seen in the 2–5 ct range.

This demantoid discovery has created a great deal of excitement in Madagascar, and gem buyers and brokers are at least as numerous as the miners at the deposit. In mid-June, for security reasons, the provincial government prohibited buyers from visiting the deposit and mandated that all trading take place at a nearby “comptoir,” as was done at the well-known Ilakaka gem deposit in 1999.

Additional images to accompany this report are available in the *G&G* Data Depository at www.gia.edu/gandg. Chemical analyses of the Madagascar demantoid, as well as additional gemological data, are available online at www.gemnant.es.fr/recherche/autre/demantoides_mada.php.

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Enstatite from Pakistan. At the 2009 Tucson gem shows, Syed Iftikhar Hussain (Syed Trading Co., Peshawar, Pakistan) displayed a parcel of small, dark yellow-green crystals and broken fragments that he had obtained as “diopside or garnet” from Baluchistan, Pakistan, in 2007. The parcel weighed 105 g, and a few of the pieces were transparent enough to facet. Mr. Hussain donated several rough samples to GIA for examination.

Initial analysis of the samples with Raman spectroscopy identified them as enstatite. Enstatite is an orthorhombic pyroxene with an end-member composition of MgSiO_3 that forms a solid-solution series with ferrosilite (FeSiO_3). It ranges from colorless to yellow, green, or brown; these various colorations are associated with the presence of chromophores such as Cr, Mn, V, and Fe. Iron-bearing enstatite has often been referred to as *hypersthene*, though the International Mineralogical Association now simply classifies it as enstatite.

Enstatite has a Mohs hardness of 5–6, and it is quite brittle and considered difficult to facet (J. Sinkankas, “Some freaks and rarities among gemstones,” Fall 1955 *G&G*, pp. 199–200). GIA had three of the pieces donated by Mr. Hussain faceted (0.42–1.29 ct; e.g., figure 13) for further examination, and the following properties were recorded: color—dark yellow-green, RI—1.665–1.675 from the table



Figure 13. These dark yellow-green gems (0.42 and 1.29 ct) from Baluchistan, Pakistan, were identified as enstatite. Photo by Robert Weldon.

face (and a higher value of 1.730 from the pavilion of one stone), birefringence—0.010, hydrostatic SG—3.31, and no UV fluorescence. The desk-model spectroscope showed a strong and sharp absorption line at 505 nm and a broad band near 550 nm. These properties are consistent with those reported for enstatite (M. O’Donoghue, Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, p. 408). Microscopic observations revealed typical fractures and “fingerprints” (see the *G&G* Data Depository).

Visible-range spectroscopy showed a sharp peak at 505.8 nm and a broad band centered at 548 nm (see the *G&G* Data Depository), which correlate well with the absorptions seen with the spectroscope. A weak feature near 680 nm was also present, due to Cr^{3+} . Some similar features have been observed with the spectroscope in dark green enstatite from Arizona and in medium green enstatite from East Africa (G. R. Crowningshield, “Enstenite!” [sic], Fall 1965 *G&G*, pp. 334–335; C. M. Stockton and D. V. Manson, “Peridot from Tanzania,” Summer 1983 *G&G*, pp. 103–107).

Chemical analysis of one of the cut samples by LA-ICP-MS indicated a composition of $(\text{Mg}_{0.79}\text{Fe}_{0.17}\text{Ca}_{0.04})\text{SiO}_3$, along with trace amounts of Cr and Mn. The Fe concentration is relatively high for gem-quality enstatite, with a ratio of $\text{Fe}/(\text{Mg}+\text{Fe}) = 0.18$ —compared to a ratio of 0.12 for the East African sample documented by Stockton and Manson (1983)—and is apparently responsible for the material’s dark tone.

The highest RI value of 1.730 is significantly higher than that of typical magnesium end-member enstatite, which has RIs ranging from 1.649 to 1.680, and is consistent with the appreciable iron measured in the chemical analysis. By comparison, RI values for iron end-member ferrosilite range from 1.755 to 1.788 (J. W. Anthony et al., *Handbook of Mineralogy*, Vol. 2—Silica, Silicates, Part 1, Mineral Data Publishing, Tucson, Arizona, 1990, p. 255). The high transparency and yellow-green color of this iron-bearing enstatite are quite unlike the “hypersthene” documented in the Summer 2003 GNI section (pp. 160–161).

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Figure 14. This new opal-CT comes from Argentina. The largest polished stone weighs 16.6 ct. Photo by B. Rondeau.

Common opal from Argentina. At the 2009 Tucson gem shows, Jorge Raul Dascal (Patagonia Minerals, Buenos Aires) displayed some new common opal from Argentina. The material was opaque to transparent, and ranged from yellow-green to orange (approximating fire opal) to brown (e.g., figure 14). The color and transparency were often layered.

We measured RI and SG values on three polished samples representing a range of typical color and transparency (again, see figure 14). The RIs were 1.440–1.445, and SG values were 2.02–2.04. Out of six pieces tested for UV fluorescence, four were inert. However, the two chalkiest samples fluoresced very weak whitish green to long-wave UV radiation and even weaker to short-wave UV, with no phosphorescence. Raman analysis of the three polished samples using a Bruker RFS100 Fourier-transform spectrometer confirmed that the material was opal-CT, with an apparent maximum for the main peak ranging from 345 to 325 cm^{-1} . Chemical analyses of three pieces performed on a JEOL 5800LV scanning electron microscope (SEM) equipped with a Princeton Gamma Tech energy-dispersive IMIX-PTS detector determined that the material was essentially SiO_2 , with traces of Al in two stones (0.05 and 0.25 wt.%) and Fe in all three (0.30–2.5 wt.%). The Fe content qualitatively correlated with the greenish yellow to brown component of the color.

Four of the six samples showed breadcrumb-like inclusions that appeared white in reflected light. Larger inclusions with similar texture sometimes had a disc-like or spherulitic appearance. One such inclusion in a dark brown zone was surrounded by a lighter rim (figure 15). SEM microchemical analysis of the inclusion revealed major amounts of Si and O (with at least some of these elements contributed by the surrounding opal), as well as ~5 wt.% Fe and ~2 wt.% Al—both more concentrated in the core—and traces of Mg, Ca, and Mn. A Raman spectrum of the inclu-

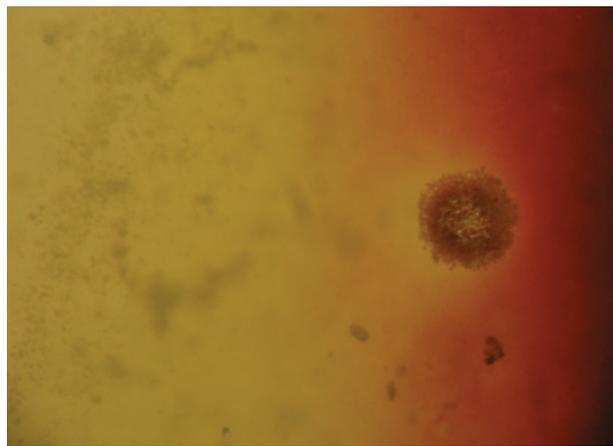


Figure 15. This spherulitic inclusion in a greenish yellow Argentine opal seems to have absorbed the iron staining around it. The inclusion consists of quartz and iron compounds. Photomicrograph by E. Fritsch; magnified 16 \times .

sion obtained with a Jobin-Yvon T64000 dispersive spectrometer showed a series of weak bands at about 690, 550, 394, and 301 cm^{-1} , as well as a sharper band at about 463 cm^{-1} . These were consistent with a mixture of quartz and an iron oxide or hydroxide, possibly hematite or goethite. As in other common opals, the yellow-to-brown bodycolor of the Argentine samples is likely related to submicroscopic-to-nanometric Fe-bearing inclusions.

Figure 16. These cabochons of opal from Argentina (4.26–8.06 ct) illustrate some of the colors that have been recovered from the new deposit. Photo by Robert Weldon; GIA Collection nos. 37967–37969.



The opal structure was investigated on freshly broken surfaces of three yellow-green and orange samples using a JEOL 6400 field-effect SEM. It consisted of coalesced nanograins 20–45 nm in apparent diameter, as is typical for common opal-CT from many localities worldwide.

The Argentine opal deposit was found in some remote undisclosed foothills in late December 2008. The opal was first discovered as loose gravel in dry riverbeds, which was traced several kilometers upstream to veins in a very hard volcanic rock. The matrix of some of the specimens was quite altered, and was apparently rich in silica and clays. Because of the cold, arid climate, the deposit can only be worked five or six months of the year. In April 2009, Mr. Dascal reported finding some yellow-green opal in the same area. By that time, he had collected a total of ~140 kg of gem-quality material, and 11 kg was being tumbled in pieces ranging up to ~10 × 7 × 7 cm. In addition, a few cabochons of the opal had been cut (e.g., figure 16).

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Mabe pearls from Vietnam with seashell nuclei. At the 2009 Tucson gem shows, VanTuyen Tran (Ferjenni Co., Fullerton, California) showed this contributor some recently harvested mabe (assembled cultured blister) pearls from Vietnam that were produced using seashell nuclei. Although they debuted at the 2008 Tucson gem shows, the 2009 material (from the company's second harvest) included a wider range of shapes and better nacre coverage. Ms. Tran reported that she came up with the concept, and then collaborated with a pearl farm in Vietnam owned by Cuc Nguyen (Boi Ngoc Co. Ltd., located near Ben Tre). The several varieties of shells used as nuclei were gathered from beaches in the Indo-Pacific region. For the most recent harvest, they were implanted into 9,000 *Pteria penguin* oysters in April–May 2008, and in January 2009 they obtained 625 high-quality mabe pearls. The relatively low yield resulted from incomplete nacre coverage on many of the shell nuclei and the fact that 15% of the oysters died after implantation.

After harvesting, the mabes were cleaned and polished, then trimmed to remove excess shell material (e.g., figure 17). Mabes up to ~5 cm long have been produced, but most range from 2 to 4 cm. Some of those from the first harvest—which had thinner nacre—were polished to reveal the color of the underlying shell nucleus (see the two cowrie mabes on the far right in figure 17). Even for those that were completely covered with nacre, the surface textures of the underlying seashell nuclei were remarkably evident (figure 18). Marketed as *mabe shell pearls*, some have been set into pendants and earrings (figure 19).

Brendan M. Laurs



Figure 17. These Vietnamese mabe pearls, which came from the first harvest, were produced using seashell nuclei consisting of coiled gastropods (left, 3.4–4.1 cm long) and cowries (right). Some of the nacre on the cowrie mabes has been polished off to expose the underlying shell colors. The inset shows the shell nucleus within an unbacked mabe pearl. Photo by Robert Weldon.

Characterization of some pearls of the Pinnidae family.

Pearls of the Pinnidae family (classified by Leach, 1819) are produced by bivalves belonging to the genera *Pinna* (Linnaeus, 1758) and *Atrina* (Gray, 1847), and are known as “pen shell” pearls. Pinnidae bivalves are widely distributed in the Mediterranean Sea as well as the Red Sea, the Indo-Pacific Ocean (including the region circumscribed by southeastern Africa, Melanesia, New Zealand, Australia, and northern Japan), and in American waters (e.g., the Pacific coast of Baja California, Mexico). Those found in the

Figure 18. A diversity of forms and textures is shown by these large Vietnamese mabes (3.8–5.1 cm in maximum dimension), which were produced from the second harvest. Photo by Robert Weldon.





Figure 19. Vietnamese mabe pearls are featured in these earrings (2.2 cm long) and a pendant with amethyst (3.4 cm long) that were manufactured by Randall Otten, Otten, Vallot & Co., Huntington Beach, California. Photo by Robert Weldon.

Mediterranean and Red Sea have probably reached the highest popularity after pearls from *Pinctada* species (E. Strack, *Pearls*, Rühle-Diebener-Verlag, Stuttgart, Germany, 2006). Pen shell pearls commonly attain sizes of 7 mm (rarely up to 16 mm), and can range from grayish white to various shades of orange and brown as well as black. Both nacreous and non-nacreous varieties exist (e.g., figure 20); the nacreous Pinnidae pearls are aragonitic.

Several years ago, one of the authors (J-PG) collected some nacreous and non-nacreous pearls from *Pinna* mol-

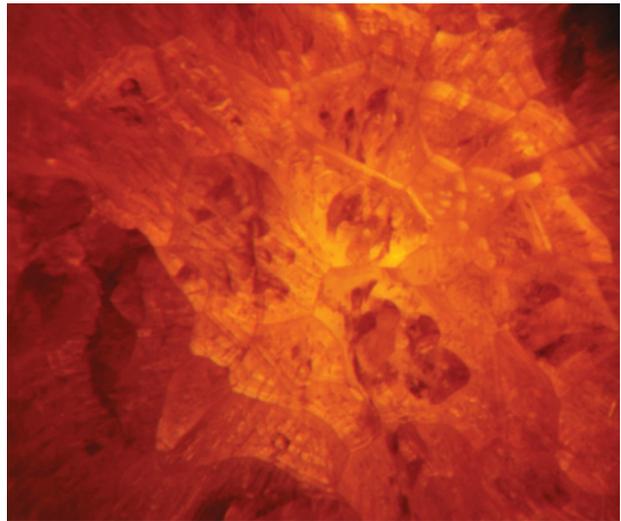
Figure 21. These five non-nacreous pen shell pearls are also from Pinnidae family mollusks. The smallest pearl is about 3.2 mm in diameter (0.39 ct), and the largest is 16.4 mm long (2.17 ct). Photo by S. Karampelas.



Figure 20. This collection of nacreous and non-nacreous Pinnidae family pearls shows various colors and shapes. The largest specimen is 13.7 mm in diameter (10.42 ct). Courtesy of the Gübelin Gem Lab; photo by Eric Erel.

lusks harvested from the bays of Hyères (Var, France), Sagone (Corsica, France), and Olbia (Sardinia, Italy). Some of these were orange, and they included near-round and teardrop shapes (figure 21). Microscopic observation revealed that they were translucent in transmitted light and had columnar structures (figure 22). Similar patterns were seen in non-nacreous pearls described in the Fall 2007 GNI section (pp. 259–260). As was the case for the pearls described in that entry, the columnar structures in the present samples were typically due to a radial arrangement of

Figure 22. Columnar calcitic structures were observed with transmitted illumination in this pen shell pearl. Photomicrograph by S. Karampelas; image height 1 mm.



calcite. One of the teardrop-shaped pearls had no visible structures in the bulbous part but displayed columnar structures in the tail. Raman spectroscopy revealed that the bulb consisted of aragonite and the tail was composed of calcite.

Raman spectroscopy of the samples in figure 21, using five different excitation wavelengths, also showed that they contained a mixture of carotenoid pigments. Similar pigments have been observed in *Stylaster* gem corals (S. Karampelas et al., "Identification of the endangered pink-to-red *Stylaster* corals by Raman spectroscopy," Spring 2009 *G&G*, pp. 48–52).

UV-Vis-NIR reflectance spectra of Pinnidae pearls showing gray, orange, brown, and black coloration (in various combinations of hue, tone, and saturation) revealed a gradual absorption continuum from the UV to the NIR region. This continuum is responsible for the gray (less intense) to black (more intense) coloration. Further, carotenoid pigments absorb in the violet-blue portion of the spectrum and are responsible for the orange hue. To our knowledge, Pinnidae pearls are the only gem-quality natural pearls that can consist of calcite and contain carotenoid pigments.

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Cat's-eye phenakite. In May 2009, a prismatic crystal of phenakite was mined from central Madagascar (probably Anjanabonoina) and subsequently cut into three cabochons that showed chatoyancy (7.03, 8.98, and 50.36 ct; e.g., figure 23). Since cat's-eye phenakite is not well known, the following properties were documented on these three stones: color—light brownish yellow; dichroism—moderate; RI—1.654–1.670; birefringence—0.016; optic character—uniaxial positive; hydrostatic SG (two measurements)—2.96; and no absorption features seen with the handheld spectroscope. These properties are consistent with those reported for phenakite by M. O'Donoghue, Ed. (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, pp. 436–437), who also mentioned that "the occasional chatoyant specimen is reported."

The stones contained fine needles (probably very thin empty tubes) oriented perpendicular to the c-axis, which were responsible for the unusual chatoyancy exhibited by this material. No other inclusions were seen in the stones with the microscope.

Fabrice Danet

Color-change pyrope-spessartine from Kenya. Color-change pyrope-spessartine has been reported from East Africa, Sri Lanka, and more recently Madagascar (see D. V. Manson and C. M. Stockton, "Pyrope-spessartine garnets with unusual color behavior," Winter 1984 *G&G*, pp. 200–207;



Figure 23. This unusual phenakite from Madagascar (50.36 ct) exhibits chatoyancy. Photo by F. Danet.

Summer 1998 GNI, p. 138; K. Schmetzer and H.-J. Bernhardt, "Garnets from Madagascar with a color change of blue-green to purple," Winter 1999 *G&G*, pp. 196–201).

A new deposit of color-change garnet, in Kenya, was recently reported to GIA 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 Taita Hills, at a village called Kamtonga, which is close to the Mwatate tsavorite mining area. This region typically produces brown-to-red material, but some remarkable green/red color-change garnet was found in January 2009. Most of the rough weighs <1.5 g, yielding cut stones <2 ct, although some attractive clean gems with a good color change that range up to 8–10 ct are known to both gentlemen. Production has been intermittent due to disputes over mining claims in the area.

Mr. Saini donated two color-change garnets from this deposit to the GIA Collection. The 1.32 and 1.39 ct stones were fashioned as rectangular and square cut-cornered step cuts, respectively. Their coloration was observed in a Gretag Macbeth Judge II light box under both daylight-equivalent and incandescent illumination. Their color changed from dark bluish green to dark violet, and from grayish bluish violet to purple, respectively (figure 24). The garnets appeared more blue under other nonstandard "daylight-equivalent" fluorescent light sources. No significant color variation between reflected and transmitted light was observed.

Gemological examination revealed the following properties (with those for the smaller stone indicated first): RI—1.762 and 1.765; SG—3.88 and 3.91; fluorescence—inert to both long- and short-wave UV radiation; Chelsea filter reaction—moderate red; and absorption bands at ~485, 505, and 575 nm with the desk-model spectroscope. Magnification revealed oriented, fine reflective needles (figure 25), as previously observed in color-change garnets from East Africa and Madagascar (Summer 1998 GNI; Schmetzer and Bernhardt, 1999). Vis-NIR spectroscopy (figure 26) confirmed two distinct areas of transmission in



Figure 24. These garnets (1.32 and 1.39 ct) are from a new deposit in Kenya. The stone on the left displays a stronger color change. Photos by Robert Weldon; daylight-equivalent light (left), incandescent light (right); GIA Collection nos. 37962 and 37963.

the visible range that are characteristic of color-change gems, one centered at ~475 nm (blue range) and the other above 650 nm (red region). Distinct absorption features were present at 486, 505, and 577 nm, with very weak features centered at 464, 524, and 688 nm.

LA-ICP-MS analysis revealed Mg and Mn, indicating a pyrope-spessartine mixture; the gemological properties were more consistent with the spessartine end member. The presence of small amounts of Fe and Ca confirmed small almandine and grossular components, respectively. Color-causing agents included Fe (average 12,000 ppm), V (4300 ppm), and Cr (500 ppm).

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Preliminary observations on new rubies from Mozambique. GIA recently examined two groups of transparent faceted rubies that were represented as coming from new localities in Mozambique. The first group of five rubies

Figure 25. Oriented needles were present in the Kenyan color-change garnets. Photomicrograph by D. Beaton; field of view 2.6 mm.



(2.03–2.73 ct; e.g., figure 27, left) was brought to us in May 2009 by J. Blue Sheppard of Millennium Inc., Pala, California. These were represented to Mr. Sheppard as being from “Lusingha,” and having been heated to “drive-out the silk.” The locality was subsequently identified as the Lichinga area, near the village of Msawizi (or M’sawize), in Mavango District, Niassa Province, north-central Mozambique. The second group of 19 rubies (0.70–4.62 ct; e.g., figure 27, right) was supplied in July 2009 by Tommy Wu of Shire Trading Ltd., Hong Kong. These stones were reportedly unheated, and consisted of a mixture of those from Lichinga and a newer mine reported to be in the Montepuez area of Cabo Delgado Province, ~225 km north of Nampula in northeastern Mozambique.

GIA examined all 24 rubies by standard gemological methods and EDXRF spectroscopy. The stones from both localities were similar in visual appearance as well as gemological properties. Their color was primarily red to

Figure 26. Vis-NIR spectroscopy of the 1.39 ct garnet confirmed two distinct areas of transmission (centered at ~475 nm and above 650 nm) that are characteristic of color-change gems, as well as several distinct features from color-causing ions.

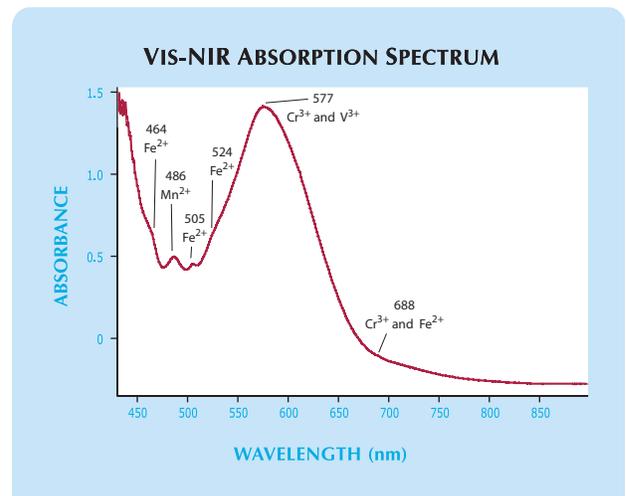




Figure 27. The heat-treated rubies on the left (2.03–2.50 ct) are reportedly from Lichinga, Mozambique. The unheated rubies on the right (1.07–4.62 ct) are a mixture of stones said to be from Lichinga and Montepuez, Mozambique. Photos by Robert Weldon.



purplish red, with none of the orange component that is commonly seen in many other African rubies. The stones Mr. Wu provided did not show any evidence of heat treatment when examined with the microscope and analyzed by FTIR spectroscopy. Chemical analysis by EDXRF revealed iron contents ranging from 0.09 to 0.31 wt. % Fe_2O_3 , with an average value of ~0.16 wt.%. Also present was 0.13–0.76 wt. % Cr_2O_3 and minute traces of Ti, Ga, and V.

The inclusion scenes in these stones showed some of the features noted in rubies from other East African localities, but in combinations that made them somewhat different in our experience. Most were fairly included. Strong laminated twinning with networks of intersection tubules were common. Some tubules were naturally stained orange with what appeared to be epigenetic iron compounds (figure 28, left). Dense clouds of reflective platelets, similar to those seen in sapphires from Uмба, Tanzania, were present in many of the rubies (again, see figure 28, left). Within some of the clouds were needle-like inclu-

sions that appeared to be rutile. A few stones also contained clouds that had a more particulate appearance (figure 28, center). In addition, dense particulate planar clouds were seen in some samples (figure 28, right).

Perhaps the most interesting inclusions we noted—in two stones—were rounded blue-gray to grayish blue transparent crystals (e.g., figure 29) that gave a Raman signal of an amphibole very close to that of pargasite. Their visual appearance was identical to the pargasite crystals found in rubies from Winza in Tanzania. It is unclear if this is a coincidence or represents contamination with Winza material. However, the inclusions in the other stones in this sample set did not resemble those documented in rubies from Winza.

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Yogo sapphire update. The Vortex sapphire mine at Yogo Gulch, Montana, has reopened under the consolidated

Figure 28. Some of the Mozambique rubies hosted epigenetically stained tubules and dense clouds consisting of reflective platelets and short needles that were reminiscent of sapphires from Uмба (left, image width 1.8 mm, by J. I. Koivula). Also seen were particulate clouds made up of small disk-shaped inclusions (center, image width 1.6 mm, by S. F. McClure). Dense planar clouds were present in several of the Mozambique rubies (right, image width 3.5 mm, by S. F. McClure).

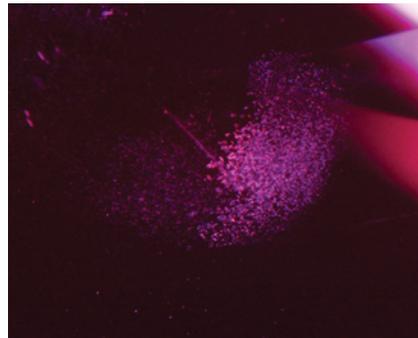
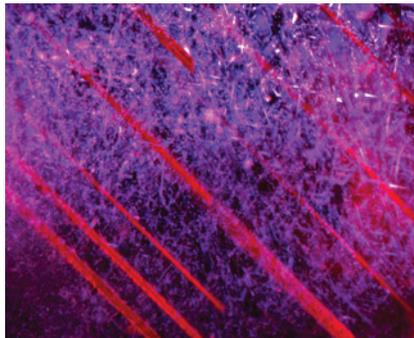




Figure 29. Rounded blue-gray to grayish blue crystals in a few of the Mozambique rubies yielded a Raman spectrum of an amphibole, close to that of pargasite. Similar inclusions are known to occur in Winza rubies. Photomicrograph by J. I. Koivula; the largest crystal is 0.17 mm long.

ownership of Mike and Laurie Roberts (Roberts Yogo Co., Great Falls, Montana). The previous owners ceased operations in late 2004 (see Fall 2005 GNI, p. 276).

Mr. Roberts and his crew of three are mining the Primary and New Downstream dikes year-round, via the access tunnel that was constructed by the former mine owners. This tunnel, a 16% decline, features compressed air and electricity, as well as ventilation fans and an escape route; it penetrates 400 feet (122 m) into the mountain.

The sapphire-bearing dikes, which vary somewhat in friability, measure 15–90 cm in width. They are mined by drilling, blasting, and mucking; pressure washing is done where possible to avoid breaking the gems. The ore is

Figure 30. Sapphires from the Vortex mine in Montana commonly show a uniform “cornflower” blue color. Photo by Amber Roberts.



brought to the surface in 5-tonne trucks, and the sapphire-bearing dike material is allowed to weather before processing. The mill employs gravity separation and processes 20 tonnes of ore per hour. The sapphires are then hand-picked from the jigs.

Roberts Yogo Co. has stockpiled 16,000 grams of rough and faceted nearly 10,000 carats. As with previous production, the vast majority of the sapphires are a consistent natural “cornflower” blue (e.g., figure 30), with a small percentage of well-saturated purple and a very few rare pink stones. The typically flat crystal morphology lends itself to smaller fancy cuts rather than larger rounds. Most of the stones are <1 ct, but they have produced about 100 per year above that threshold. The smaller sapphires are fashioned overseas at fair-trade cutting facilities operated by Columbia Gem House (Vancouver, Washington). The larger rough (e.g., figure 31) is cut in Montana. Full-depth brilliant-cut stones of appreciable size are uncommon, and the 2.50 ct stone in figure 31 is exceptional for Yogo sapphire.

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Topaz with unstable brown color. Since early 2007, there has been an influx of orangy to reddish to pinkish brown topaz on the market in Chanthaburi, Thailand (see G. Roskin, “Topaz alert,” *JCK*, Vol. 178, No. 9, 2007, p. 60). Some of the stones have been represented as coming from Myanmar, others as Brazilian goods. This material has been widely available on the Internet as well. Two of these topazes were supplied to the GIA Laboratory in Bangkok for examination by Jeffery Bergman (LGL Co., Bangkok): an orangy brown sample that had been kept in the dark, and a near-colorless topaz that had faded from orangy brown to almost colorless after being exposed to sunlight

Figure 31. This 2.50 ct concave-cut Yogo sapphire, fashioned by Richard Homer, is shown with a 1.5 g piece of Yogo rough. Both were produced from Montana’s Vortex mine since it reopened in late 2006. Courtesy of Mike Roberts and Robert Kane/Fine Gems International; photo by Robert Weldon.



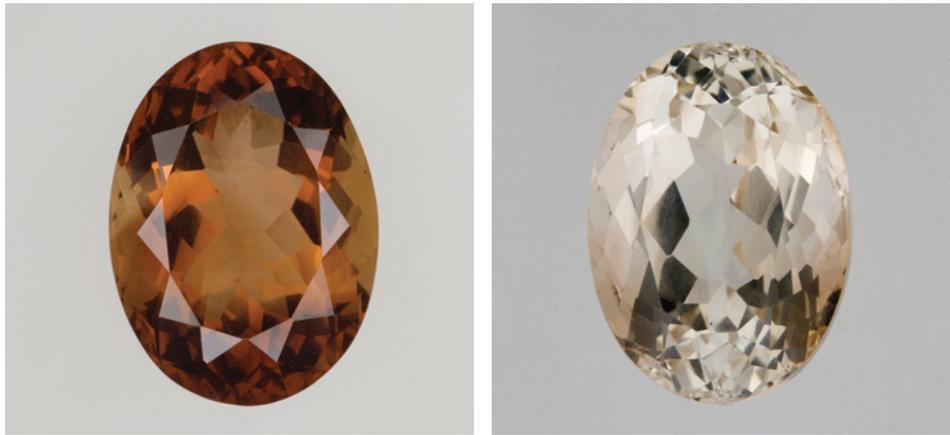


Figure 32. Some brown topaz currently on the market is not color stable. Both of these samples were the same orangy brown color when purchased. While the stone on the left (22.22 ct) was kept in the dark, the other (18.99 ct) turned near-colorless after exposure to sunlight for one day. Photo by Adirote Sripradist.

for one day (figure 32). The samples were obtained in Chanthaburi, with no disclosure of color instability.

In June 2008, some additional samples of this color-fading topaz (also purchased in Chanthaburi, in November 2007) were brought to GIA's attention by L. Allen Brown (All That Glitters, Methuen, Massachusetts). To observe the effect of light on this material first-hand, GIA purchased four faceted orangy brown topaz samples (19.18–21.29 ct) from Mr. Brown, and had three of them sawn in half; the fourth stone was retained as a reference sample. One-half of each of the three stones was kept in the dark for comparison, and the other portions were each exposed to different lighting environments: (1) placed on a windowsill in daylight for 80 hours; (2) exposed to a standard 100-watt incandescent light bulb for 80 hours at a distance of 2.5 cm; and (3) exposed to long-wave UV radiation for 40 hours, using a 6-watt bulb at a distance of 2.5 cm. As seen in figure 33, the samples exposed to daylight and incandescent light faded considerably; the fading of the latter piece was probably also enhanced by the heat of the bulb, since much brown topaz loses color above 200°C (K. Nassau, *Gemstone Enhancement*, 2nd ed., Butterworth-Heinemann, Oxford, U.K., 1994, p. 192). The

sample that was exposed to UV radiation faded even further, despite the shorter exposure time.

Some brown topaz (e.g., from the Thomas Range in Utah) may lose its color when exposed to sunlight (M. O'Donoghue, Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, pp. 176–177). In addition, O'Donoghue (2006) noted that unstable brown color centers may develop from the laboratory irradiation of colorless topaz. To date there is no gemological test that can identify whether brown color in topaz is due to natural or laboratory irradiation, and a fade test is the only way to determine if the color is stable.

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New tourmaline production from Keffi, Nigeria. Gem-quality tourmaline has been known from granitic pegmatites in the Keffi area of central Nigeria for about 25 years (J. Kanis and R. R. Harding, "Gemstone prospects in central Nigeria," *Journal of Gemmology*, Vol. 22, No. 4, 1990, pp. 195–202). In late 2008, there was a new find of

Figure 33. Three samples of brown topaz were sawn in half, and one piece from each pair was subjected to fade testing: in daylight for 80 hours (19.18 ct, left), in incandescent light for 80 hours (21.03 ct, center), and by exposure to long-wave UV radiation for 40 hours (21.29 ct, right). Thermal fading is probably responsible for some of the decolorization shown by the topaz exposed to the incandescent bulb. The UV-faded sample showed the most pronounced change. Composite photo by Adirote Sripradist.





Figure 34. These tourmalines are from a new find in the Keffi area of central Nigeria. The crystal at the top measures 31.6 mm long, and the cut stones range from 6.71 to 16.82 ct. Photo by Robert Weldon.

tourmaline in this region, near the village of Akwandoka (see J. C. Michelou, "New tourmaline deposit found in Nigeria," *InColor*, Fall-Winter 2008–2009, pp. 21, 24).

Eight specimens of the new Keffi tourmaline, consisting of two pieces of rough (17.5 and 6.8 g) and six faceted stones

(6.71–16.82 ct), were loaned to GIA for characterization by Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado). The rough consisted of a well-formed crystal and a spherical nodule, both of which were mostly pink with a yellowish green zone (figure 34). The faceted stones were homogeneous pink, zoned yellow and pink, and zoned greenish yellow and pink (e.g., figure 35). Both the rough and cut samples ranged from eye-clean to very slightly included.

Standard gemological testing of the faceted stones established the following properties: RI—1.620–1.640 (both ± 0.002); hydrostatic SG—3.03 (± 0.02); and fluorescence—inert to long-wave, and moderate chalky blue to short-wave UV radiation; the color-zoned stones showed a zoned chalky yellow fluorescence to short-wave UV. Using a dichroscope, we observed two distinct pleochroic colors perpendicular to the c-axis: light yellow and pink in the pink tourmaline, and light green and orange in the greenish yellow tourmaline. The main internal characteristics were short needles, small particles, and "fingerprints" composed of fluid inclusions. The properties of these samples were typical of tourmaline.

Mr. Blauwet also loaned two other bicolored samples (a crystal and a nodule) of Keffi tourmaline to the University of New Orleans for chemical analysis by electron microprobe. The crystal was analyzed in 10 spots (seven pink and three yellowish green), and the nodule was analyzed in seven spots (five pink and two yellowish green). All the data showed an elbaite composition, with traces of F, Mn, Ca, K, and sometimes Fe (particularly in the yellowish green) and Ti. The elements Cr, Bi, V, Mg, Cu, Ba, Pb, and Cl were below or near the detection limits of the microprobe (i.e., 0.01–0.02 wt.% oxide). The full analyses are available in the *Ge/G* Data Depository.

Riccardo Befi

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"Lilac"-colored Cu-bearing tourmaline from Nigeria. At the 2009 Tucson gem shows, Bill Barker (Barker & Co., Scottsdale, Arizona) had some copper-bearing tourmaline that was represented by his supplier as being from a new



Figure 35. The face-up appearance of this 12.20 ct color-zoned tourmaline changes when it is viewed at slightly different angles. Photos by Robert Weldon.

deposit in Nigeria. The stones had a consistent “lilac” pink color and reportedly were not heat treated (e.g., figure 36). He obtained the rough at the June 2008 JCK show in Las Vegas, and faceted ~400 carats into stones that ranged up to ~15 ct. The rough material consisted of broken crystals, some of which had green rims. Heat-treatment experiments performed by Mr. Barker yielded no change in color in either the pink or green material.

Mr. Barker donated several samples of the rough pink/green tourmaline to GIA, and LA-ICP-MS analyses of eight pieces by research scientist Dr. Mike Breeding showed 0.03–0.08 wt.% CuO in the pink stones and 0.05–0.10 wt.% CuO in the green material. The samples also contained trace-to-minor amounts of Fe (mainly in the green tourmaline), Mn, Ca, and Zn, and significant traces of Ti, Ga, Pb, and Sr.

The Cu content of this pink/green tourmaline is similar to that of some greenish blue samples from Nigeria that were described in a Spring 2002 GNI entry (pp. 99–100), but it is considerably less than the Cu concentrations measured in the Nigerian tourmalines reported in Fall 2001 and Winter 2007 GNI entries (pp. 239–240 and 384–385, respectively).

Brendan M. Laurs

Triphylite from Brazil. In October 2008, Brad Payne (The Gem Trader, Surprise, Arizona) informed GIA about the recent availability of some facetable triphylite (figure 37), reportedly from Galiléia in the Brazilian state of Minas Gerais. Galiléia mines are famous for producing rare col-



Figure 36. Nigeria is reportedly the source of this unheated “lilac”-colored copper-bearing tourmaline (6.35–13.92 ct). Photo by Robert Weldon.

lectible minerals, sourced from granitic pegmatites of Brasileiro age (550–500 Ma; M. L. S. C. Chaves et al., “Assembléias e paragêneses minerais singulares nos pegmatitos da região de Galiléia [Minas Gerais],” *Geociências*, Vol. 24, No. 2, 2005, pp. 143–161). Triphylite is the iron-rich variety of the triphylite-lithiophilite series $\text{Li}(\text{Fe}, \text{Mn})\text{PO}_4$; lithiophilite is the manganese-rich variety. Gem-quality triphylite large enough to cut multi-carat stones is quite rare. Mr. Payne was aware of ~200 carats of mixed-quality faceted stones; the vast majority weighed less than 4 ct. Although the material was typically dark



Figure 37. These triphylites (0.26–9.31 ct) were recently produced from Minas Gerais, Brazil. Three of the stones show a slight color change from greenish brown in daylight (left) to brownish pink or purple in incandescent light (right). Photos by Robert Weldon.

TABLE 1. Physical properties and chemical analyses (by LA-ICP-MS) of six Brazilian triphylites.^a

Property	7.31 ct	9.31 ct	2.63 ct	0.56 ct	0.48 ct	0.26 ct
RI						
n_{α}	1.687	1.690	1.690	1.690	1.690	1.692
n_{β}	1.689	1.693	1.694	1.694	1.693	1.695
n_{γ}	1.695	1.698	1.698	1.698	1.697	1.700
SG	3.53	3.56	3.57	3.52	3.52	nd ^b
Oxide (wt.%)						
P_2O_5	20.02	20.64	20.44	46.00	48.12	48.43
H_2O	12.02	12.67	13.73	10.29	10.66	10.40
FeO	30.56	38.54	38.04	28.05	27.83	28.48
MnO	27.75	17.79	17.63	12.05	12.35	12.30
ZnO	0.16	0.24	0.24	0.20	0.19	0.20
MgO	0.50	1.07	1.09	0.71	0.70	0.69
Total	100.01	99.95	100.01	100.00	99.84	99.99
Ion ratio						
Fe/Mn	1.10	2.17	2.17	2.24	2.25	2.29

^a Analyses performed with a Thermo Fisher X Series II ICP-MS with a NewWave UP 213 laser ablation unit, calibrated using NIST glasses, using the following ablation parameters: 213 nm laser excitation, 7 Hz frequency, 30 μ m diameter spot size, and 40 second dwell time.

^b Abbreviation: nd = not determined (due to small sample size).

Note: The major-element data (for P, Li, Fe, and Mn) were reported incorrectly.

orangy red in both daylight-equivalent and incandescent light, some of the gems showed a slight color change.

Mr. Payne loaned GIA six faceted samples, ranging from 0.26 to 9.31 ct (again, see figure 37). Gemological testing produced the following results: color—three were dark orangy red, and three exhibited a slight color change from greenish brown in daylight to brownish pink or purple in incandescent light; pleochroism—strong blue or bluish green, brownish orange, and brown; RI— n_{α} = 1.687–1.692, n_{β} = 1.689–1.695, and n_{γ} = 1.695–1.700; birefringence—0.007–0.008; and hydrostatic SG—3.52–3.57. All were inert to long- and short-wave UV radiation. The absorption spectrum seen with a desk-model spectroscope consisted of a strong line at 410 nm, a band at 450–460 nm, strong lines near 470 nm, and bands at 490–500 and 600 nm. These properties are consistent with those reported for triphylite (Fall 1988 Lab Notes, p. 174; M. O'Donoghue, Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, p. 460). Microscopic observation revealed fine particles arranged in parallel bands, as well as short needles, transparent crystals, and fine-grained “fingerprints.”

Infrared and Raman spectra were typical for Li-Fe-Mn-phosphates. Chemical analysis with EDXRF and LA-ICP-MS (the latter performed by research associate David Kondo; table 1) revealed traces of Mg and Zn in all the samples. The concentrations of Fe and Mn affect the optical and physical properties in the triphylite-lithiophilite series: RI and SG increase or decrease proportionally with Fe and Mn (S. L. Penfield and J. H. Pratt, “Effect of the mutual replacement of manganese and iron on the optical properties of lithiophilite and triphylite,” *American Journal of Science*, Series 3, Vol. 50, No. 299, 1895, pp. 387–390). In these triphylites from Galiléia, the RI values

varied according to the Fe/Mn ratio, and SG fluctuated consistently with iron content (table 1).

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SYNTHETICS AND SIMULANTS

Colorless synthetic sapphire imitating rough diamond.

Many types of near-colorless transparent crystalline materials have been fashioned to imitate rough diamond (see, e.g., Lab Notes: Fall 1996, p. 205 [cubic zirconia]; Fall 1997, pp. 217–218 [topaz]; and Fall 2007, p. 250 [phenakite]). The Dubai Gemstone Laboratory has seen cubic zirconia, topaz, phenakite, and rock crystal fashioned in this manner. Recently, we received for identification a 2.5 g near-colorless sample that resembled a water-worn, distorted octahedral diamond crystal (figure 38). Despite the client's long experience in rough diamond trading, he was unsure of its authenticity.

Standard gemological testing quickly established that the sample was not a diamond. It was doubly refractive and uniaxial, with a spot RI of approximately 1.76 and a hydrostatic SG of 4.00. These properties were consistent with corundum, which was confirmed by Raman spectroscopy. The sample was inert to long-wave UV radiation and fluoresced weak chalky blue to short-wave UV. Microscopic examination revealed no visible inclusions, nor any curved striae or Plato lines in immersion that would point to synthetic sapphire. However, the UV-Vis absorption spectrum showed transparency down to 224 nm—a strong indication that the sample was synthetic because natural corundum typically does not transmit wavelengths less than 288 nm. This identification was

Figure 38. Despite its outward appearance resembling a natural octahedral diamond crystal, this 2.5 g sample is a synthetic sapphire. Photo by N. Ahmed, © Dubai Gemstone Laboratory.



confirmed by EDXRF analysis, which showed the expected Al, and a very small amount of Fe as the only trace element (see S. Elen and E. Fritsch, "The separation of natural from synthetic colorless sapphire," Spring 1999 *G&G*, pp. 30–41).

We had never seen colorless synthetic sapphire imitating rough diamond, perhaps because its higher hardness makes it more difficult to fashion than more common simulants such as topaz and phenakite. This example shows that even experienced traders can make costly mistakes when dealing with rough diamonds from unknown sources or spot buying, and extra care should always be taken to confirm a suspect sample's identity. In this case, simple gemological testing was sufficient to detect the fraud.

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MISCELLANEOUS

Update on Myanmar gems. This contributor recently had the opportunity to test a bipyramidal ruby crystal with good color and luster. The sample was ~2.5 cm tall and weighed ~5 g. The faces were curved and bent, as if water-worn. Yet, the sample's luster was different from that of a natural alluvial crystal, and the horizontal striations were inclined rather than perpendicular to the vertical axis. Detailed observation with 10× magnification revealed that the pyramidal faces were not natural, but rather hand-fashioned or engraved. The presence of curved striae, also seen with the microscope, proved it was a synthetic ruby.

A colleague who recently visited the jadeite mining areas reported that the largest company mining there was Ever Winner, which was working about 100 plots, each measuring 200 × 200 ft (61 × 61 m), and employing some 800–1,000 workers. The company was operating more than 30 backhoe machines, 20 tractors, and about 40 dump trucks. Heavy rains in the jade mining area during this year's monsoon season have caused landslides and flooding along the Uru River. The floods were due to the diversion of river channels and accumulation of mine tailings, underscoring the need to enforce environmental regulations. A 30 kg piece of jadeite recovered from the Mana mining area sold at the Myanmar Gems Emporium for US\$25 million.

At Mong Hsu, a joint mining venture with the Myanmar Economic Corporation found some attractive rubies by following the geologic structure (fold axes) to the south-southeast in underground operations.

Gem shops in Yangon have experienced slumping sales in the downtown and Kaba Aye areas. The downturn is due to decreased tourism, economic sanctions by the U.S. government, and the global economic situation.

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CONFERENCE REPORTS

3rd European Gemmological Symposium. This successful conference was held June 4–7 in Berne, Switzerland, and was hosted by the Swiss Gemmological Society, the SSEF Swiss Gemmological Institute (Basel), and the Gübelin Gem Lab (Lucerne). A number of interesting presentations—some of which are described here—were offered to the 130 participants who attended. The symposium opened with two keynote speakers: **Martin Rapaport** offered insights on the troubled diamond market, while **Gabi Tolkowsky** discussed diamonds from a different perspective, emphasizing their beauty.

Dr. Daniel Nyfeler (Gübelin Gem Lab) stressed the importance of using algorithms to handle the large quantity of data obtained with new analytical methods, especially for determining the geographic origin of gems. **This contributor** demonstrated the possibilities and limitations of LA-ICP-MS in gem testing. **Dr. Karl Schmetzner** (Petershausen, Germany) spoke on the colorimetry of color-change garnets and their vanadium, chromium, and manganese contents. **Dr. Benjamin Rondeau** (Laboratoire de Planétologie et Géodynamique, University of Nantes, France) discussed the role of organic matter in sediments as a source of vanadium in emeralds from Colombia and other localities.

Jean-Pierre Chalain (SSEF) showed a diagram illustrating the characteristic width (full width at half maximum) and position of the platelet peak of type Ia HPHT-treated diamonds. **Thomas Hainschwang** (Gemlab Gemological Laboratory, Balzers, Liechtenstein) presented the results of type Ia diamond irradiation experiments with subsequent annealing. The samples turned from near-colorless to very dark green and black upon irradiation, and then deep greenish yellow to deep orangy brown upon annealing. **George Bosshart** (Horgen, Switzerland) discussed his research on the genesis of natural green diamond colors. He postulated that the radiation-induced green color in the investigated diamonds resulted from contact with radioactive element-bearing fluids or groundwaters.

Dr. Henry Hänni (SSEF) summarized the current status of cultured pearls, explaining the three basic distinctions: beaded or beadless, mantle-grown or gonad-grown, and saltwater or freshwater. **Dr. Stefanos Karampelas** (Gübelin Gem Lab) presented Raman spectra confirming that all natural colors of freshwater cultured pearls originate from a mixture of unsubstituted polyenes and not from impurities or carotenes, as previously believed. The absence of characteristic polyenic Raman bands provides evidence of artificial color.

Further interesting topics included spessartine deposits around the world (**Dr. Claudio Milisenda**, DSEF, Idar-Oberstein, Germany); basalt-related ruby and sapphire deposits (**Dr. Dietmar Schwarz**, Gübelin Gem Lab); zircon from Ratanakiri, Cambodia (**Dr. Walter Balmer**, Chulalongkorn University, Bangkok); the detection of jewelry fakes (**Dr. Jack Ogden**, Gem-A, London); the nondestructive identification of ornamental materials (**Dr. Vera Hammer**, Natural History Museum, Vienna, Austria); the identification of treated fancy-color diamonds (**Dr. Eric Erel**,

Gübelin Gem Lab); digital photomicrography of inclusions (**Michael Hügi**, Swiss Gemmological Society); the interplay between world politics and gems in Mogok, Myanmar (**Roland Schlüssel**, Pillar & Stone International, San Francisco); historic highlights at auction and the influence of the celebrity factor ("origin") on the selling price of jewelry at auction (**Helen Molesworth**, Christie's, Geneva); the microscopic and macroscopic characteristics of ivories (**Maggie Campbell Pedersen**, *Organic Gems*); and the cultured pearl market (**Andy Muller**, Golay Buchel Japan, Kobe).

After the symposium, many participants joined an excursion to Switzerland's Grimsel region, where a visit to a protected crystal fissure—the walls of which are covered with well-formed colorless quartz crystals and pink fluorite—crowned the outing.

Michael S. Krzemnicki

ANNOUNCEMENTS

CIBJO resources for retailers. CIBJO, the World Jewellery Confederation, is releasing its *Retailers' Reference Guide: Diamonds, Gemstones, Pearls and Precious Metals*. It contains comprehensive information on various gem materials and metals, as well as handouts for sales staff. Other resources include *Believe in Me: A Jewellery Retailer's Guide to Consumer Trust*, which offers steps that can be taken to instill confidence in today's consumer, and *The Retailer's Guide to Marketing Diamond Jewellery*, which contains practical advice on analyzing your business, know-

ing your customer, staff training, branding, and merchandising, plus step-by-step business tools and case studies. Visit www.cibjo.org to download these free publications.

Gem cutting notes available. The Summer 2009 GNI entry on colorless petalite and pollucite from Laghman, Afghanistan (pp. 150–151) documented three stones that were faceted by Robert C. Buchanan (Hendersonville, Tennessee). Mr. Buchanan has kindly provided information on the cutting of these gemstones, which is available in the *G&G Data Depository* (www.gia.edu/gandg). Notes on additional gems cut by Mr. Buchanan will be posted in the Depository as GNI entries on them are published.

ERRATUM

Due to a drafting error, the definition for the 3H (503.5 nm) defect in "The 'type' classification system of diamonds and its importance in gemology" on p. 100 of the Summer 2009 issue described a different lattice defect. The definition should have read:

3H (503.5 nm): This defect is thought to be related to an interstitial carbon atom in the diamond lattice. It is created by radiation damage and often occurs with the GR1. On rare occasions, 3H absorbs strongly enough to enhance the green color caused by GR1 absorption.

We thank Andrea Blake for bringing this to our attention. *Gems & Gemology* regrets the error.

IN MEMORIAM CAMPBELL R. BRIDGES (1937–2009)

The gemological community was stunned by the recent death of one of its most remarkable figures. Geologist Campbell Bridges, who is credited with the discovery of tsavorite garnet in the 1960s and led most of its mining in the decades since, was killed August 11 in southern Kenya, the victim of a mob attack over mining rights.

A native of Scotland, Mr. Bridges spent most of his life in Africa. There he became inextricably linked with tsavorite, the brilliant green grossular garnet. He encountered his first crystal in 1961 but was too involved with another newly discovered gem material, tanzanite, to pursue the find. Mr. Bridges rediscovered the green garnet six years later in Tanzania, but was forced to abandon his operation when the government nationalized the mines. Undaunted, he crossed the border into Kenya to resume the search.

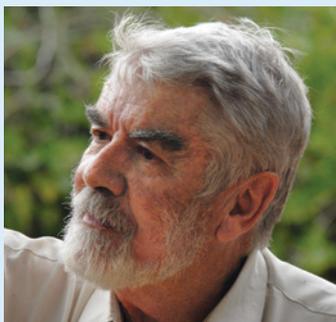
His careful analysis of southern Kenya's geology and even its vegetation patterns paid dividends when he struck

tsavorite on the first day of ground exploration. By 1971 he had staked numerous claims. Tiffany & Co. christened the gem, naming it after the nearby Tsavo National Park, and introduced it in September 1974. Mr. Bridges's article in the Summer 1974 issue of *Gems & Gemology* (pp. 290–295) offered a detailed study of its characteristics and geology.

Mr. Bridges was known for his rugged, adventurous spirit, and many of his mining stories featured brushes with lions, cobras, and scorpions. A popular lecturer, he spoke on East African gems at conferences around the world, including GIA's International Gemological Symposiums in 1982 and 1991.

Mr. Bridges was a director and founding member of the International Colored Gemstone Association (ICA). He was also a staunch wildlife conservationist and pioneered methods of environmentally responsible mining.

Campbell Bridges is survived by his wife, Judith, and two children, Laura and Bruce.



Robert Weldon