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## COLORED STONES AND ORGANIC MATERIALS

**Alaskan amber.** Few may think of Alaska as a source of amber, but the Inuit people have long collected this organic gem from northern beach gravels between Harrison Bay and Smith Bay on the Arctic Ocean. In *Gemstones of North America* (D. Van Nostrand Co., Princeton, NJ, 1959), J. Sinkankas noted that locals refer to the amber as *auma*, which translates as "live coal."

In 1943, an American soldier stationed in Alaska found a 117.8 g chunk of amber (figure 1) while strolling along the coast. Subsequent visits to the area yielded other smaller amber pieces, woolly mammoth teeth, and ivory

Figure 1. This Alaskan amber specimen (117.8 g; 78 × 59 × 36 mm) contains an unusually wide variety of trapped insects, some easily visible without magnification. Photo by R. Weldon.



tusk fragments. The amber in figure 1 was eventually acquired by Barry Schenck of M. M. Schenck Jeweler Inc., Chattanooga, Tennessee, who recently loaned it to GIA for examination. Mr. Schenck has counted more than 30 insects trapped inside the piece, as well as other organic materials, including an apparent seedpod. GIA subsequently purchased the piece (Collection no. 35840).

Most of the insects were eye-visible, though others were best seen with magnification (up to 40×). Prominent were a mosquito, spiders, beetles, gnats, ants, and possibly a bee (see, e.g., figure 2). Other inclusions consisted of gas bubbles and debris that was probably associated with the trees from which the amber formed. The specimen also contained a network of fissures that are undoubtedly due to the stress from numerous freeze-thaw cycles that the fossil endured over time.

Sinkankas (1959) noted that white cedar forests once covered vast swaths of the northern hemisphere, including Asia and Alaska. As resins oozed from the trees, they trapped a variety of insects. These exudations hardened over time, and the fossil resins were incorporated into sedimentary deposits. Geologic upheavals and erosion exposed these deposits, and in some cases the amber

*Editor's note: The initials at the end of each item identify the editor or contributing editor who provided it. Full names and affiliations are given for other contributors.*

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*Figure 2. Viewed with 10× magnification, details of the Alaskan amber become evident: A mosquito, spider, and possibly a bee are permanent neighbors, entombed together with hundreds of gas bubbles. Photomicrograph by R. Weldon.*

was loosened and tumbled by rivers or washed out to sea. Because amber floats in saltwater, it was carried by currents and deposited in a random fashion along Alaska's coast.

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**Update on iridescent andradite from Mexico.** During the past few years, additional production of iridescent andradite has come from the previously known mining area for this material that is located about 150–200 km southeast of Hermosillo, Sonora, Mexico. After two years of test marketing the garnet in Tucson, and a number of trips to the mine to purchase rough, Pala International (Fallbrook, California) and JOEB Enterprises helped reactivate the mine in January 2006.

The andradite crystals commonly consist of two distinct layers: an opaque dark brown core that is overgrown

by a layer of transparent greenish yellow material that shows the iridescence. Since the layer exhibiting the phenomenon tends to be very thin (i.e., less than 1–2 mm), pieces of rough are carefully polished to help bring out their colors. The polished material exhibits a range of spectral colors from orange to blue; a few stones also are chatoyant, and some show four-rayed stars. The color display is quite dramatic in daylight or with strong incandescent illumination; some of the initial material from this locality has even been mistaken for black opal (see Fall 1987 Gem News, pp. 173–174). The visual appearance of the material recently recovered is consistent with observations reported for earlier production in the Summer 1988 Gem News section (pp. 120–121). E. J. Gübelin and J. I. Koivula attributed the color display to interference colors, and referred to their lamellar appearance as “kaleidoscopic stripes” (*PhotoAtlas of Inclusions in Gemstones, Vol. 2*, Opinio Publishers, Basel, Switzerland, 2005, pp. 482–484).

The garnets are mined from a skarn deposit (figure 3). In 2003, local miners using only picks and shovels recovered enough material to bring two parcels to the U.S. The initial parcel consisted of about 20 small crystals ranging from 5 to 10 mm in diameter. The miners were encouraged to polish as much of the production as possible for the 2004 Tucson gem show, and they subsequently produced approximately 100 polished crystal fragments and cabochons. Marketed as Rainbow garnet, interest in higher-quality material especially (e.g., figure 4) has been strong among designers and collectors.

John McLean, Pala International's mine foreman, subsequently worked with the local mine owners to introduce more effective mining methods through the use of explosives and a compressor to operate a pneumatic jackham-

*Figure 3. The iridescent andradite is mined from a skarn deposit, as shown in this boulder. The iridescent garnet is cut from the greenish yellow material, which here has been mostly removed, leaving the underlying brown garnets. Photo by E. Boehm.*



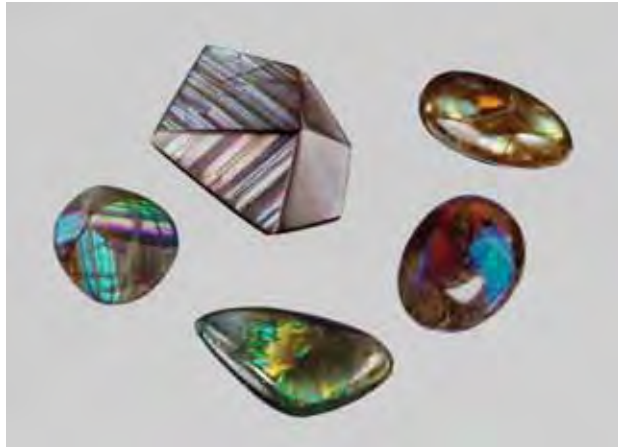


Figure 4. These cabochons and polished crystal fragments of Rainbow garnet (2.38–6.23 ct) are representative of recent production from the previously known mining area in Sonora, Mexico. Courtesy of Pala International © JOEB Enterprises; composite photo by C. D. Mengason.

mer. By the beginning of April 2006, they had achieved production of approximately 50 kg of material consisting of small crystals with areas of cutting quality. Today, several lapidaries are experimenting with polishing, cutting, and carving the material. Because the iridescence is restricted to such a thin overgrowth, they must exercise extreme caution to avoid cutting through it and exposing the dark underlying garnet. Nevertheless, sizable carvings have been produced from some of the crystal clusters (figure 5). Most of the rough, however, has a finished yield of less than 10%, which is lower than the yield from most transparent gem rough (usually about 20%). As of June 2006, approximately 70 finished gems had been produced, in sizes ranging from just under 2 ct to more than 20 ct.

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**Two unusual star emeralds.** The Gem Testing Laboratory, Jaipur, India, recently examined two fine bright green emeralds that showed asterism (5.40 and 11.37 ct; figure 6). Both displayed a weak (though distinct) six-rayed star, with the strongest ray aligned parallel to the length of the stone.

The gemological properties were consistent with natural emerald: A spot R.I. was measured at around 1.59, the hydrostatic S.G. was 2.73, and both specimens exhibited the strong chromium absorption spectrum characteristic for emeralds when they were examined with a desk-model spectroscope.

Observation of both cabochons with magnification and strong fiber-optic lighting revealed minute iridescent inclusions in abundance (figure 7). At higher magnification, these inclusions appeared to be hexagonal and triangular discs or platelets; some were elongated as well, similar to knife-shaped rutile silk in corundum (see, e.g., K.



Figure 5. At 25.89 ct, this free-form carving is the largest fashioned Rainbow garnet known to this contributor. Carved by Bud Standley (Oceanside, California) and courtesy of Pala International; photo by Wimon Manorotkul.

Schmetzer et al., “Asterism in beryl, aquamarine and emerald—an update,” *Journal of Gemmology*, Vol. 29, No. 2, 2004, pp. 65–71). In transmitted light, the inclusions appeared gray, varying from translucent to opaque (figure 8), whereas they appeared weakly birefringent in cross-polarized illumination.

When the stones were viewed in immersion (using bromoform), the inclusions were seen to form cloudy planes that were mainly oriented perpendicular to the

Figure 6. These emeralds (5.40 and 11.37 ct) show asterism as well as an attractive green color. Photo by G. Choudhary.



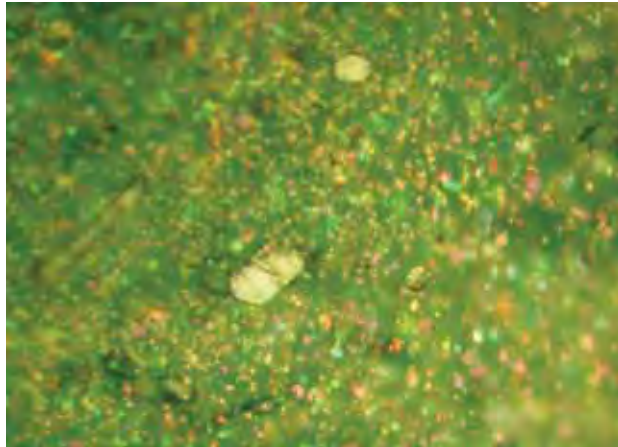


Figure 7. Magnification of the star emeralds in figure 6 revealed iridescent hexagonal and triangular platelets that are mainly concentrated in planes perpendicular to the c-axis. Although not visible in this image, some of the inclusions were elongated. Photomicrograph by G. Choudhary; magnified 50 $\times$ .

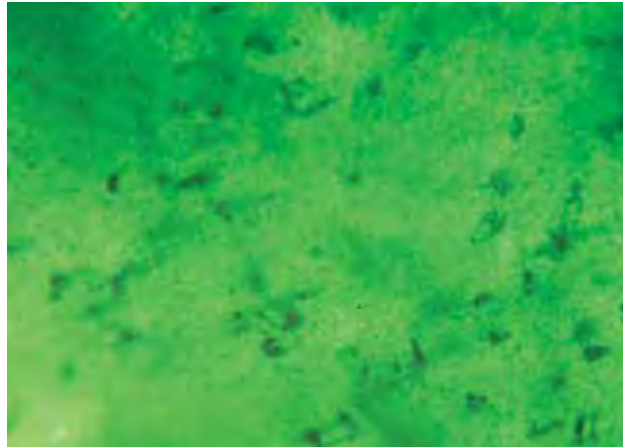
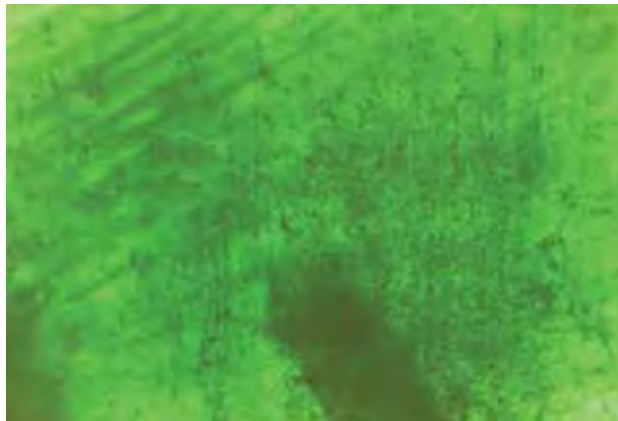


Figure 8. When the star emeralds were immersed in bromoform and viewed with transmitted light, the inclusions in figure 7 appeared gray, with diaphaneity varying from translucent to opaque. Photomicrograph by G. Choudhary; magnified 50 $\times$ .

c-axis. These orientations are similar to those seen in star corundum. The maximum concentration of inclusions occurred at the center of both stones, causing the central area of the star to appear brightest when the stones were viewed with reflected light. Careful examination showed that the inclusions within the planes were roughly aligned (figure 9); up to three directions of alignment could be seen that intersected at approximately 60°. This, combined with the elongate habit of some of

Figure 9. In this view looking down the c-axis of one of the star emeralds, two directions of inclusion alignment (oriented at approximately 60°) can be seen. A third direction of alignment was also present in the samples; combined with the elongate habit of some of the inclusions, it was apparently responsible for the asterism. Photomicrograph by G. Choudhary; in immersion with transmitted light, magnified 35 $\times$ .



the inclusions, is apparently responsible for the asterism seen in these emeralds.

Both stones also contained a number of long, tube-like, two-phase inclusions parallel to the c-axis (figure 10). Other inclusions present were colorless rhombohedrons and rounded colorless crystals.

The source of these stones is not known, but star emeralds have been reported from Brazil (Nova Era and Santa Terezinha) and Madagascar (Mananjary area; see K. Schmetzer et al., 2004, and references therein). Although star emerald is unusual, the bright green color of these emeralds makes them even rarer.

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Figure 10. Long, tube-like, two-phase inclusions were oriented parallel to the c-axis in the star emeralds. Photomicrograph by G. Choudhary; magnified 40 $\times$ .

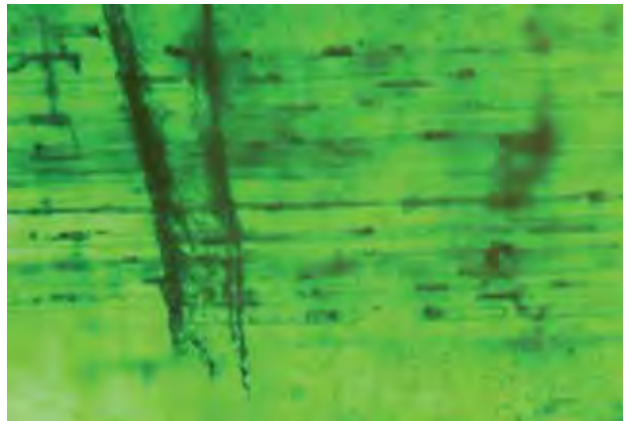




Figure 11. This 9.50 ct euclase from the Chivor emerald mine in Colombia is notable for its size and intense greenish blue color. Photo by C. D. Mengason.

**Faceted blue euclase from Colombia.** The Spring 2003 Lab Notes section (p. 42) reported on an attractive crystal specimen of greenish blue euclase from Pauna, Boyacá District, Colombia (also see erratum, Spring 2004 *Gems & Gemology*, p. 65). Another source of blue euclase in Colombia is the famous Chivor emerald mine, also located in the Boyacá District, approximately 110 km southeast of Pauna. Most of the euclase has been produced sporadically from a small area of this mine (i.e., the San Francisco tunnel). The site is located about 8 km from the nearest town and can only be reached by a four-wheel-drive vehicle or a helicopter. The euclase was initially found in the 1980s, when a large amount of emeralds were produced from Chivor. The miners did not give much importance to the euclase because they lacked knowledge of the material and were focused on the important emerald production at that time.

Recently, some fine gem-quality crystals of blue euclase have been appearing in the Colombian market, and the faceted gems are sometimes seen in parcels of cut

emeralds offered in Bogotá. The cut euclase is light-to-medium greenish blue, and the stones typically weigh less than 2 ct. By contrast, the 9.50 ct Chivor euclase in figure 11 is notable for its size and intense greenish blue color; the rough was reportedly mined in 2005.

The 9.50 ct euclase was loaned to the GIA Laboratory for examination, and the following gemological properties were recorded by Shane F. McClure: Color—greenish blue; pleochroism—near colorless, light purple, and blue-green; R.I.—1.650–1.670; biaxial optic figure; hydrostatic S.G.—3.10; fluorescence—inert to long- and short-wave UV radiation; and no spectrum was observed with the desk-model spectroscope. Examination with a gemological microscope revealed a large cleavage plane, inclusions of tiny transparent colorless crystals, and strong angular graining and associated color zoning.

In addition to Colombia, gem-quality euclase is known from Brazil and Zimbabwe (Summer 1993 Lab Notes, pp. 125–126). Nevertheless, euclase remains a rare stone. Unless a productive source is discovered in the future, the supply of this material will likely remain limited to a few sporadic gems destined for museums and private collectors.

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**Color-change fluorite.** Fluorite shows a remarkable diversity of color, crystal morphology, and optical properties—specifically, the UV fluorescence from which its name derives—that make it one of the most fascinating minerals. Fluorite is known to occur in almost every hue, and often exhibits distinct and beautiful color banding/zoning. Some fluorite shows a distinct color change. Such was the case with a 10.00 ct triangular modified brilliant that these contributors noticed in the local market. The stone appeared medium blue in daylight-equivalent fluorescent light and in indirect sunlight, but it changed to a medium purple in incandescent light (figure 12).

Figure 12. This 10.00 ct fluorite exhibits a distinct color change from blue in day or fluorescent light to purple in incandescent light. Photos by N. Sturman.



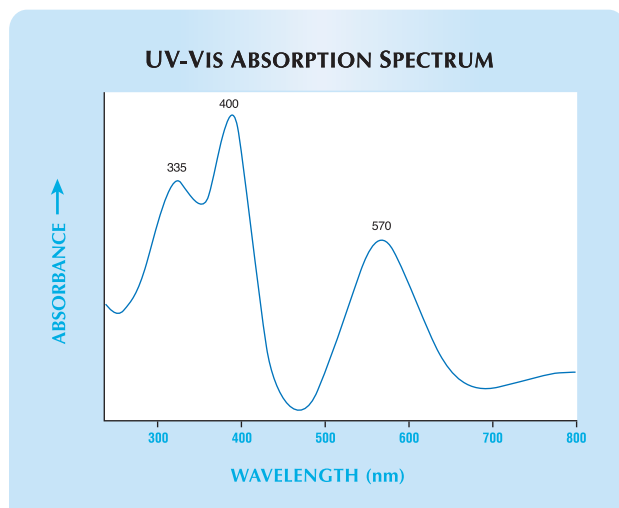


Figure 13. The UV-Vis absorption spectrum of the color-change fluorite shows absorption bands centered at ~400 and ~570 nm. The transmission windows in the blue-green and red regions, and a local absorption maximum in the yellow region, are consistent with that of other true color-change stones.

The R.I. (1.430) and hydrostatic S.G. (3.18) were consistent with fluorite, including an irradiated color-change fluorite reported in the Summer 2002 Gem News International section (p. 186). Magnification revealed prominent wavy color banding that was related to fine planar zones of minute pinpoint inclusions. Damage to one point of the stone (again, see figure 12) revealed the distinct cleavage present in fluorite, as did some minor surface-reaching cleavage fractures.

With a handheld spectroscope, the fluorite showed an

Figure 14. These cut stones (2.06 and 5.52 ct) and crystal (14 g) of herderite are from northern Pakistan. Courtesy of Farooq Hashmi; photo by C. D. Mengason.



absorption band in the yellow-orange area of the spectrum and some absorption in the violet region. This could be seen more clearly in the UV-Vis spectrum (figure 13), with absorption bands centered at ~400 and ~570 nm. Consistent with other true color-change stones, the spectrum showed transmission windows in the blue-green and red regions and a local absorption maximum in the yellow region. As expected given the spectral features, the fluorite appeared very strong red through the Chelsea color filter. Although fluorite commonly fluoresces to UV radiation, this sample was inert, as was the irradiated color-change fluorite in the Summer 2002 GNI entry. However, the inert behavior of the present color-change fluorite does not necessarily indicate that it has been irradiated, since fluorite does not always show fluorescence.

The Summer 2002 GNI entry mentioned that no fade testing was performed on the irradiated color-change fluorite described. Similarly, we did not perform fade testing on the present fluorite. Although fade testing could reveal the presence of unstable color centers that were created by exposure to radiation, it could not confirm whether this exposure occurred naturally or artificially.

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**Herderite from Pakistan.** Herderite—hydroxyl-herderite [ $\text{CaBePO}_4(\text{F},\text{OH})$ ] has been known from granitic pegmatites in Pakistan's Northern Areas for several years. Well-formed crystal specimens of herderite from this region are sought after by mineral collectors, but the material is rarely transparent enough to be faceted. In June 2006, Farooq Hashmi (Intimate Gems, Jamaica, New York) loaned GIA some rough and cut examples of "lime" green herderite that he obtained during the past two years in the mineral market of Peshawar, Pakistan. The material was represented as coming from the Shigar Valley, as well as from the more general localities of Skardu and Gilgit, which are common gem and mineral trading areas in northern Pakistan. The most likely source of the gem herderite is the Kandahar mine, Baha, Braldu Valley (about 35 km north of Skardu), according to Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado), who has extensive experience traveling to the gem and mineral localities of northern Pakistan. Mr. Blauwet also indicated that he recently obtained cuttable herderite from two additional locations in the Shigar Valley area: near Chhappu in the Braldu Valley, and at a new mine near Doko in the Basha Valley.

The two faceted herderites (2.06 and 5.52 ct; figure 14) were characterized by one of us (EPQ) for this report; the properties of the smaller stone are listed first, as appropriate: color—light green and medium-light green; pleochroism—both stones showed weak-to-moderate green and yellowish green (a third color was not observed); diaphaneity—transparent; R.I.—1.587–1.616 and

1.586–1.616; birefringence—0.029 and 0.030; hydrostatic S.G.—3.02 and 3.04; Chelsea filter reaction—none; fluorescence—weak-to-moderate blue and moderate-to-strong blue to long-wave UV radiation, weak violet and moderate violet to short-wave UV radiation; and a weak 585 nm absorption feature was observed with the desk-model spectroscope for both stones. Microscopic examination of both samples revealed moderate-to-strong doubling and numerous partially healed fractures with negative crystals, some of which contained both a liquid and a gas. EDXRF spectroscopy of the larger stone showed major amounts of Ca, P, and Sr, and minor Cr, Mn, Y, and Pb. The instrument cannot detect Be or F.

The properties of these Pakistani samples are comparable to those previously reported for herderite (e.g., Spring 2004 Lab Notes, pp. 61–62), although their refractive indices were somewhat higher. Based on the work of P. B. Leavens et al. ("Compositional and refractive index variations of the herderite-hydroxyl-herderite series," *American Mineralogist*, Vol. 63, No. 9–10, 1978, pp. 913–917), the R.I. values of the Pakistani herderite indicate that the composition is near the midpoint between the OH- and F-dominant end-members. Such a composition was also inferred from an R.I. value ( $n_b = 1.610$ ) of a herderite from the Shigar Valley area by A. H. Kazmi et al. ("Gem pegmatites of the Shingus-Dusso area, Gilgit, Pakistan," *Mineralogical Record*, Vol. 16, No. 5, 1985, pp. 393–411). Although we have referred to the material as *herderite* in this entry for simplicity, the correct mineralogical designation is herderite-hydroxyl-herderite.

BML

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**Jeremejevite from Myanmar and Sri Lanka.** Jeremejevite is a rare gem that is mainly known from Namibia (Cape Cross and the Erongo Mountains) and the Pamir Mountains of Tajikistan (see K. Scarratt et al., "Jeremejevite: A gemological update," Fall 2001 *Gems & Gemology*, pp. 206–211; Fall 2002 GNI, pp. 264–265). More recently, a near-colorless 7.88 ct jeremejevite was documented from an additional locality, Madagascar (Winter 2004 GNI, pp. 340–341). With only a few sources of this rare gem known for many years, it is surprising that two more localities for gem-quality jeremejevite have just been reported: Myanmar (Burma) and Sri Lanka (figure 15).

The Burmese jeremejevite was recently documented by H. Kyi and K. Thu ("A new deposit of jeremejevite from the Mogok Stone Tract, Myanmar," *Australian Gemmologist*, Vol. 22, No. 9, 2006, pp. 402–405), who pictured a 4.35 ct light yellow faceted stone and indicated that gemmy crystals can reach  $4.0 \times 1.3$  cm. They reported that the jeremejevite ranges from colorless to light yellow and was mined from alluvial deposits and associated pegmatite



Figure 15. These jeremejevites are from Sri Lanka (left, 5.26 ct) and Myanmar (right, 1.34 ct). Courtesy of Dudley Blauwet; photo by C. D. Mengason.

dikes. Their samples came from a pegmatite on Loi-Sau mountain, which is located 19 km northeast of Mogok, near Pan-tara village; some pink tourmaline and quartz crystals were also produced from this mine (K. Thu, pers. comm., 2006). According to Bill Larson (Pala International, Fallbrook, California), who regularly travels to Myanmar, most of the jeremejevite was produced 1–2½ years ago. Well-formed crystals have been found, with terminations that show varying development of pyramidal and basal forms (figure 16).

Figure 16. Jeremejevite crystals from Myanmar are prismatic and commonly of gem quality. The crystal on the left is  $21.6 \times 5.4$  mm. Courtesy of Bill Larson; photo by Wimon Manorotkul.





Figure 17. The Sri Lankan jeremejevite contained a conspicuous inclusion formed by angular platelets that ranged from white to yellow to orange. This feature might have been created by a series of negative crystals that were epigenetically iron-stained. Photomicrograph by Shane F. McClure; magnified 15 $\times$ .

In late 2005, Dudley Blauwet loaned a 1.34 ct Burmese jeremejevite to GIA for examination (again, see figure 15). The following properties were determined by one of us (EAF): color—light yellowish orange; R.I.—1.643–1.650; birefringence—0.007; hydrostatic S.G.—3.29; and fluorescence—inert to long-wave and weak yellow to short-wave UV radiation. No absorption features were observed with the desk-model spectroscope. Microscopic examination revealed angular growth lines, growth tubes, and two-phase inclusions. The R.I. values of this stone fell within a slightly narrower range (yielding a lower birefringence) than was reported for Burmese jeremejevite by Kyi and Thu (2006;  $n_e = 1.640$  and  $n_o = 1.653$ ).

Sri Lankan jeremejevite was brought to our attention by Mr. Blauwet in September 2005. He obtained a piece of rough that was reportedly from the Ratnapura area, and it was subsequently faceted into a 5.26 ct colorless gem with an interesting inclusion centered beneath the table (again, see figure 15). Mr. Blauwet's supplier in Sri Lanka indicated that several small pieces of colorless jeremejevite have been found sporadically in the same area over the past few years. Examination of the 5.26 ct jeremejevite by one of us (EAF) yielded the following properties: color—colorless; R.I.—1.640–1.649; birefringence—0.009; hydrostatic S.G.—3.29; and fluorescence—inert to long- and short-wave UV radiation. Again, no absorption features were observed with the desk-model spectroscope. Microscopic examination showed that the inclusion under the table consisted of a linear arrangement of angular platelets that ranged from white to yellow to orange (figure 17). Primary fluid inclusions of similar shape have been seen in jeremejevite crystals previously by J. I. Koivula (pers. comm., 2005); he suggested that those in the Sri Lankan stone

are probably drained negative crystals that have been epigenetically iron-stained. No other inclusions were observed in this stone. Mr. Blauwet recently informed us about another colorless jeremejevite that was found in the Ratnapura area in May 2006, which is expected to yield a cut stone weighing ~2 ct.

BML

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**Pink opal from Monte Rosa, Peru.** Peru is an important producer of a few lapidary materials, especially chrysocolla and blue and pink opal from the Acari mine near Nazca (460 km south of Lima), as well as "gem silica" (chrysocolla-stained chalcedony) from the Lily mine near Pisco (J. Hyršl, "Gemstones of Peru," *Journal of Gemmology*, Vol. 27, No. 6, 2001, pp. 328–334), 150 km south of Lima. Pink opal is a mixture of opal with palygorskite, and the color is caused by organic compounds called quinones (E. Fritsch et al., "Relationship between nanostructure and optical absorption in fibrous pink opals from Mexico and Peru," *European Journal of Mineralogy*, Vol. 16, 2004, pp. 743–752). Pink and blue opals probably form in volcanic lake environments.

Pink opal from the Acari mine is typically of mediocre quality, and only rarely has it been found in homogeneously colored pieces large enough to be polished into gems. Much better quality material (e.g., figure 18) was found in 2002 at Monte Rosa, about 5 km east of Ica and 250 km southeast of Lima. At present, about 60 people are using primitive methods to mine the deposit via tunnels that reach almost 100 m underground. The saturated pink opal forms veins up to 30 cm thick. The veins sometimes contain very soft, felt-like aggregates of white

Figure 18. This specimen of pink opal (9 cm long) was mined at a relatively new locality in Peru, known as Monte Rosa. Photo by J. Hyršl.





palygorskite. Also typical in the opal are cavities, sometimes with a sparkling surface caused by an overgrowth of drusy quartz crystals (figure 19). Some specimens of the pink opal are covered by a layer of milky white opal. However, the youngest phase of deposition identified was a crust of botryoidal colorless hyalite opal, up to 7 mm thick, which commonly fluoresced green to short-wave UV radiation. So far, blue Cu-bearing opal has not been found at Monte Rosa.

Gemological properties were collected on five cabochons and two pieces of polished rough pink opal that were obtained from a local dealer who regularly visits Monte Rosa: R.I.—1.475, hydrostatic S.G.—2.18–2.25, Mohs hardness—6, and fluorescence—inert to short-wave UV radiation and weak pinkish white to long-wave UV. These properties are identical to those reported for the Acari material (Hyršl, 2001). Powder X-ray diffraction analysis confirmed that this material is a mixture of opal, palygorskite, and minor chalcedony.

The Monte Rosa opal is available in large quantities (tonnes) from several dealers in Lima and at international gem shows. The relatively large size of the veins allows the material to be carved into large objects; an attractive fish carving measuring 60 cm in diameter was seen by this contributor in Lima. The mine owners plan to develop a large open pit, which will help guarantee a steady production of this attractive material in the future.

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Figure 19. Drusy quartz crystals have overgrown the pink opal within a cavity in this 7-cm-long sample from Monte Rosa, Peru. Note also the surrounding layers of milky white opal and the thin crust of botryoidal colorless hyalite opal on the top of this sample, which represents the last stage of deposition in the vein. Photo by J. Hyršl.



Figure 20. Prehnite from Australia is being mined by a new venture, and the higher-quality material is being polished into cabochons and faceted stones in colors ranging from yellowish green to yellow. The cabochons shown here weigh 9.52–45.80 ct, and the faceted stones are 1.55 and 7.19 ct. Gift of Robert Sielecki–Ausrox/Crystal Universe; GIA Collection nos. 32980–32984. Photo by C. D. Mengason.

**Update on prehnite from Australia.** The Spring 2001 Gem News International section (pp. 71–72) reported on attractive gem-quality prehnite from Wave Hill, Northern Territories. At the 2006 TGMS show in Tucson, Arizona, some new samples of prehnite from this deposit (e.g., figure 20) were shown to this contributor by Robert Sielecki (Ausrox/Crystal Universe, Port Melbourne, Victoria, Australia). Mr. Sielecki reported that in early 2005, his company began exploring an area of Wave Hill that had been prospected for 30 years by Gerald Pauley, who became interested in collaborating on developing the prospect. The deposit is located near the small township of Kalkarindji on the edge of the Tanami Desert, approximately 885 km (550 miles) by road south of Darwin. Mr. Sielecki stated that this area is underlain by ancient (early Cambrian) flood basalts of the Antrim Plateau Volcanics, and there are several minerals produced in addition to prehnite: scolecite, calcite, amethyst, smoky quartz, and agates.

So far the prehnite has only been surface collected as part of a bulk-sampling program being conducted to assess the viability of the deposit for commercial production. A program of pitting and trenching will commence shortly, and full-scale mining is planned for late 2006, depending on the onset of the rainy season (which will limit access to the area). Preliminary results suggest that approximately 3% of the prehnite is of sufficient gem grade for polishing cabochons or faceted stones, with 95% of this yellowish green and the remainder yellow. While to date mostly small faceted stones have been cut from the weathered surface material, Mr. Sielecki expects to recover larger and more transparent rough once mining begins. The lower-quality prehnite is being fashioned into



Figure 21. The largest cabochon in figure 20 contains a conspicuous radiating internal feature that is attributed to the fibrous structure of the prehnite. Photo by C. D. Mengason.

beads, carvings, and objects for the metaphysical market. Mr. Sielecki has trademarked the yellowish green prehnite as "SunJade" and the yellow material as "Golden SunJade." In addition, an unusual green-to-yellow variety of prehnite, which contains radial white patterns resembling flowers, will be marketed as "Flower SunJade." He indicated that the fibrous nature of the prehnite also produces chatoyancy or adularescence in some cabochons. The largest cabochon with adularescence that has been cut so far weighed 61 ct.

Mr. Sielecki donated three cabochons and two faceted stones of the Australian prehnite to GIA for examination (again, see figure 20). Since the gemological properties of this material were already reported in the Spring 2001 GNI entry, these samples were not characterized for this report. One of these samples contained the radial pattern mentioned above (figure 21). Raman analysis of the white radial inclusions by GIA research scientist Dr. Mike Breeding showed no difference from the surrounding prehnite. This indicated that the inclusions are structural features related to the fibrous nature of the material, rather than a foreign mineral.

BML

**Prehnite from Mali.** In 1994, gem-quality garnets were discovered in western Mali in the "Zone of Sangafé," about 130 km east of Kayes and 100 km south of the border with Mauritania (M. L. Johnson et al., "Gem-quality grossular-andradite: A new garnet from Mali," Fall 1995 *Gems & Gemology*, pp. 152–166). Initial mining of alluvial deposits progressed into bedrock, and the mines were soon exhausted. More than 13 tonnes of garnet were recovered before most operations ceased. However, the Kayes region continues to support small-scale mining for garnet as well as epidote, chalcedony, vesuvianite, and prehnite. In December 2005, two of these contributors (RHC and DP) traveled to this region and observed mining for prehnite and associated minerals at several localities

near the villages of Bendoukou and Diakon. The most active locality was Djouga (N14°36'08.2", W10°14'57.1"), located about 5 km north of Bendoukou village.

Several types of minerals were available in the market in Mali's capital, Bamako, but prehnite and garnet were dominant. We saw >1-m-high piles of rough "apple" green prehnite, although some of the material was weathered and discolored by iron stains. The cobbled prehnite is commonly shipped in 120 kg bags to lapidary factories (mostly for beads) in Asia. The prehnite consisted of crusts, balls, and intergrown clusters of spheres or hemispheres that reached up to 5 cm in diameter but were typically 2–3 cm (see, e.g., figure 22). Most of the prehnite was oiled to improve its appearance.

The prehnite is mined from a rather small area centered around Bendoukou village. The deposits are associated with localized diabase intrusions in the vast sedimentary Taoudeni Basin lying north of the Niger and Senegal Rivers. The mineral occurrences are hosted within a Neoproterozoic (800–600 million years old) sequence of sandstones and calcareous rock, which overlay flat-lying, aeolian sandstones. The prehnite, epidote, garnet, and vesuvianite mineralization is hosted by brecciated calcisilicate rocks adjacent to the diabase intrusions.

Figure 22. Prehnite balls joined with black epidote crystals create striking mineral specimens, such as this one from the Kayes region of Mali (5.1 cm tall). Photo © Jeff Scovil; Laura Delano collection.



Over the past three years, prehnite mining has become an important part of the economy of Bendoukou. The mines—actually, individual shafts—are worked by rudimentary methods (figure 23) and the material is hand-sorted on-site. We observed 50–75 independent miners during the trip, but the workforce fluctuates according to agricultural priorities; it grows to several hundred at the end of the dry season. There were about 120 shafts within a 200 × 100 m area, reaching a maximum depth of about 24 m. They were dug randomly until prehnite-bearing rock was located, and then tunnels radiated outward from the shaft. The production included crusts of translucent gray-green, blue-green, and yellow-green prehnite up to a maximum of 10 cm thick, although most are 2–5 cm thick. Many of these crusts have flat undersides and had grown on what may have been anhydrite crystals that subsequently dissolved. Also found in this area were balls and intergrown spherical clusters of prehnite, sometimes intergrown with stout, black, prismatic epidote crystals up to about 5 cm long (again, see figure 22).

Another area near Bendoukou, called Baga (N14°30'34.2", W10°15'54.9"), produced prehnite crusts that varied in color from gray to grayish green. Specimens weighing at least 100 kg were produced at this deposit, but prehnite mining has ceased because of the poor color. Baga is also the source of some very fine epidote specimens, with crystals up to about 10 cm, as well as abundant small, rhombic dodecahedral yellow-brown garnets, some associated with epidote.

Four polished samples of prehnite from unknown localities in Mali were donated to GIA by Dudley Blauwet, and were characterized by one of us (EPQ). The samples consisted of three oval modified brilliants and one cabochon (figure 24), and they yielded the following gemological properties: color—light-to-medium grayish green and yellow; diaphaneity—transparent to semitransparent; R.I.— $n_{\alpha}=1.617-1.619$  and  $n_{\gamma}=1.643-1.645$  from the faceted stones; birefringence—0.026; hydrostatic S.G.—2.92–2.93; Chelsea filter reaction—very weak red reaction from the three green stones and no reaction from the yellow sample; and fluorescence—inert to both long- and short-wave UV radiation. No absorption was observed with the desk-model spectroscope. These properties are comparable to those reported for prehnite by R. Webster (*Gems*, 5th ed., rev. by P. Read, Butterworth-Heinemann, Oxford, 1994, p. 361). Microscopic examination of the four samples revealed a wavy fibrous aggregate structure that sometimes showed a radiating pattern, “fingerprints,” hazy clouds, and reflective thin films. The yellow prehnite had some weak, irregular color zoning.

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Figure 23. Djouga is the most active mining area for prehnite in Mali. Simple hand methods are used to follow the prehnite veins underground for up to 24 m. Photo by R. H. Currier.

**Natural sapphire with unusual inclusions.** A 3.56 ct blue cushion-shaped mixed cut (figure 25) was tested and certified at the Gem Testing Laboratory, Jaipur, India. Refractive indices of 1.760–1.770 and a hydrostatic S.G. value of 3.99 confirmed the stone as corundum.

With magnification, the sample displayed some unusual inclusion patterns. Long, parallel needle-like inclusions with some curved bends (figure 26, left) were present, along with long, slightly wavy fiber- or needle-like

Figure 24. Although prehnite from Mali is typically sold to bead manufacturers, a small amount of the production is polished into cabochons and faceted stones (here, 17.91 ct and 1.62–2.19 ct, respectively). Gift of Dudley Blauwet; GIA Collection nos. 32974–32977. Photo by Maha Calderon.

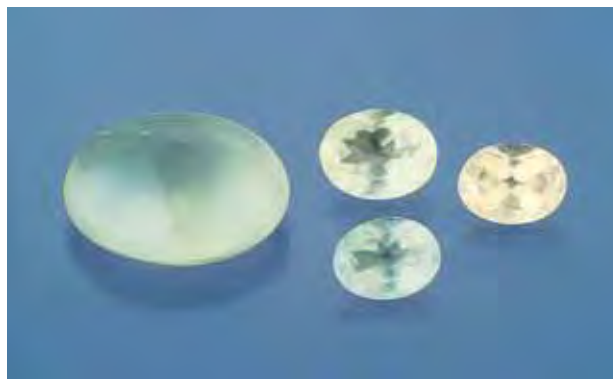




Figure 25. Magnification revealed some unusual inclusions in this 3.56 ct sapphire. Photo by G. Choudhary.

structures (figure 26, right). The visual appearance of both was similar to etch channels seen in stones such as scapolite (Summer 2004 GNI, pp. 172–173) or diamond. Additionally, the stone contained a reddish brown to white inclusion, with a hexagonal cross-section, that resembled a hockey stick (figure 27). Its appearance varied from sugary to wavy to cloudy; in some areas, it gave the impression of a hollow tube filled with foreign material.

When viewed at higher magnification using a fiber-optic light, the sapphire displayed three directions of platelets and short needles that were oriented at approximately 60° to one another (figure 28), which indicated natural origin. The overall undamaged inclusion pattern indicated that the sapphire had not been subjected to high-temperature heat treatment.

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**Sillimanite from India resembling moonstone.** In mid-2005, these contributors received an interesting sillimanite (figure 29) that showed an unusual blue-white sheen when strongly illuminated in certain orientations. The stone was donated to GIA by Scott Davies (American-Thai Trading, Bangkok), after he noticed its optical behavior in

a large parcel of transparent faceted sillimanites he had obtained in mid-2004 in Jaipur, India.

The 6.65 ct oval modified brilliant displayed a weak-to-moderate blue-white sheen that was similar in appearance to the billowy adularescence displayed by some moonstones. The following properties were obtained by one of us (EPQ): color—light gray; diaphaneity—transparent; R.I.—1.661–1.680; birefringence—0.019; hydrostatic S.G.—3.26; no Chelsea filter reaction; and inert to both long- and short-wave UV radiation. No absorption features were observed with a desk-model spectroscope. The properties of this stone are generally consistent with those listed for sillimanite (fibrolite) by R. Webster (*Gems*, 5th ed., revised by P. Read, Butterworth-Heinemann, Oxford, England, 1994, p. 337). Microscopic examination revealed that the stone contained two-phase inclusions and numerous fine, parallel, whitish needles.

Moonstone's billowy sheen (known as adularescence) is caused when light is scattered off very thin alternating lamellae of albite and orthoclase feldspars. The exact cause of the bluish sheen displayed by this sillimanite is not yet fully understood and would require further research. It appears to be due to a combination of the scattering of light off submicroscopic particles (responsible for the bluish color of the sheen) and the reflection of light from the numerous fine needles throughout the stone (causing the sheen to be strongest in two directions; figure 30). If the stone had been cut *en cabochon*, we believe it would have shown chatoyancy.

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**Sphene from Afghanistan.** The Spring 2006 GNI section (pp. 68–69) reported on some “golden” orange sphene from Pakistan that has been mined for the past two years. We were surprised, therefore, when we recently encountered another source of this uncommon gem from the same general region: Badakhshan, Afghanistan. This material was brought to our attention by Scott Davies and Dudley Blauwet, who both reported that it first appeared in late 2005 in the gem market of Peshawar, Pakistan. Mr. Blauwet

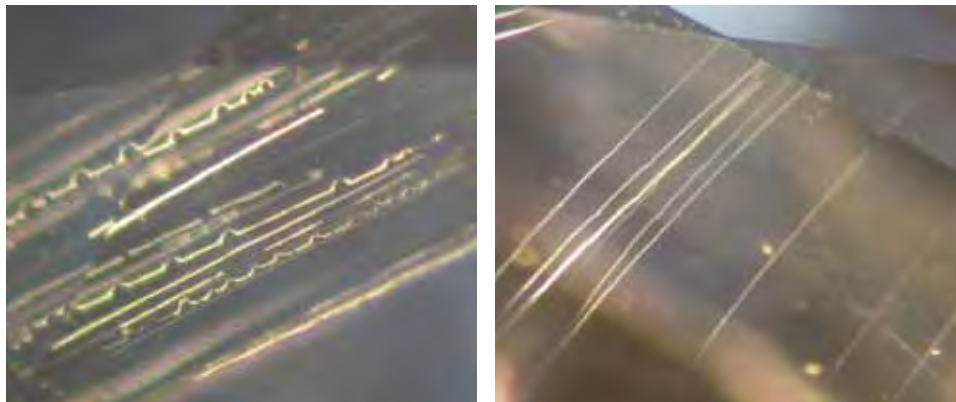


Figure 26. Needle-like inclusions with curved bends (left) and slightly wavy needle-like inclusions (right) in the 3.56 ct sapphire are possibly etch channels. Photo-micrographs by G. Choudhary; magnified 25×.

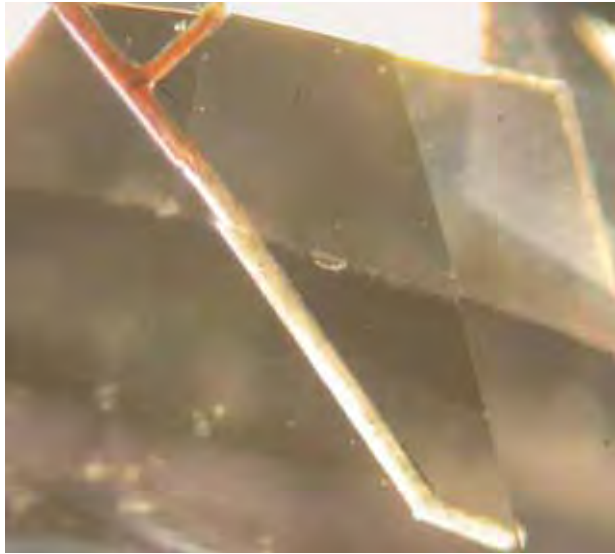


Figure 27. This inclusion in the 3.56 ct sapphire, which resembles a hockey stick, appears to be a hollow tube that is filled with foreign material. Photomicrograph by G. Choudhary; magnified 30 $\times$ .

learned that the sphene is mined near the village of “Fargon Meeru” (Farghāmīrū), which is four hours by jeep down the Kokcha Valley from the lapis lazuli mines and four hours by jeep up from the capital of Badakhshan, Faizābād (Feyzābād).

During a visit to Peshawar in early 2006, Mr. Davies was shown approximately 20 kg of rough material (considerably more than was available at that time from deposits in Pakistan). Unlike the Pakistani material, which varies from yellow to orange-brown (with rare greenish hues), the

Figure 29. When viewed with strong lighting in certain directions, this 6.65 ct sillimanite showed a weak-to-moderate blue-white sheen that is reminiscent of the adularescence displayed by some moonstones. Gift of G. Scott Davies; GIA Collection no. 32498. Photo by C. D. Mengason.



Figure 28. Higher magnification reveals fine needles and platelets in the sapphire, which are oriented in three directions at approximately 60° to one another. They show that the sapphire has not undergone high-temperature heat treatment. Also visible is a portion of the “hockey stick” inclusion in figure 27. Photomicrograph by G. Choudhary; magnified 70 $\times$ .

color of the Afghan sphene he examined fell into a narrower range of light-to-medium greenish yellow to brownish yellow (and, rarely, reddish orange). In addition, while the Pakistani sphene was typically seen as broken crystal fragments, the Afghan rough consisted of smaller but more complete crystals, with some showing glassy surfaces. He reported that most of the stones he has cut from 1.2 kg of selected rough weighed 1–2 ct, with a few in the 3–5 ct range, and only six clean gems were over 5 ct. The largest clean stone he has cut weighed 8.36 ct.

Mr. Davies indicated that sizeable clean gems are difficult to produce for two reasons: the abundance of inclusions and the twin plane that is typical of sphene. Fractures are common in the sphene, and it must be

Figure 30. As seen here through the pavilion of the sillimanite in figure 29, the blue-white sheen shows linear concentrations that correlate to the orientation of parallel needle inclusions. Photomicrograph by James E. Shigley; magnified 20 $\times$ .





Figure 31. These brownish yellow to brownish greenish yellow sphenes from Afghanistan (1.28–1.95 ct) show the narrow range of color that is typically seen in material from this locality. Gift of G. Scott Davies; GIA Collection nos. 32908–32912. Photo by Candice Grobon.

faceted so that the twin plane does not intersect the crown or it will be easily seen. The twin plane does not appear to be a source of weakness; his cutters have not reported any breakage along it. Positioning the twin plane below the girdle restricts the cutter's options for orienting the rough, and therefore reduces the size of the cut gems and decreases the overall yield. For example, Mr. Blauwert reported that he was able to facet only about 70 carats of clean 4–5 mm round brilliants from 450 grams of rough. The bright yellow color and dispersion shown by these stones gave a resemblance to yellow diamond.

Mr. Davies donated five faceted samples (1.28–1.95 ct; figure 31) of the Afghan sphenes to GIA, and gemological properties were collected by one of us (EPQ): color—brownish yellow to greenish yellow; trichroism—medium yellow, yellow-brown, and yellow-green; diaphaneity—transparent; dispersion—strong with predominantly red and green flashes; R.I.—above the limits of a standard refractometer; hydrostatic S.G.—3.53–3.54; Chelsea filter—weak pink; and fluorescence—inert to both long- and short-wave UV radiation. All of the sphenes displayed a 580 nm doublet along with a 510 nm line when viewed with a handheld spectroscope. These properties are comparable to those reported for sphenes by R. Webster (*Gems*, 5th ed., revised by P. Read, Butterworth-Heinemann, Oxford, England, 1994, pp. 375–376). Microscopic examination of the five samples revealed strong doubling, straight and/or angular transparent growth lines, partially healed fractures with two-phase negative crystals containing a liquid and a doubly refractive crystal (in all but one stone), one or more twin planes (in three samples), and a few small crystals (in two of the stones).

EDXRF spectroscopy of three of the samples indicated Si, Ca, and Ti, as expected, along with varying amounts of Al, Fe, Nb, Zr, and Nd with some Y. Interestingly, these sphenes showed a subtle shift in their colors when viewed

under different light sources. In both incandescent light and natural daylight, three of the stones appeared brownish yellow and the other two were greenish yellow. But when they were viewed with a 5500 K non-daylight-equivalent fluorescent light, we observed that the three brownish yellow sphenes shifted to brownish greenish yellow and the two greenish yellow sphenes changed to yellow-green. This shift in color could be due to the interaction between the rare-earth elements in the sphenes and the emission bands of the fluorescent light.

We previously reported on a material (manufactured glass) that exhibited a “color change” also believed to be caused by the interaction of rare-earth elements and certain fluorescent light sources (see Winter 2005 GNI, pp. 364–365). To fully understand this type of “color change,” however, more research would be needed.

Elizabeth P Quinn and BML

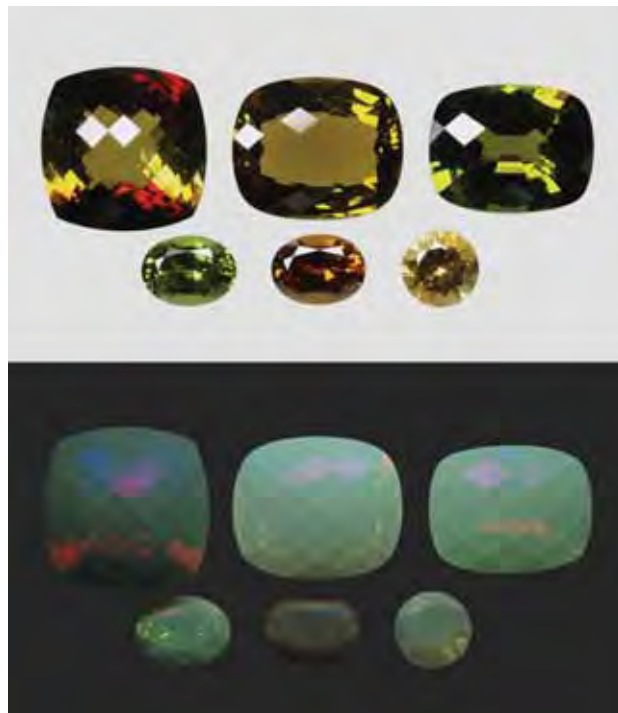
**Uvite-dravite tourmaline from Morogoro, Tanzania.** At the 2006 Tucson gem shows, Menahem Sevdernish of Advanced Quality A.C.C. Ltd., Ramat Gan, Israel, showed one of us (BML) some new tourmalines from Morogoro, Tanzania, that were available in a range of “earth tone” colors. The rough was recovered from alluvial deposits in January 2005, as waterworn pebbles weighing 0.1–5 grams. Most of the rough material (95%) that Mr. Sevdernish obtained weighed up to one gram. Larger pieces have been recovered, but most were too dark (only about one-third of the 2+ gram material was suitable for faceting). He estimated that an average of about 5–10 kg per month of fine facetable material was being produced. The faceted tourmalines typically range from 0.25 to 3 ct, although stones as large as 15 ct have been cut.

Six faceted stones (0.93–9.05 ct; figure 32), representing the range of color of this tourmaline, were loaned to GIA by Mr. Sevdernish, and one of us (EPQ) recorded the following properties: color—brownish orange, brown-yellow, orangy yellow, brownish yellowish green, and yellowish green, with one stone appearing bicolored in yellow-green and reddish brown due to its cut revealing strong pleochroism face-up; pleochroism—moderate to strong in brown-yellow, brown-orange, yellow-brown, or reddish brown, and yellowish green to green; diaphaneity—transparent; R.I.— $n_o=1.641-1.643$ ,  $n_e=1.622-1.623$ ; birefringence—0.019–0.021; hydrostatic S.G.—3.05–3.07; Chelsea filter reaction—none to medium red; fluorescence—inert to long-wave UV radiation and weak-to-strong chalky greenish yellow to short-wave UV (again, see figure 32). The properties of this stone are generally consistent with those listed for tourmaline by R. Webster (*Gems*, 5th ed., revised by P. Read, Butterworth-Heinemann, Oxford, England, 1994, pp. 168–169); this reference also mentions the short-wave UV fluorescence in tourmaline of this color range from Tanzania. Microscopic examination revealed moderate doubling, straight and angular transparent growth lines, pinpoints and small clouds in two stones occurring

in linear stringers oriented near-parallel to the c-axis and also in three directions at  $\pm 28^\circ$  from the c-axis (perpendicular to the three pyramid faces), and a small semitransparent crystal in one stone.

The six samples were chemically analyzed by electron microprobe at the University of Oklahoma, Norman. Energy-dispersive X-ray analysis showed that the tourmalines are Ti-bearing solid solutions between the end members uvite and alkali-deficient dravite. Alkali-deficient (or alkali-free) dravite is an aluminum-rich theoretical end-member in which  $\text{Al}^{3+}$  is accommodated in the normally divalent Y site by removal of cations from the X (alkali) site (G. Werding and W. Schreyer, "Alkali-free tourmaline in the system  $\text{MgO-Al}_2\text{O}_3\text{-B}_2\text{O}_3\text{-SiO}_2\text{-H}_2\text{O}$ ," *Geochimica et Cosmochimica Acta*, Vol. 48, 1984, pp. 1331–1344). Two of the samples were dominated by the alkali-deficient dravite component, three were dominated by uvite, and one of them was transitional between the end members (slightly uvite-dominant). The Ti concentrations ( $\sim 0.5\text{--}1.1$  wt.%  $\text{TiO}_2$ ) were higher in the alkali-deficient dravite

*Figure 32. Tourmaline has recently been recovered from the Morogoro region of Tanzania in a range of "earth tone" colors (top, 0.93–9.05 ct). Chemical analysis of these samples revealed that they are uvite-dravite tourmalines. The stones display weak-to-strong chalky greenish yellow fluorescence when exposed to short-wave UV radiation (bottom). Courtesy of Advanced Quality A.C.C. Ltd.; photos by Candice Grobon (top) and Franck Notari (bottom).*



*Figure 33. This faceted stone (3.70 ct) and cabochon (14.97 ct) of triploidite were cut from a portion of the rough sample, which was obtained at a local mineral market in Guilin, China. Courtesy of John Lucking; photo © Jeff Scovil.*

samples. No Fe or other cations were found at the detectable concentration of  $\sim 0.3\text{--}0.5$  wt.% on an oxide basis. The chemical analyses of these samples indicate that gemologists would best refer to them as tourmalines in the uvite-dravite series.

*Elizabeth P. Quinn and BML*

**Triploidite from China.** In August 2004, mineral collector John Lucking (Phoenix, Arizona) purchased a reddish orange mineral while visiting a local stone market in Guilin, China. The dealer represented the material as rhodochrosite, but the color, luster, cleavage, and hardness suggested a different mineral. Mr. Lucking was unable to obtain reliable information on the source of the mineral, but based on the associated minerals and other material that he saw for sale, he believes that it came from the tin-polymetallic sulfide deposits near Dachang, Guangxi, China. After returning to the U.S., he asked Mark Kaufman (Kaufman Enterprises, San Diego, California) to cut a cabochon and a faceted stone from this material (figure 33).

In March 2005, Mr. Lucking submitted samples to researchers at the Department of Geosciences of the University of Arizona, Tucson. Single-crystal X-ray diffraction (XRD) and chemical analysis obtained by two of these contributors (MJO and RTD) identified the mineral as triploidite, which has an idealized formula of  $\text{Mn}_2(\text{PO}_4)(\text{OH})$  and a Mohs hardness of  $4\frac{1}{2}\text{--}5$ . Powder XRD data and Raman spectra for the sample are available on the Internet at <http://ruff.geo.arizona.edu/ruff> (search for R050186, and click the icon under "Options"). The results for both electron-microprobe analysis and a crystal structure refinement yielded an empirical formula of  $(\text{Mn}_{1.70}\text{Mg}_{0.15}\text{Fe}_{0.06}^{3+}\text{Fe}_{0.05}^{2+}\text{Ca}_{0.04})(\text{P}_{0.97}\text{Fe}_{0.03}^{3+})\text{O}_4(\text{OH}_{0.67}\text{F}_{0.33})$ . The triploidite occurred with quartz (identified by Raman spectroscopy), pyrite (identified by XRD), and sphalerite (identified by XRD), which is consistent with an origin from a hydrothermal mineral deposit.

In March 2006, Mr. Lucking loaned the faceted stone and the cabochon (3.70 and 14.97 ct, respectively) to GIA, and donated some fragments of the triploidite. The following gemological properties were collected by one of us (EAF) on the polished samples: color—reddish orange, with very weak pleochroism in reddish orange and yellowish orange; diaphaneity—transparent (faceted stone) and translucent (cabochon); R.I.—1.660–1.679 (faceted stone) and a spot reading of 1.66 (cabochon); birefringence 0.019; hydrostatic S.G.—3.83 and 3.80; and fluorescence—inert to long- and short-wave UV radiation. A cutoff at 420 nm and an absorption band at 530–550 nm were seen in both samples with the desk-model spectroscope. Microscopic examination revealed numerous two-phase (liquid-gas) inclusions and fractures.

The R.I. values are lower than those reported for triploidite in mineralogy textbooks (e.g., 1.723–1.730 for a sample with a Mn/Fe ratio of 3.3:1; C. Palache et al., *The System of Mineralogy, Volume 2*, John Wiley & Sons, New York, 1966, pp. 853–855). However, lower R.I. values are expected for triploidite Mn end-member compositions (Palache et al., 1966), and this is consistent with the much higher Mn/Fe ratio of the gem-quality triploidite reported here. The S.G. of triploidite is typically reported as 3.70, which is considerably lower than the values recorded in the present study. Nevertheless, the density calculated from the crystal structure refinement was 3.82 g/cm<sup>3</sup>, which is quite similar to the S.G. values that were measured hydrostatically.

UV-Vis-NIR spectra of the two samples showed features similar to those noted in the desk-model spectroscope (e.g., figure 34): A strong absorption at 400–420 nm (actually a doublet) and a broad peak at approximately

Figure 34. This UV-Vis-NIR spectrum of the faceted triploidite shows a strong absorption at 400–420 nm and a broad peak at approximately 520–560 nm, as well as a series of absorption features in the UV region below 370 nm.

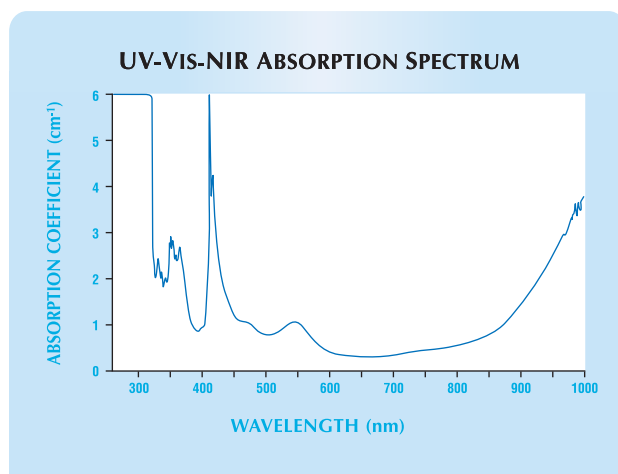


Figure 35. Laghman, Afghanistan is reportedly the source of these vāyrynenites (0.09–0.17 ct). Courtesy of Farooq Hashmi; photo by C. D. Mengason.

520–560 nm. A series of absorption features were also recorded in the UV region below 370 nm.

To our knowledge, this is the first report of gem-quality triploidite.

BML

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**Vāyrynenite from Afghanistan.** The Spring 2006 Gem News International section (p. 75) documented a faceted vāyrynenite from Pakistan, which had properties comparable to a vāyrynenite from an unspecified locality that was described in the Summer 1994 Lab Notes section (p. 121). Since it is such a rare mineral, we were quite surprised when we received three more faceted vāyrynenites in May 2006, this time from a different locality. The stones were supplied by Farooq Hashmi, who obtained the rough from Afghan suppliers in Peshawar, Pakistan; they reported that the material came from granitic pegmatites in Laghman Province, Afghanistan, but they did not know the identity of the mineral. Over the course of the past two years, Mr. Hashmi saw a few parcels of this material in Peshawar, with a total weight of up to 20 grams, but only small pieces of gem rough were available. He noticed that the Afghan vāyrynenite was more pink and less orange than the Pakistani material.

Gemological properties of the three faceted stones (0.09–0.17 ct; figure 35) were collected by one of us (EAF): color—orangy pink, with orange and pink pleochroism; R.I.— $n_{\alpha}=1.640$ – $1.642$  and  $n_{\gamma}=1.668$ – $1.770$ ; birefringence—0.028; hydrostatic S.G.—3.20–3.25; Chelsea filter reaction—none; and fluorescence—inert to both long- and short-wave UV radiation. An absorption line at 413 nm, and weak bands at 435, 465, 505, and 565 nm, were visible with the desk-model spectroscope in the two larger stones. With magnification, all three stones had numerous fractures and chips, and the largest vāyrynenite also contained a “fingerprint.” EDXRF spectroscopy recorded the expected Mn and P, as well as minor amounts of Fe.

The  $n_{\gamma}$  and birefringence values of the Afghan vāyrynenite were somewhat higher than those reported in the two *Gems & Gemology* entries referenced above, but they are



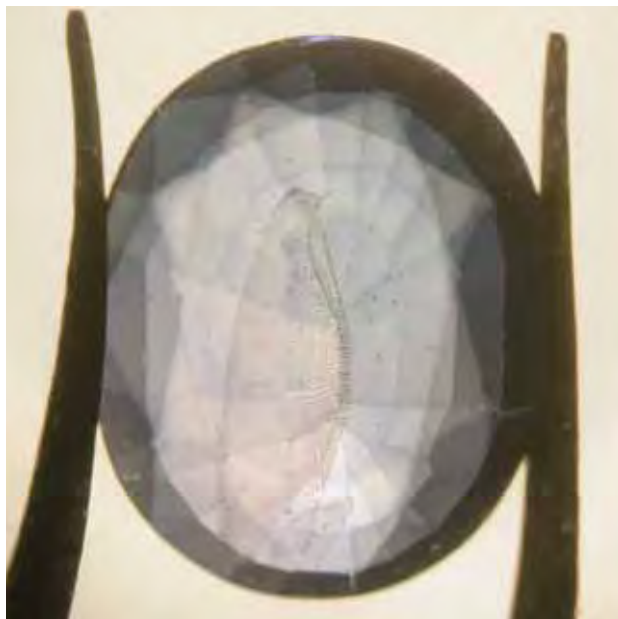


Figure 36. This 2.95 ct pale blue gem was identified as a flame-fusion synthetic sapphire treated by a diffusion process. Photo by G. Choudhary.

still consistent with the values given for väyrynenite in mineralogy textbooks. The absorption in the blue-green to green region of the spectrum (i.e., at 500–570 nm) was somewhat different from the absorption features reported previously. While the Pakistani väyrynenite was also described as orangy pink, slightly more pink color was seen in these Afghan stones, which is consistent with Mr. Hashmi's observations.

BML and Eric A. Fritz

Figure 37. When viewed with immersion, the blue color in the 2.95 ct synthetic sapphire is concentrated along facet junctions, which is an indication of diffusion treatment. Also note the large surface-reaching fingerprint inclusion. Photomicrograph by C. Golecha.



## SYNTHETICS AND SIMULANTS

**Diffusion-treated synthetic sapphire.** Recently, a 2.95 ct transparent blue oval mixed cut (figure 36) was submitted for identification to the Gem Testing Laboratory, Jaipur, India. Initial testing produced values of R.I.—1.763–1.772; birefringence—0.009; uniaxial negative optic sign; and hydrostatic S.G.—3.99. These were consistent with either natural or synthetic sapphire.

When exposed to short-wave UV radiation, the specimen showed a strong patchy chalky blue fluorescence following the crown facets. The pavilion was inert, although a weak internal glow was observed through the pavilion that is commonly associated with synthetic material. There was no reaction to long-wave UV. Such an overall result could indicate the presence of an assembled stone. However, no other features were detected (such as a separation plane) that might indicate a composite material.

With magnification and immersion of the stone in bromoform, a slightly wavy "fingerprint" inclusion was observed that was oriented almost parallel to the optic axis (figure 37). On careful examination at higher magnification, this fingerprint appeared to be made up of opaque, dark, nonreflective flux-like particles arranged in linear and square-shaped patterns (figure 38). A similar but smaller fingerprint was seen inclined to the first; both reached the surface of the stone. No other inclusions were visible.

Further examination with diffuse illumination confirmed the source of the blue color. The patchy, shallow coloration and its confinement to the facet junctions

Figure 38. This fingerprint inclusion in the synthetic sapphire consists of unusual square-shaped arrangements of flux particles. The linear trails are somewhat similar to rows of mineral inclusions in natural stones. The flux was apparently trapped in surface-reaching fractures during the diffusion treatment. Photomicrograph by C. Golecha; magnified 35x.

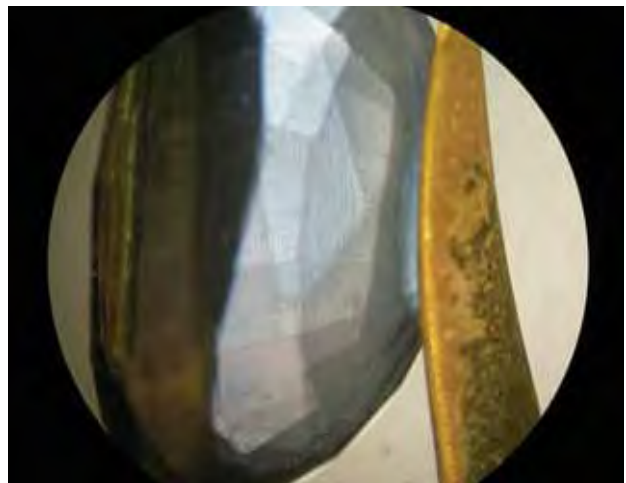




Figure 39. Plato lines are seen when the synthetic sapphire is viewed between crossed polarizers in the optic-axis direction while immersed in bromoform. This feature is strongly indicative of Verneuil synthetic sapphires. Photomicrograph by G. Choudhary; magnified 40 $\times$ .

indicated that the specimen owed its color to a diffusion process (again, see figure 37). No curved color banding or angular color zoning was present, which would have been expected if the color was inherent to the sapphire, synthetic or natural. Since the use of flux is common with high-temperature heat treatment (which is typically required for diffusion treatment), we concluded that a pre-existing fracture may have trapped flux during the diffusion process. However, the square-shaped patterns of the flux particles were highly unusual.

The specimen, still immersed in bromoform, was then examined between crossed polarizers. When viewed down the optic axis, distinct Plato lines were observed (figure 39), which are highly indicative of a Verneuil synthetic origin (see Spring 1999 Gem News, pp. 58–59; S. Elen and E. Fritsch, "The separation of natural from synthetic colorless sapphire," Spring 1999 *Gems & Gemology*, pp.

30–41). This feature consisted of two sets of lines (with one set being more prominent than the other) that formed a crisscross pattern in certain portions of the specimen. Plato lines have traditionally been seen only in pale-colored flame-fusion synthetic sapphires, and this is consistent with this sample since the blue color was a result of the surface diffusion treatment of a pale starting material.

Synthetic materials with natural-appearing features are encountered from time to time (see, e.g., Spring 1991 Lab Notes, p. 45; K. Schmetzer and F. J. Schupp, "Flux-induced fingerprint pattern in synthetic ruby: An update," Spring 1994 *Gems & Gemology*, pp. 33–38; Fall 1996 Lab Notes, pp. 211–212; Fall 2003 Gem News International, pp. 239–240). However, this is the first time we have seen flux inclusions trapped in a square-shaped arrangement. The cause of such an unusual inclusion pattern, as well as the unusual fluorescence characteristics, is unclear. Any suggestions or comments that might help explain these features are welcome.

With other standard gemological properties being similar, magnification is the key to separating natural from synthetic gemstones. However, the several reports of misleading natural-appearing features in synthetic materials reinforce the importance of careful examination.

*Acknowledgment:* The author is grateful to Gagan Choudhary, assistant director of the Gem Testing Laboratory, Jaipur, for his helpful discussions.

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## TREATMENTS

**Lead glass-filled ruby bead necklace.** Gem trade fairs provide an excellent opportunity to screen gem materials currently in the market. During the recent BaselWorld

Figure 40. All of the ruby rondelles in this necklace (13–23 mm in diameter) proved to be lead-glass filled. Photo by H. A. Hänni, © SSEF Swiss Gemmological Institute.





Figure 41. With magnification, numerous gas bubbles are apparent in the glassy substance filling fractures, twin planes, and cavities in this ruby bead. Photomicrograph by H. A. Hänni, © SSEF Swiss Gemmological Institute; magnified 15x.



Figure 42. This ruby bead contains filled fractures and twin planes, as well as cavities with multiple gas bubbles. Photomicrograph by H. A. Hänni, © SSEF Swiss Gemmological Institute; magnified 30x.

fair, the SSEF Swiss Gemmological Institute received a ruby necklace for an identification report. The necklace consisted of 41 translucent “raspberry” red rondelles with a total weight of 290 grams (figure 40). A microscopic inspection revealed the presence of undamaged inclusions such as rutile and negative crystals, indicating that the beads had not been subjected to high-temperature heat treatment.

However, further examination with the microscope showed evidence of glass filling, such as faint bluish flashes and gas bubbles throughout the beads. In addition, many fractures, twin planes, and cavities were filled with a glassy substance (figure 41). Some of the cavities even contained more than one gas bubble,

Figure 43. These semitranslucent ruby crystals from an East African source are typical of the material used for lead-glass filling. Photo by H. A. Hänni, © SSEF Swiss Gemmological Institute.



another sign that the beads were glass filled (figure 42). The presence of the undamaged natural inclusions was not surprising, since modern fissure treatment in rubies can be done with lead-bearing glass at lower temperatures than are commonly used with the traditional borax process. Although the yellowish color in the larger cavities that is characteristic of lead-glass filling was not evident, analysis of the rondelles with EDXRF spectroscopy did reveal the presence of Pb in addition to the expected Al, Cr, Fe, and Ga.

While in Kenya recently, this contributor had the opportunity to see large amounts of rough Tanzanian corundum that was intended for lead-glass treatment in Thailand (figure 43). The tabular crystals were closer to pink sapphire than ruby, but filling of porous material usually causes an increased saturation of the color.

HAH

## ANNOUNCEMENTS

**AGTA Spectrum Awards competition.** The 2007 AGTA Spectrum Awards will recognize outstanding colored gemstone and cultured pearl jewelry designs from North America, as well as achievements in the lapidary arts. Winning entries will be displayed and award recipients honored at the 2007 AGTA GemFairs in Tucson and Las Vegas. The entry deadline is September 22; the competition will be held in New York City during October. For entry forms and more information, visit [www.agta.org](http://www.agta.org) or call 800-972-1162.

**NAJA conference scholarship.** The National Association of Jewelry Appraisers is offering a scholarship for gemology students who are interested in exploring a career in gem and jewelry appraising. Open to GIA, FGA, FGAA, FGG, and FCGmA students, the scholarship covers the conference fee for NAJA's 27th Annual Winter Educational Conference January 29–30, 2007, in Tucson. Applications

are available at [www.najaappraisers.com](http://www.najaappraisers.com) or by fax to 718-997-9057. The submission deadline is November 1, 2006, and the selection will be announced December 1.

## Conferences

**Gems at IAGOD.** The 12th Quadrennial International Association on the Genesis of Ore Deposits symposium will be held on August 21–24, 2006, in Moscow, Russia. The program will include symposia titled “Genesis of Gem Deposits” and “Genesis of Diamonds.” A field trip to diamond placer deposits of the Central Ural Mountains will take place on August 25–31. Visit [www.iagod.sgm.ru](http://www.iagod.sgm.ru) or e-mail [iagod@sgm.ru](mailto:iagod@sgm.ru).

**Goldschmidt 2006.** 16th Annual V.M. Goldschmidt Conference will take place August 27–September 1 in Melbourne, Australia. This important geochemistry conference will feature a session titled “The deepest lithosphere and beyond: Diamonds and related research, a session in honour of Jeff Harris.” Visit [www.goldschmidt2006.org](http://www.goldschmidt2006.org) or e-mail [goldschmidt2006@tourhosts.com.au](mailto:goldschmidt2006@tourhosts.com.au).

**Diamond 2006.** The 17th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes, and Nitrides will be held September 3–8 in Estoril, Portugal. Presentations on the growth, processing, and characterization of diamond will be given at this meeting. Visit [www.diamond-conference.elsevier.com](http://www.diamond-conference.elsevier.com) or e-mail Nina Woods at [n.woods@elsevier.com](mailto:n.woods@elsevier.com).

**Santa Fe Symposium changes venue in 2006.** The 20th annual Santa Fe Symposium on jewelry manufacturing technology will be held in Nashville, Tennessee, on September 10–13. Visit [www.santafesymposium.org](http://www.santafesymposium.org).

**Minerals, Magmas and Megastructures.** Diamonds will be among the topics included at the 2006 Geological Society Ferman Meeting, titled *Minerals, Magmas and Megastructures*, which will be held at the Natural History Museum in London on September 13–15, 2006. Visit [www.geolsoc.org.uk/fermor2006](http://www.geolsoc.org.uk/fermor2006).

**Clasp: A Convergence of Jewelers.** This new conference aimed at small manufacturers, metalsmiths, jewelry designers, and bench jewelers will be held September 15–17 in Nashville, Tennessee. The educational program will cover all aspects of the art, methodology, and business of jewelry making, from design to marketing. Visit <http://secure.lenos.com/lenos/riogrande/clasp>.

**Hong Kong Jewellery & Watch Fair.** Held at the AsiaWorld-Expo (September 18–23, 2006) and the Hong Kong Convention & Exhibition Centre (September 19–23), this show will also host GIA GemFest Asia (on pearls) on Thursday, September 21. RSVP to [giahk@netvigator.net](mailto:giahk@netvigator.net), or call +852-2303-0075 in Hong Kong. A num-

ber of educational seminars are also planned. For more information visit [www.jewellerynetasia.com/exhibitions](http://www.jewellerynetasia.com/exhibitions).

**Gem and Mineral Conference in China.** The 1st International Minerals & Gem Crystal Conference and Exhibition will be held October 9–10 in Beijing. The program includes educational seminars on gem and mineral localities, collecting, and marketing in China, and optional visits to gem mines in Hunan Province. Visit [www.aaamineral.com/Minerals/conference/conference\\_details.asp](http://www.aaamineral.com/Minerals/conference/conference_details.asp).

## Exhibits

**Upcoming GIA Museum Exhibits.** Beginning August 27, 2006, in conjunction with the 4th International Gemological Symposium, the GIA Museum in Carlsbad will present “Celebrating Excellence in Gems & Jewelry,” an exhibit featuring mineral specimens, finished gems, jewelry, and jeweled objects that are superlative examples of their type or have special provenance or historic significance. This exhibit will remain open until November 30, 2006.

During the International Gemological Symposium, there will be additional exhibit areas open throughout the Institute, including a display of important and historic diamond replicas from Graff; photos by noted photographers Harold & Erica Van Pelt, Tino Hammid, and Robert Weldon; and gems and jewelry from the GIA Collection; these will remain on view until March 2007.

**King Tut Returns.** “Tutankhamun and the Golden Age of the Pharaohs,” an exhibition of more than 130 artifacts from the tomb of King Tut and other royal tombs in Egypt's Valley of the Kings, are on display at the Field Museum in Chicago through January 1, 2007. Among the items included are a gem-studded gold diadem and a jeweled pectoral ornament. Only a few of the artifacts in this exhibit were part of the famed 1977 exhibition, and many have never traveled outside Egypt. Visit [www.kingtut.org](http://www.kingtut.org).

## ERRATA

1. The biography for Dr. Wuyi Wang in the Spring 2006 Most Valuable Article Award section (p. 3) should have read, “Wuyi Wang is a research scientist for GIA Research and Identification in New York. He holds a Ph.D. in geology from the University of Tsukuba in Japan, and has considerable experience in studying diamond geochemistry.” *Gems & Gemology* regrets the error.
2. In the Spring 2006 article by S. F. McClure et al., “Identification and durability of lead glass-filled rubies,” the carat weight given in figure 5 on p. 26 was in error. The correct weight of the stone is 2.31 ct, as stated on p. 33. We thank Brent Malgarin, Elegant Gems Ltd., Spokane, Washington, for bringing this to our attention.