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Tucson

2008

The annual Tucson gem and mineral shows continue to showcase a wide variety of polished material, mineral specimens, and gem rough from around the world. This year saw the introduction of spessartine from a new mine in Tanzania (see report below). Tanzania is also the source of some impressive orangy pinkish red spinel (figure 1), cut from an enormous crystal (reportedly more than 52 kg) that was found near Mahenge in the latter part of 2007 (www.multicolour.com/spinel).

Glass-filled rubies were common at this year's Tucson shows, in a range of qualities and prices (figure 2). Of course, several unusual stones and remarkable oddities were also seen, including a 76.27 ct sphene (figure 3), a 59.58 ct jerejevite (figure 4), and a diamond showing a crystal form that resulted from mixed octahedral and cuboid growth (see figure 5 and C. M. Welbourn et al., "A study of diamonds of cube and cube-related shape from the Jwaneng mine," *Journal of Crystal Growth*, Vol. 94, 1989, pp. 229–252). Additional items seen in Tucson will be described in more detail in future issues of *Gems & Gemology*.

This year's theme for the Tucson Gem and Mineral Society show was "Minerals of the USA," and several superb displays showcased noteworthy specimens from 44 of the most important mineral localities in the United States. Some of the classic sources represented for gem

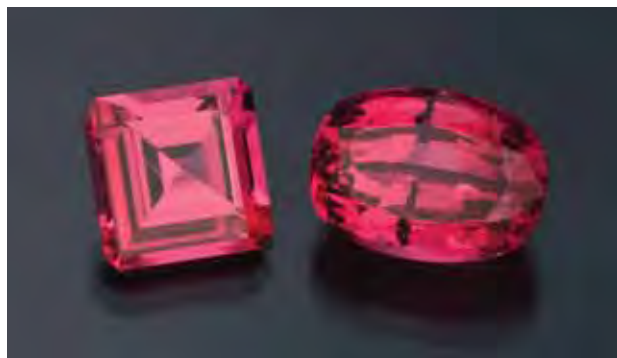
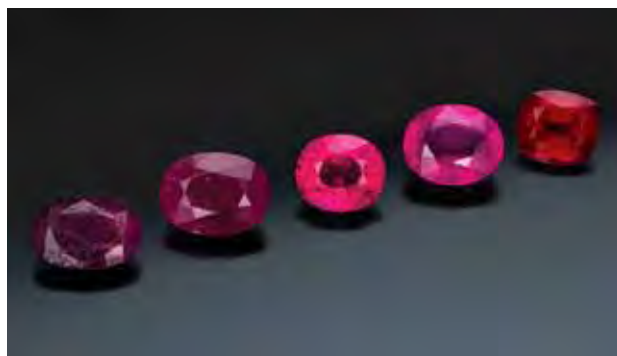


Figure 1. These spinels (6.77 and 12.07 ct) were reportedly cut from a 52 kg crystal that was recovered near Mahenge, Tanzania, in the latter part of 2007. Courtesy of Nomad's Co., Bangkok; photo by Robert Weldon.

Figure 2. Glass-filled ruby was available at the Tucson gem shows in a wide range of qualities, priced from less than \$1/ct (far left) to \$150/ct (far right). Courtesy of Real Creation Inc., Los Angeles; photo by Robert Weldon.



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

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Figure 3. This 76.27 ct sapphire is notable for its large size and vibrant display of dispersion. Courtesy of H. Obodda, Short Hills, New Jersey; photo by Robert Weldon.



Figure 4. This Madagascar jeremejevite is an impressive 59.58 ct. Courtesy of Nakoa Gems, Simi Valley, California; photo by Robert Weldon.

material/crystals included California and Maine pegmatites, North Carolina emerald/hiddenite deposits (see report below on one of these emerald mines), and Colorado rhodochrosite, California benitoite, and Utah red beryl. Released in conjunction with the exhibit was a comprehensive book titled *American Mineral Treasures*, edited by G. A. Staebler and W. E. Wilson (Lithographie, East Hampton, Conn., 2008). The 2009 Tucson Gem and Mineral Show will take place February 12–15, 2009, and will feature “Mineral Oddities.”

G&G appreciates the assistance of the many friends who shared material and information with us this year, and also thanks the American Gem Trade Association for providing space to photograph these items during the AGTA show.

Emerald-bearing gem pockets from North Carolina. The 2008 Tucson Gem and Mineral Society show featured a symposium on February 16 titled “Minerals of the USA,”

which was sponsored jointly by the Friends of Mineralogy, the Tucson Gem and Mineral Society, and the Mineralogical Society of America. Of particular interest to *G&G* readers was the presentation by geologist Ed Speer titled “Emerald crystal pockets of the Hiddenite District, Alexander County, North Carolina.” Mr. Speer is a consultant to Jamie Hill’s North American Emerald mine (formerly the Rist mine), located near Hiddenite.

The emeralds occur within “pockets” hosted by subvertical quartz veins intruding foliated migmatitic gneiss (figure 6). A typical, well-developed pocket consists of three distinct components: (1) an uppermost portion filled with massive quartz; (2) a central open cavity that may contain emerald crystals in association with quartz, albite, muscovite, schorl, and, rarely, hiddenite; and (3) a bottom portion that is filled with clay containing mineral fragments and crystals from the overlying cavity (i.e., a

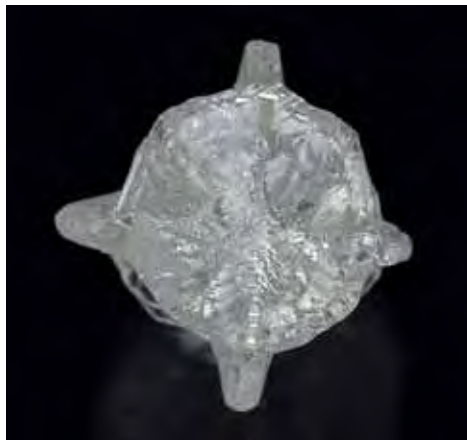


Figure 5. The Orapa mine in Botswana is the source of this unusual diamond crystal (1.1 cm in diameter), which was mined in 2007. Although such crystals have been attributed to hopped growth, this is actually a reentrant cube resulting from mixed octahedral and cuboid growth. Courtesy of North Star Minerals, West Bloomfield, Michigan; photos by Jeff Scovil.



Figure 6. Typical “pockets” at the North American Emerald mine in North Carolina consist of an upper massive quartz portion, a central open cavity lined with various well-formed crystals (including emeralds), and a bottom portion filled with pocket rubble. In the pocket shown here, the latter two components have been excavated by the miners. Photo by Ed Speer.

collapse breccia). The pockets range from a few centimeters to 3 m in the longest dimension, and their distribution varies across the property.

Mr. Speer presented interesting statistics that reflect the small quantity but very high carat weight of the emeralds recovered from the cavities. For example, not all pockets contain emeralds, but when they are present, 50% of the crystals weigh 100+ ct (20+ g). Records and photos provided showed more than 10 emerald crystals exceeding 100 ct, including discoveries made in recent years. Some of the crystals from this mine contain considerable gem-quality areas (figure 7).

North Carolina emeralds are colored by chromium, but Mr. Speer indicated that the source of this element, as well as the mechanism by which it is incorporated into the emerald-bearing fluids, is still unknown. Geologic research is ongoing.

The mining operation excavates significant amounts of country rock to uncover the emerald-bearing veins. In a



Figure 7. North Carolina emeralds have been cut into attractive gemstones. The 14.2 g crystal shown here was faceted into the 18.8 ct Carolina Queen and the 7.85 ct Carolina Prince. Courtesy of Jamie Hill; photo by Robert Weldon.

true entrepreneurial spirit, however, the mine is selling this material as aggregate to the local construction industry. Effectively they are converting their country rock dilution into “ore”—just of another variety. More information on the emerald production and mining activities at various North Carolina localities can be found at www.northcarolinaemeralds.info.

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Spessartine from Loliondo, Tanzania. Spessartine has been found in a number of locations worldwide and is prized for its vibrant orange hue. This year at the Tucson shows, several dealers exhibited large, well-formed crystals of spessartine from a new deposit in Tanzania (figure 8). According to Werner Radl (Mawingu Gems, Niederwörresbach, Germany), the mine is located ~14 km northeast of Loliondo, near the village of Lemisikio (i.e., just a few kilometers from the border with Kenya). In addition to the crystals and gem rough, Steve Ulatowski (New Era Gems, Grass Valley, California) showed a few faceted stones to one of these contributors (BML). Mr. Ulatowski reported having first seen a few crystals of this garnet during a May 2007 buying trip to Tanzania. Later, in January 2008, he obtained a considerable quantity of the spessartine; local suppliers told him it was mined in late 2007, apparently from a weathered schist host rock. The presence of abundant inclusions has limited the amount of good gem-quality material to an average of approximately 3 kg per month, in pieces weighing up to 4 g.

As of March 2008, Mr. Ulatowski had cut only a few pieces, and faceted stones weighing more than 2 ct were rare. However, the largest stone known to Mr. Ulatowski weighed 10.92 ct (figure 9). This specimen was loaned to GIA for examination, together with a 3.36 g piece of rough, by Brian Cook (Nature’s Geometry, Laguna Beach, California). In addition, Mr. Ulatowski donated a 2.01 ct



Figure 8. Spessartine from a new deposit near Loliondo, Tanzania, has been recovered as relatively large, well-formed crystals. The crystals on the left range from 4.0×4.1 cm to 2.6×3.5 cm, and the sample on the right (with associated reddish purple mica) measures 4.6×9.9 cm (GIA Collection no. 37554). Photos by Robert Weldon.

stone (again, see figure 9) and three pieces of rough (2.07–4.64 g) for our research, while an attractive crystal specimen with some associated purple mica (figure 8, right) was donated to GIA by Abe Suleman (Tuckman Mines and Minerals Ltd., Arusha, Tanzania).

Examination of the two cut stones gave the following properties: color—medium orange and medium yellow-orange; RI—1.780; hydrostatic SG—4.04; inert to long- and short-wave UV radiation; and bands centered at 460, 480, and 520 nm (with a cutoff below 435 nm) when viewed with the desk-model spectroscope. These properties lie between the values listed for spessartine and pyrope-spessartine by C. M. Stockton and D. V. Manson (“A proposed new classification for gem-quality garnets,” Winter 1985 *Gems & Gemology*, pp. 205–218); for spessartine, RI—1.780–<1.810, and bands “at about 410, 421, 430, 460, 480, and 520 nm, but the first three may merge to form a cutoff to about 435 nm”; and for pyrope-spessartine, RI—

1.742–<1.780, and bands “at 410 and 430 nm, and usually at 421 nm, that occasionally merge to form a 435 nm cut-off. Also show some combination of bands at 460, 480, 504, 520, and 573 nm.” M. O’Donoghue (Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, pp. 233) also reported RI—1.80 and SG—4.04–4.15 for Mandarin garnet (spessartine) from Namibia.

Microscopic examination of the faceted stones revealed numerous mineral inclusions. Using Raman microspectroscopy on the larger sample, we identified some angular euhedral-to-subhedral transparent crystals as quartz (figure 10, left) and rounded anhedral transparent crystals as zircon. We also noted, and identified via Raman analysis, some off-white translucent-to-opaque “snowballs” of zircon that were surrounded by tiny tension cracks (figure 10, middle). Mica inclusions (figure 10, right) were recognized visually and through their reaction in polarized light. Dark, opaque crystals near one of the corners of the smaller stone (figure 11) visually resembled some form of manganese mineral, and a sample of black matrix associated with a spessartine crystal was identified as braunite ($\text{Mn}^{2+}\text{Mn}^{3+}\text{SiO}_3$) by powder X-ray diffraction. However, Raman spectroscopy of the dark inclusions in figure 11 yielded no spectral match to any mineral in our database, including braunite.

One of us (JA) arranged for electron-microprobe analysis of a polished fragment of the spessartine. Data gathered using the instrument’s energy-dispersive spectrometer revealed a significant pyrope component (Mg; $\text{Pyr}_9\%$) and a small grossular content (Ca; $\text{Gro}_\%$)— $\text{Sps}_{77.5}\text{Pyr}_{17.9}\text{Gro}_{4.6}$ —and no measurable almandine component (Fe^{2+}). The high-Mg, low-Fe content of this spessartine is similar to, but more pronounced than, that of the Mandarin garnet from Namibia (derived from Mn-rich gneisses), and it contrasts markedly with the low-Mg spessartine that is typical of granitic pegmatites (see, e.g., table 2 in B. M. Laurs and K. Knox, “Spessartine garnet from Ramona, San Diego County, California,” Winter 2001 *Gems & Gemology*, pp. 278–295). Laurs and Knox (2001) also compiled gemological properties for spessartine from several localities; the RI

Figure 9. The new Tanzanian spessartine is notable for its pure orange color, typically without brown overtones. Due to abundant inclusions, most of the faceted material weighs less than the 2.01 ct stone shown on the right (GIA Collection no. 37555). The 10.92 ct stone on the left is exceptionally large for this locality. Photo by Kevin Schumacher.



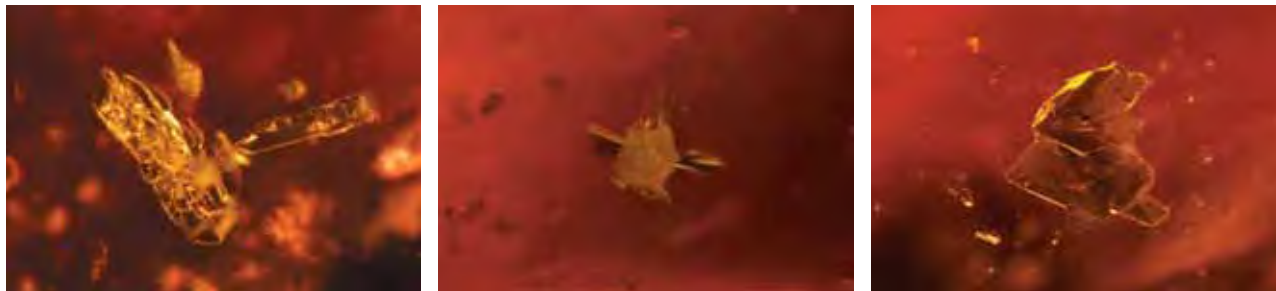


Figure 10. Transparent angular crystals of quartz were relatively common inclusions in the spessartine from Tanzania (left, field of view 0.8 mm). The translucent white spheroidal mass (center, 0.09 mm in diameter) was identified by Raman analysis as zircon; it is surrounded by minute tension fractures. Less common were angular subhedral inclusions of transparent-to-translucent brown mica (right, 0.63 mm in longest dimension). Photomicrographs by J. I. Koivula.

value reported here (1.780) is considerably lower than any of those values, but is closest to the Namibian values (1.790–1.797 for $\text{Sps}_{84.0-87.0}\text{Pyr}_{9.8-12.6}\text{Gro}_{1.1-1.4}$).

A fragment of purple mica associated with the specimen in figure 8 (right) was also analyzed by microprobe, and was identified as muscovite containing 3.77 wt.% FeO, 1.92 wt.% MgO, and 0.44 wt.% MnO. Minor amounts of Ba and Ti were also detected. Although the purple color suggested lepidolite, only ~20 ppm Li was recorded by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) analysis of another

sample of this muscovite by GIA Laboratory research scientist Dr. Andy H. Shen; the low Li content is consistent with the apparent metamorphic origin of this spessartine. Dark brown to black mica was also seen in association with the spessartine crystals, but none was analyzed for this report.

Some additional mineral samples associated with the spessartine were donated to GIA by Mr. Radl. The first mineral—a 1.71 g crystal of medium yellowish orange color—was identified by Raman analysis as kyanite; basic gemological properties (hydrostatic SG and spot RI) confirmed the spectral identification. The orange hue is noteworthy, since kyanite is generally blue to green (see, e.g., O'Donoghue, 2006, p. 422). A small dark gray crystal on a spessartine sample was identified as rutile using the Raman technique, while an opaque dark gray/brown sample could not be identified, but appeared to be composed of Mn-oxides. Finally, a transparent dark red fragment was identified as dravite by electron-microprobe analysis at the University of New Orleans. An average of five data points showed the following chromophoric elements: 2.69 wt.% FeO, 0.26 wt.% MnO, 0.12 wt.% TiO_2 , and 0.06 wt.% V_2O_3 .

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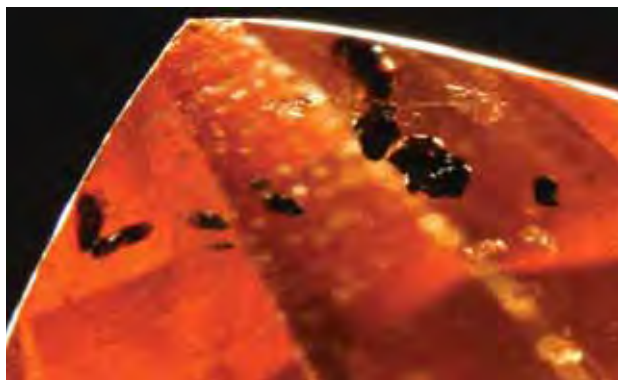
John Attard

Attard's Minerals

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Figure 11. Situated near the edge of the 2.01 ct stone was this series of nearly opaque inclusions that were reminiscent of senaite previously encountered in other spessartines. However, their identity could not be confirmed by Raman spectroscopy. Photomicrograph by J. I. Koivula; field of view 2.0 mm.





COLORED STONES AND ORGANIC MATERIALS

Gem-quality afghanite and haiüyne from Afghanistan. In April 2007, Farooq Hashmi (Intimate Gems, Jamaica, New York) loaned two parcels of blue rough from Badakhshan, Afghanistan, to GIA for examination. He purchased the parcels in Peshawar, Pakistan. One group was dark blue and sold to him as afghanite, and the other was “turquoise” blue with its identity unknown to the seller (e.g., figure 12). Mr. Hashmi also donated a sample of each color to the RRUFF project (<http://rruff.info>), and both were analyzed by single-crystal X-ray diffraction and electron microprobe. The dark blue fragment (R070558) was identified as afghanite with the formula $(\text{Na}_{19.10}\text{K}_{2.90})_{\Sigma=22}\text{Ca}_{10.00}(\text{Si}_{24.00}\text{Al}_{24.00})_{\Sigma=48}\text{O}_{96}(\text{S}_{1.00}\text{O}_4)_6([\text{OH}]_{3.21}\text{Cl}_{2.79})_{\Sigma=6}$ (OH estimated by difference and charge balance), and the “turquoise” blue sample (R070557) was haiüyne with the formula $\text{Na}_{3.00}(\text{Ca}_{0.84}\text{Na}_{0.16})_{\Sigma=1}(\text{Si}_{3.05}\text{Al}_{2.95})\text{O}_{12}([\text{SO}_4]_{0.89}\text{Cl}_{0.11})_{\Sigma=1}$.

Gem-quality afghanite is quite rare, although the Winter 2003 Gem News International (GNI) section (pp. 326–327) documented some cabochons from Badakhshan containing conspicuous lazurite inclusions. Haiüyne is likewise uncommon in gem quality, and facetable material is principally known from Germany (see, e.g., L. Kiefert and H. A. Hänni, “Gem-quality haiüyne from the Eifel District, Germany,” Fall 2000 *Gems & Gemology*, pp. 246–253).

Some of Mr. Hashmi’s rough afghanite was sufficiently large and transparent to facet, so he had two stones cut by John Bradshaw (Coast-to-Coast Rare Stones International, Nashua, New Hampshire): a 0.34 ct emerald cut and a 0.79 ct modified triangular step cut (figure 13). To stabilize the larger stone and improve its transparency, Mr. Bradshaw filled the fractures with an epoxy resin.

Both faceted afghanites were characterized by standard gemological techniques. These samples had intense blue to moderate blue pleochroism, refractive indices of 1.530–1.538 (birefringence 0.008), and SG values of 2.51 (larger stone, determined hydrostatically) and 2.54 (smaller stone; obtained by DiaVision, a noncontact optical measuring device that was used to calculate SG based on the measured weight and calculated volume, when the hydrostatic method failed due to persistent gas bubbles). The stones were inert to long-wave UV radiation, and had an inert to weak red reaction to short-wave UV (except for very weak to moderate yellowish white fluorescence confined to the fractures in both stones). A desk-model spectroscope showed a weak absorption band at approximately 590 nm. Our RI and birefringence values are somewhat higher than the data reported for afghanite in the Winter 2003 GNI entry and by R. V. Gaines et al. (*Dana’s New*



Figure 12. These afghanite (2.0 g, left) and haiüyne (0.9 g, right) samples are representative of rough material from Badakhshan, Afghanistan, that was purchased in the Peshawar mineral market in 2006–2007. Photo by Robert Weldon.

Mineralogy, John Wiley & Sons, New York, 1997, p. 1634). The SG values determined for this report are lower than those in Gaines et al. (1997), but comparable to those in the Winter 2003 GNI entry.

The smaller stone contained parallel breaks (afghanite has one perfect cleavage) and transparent crystals identified as diopside by Raman microspectroscopy. The larger sample had transparent two-phase inclusions that contained a dark solid material (figure 14, left) as well as colorless prisms (figure 14, right); unfortunately, they were too deep in the stone to be identified by Raman analysis. In both stones, however, the dominant internal features were fractures with evidence of enhancement. Although

Figure 13. Faceted afghanite is extremely rare. These stones from Badakhshan weigh 0.79 and 0.34 ct. Photo by Robert Weldon.



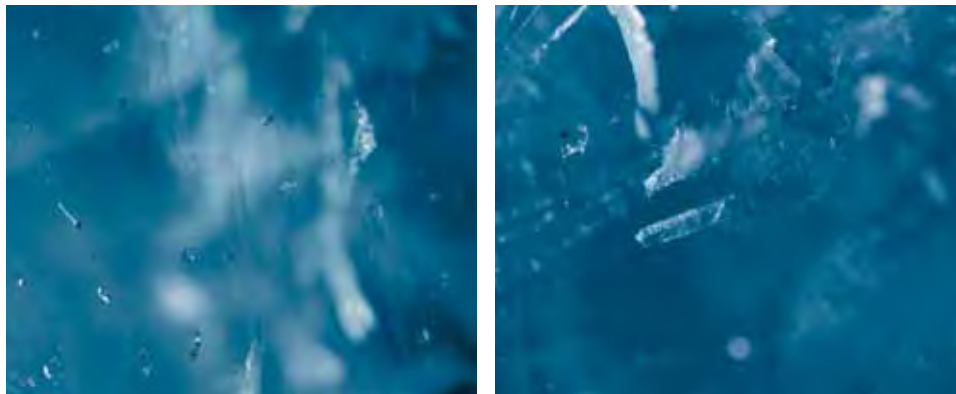


Figure 14. The interior of the 0.79 ct afghanite featured two-phase inclusions that each contained a dark solid grain (left). The stone also hosted a few colorless prisms (right). Photomicrographs by D. M. Kondo; field of view 1.5 mm for both.

Mr. Bradshaw had only filled the fractures in the larger stone, he indicated that the residue in the untreated stone might be due to the “soaking off” process, in which the epoxy used to attach the stone to the dop stick was dissolved by immersion in methylene chloride.

Polarized ultraviolet-visible-near infrared (UV-Vis-NIR) absorption spectroscopy of both samples showed distinct bands at approximately 370, 590, and 895 nm. These bands are quite similar to those documented in häüyne by Kiefert and Hänni (2000). The band at 590 nm is responsible for the blue color. In both of our samples, energy-dispersive X-ray fluorescence (EDXRF) spectroscopy showed major amounts of Si, Al, Ca, K, S, and Cl, which are expected for afghanite, as well as traces of Sr and Ba.

By coincidence, two faceted examples of häüyne from Badakhshan were seen at GIA in 2006–2007. In August 2006, Brad Payne (The Gem Trader, Grand Rapids, Michigan) submitted a 1.21 ct stone to the GIA Laboratory for an identification report (figure 15, left). He had purchased the rough as afghanite, but after cutting the stone he noted properties that were inconsistent for this mineral. The GIA Laboratory recorded the following characteristics: color—greenish blue, with no pleochroism; RI—1.499; optic character—singly refractive; hydrostatic SG—2.44; fluorescence—moderate-to-strong orange to long-wave UV radiation and very weak orange to short-wave UV; and a cutoff at ~450 nm and an absorption band at 600 nm visible with the desk-model spectroscope. These properties are

comparable to those reported for häüyne by Kiefert and Hänni (2000), except for the greener color. Microscopic examination revealed cleavage fractures and slightly flattened whitish crystalline inclusions. EDXRF spectroscopy showed major Si, Al, Ca, Na, K, S, and Cl, which are consistent for both häüyne and afghanite. However, the Raman spectrum provided the best match for häüyne.

Then, in early 2007, Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado) sent a 0.92 ct oval cut from Badakhshan to GIA for examination (figure 15, right). He had obtained the piece of rough in December 2006 in Peshawar; he also purchased similar material there in June 2006 and November 2007. The 0.92 ct oval cut was similar in color to the stone from Mr. Payne, but brighter, and Raman analysis of a fragment from the same piece of rough by Dr. Robert Downs (Department of Geosciences, University of Arizona, Tucson) gave a spectrum that was identical to that of Mr. Hashmi’s häüyne. So far Mr. Blauwet has cut 114 of these häüynes (total weight 16.89 carats), and he noted a particularly good demand for this unusual brightly colored gem in the Japanese market.

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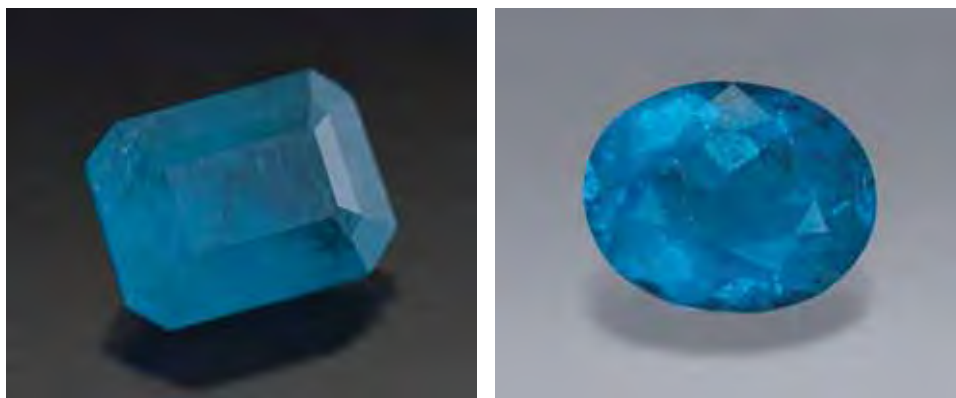


Figure 15. Faceted häüyne from Badakhshan has a distinctive bright greenish blue color, as shown by this 1.21 ct emerald cut (photo by Brad Payne) and 0.92 ct oval (photo by Robert Weldon).



Figure 16. This 0.81 ct piece of light blue rough, originally sold as tanzanite, proved to be manganaxinite. Photo by J.-M. Arlabosse.

A blue manganaxinite. While inspecting a parcel of rough tanzanite, one of these contributors (J-MA) noticed a pale blue sample (figure 16) that stood out from the others because of its moderate-to-strong orange-red fluorescence to long-wave UV radiation (the other pieces were inert). The sample's refractive indices, measured on a polished face, were $n_{\alpha} = 1.665$, $n_{\beta} = 1.672$, and $n_{\gamma} = 1.679$, yielding a birefringence of 0.014, but it was difficult to determine whether the optic sign was biaxial positive or negative. We measured a specific gravity of 3.24 and observed distinct trichroism (blue to brown to purple).

These results were not consistent with zoisite, but instead suggested a member of the axinite group. While kornerupine has similar RI and SG ranges and may also fluoresce orange to long-wave UV, it has different pleochroism. The color was zoned in two faint blue bands, and there were no noticeable inclusions. With a handheld spectroscope, the sample showed only one weak sharp line at about 415 nm. This indicated that it contained Mn^{2+} , so we speculated that it might be manganaxinite. By comparison, a nongem reference sample of blue magnesio-axinite from Tanzania had similar properties, including red fluorescence to long-wave UV, but no 415 nm line. In addition, faceted Tanzanian magnesio-axinite with similar properties (orangy pink UV fluorescence and a 410 nm line) was reported recently (see Winter 2007 GNI, pp. 373–375); those samples were also found in a parcel of tanzanite.

To confirm the identity, we performed quantitative chemical analysis using a JEOL 5800 scanning electron microscope (SEM) with a high-resolution Princeton Gamma Tech IMIX-PTS germanium detector. The results were consistent with axinite: 6.9 wt.% MnO, 2.7 wt.% MgO, and only 0.7 wt.% FeO. The Mn/Mg ratio (~1.5) clearly classified this sample as manganaxinite. Using long count times, we also detected approximately 0.1 wt.% V_2O_5 , as well as traces of chromium that were too small to be quantified.

The UV-Vis absorption spectrum (figure 17) was dominated by a broad band with a maximum at about 597

nm, creating a transmission window in the blue region at about 475 nm. There were also two weak sharp bands at 355 and 368 nm, a moderate sharp band at 413 nm (confirming the handheld spectroscope observations) with a shoulder at 421 nm, and two weak broad bands at approximately 515 and 733 nm. These sharp peaks and the weak broad bands could all be due to Mn^{2+} (R. G. Burns, *Mineralogical Applications of Crystal Field Theory*, 2nd ed., Cambridge University Press, 1993), but they were too weak to affect the color. The broad band around 597 nm is probably from V^{3+} . Even if Cr^{3+} was present, no distinct Cr^{3+} -forbidden transitions could be detected at around 700 nm.

The orange-red fluorescence appeared to be zoned, with a weaker emission in the bluer parts of the sample. The reaction was too weak to obtain a fluorescence spectrum, and we can only hypothesize that its origin might be Mn^{2+} , with possibly a red component imparted by Cr^{3+} .

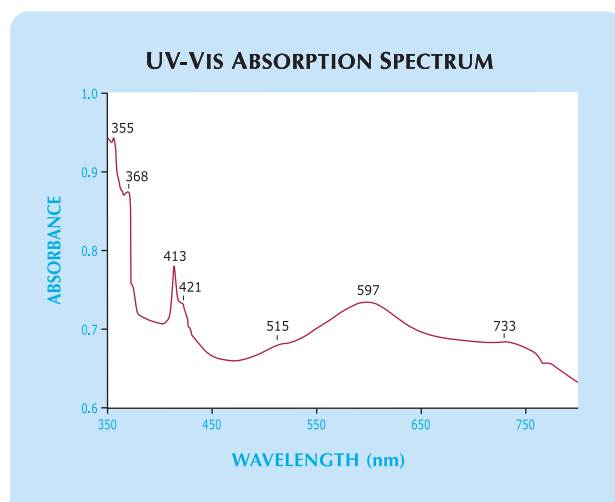
To our knowledge, this is the first report of manganaxinite colored by vanadium. It is also surprising to have two gem materials with such similar properties—the manganaxinite described here and the magnesio-axinite in the Winter 2007 GNI entry—recently appearing in parcels of tanzanite.

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Figure 17. The UV-Vis absorption spectrum of the blue manganaxinite shows a broad band with a maximum at approximately 597 nm (due to V^{3+}) that accounts for the color. The sharp peaks at 355, 368, 413, and 421 nm could be due to Mn^{2+} , as could the two broad bands at 515 and 733 nm.



Gem news from Myanmar. From mid-2007 to early 2008, this contributor received information on several new gem occurrences in Myanmar, as described below.

Rubies have been found approximately 32 km north of Namya (Nanyaseik), at a locality called Nam Phyu. This may represent an extension of the Namya deposit, to which the rubies show equivalent quality.

Sapphires have been rediscovered near Mong Ngen village in the Mong Htak township of eastern Shan State. A map published in 1900 (no. 93 O/2) showed a sapphire mine near Mong Ngen, which is located at coordinates 21°40'00" N, 99°50'30" E, at ~1420 m elevation. The sapphires recently found were recovered from a hillside, a paddy field, and a stream. Approximately 15 cabochons and rough samples were examined by this author, and some had been heat treated with a charcoal fire in a clay oven used for home cooking. The heated stones (both rough and cut) weighed ~0.5–1.5 ct and ranged from 40 × 23 mm to 54 × 34 mm. After heating for four hours, dark blue samples changed to medium blue, and greenish blue samples turned light greenish blue. Pale purplish blue and particolored stones were also seen. The largest piece was a 7.5 ct partially polished dark blue *trapiche sapphire* with white "arms." Internal features consisted of color zoning, small colorless inclusions, vague fluid-filled feathers, and parting lines. Some of the sapphires showed prismatic faces. Associated pebbles consisted of quartzite, quartz, and garnet.

Gem-quality *trapiche corundum* has been found in the alluvial gold deposits of Zayatkyin near Mogok, 113 km by road from Mandalay. The material is being sold in the Bogyoke market in Yangon. The corundum consists of irregular pyramidal crystals that are cut in half to make low-domed cabochons. The crystals seen to date by this author range up to about 9 g and measure up to 2.3 × 2.2 cm. The cabochons seen range from 5 to 11 ct and measure 1.2–1.6 cm in diameter and 0.3–1.3 mm thick. They show dark blue and light gray sectors that are neither uniform nor symmetrical. Parting lines, fractures, and small solid inclusions were observed with the microscope.

Green tourmaline is being mined from coarse-grained marbles between Pawn Chaung and the Salween River, southeast of Loikaw (capital of Kayah State). These tourmalines have been referred to as Saw La Phaw (or Loi-Kaw "emerald"; see T. Hlaing, "Hsa-Taw green tourmaline," *Australian Gemmologist*, Vol. 18, No. 11, 1994, pp. 352–353). A piece of marble containing this tourmaline was examined by the author and revealed no additional minerals. The tourmaline was dark green and showed well-developed rhombohedral faces. Microscopic examination revealed parallel tubes and color zoning.

Granitic pegmatites containing *quartz*, *topaz*, *aquamarine*, *amazonite*, *garnet*, and *fluorite* have been found in the Pyethkaye mountain range in the Mandalay region, near coordinates 21°13'40" N, 96°12'30" E. This mountain range attains an elevation of 1094 m and consists of a large batholith measuring 70 km in a north-south direction and

25 km wide. Approximately 50 major pegmatite dikes have been located, striking north-south and measuring up to 150 m long and 4 m wide.

Diamonds were recovered from the Irrawaddy River near Shwegu in southern Kachin State. Gem-quality crystals have ranged up to 3 mm. This contributor also encountered a single 0.65 ct pale yellow hexoctahedral diamond crystal that was purchased in Mong Hsu. Diamonds have recently been reported from the Salween River near Mong Hsu.

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Gems on the market in Taunggyi, Myanmar, 1990–2007.

Since 1990, this contributor has conducted regular gemology classes and provided gem identification services for local dealers, retailers, and buyers in Taunggyi, Myanmar (160 km southeast of Mandalay). The clients typically come from the surrounding towns of Kalaw, Shwenyaung, Nyaungshwe, Ho Pong, Lawksawk, and Hseng (near Kayah State). Following is a review of the gem materials identified in the market during this period.

Single stones were encountered most often, although jewelry and unprocessed metal ore (gold and other ores) were sometimes presented for identification. Of all the stones tested, 62% were ruby, of which 58% were synthetic (Verneuil) and 42% were natural, mostly of Mong Hsu and Mogok origin. Sapphire (blue and colorless) comprised 27% of the total; over 90% of these proved to be Verneuil synthetics. However, natural colorless sapphires were more common than colorless synthetics.

Other gems seen were quartz (smoky, citrine, and brown chalcedony of unknown origin); peridot from Mogok; pinkish red spinel crystals of good color but small sizes (<1 ct); blue synthetic spinel with a color simulating aquamarine, available in large sizes (one semi-cut from a boule); garnets of good size (>10 ct), though probably not of Burmese origin, as the color was different from local material; topaz; GGG (imitating peridot, although the color was not convincing); YAG; and cubic zirconia. Glass imitations were common and often of large size.

U Tin Hlaing

Large gem pocket discovered at the Oceanview mine, San Diego County, California.

In early fall 2007, a significant pocket was uncovered at the Oceanview mine in the Pala District of San Diego County. This mine is a historic source of quartz and morganite, and is adjacent to the Elizabeth R mine, which has produced tourmaline, kunzite, and other gems (see Fall 2001 GNI, pp. 228–231). The Oceanview was sold in 2000, and current owner Jeff Swanger is mining the pegmatite with a team comprised of Mark Baker, Steve Carter, Phil Osborn, and Peter Renwick. The group had spent more than six years tunneling into the pegmatite with little success. After penetrating 400 feet

into the dike, however, the crew noted some promising mineralization and decided to carefully explore that zone.

On September 22, the miners uncovered the first part of what has become known as the 49er pocket (figure 18). That day happened to be Mr. Swanger's 49th birthday, and this fact along with the mining spirit that prevailed during the 1849 California gold rush inspired the name.

Over the next several months, the 7+ m × 1.5–2 m pocket yielded many kilos of material, including several dozen very fine mineral specimens, especially aquamarine (figure 19) and morganite. In addition, many collector-quality specimens of quartz (pale smoky citrine), albite (clevelandite), and microcline have been recovered. The operation is chiefly aimed at recovering mineral specimens, but some cuttable material has been produced as well; indeed, Mr. Swanger estimates that the rough will yield a minimum of 50,000 carats of polished pale smoky citrine. Although the 49er Pocket appears to be worked out, numerous side pockets have been found (containing quartz, feldspar, and mica), and mining is currently ongoing as of March 2008. Further updates will be posted at <http://digforgems.com>.

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Green sodic plagioclase from East Africa. Green gem plagioclase is known mainly from Oregon (labradorite: e.g., C. L. Johnston et al., "Sunstone labradorite from the Ponderosa mine, Oregon," Winter 1991 *Gems & Gemology*, pp. 220–233) but has also been reported from China/Tibet and the Democratic Republic of the Congo (andesine-labradorite: see Winter 2005 GNI, pp. 356–357, and references therein). In mid-2007, we were informed about another source of green gem plagioclase—Tanzania—by G. Scott Davies of American-Thai Trading (Bangkok). Mr. Davies donated five faceted stones (1.62–2.70 ct) and three pieces of rough (2.41–6.31 g; e.g., figure 20) to GIA for examination. He indicated that he had obtained 2.5 kg of rough in June 2007, and that stones faceted from this material are seldom larger than 3 ct while those weighing more than 5 ct are quite unusual.

Examination of the five cut stones gave the following properties: color—light green; pleochroism—none to very weak (light green and colorless); RI— $n_{\alpha} = 1.531\text{--}1.533$ and $n_{\gamma} = 1.541\text{--}1.543$; birefringence—0.010–0.012; optic character—biaxial with no sign to biaxial positive; hydrostatic SG—2.63–2.65; inert to both long- and short-wave UV radiation; and no absorption features visible with the desk-model spectroscope. These properties are similar—but with slightly lower RI and SG values—to those published for oligoclase by M. O'Donoghue (Ed., *Gems*, 6th ed., Butterworth-Heinemann, Oxford, UK, 2006, p. 261): RI— $n_{\alpha} = 1.533\text{--}1.543$, $n_{\gamma} = 1.542\text{--}1.552$; birefringence—0.009; optic character—biaxial negative; SG—2.64–2.66. Microscopic examination revealed cleavage fractures, polysynthetic twinning, white "woolly" inclusions, and low-relief wafer-thin transparent crystals that were surrounded by



Figure 18. This view of an early part of the 49er pocket at the Oceanview mine shows smoky citrine crystals being excavated by Peter Renwick (left) and Mark Baker (right). Photo by M. Mauthner.

Figure 19. The 49er pocket has produced some fine crystals of aquamarine (here, 4.5 cm tall) on a matrix of albite (clevelandite). This specimen was collected in October 2007. Photo by M. Mauthner.





Figure 20. These light green feldspars from Tanzania, weighing 2.41–6.31 g (rough) and 1.94–2.38 ct (faceted), were identified as oligoclase. GIA Collection nos. 37517 (rough) and 37518 (faceted); photo by G. Scott Davies.

microfractures and showed spectral colors when tilted. The visual appearance of both the latter types of inclusions suggested they were albite, and Raman microspectroscopy analysis also proved consistent with albite.

Plagioclase feldspars, which include oligoclase, form a solid-solution series from albite ($\text{NaAlSi}_3\text{O}_8$ in its pure form) to anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$). Their composition is typically represented by the percentage of the anorthite content ($\text{An}_{\%}$); albite varies from An_0 to An_{10} and anorthite from An_{90} to An_{100} , while oligoclase ranges from An_{10} to An_{30} . RI and SG values systematically increase with anorthite content, while optic sign varies cyclically (figure 21). It is therefore possible to estimate the anorthite content of a sample using these relationships. Our observed values resulted in ranges of $\sim\text{An}_6$ – An_{10} when using n_α , $\sim\text{An}_6$ – An_{10} for n_β , and $\sim\text{An}_4$ – An_{16} for SG, all of which correlate to albite-oligoclase compositions. Further, in conjunction with the RI and SG values, the optic sign (biaxial with no sign to biaxial positive) indicated a composition less than $\sim\text{An}_{17}$.

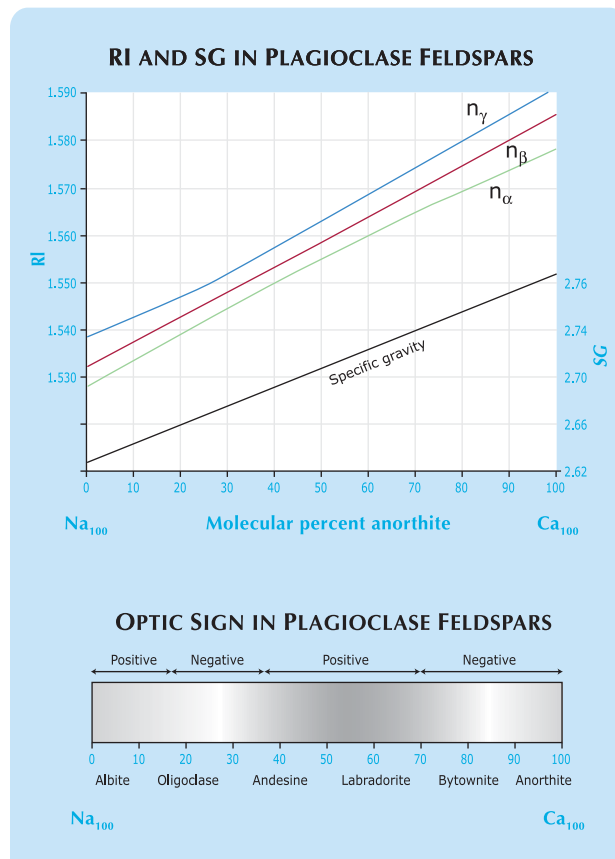
Quantitative chemical analyses were performed by electron microprobe at the University of New Orleans (three rough samples) and at the University of Oklahoma (two of the three rough samples). The data yielded average values of $\sim\text{An}_{10}$ – An_{14} , indicating that the samples were oligoclase or had compositions corresponding to the albite-oligoclase boundary. These values fall within the range of anorthite contents determined from the SG and optic sign, but only border on those estimated from the RIs.

EDXRF analysis of the faceted stones detected major amounts of Na, Al, Si, and Ca; minor K, Fe, and Sr; and traces of Mn, Zn, Ga, Ba, and Pb. LA-ICP-MS analysis corroborated the presence of these elements, and additionally detected Be, B, Mg, and Ti (Mg must be present in significant quantities to be detected by EDXRF, and any traces of Ti in the EDXRF results were obscured by the Ba signal).

None of these elements are unexpected in feldspars.

The LA-ICP-MS analysis did not detect any Cu, which is a known chromophore in green gem labradorite (A. M. Hofmeister and G. R. Rossman, "Exsolution of metallic copper from Lake County labradorite," *Geology*, Vol. 13, 1985, pp. 644–647). Another chromophore in green feldspar—Pb—was present in the oligoclase samples in only very small amounts (~ 18 – 56 ppm). However, the depth of green color in amazonite (and the blue color in plagioclase) appears to be related to a combination of Pb, radiation, and water content (A. M. Hofmeister and G. R. Rossman, "A spectroscopic study of irradiation coloring of amazonite: Structurally hydrous, Pb-bearing feldspar," *American Mineralogist*, Vol. 70, 1985, pp. 794–804; A. M. Hofmeister and G. R. Rossman, "A spectroscopic study of blue radiation coloring in plagioclase," *American Mineralogist*, Vol. 71, 1986, pp. 95–98). FTIR spectroscopy confirmed the presence of a hydrous component (as structural OH groups) in the feldspar. Oriented UV-Vis-NIR absorption spectra (figure 22) showed a transmission win-

Figure 21. The optical properties and specific gravity of plagioclase feldspars vary with anorthite content. Reproduced, with permission, from O'Donoghue (2006), p. 245.



dow located at ~500–530 nm, depending on the direction, which is responsible for the green color. An absorption band was centered at about 615 nm in the β direction that had a full width at half maximum (FWHM) of ~4800 cm^{-1} and an intensity of 0.24 cm^{-1} . These characteristics are similar to those presented for blue plagioclase by Hofmeister and Rossman (1986), suggesting a similar cause of color related to the presence of traces of Pb and water combined with exposure to radiation. The color of this feldspar was represented as natural. We have no reason to believe that it has been laboratory irradiated, and its coloration is consistent with that expected for material exposed to natural radiation in the earth.

A similar light green color was documented in some Tanzanian oligoclase sunstone that was described in the Summer 2002 GNI section (pp. 177–178). It is possible that the material described here came from the same area (northwest of Arusha, near the border with Kenya), but simply lacks the hematite inclusions that were observed in the sunstone.

Furthermore, at the 2007 Tucson gem shows, one of these contributors (BML) was shown some attractive pale slightly bluish green plagioclase from Kenya (figure 23) by Bruce Bridges and Jim Walker (Tavorite USA Inc., Collegeville, Pennsylvania). This material has been known since the mid-1980s from Kioo Hill in the Sultan Hamud area, about 100 km southeast of Nairobi (C. R. Bridges et al., “Ein neuer Edelstein aus der Feldspat-Familie [A new gemstone in the feldspar family],” *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 33, No.

Figure 22. The oriented UV-Vis-NIR absorption spectra for one of the rough green oligoclase samples show a transmission window located at ~500–530 nm. Sample thickness in each direction: $\alpha = 22.8$ mm, $\beta = 10.9$ mm, $\gamma = 6.1$ mm.

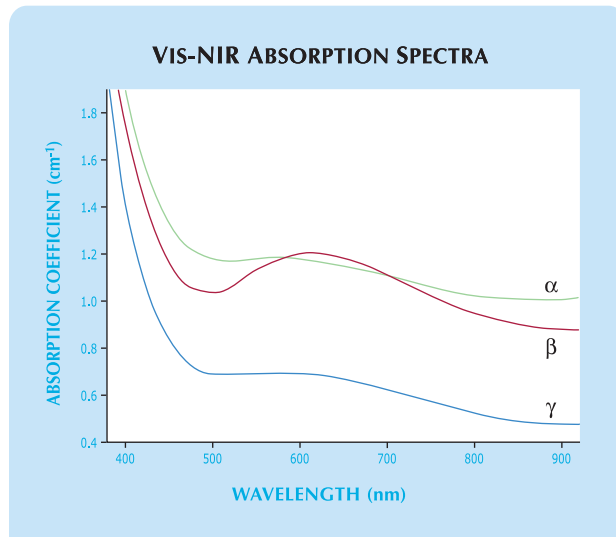


Figure 23. This selection of slightly bluish green plagioclase from Kenya weighs 1.84–15.72 ct. Photo by Robert Weldon.

3–4, 1984, pp. 104–113; C. R. Bridges et al., “A Kenyan gemstone from the feldspar family: Further observations,” *Australian Gemmologist*, Vol. 17, No. 5, 1990, pp. 177–183). These articles documented samples of pale blue-to-green plagioclase that were typically albite, with compositions ranging from An_5 to An_{11} . Although their gemological properties were similar to those described here for the Tanzanian oligoclase, the presence of vermiculite inclusions was indicated by Bridges et al. (1989) as evidence of origin from Kioo Hill. No explanation for the coloration was provided. According to Bruce Bridges, some new production of this feldspar from Kioo Hill occurred in early 2005. The color ranged from near colorless to pale green, and Mr. Bridges knew of faceted stones ranging up to 30 ct.

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A blue topaz with 2500+ facets. Terry Lee Martin, a gemstone artist and owner of 5Cs Collectors Gems in Seattle, Washington, recently showed the *G&G* editors a selection of gems he had cut with an unusually large number of facets. Among them was a 16.90 ct blue topaz (figure 24) that he estimates to have about 2,530 facets (the exact number is unknown, as he lost count near the conclusion of the stone). Mr. Martin has completed more than 200 similar gems, though the topaz is by far the most complex. Only one gem is cut from each design, and each can take 20–60 hours to complete. Mr. Martin uses conventional faceting techniques and equipment, but he needed several months of practice to learn how to polish facets that are sometimes less than 0.1 mm across.

One consequence of the large number of facets is a very small table. The optical effects produced by the abundance of tiny facets ranges from billowy light under the crown to micropatterns of light and dark areas that are

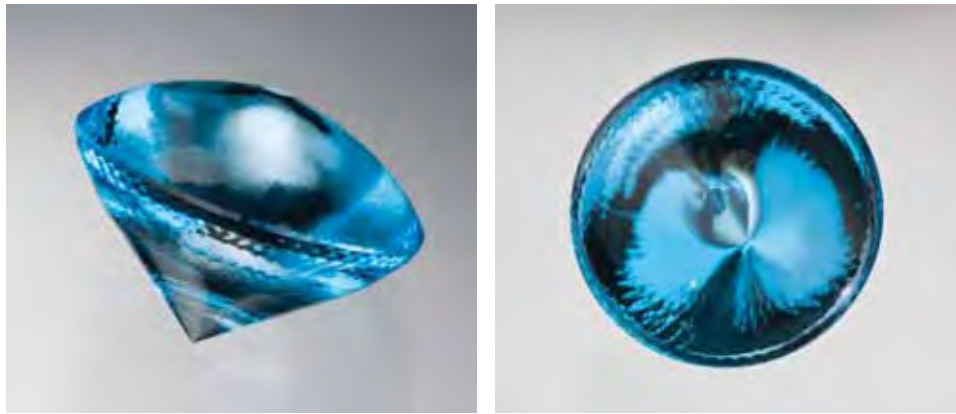


Figure 24. This unique 16.90 ct topaz, created by gem artist Terry Martin, has more than 2,500 facets. Photos by Robert Weldon.

quite unlike those seen in stones faceted with standard cutting styles (e.g., figures 24 and 25).

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SYNTHETICS AND SIMULANTS

An imitation “elephant pearl.” The “elephant pearl,” or *gajamuthu*, is an ancient and much-revered object in Indian and Sri Lankan culture. Its possession is commonly believed to increase one’s success in life. Elephant pearls are rounded concretions of dentin that are recovered from the soft tissue pulp within tusks of African and Asian elephants as well as the extinct woolly mammoth (B. Mann and G. Brown, “Elephant pearls: True or false?,” *Australian Gemmologist*, Vol. 22, No. 11, 2006, pp. 503–507; G. Brown, “Rare ivories—Challenging identifications,” presentation to the 2007 Federal Conference of the Gemmological Association of Australia, May 19, Hobart, Tasmania, www.australiangemmologist.com.au/images/rareivories.pdf).

The Dubai Gemstone Laboratory recently received for identification a 642 ct opaque, banded, yellow-to-brown and

white sample that the client represented to be an elephant pearl. When viewed from the sides (figure 26, top left and center), the sample showed a near-parallel banded structure; however, when viewed from the bottom (figure 26, top right), the thin white bands appeared wavy. In contrast, genuine elephant pearls consist of a rounded mass of dentin (only) that shows a curved growth layer structure; see the right-hand photo on p. 6 of Brown (2007). In addition, the thin wavy white bands in this sample suggested the appearance of a molar tooth structure from an Asian elephant.

Standard gemological testing revealed spot refractive indices ranging from ~1.50 to 1.55 (the typical range for organic gem materials) and a hydrostatic SG of 1.91. Long-wave UV fluorescence was weak-to-moderate chalky bluish white, with the strongest reaction from some portions of the white bands (figure 26 second row); short-wave UV fluorescence was similar but weaker. No distinguishing spectrum was seen with the desk-model spectroscope. X-radiography in the three directions (figure 26, bottom row) showed significant differences in the opacity to X-rays of the various bands. In addition, microscopic examination with reflected light clearly revealed polishing marks on the surface (figure 27), which indicated that it had been fashioned. EDXRF chemical analysis detected Ca and P as main components, along with minor amounts of Ti and Fe, and traces of Mn, Zn, and Sr. By comparison, the pure dentin of a genuine elephant pearl should show the same range of RI and SG values, moderate chalky bluish white fluorescence to long-wave UV, no significant differences in opacity to X-rays, no obvious polishing marks on the surface, and the same EDXRF results as reported here except no Ti, which was mainly detected in areas containing the white enamel bands.

The structural characteristics and gemological properties of this sample were consistent with those reported for imitation elephant pearls by Mann and Brown (2006). Consequently, it was identified as a manufactured object fashioned from the molar tooth of, most likely, an Asian elephant.

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Figure 25. Shown here are five other gems cut by Mr. Martin, from left: a 1.50 ct, 601-facet sunstone; a 5.30 ct, 469-facet topaz; a 13.65 ct, 781-facet sunstone; a 2.45 ct, 474-facet sunstone; and a 2.95 ct, 561-facet sapphire. Photo by Robert Weldon.



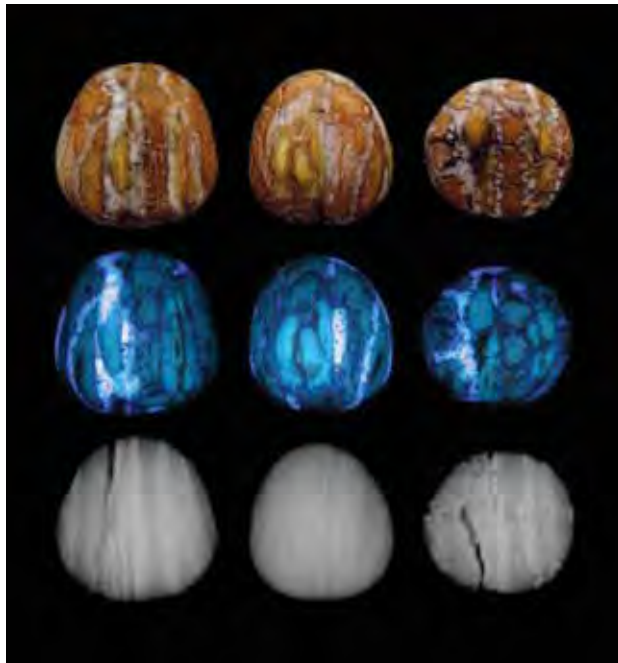


Figure 26. Side (top left and center) and bottom (top right) views of the imitation elephant pearl showed a varying banded structure. Exposure to long-wave UV radiation (second row) gave a variety of reactions that correlated to the structure of the piece; X-radiography also revealed significant differences in its opacity to X-rays (third row). Composite photo by S. Singbamroong, © Dubai Gemstone Laboratory.

An interesting synthetic sapphire. Natural and synthetic gem materials are commonly differentiated on the basis of their microscopic features. Often, however, a natural stone may show characteristics resembling those of synthetic material and vice versa (see, e.g., G. Choudhary and C. Golecha, "A study of nail-head spicule inclusions in natural gemstones," Fall 2007 *Gems & Gemology*, pp. 228–235; and GNI, Fall 2005, pp. 265–266; Summer 2006, pp. 185–186; Summer 2007, p. 177). This contributor recently encountered another such specimen that was submitted to the Gem Testing Laboratory of Jaipur, India.

The sample was a 4.78 ct pear-shape mixed cut, with a brownish orange color similar to that seen in beryllium-diffused sapphire (figure 28). Standard gemological properties (RI and SG) were consistent with corundum, and fine lines in the red region were easily visible in the desk-model spectroscope, indicating the presence of chromium.

With magnification, surface-reaching fingerprint-like inclusions (figure 29, left) were observed. They had a whitish appearance, suggesting they contained a foreign substance, as is commonly seen in corundum exposed to high-temperature heating. A trail of dot-like inclusions giving the impression of a broken (melted) needle (figure 29, right) was also visible, as were fine scattered pinpoints resembling gas bubbles. These features also indicated that



Figure 27. Magnification revealed polishing marks on the surface of the imitation elephant pearl. The object was apparently fashioned from the molar tooth of an elephant, consisting of brown cementum, white enamel, and yellow dentin. Photomicrograph by S. Singbamroong, © Dubai Gemstone Laboratory; magnified 10 \times .

the sapphire had been exposed to high-temperature heat treatment.

Immersion in methylene iodide revealed a colorless girdle area, with most of the color concentrated toward the center (figure 30, left). As the stone was rotated and viewed from various directions, we observed wide color zones that were separated by near-parallel curved boundaries (figure 30, right), which are typical for flame-fusion synthetics. Variations in the color intensity of the bands are consistent with a darker core and paler rim in the original boule. When the sample was viewed in the optic axis direction between crossed polarizers, strong Plato lines confirmed that it was a flame-fusion synthetic. Exposure to short-wave UV produced strong

Figure 28. This 4.78 ct synthetic sapphire shows a brownish orange color similar to that observed in beryllium diffusion-treated corundum.



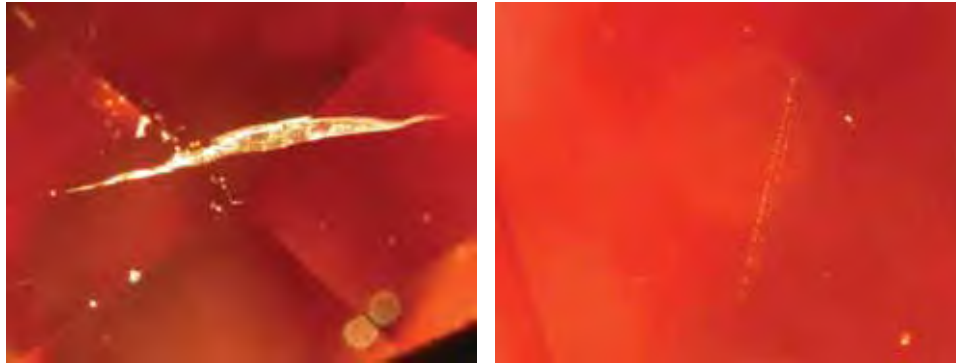


Figure 29. The synthetic sapphire contained a surface-reaching fingerprint-like inclusion (left) and a row of dot-like inclusions resembling a melted needle (right); the latter may also be observed in flame-fusion synthetics. Photomicrographs by G. Choudhary; magnified 30× (left) and 65× (right).

chalky blue fluorescence that was mainly restricted to areas at or near the surface, as would be expected for a heat-treated flame-fusion synthetic sapphire.

EDXRF qualitative chemical analyses revealed the presence of Ca, Ti, Cr, Fe, and Zn as trace elements. Zn was present in unusually high amounts compared to the other impurities.

The presence of surface-reaching fingerprint-like inclusions and rows of dot-like inclusions, along with the surface-related fluorescence, indicated that the synthetic sapphire had undergone some sort of heat treatment. This sample's unusual combination of features could have led to a misidentification, but careful examination with multiple techniques gave useful clues to its synthetic origin.

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TREATMENTS

Lead glass-filled color-change sapphire. Lead glass-filled rubies were first seen in the market in 2004. Much research has since been conducted to classify these rubies correctly, and the treatment is now well understood. Currently, however, such fillings are being applied to sapphires as well.

Recently, the Gem Testing Laboratory in Jaipur, India, encountered a 3.76 ct oval mixed cut sapphire with numerous eye-visible fissures. The RI and SG values were both

consistent with corundum. The stone appeared brownish green in daylight and fluorescent light (figure 31, left) and brownish purple in incandescent light (figure 31, right). Under long-wave UV radiation, it fluoresced weak reddish orange; it was inert to short-wave UV. Observation with the desk-model spectroscope showed a doublet in the red region (typically associated with chromium in corundum), a weak absorption in the orange-yellow region, and a strong band in the blue region at ~450 nm, probably due to iron.

With magnification, the surface-reaching cracks showed an obvious blue-to-violet flash effect, which changed to greenish blue as the stone was moved. The fractures also contained large, rounded, and highly reflective flattened gas bubbles (figure 32, left and center). In addition, white crystallites were observed in the filled cavities (figure 32, right). These features are consistent with those reported in lead glass-filled rubies (e.g., S. F. McClure et al., "Identification and durability of lead glass-filled rubies," Spring 2006 *Gems & Gemology*, pp. 22–34).

The presence of lead-glass filling in this sapphire was further confirmed by EDXRF analysis, which displayed a strong Pb peak. Other trace elements detected were Cr, Fe, and Ga, as expected in a color-change sapphire of natural origin.

This was the first time we have seen a lead glass-filled sapphire, and we would not be surprised to see the treatment applied to other sapphire colors in the future.

Gagan Choudhary

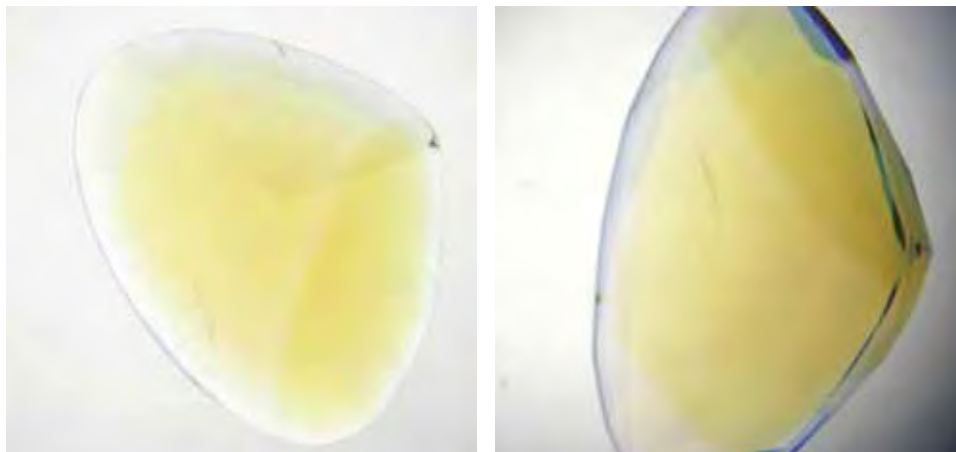


Figure 30. When immersed in methylene iodide, the sample showed a concentration of color toward the center, while the edges appeared colorless (left). This is a common result of beryllium diffusion treatment. In some directions, vague curved colored zones could be seen, indicating synthetic origin (right). Photos by G. Choudhary.



Figure 31. This 3.76 ct color-change sapphire (fluorescent light, left; incandescent light, right) proved to be lead-glass filled. Photos by G. Choudhary.

MISCELLANEOUS

Myanma Gem Emporium offerings for 1992–2007. For many years, the state-run Myanma Gem Enterprise (MGE) has held twice-yearly sales of gem materials produced in Myanmar. This contributor has summarized published sales records for the Myanma Gem Emporium from 1992 to 2007 (although some years are missing) for this report.

Jadeite sales were divided into three categories by quality: Imperial, Commercial, and Utility. Before 2000, jadeite was sold by competitive bidding only, but subsequently 43–92% of the total was sold by tender (i.e., sealed bidding). From 1992 to 2007, jadeite sold by competitive bidding comprised, by number of lots: Imperial 0.1–2%, Commercial 31–96%, and Utility 4–69%. These varying levels generally reflect the quality of material available from year to year. The tender lots offered from 2000 forward ranged from as little as 18% to as high as 48% Commercial, with the balance Utility (Imperial jade constituted less than 1%). Some recent Imperial jadeite lots offered included: two pieces weighing 1,040 kg, for a total reserve price of €1,368,000 (38th Emporium, 2001); 10 pieces weighing 176.6 kg, for a total reserve price of €1,530,000 (39th Emporium, 2002); and three pieces weighing 15 kg, for a total reserve price of €1,688,888 (44th Emporium, 2007). (Since 2002, reserve prices have been given in euros) In 2006, at the mid-year October Emporium,

a lot of Commercial jadeite weighing 1,040 kg was offered at a reserve price of €1,368,000. Approximately one-third of the lots sold at their reserve prices; other actual sale prices are not available.

Lot sizes (smallest and largest) and reserve prices of rough gem materials other than jadeite are summarized in table 1. In addition to ruby and blue sapphire, corundum included pink, yellow, purple, and colorless sapphires, as well as mineral specimens of ruby in marble. Also sold were aquamarine, danburite, diamond, diopside, fluorite, garnet, kyanite, lapis lazuli, moonstone, peridot, quartz (amethyst, citrine, and smoky, as well as quartz crystal specimens), scapolite, spinel, topaz, tourmaline (green), zircon, and parcels described as “assorted gems” (~1–3 carat parcels, usually >90% spinel). Spinel, aquamarine, zircon, peridot, danburite, and yellow sapphire are the highlights (in addition to ruby and sapphire) of most Emporiums in the nonjadeite section.

During the period 1992–1995, on average 500 jadeite lots were offered annually. From 2005 to 2007, this figure was 3,500, representing a seven-fold increase. By comparison, an average of 550 gem lots were offered in 1992–1995. During 2005–2007, that figure fell to 250. Since 1992, gem lots have comprised as little as 2% to as much as 49% of the total lots offered, while jadeite lots comprised 51–98%.

Figure 32. The lead glass-filled fissures showed rounded (left) and flattened (center) gas bubbles, the latter often highly reflective, an important identifying feature for this treatment. Some whitish crystallites were also seen in a few cavities (right). Photomicrographs by G. Choudhary; magnified 45× (left and center) and 35× (right).



TABLE 1. Range of lot sizes and reserve prices for gem materials (other than jadeite) sold at the Myanma Gem Emporium, 1992–2007.

Gem	Lot size ^a	Reserve price ^b
Aquamarine	94.64–215.9	\$1,000–5,750
Danburite	4.15–31.6	\$700–€2,000
Diamond	1.94–13.68	\$6,600–68,400
Diopside	7.0–14.55	€1,800–\$5,000
Fluorite	28.25	\$3,000
Garnet	10.38–14.7	\$1,000–€2,500
Kyanite	42.42	\$4,200
Lapis lazuli	21–75 kg	\$2,000–3,000
Peridot	29.45–232.2	\$1,500–58,050
Quartz		
Amethyst	239.96	\$5,000
Quartz crystals	3.5 kg	€1200
Ruby	1.22–7.4	€1,000–\$6,000
in marble matrix	317	€8,000
Sapphire		
Blue	2.38–22.30	€1,000–€45,000
Pink	7.7–33.96	\$4,500–€15,000
Yellow	15.62–77.0	\$2,000–€7,000
Purple	6.78–885	\$1,500–4,300
Colorless	12.8–36.68	\$2,300–3,000
Scapolite	118.45	\$2,000
Spinel	8.37–52.32	\$1,000–50,000
Topaz	56.68–316.72	\$2,000–3,200
Tourmaline (green)	25.77	\$2,000
Zircon	21.98–48.9	\$2,000–10,000
Assorted	134.67–349.38	\$4,890–13,800

^a In carats, except where noted.

^b In US\$, except where noted.

Also sold in 2001 and 2002, as part of the jadeite tender, were a total of 25 parcels of petrified wood (*Ingyin*) from central Myanmar. Individual lots were offered at a reserve price of US\$1,000–1,500; these included parcels with a maximum of 470 pieces and a maximum weight of 2,420 kg.

U Tin Hlaing

CONFERENCE REPORTS

2008 Winter Conference on Plasma Spectrochemistry.

Approximately 600 participants from 30 countries attended this 15th biennial meeting sponsored by the ICP Information Newsletter Inc., which was held January 7–12 in Temecula, California. The conference addressed developments in spectrochemical analysis by inductively coupled plasma, direct coupled plasma, microwave plasma, glow discharge, and laser sources. More than 300 presentations covered the applications, fundamentals, and instrumental developments of plasma sources. A few of these were relevant to the gemological community and are summarized here.

In the keynote speech, **Dr. Detlef Günther** (ETH Zurich, Switzerland) discussed new understandings of the principles

behind LA-ICP-MS, such as transport and interface design, and their role in the method's overall performance. He also cited numerous examples of the technique's applications in various disciplines, including gemology. **Dr. Ingo Horn** (University of Hanover, Germany) discussed the application of UV femtosecond laser ablation–multi-collector ICP-MS in accurately measuring iron isotope ratios. Such ratios allow geologists to determine the formation conditions of iron-containing minerals.

Dr. Claude Dalpé (Royal Canadian Mounted Police, Forensic Science and Identification Services, Ottawa, Ontario) reported on the use of LA-ICP-MS to determine the provenance of rough diamonds. His research indicated that as many as 20 trace elements (most on the order of parts per billion) can be used to identify a rough diamond's country of origin. He also indicated, however, that diamond standards containing several different trace elements are very difficult to obtain. **This contributor** reported on the current applications of LA-ICP-MS in the gemological community, specifically in identifying natural versus synthetic materials, gem treatments (such as Be diffusion in corundum), and country of origin for various gem species. A poster presentation by **Dr. Christopher M. Breeding** (GIA Research, Carlsbad) described a normalization method for determining the chemical composition of plagioclase feldspars using LA-ICP-MS. Results from this method were in good agreement ($\pm 10\%$) with electron-microprobe data for the same samples.

*Andy H. Shen (andy.shen@gia.edu)
GIA Research, Carlsbad*

Gemological LA-ICP-MS User Group (GLIUG) workshop and meeting.

This gathering, the first of its kind in the gemological community, was held January 6 at GIA in Carlsbad. Organized by researchers from the GIA Laboratory, its theme was "Analysis of trace elements in corundum using LA-ICP-MS."

The workshop featured four invited talks. **Dr. John Emmett** (Crystal Chemistry, Brush Prairie, Washington) gave a presentation on accuracy in trace-element analysis, in which he showed the effect that a 1 ppm Fe-Ti intervalence charge transfer (IVCT) pair can have on the apparent color of a blue sapphire. To detect such small variations in Fe or Ti concentration, he estimated that a chemical analysis with an accuracy of better than 15% is required. **Dr. Detlef Günther** (ETH Zurich, Switzerland) discussed the fundamentals of LA-ICP-MS and the application of ultraviolet femtosecond lasers to the analysis of gems. Some concepts that emerged were the importance of high precision and the need for a sample's absorption characteristics to be very similar to those of the standard. **Dr. George Rossman** (California Institute of Technology, Pasadena, California) discussed various nano-inclusions in gems. The chemical composition of nano-minerals can differ significantly from that of their host minerals, so a spot analysis such as LA-ICP-MS must account for this disparity. **Dr. Alan Koenig** (U.S. Geological

Survey, Denver, Colorado) reported the comparative results of ablating gems using 193, 213, and 266 nm laser emissions. He noted the superiority of the 193 nm laser in analyzing many gem materials. Dr. Koenig also discussed the USGS geological material standard program and some comparative studies on which GIA and USGS have collaborated.

Five other talks were given by **Dr. Ahmadjan Abduriyim** (Gemmological Association of All Japan, Tokyo), **Pierre Lefèvre** (SSEF Swiss Gemmological Institute, Basel), **Thanong Lee** (Gem and Jewelry Institute of Thailand, Bangkok), **Dr. Wuyi Wang** (GIA Research, New York), and **this contributor**. Each reported on the current status and future plans for LA-ICP-MS in their respective institutions, and the last two presenters also covered more specific topics. Dr. Wang presented detailed information on the corundum standards developed at GIA. This contributor discussed natural beryllium-containing inclusions in corundum. From these two presentations, many concerns were raised, including the importance of developing and sharing standards, comparing results with those obtained from other analytical techniques, analyzing gem samples at multiple laboratories, and having interested laboratories pursue certification by the International Association of Geoanalysts (IAG).

Andy H. Shen

First International Pearl Convention. This conference was held in Abu Dhabi, United Arab Emirates (UAE), November 19–20, 2007. Organized by the Dubai-based Pearl Revival Committee to raise the profile of natural pearls from the Persian Gulf (referred to locally as the “Arabian Gulf”) and to discuss related issues, the conference included a seminar dedicated to technical issues and a summit focused on production and marketing.

Kenneth Scarratt (GIA Thailand) described the wide variety of mollusks that can produce pearls, whether for mass production or expensive collectors’ items. He argued that the term *pearl* should be applied to both nacreous and non-nacreous materials, such as conch pearls. He also told participants to “keep their minds open” to the theory that pearls may nucleate on a grain of sand, and displayed X-radiographs of pearls with minuscule shells in their centers. **Elisabeth Strack** (Hamburg, Germany) pointed out that natural freshwater pearls come from numerous locations, including lesser-known ones such as northwest Russia. She also discussed terminology and taxonomy issues (e.g., the vast majority of pearl “oysters” are actually not classified biologically as oysters). Most saltwater cultured pearls in the market come from essentially one oyster genus, *Pinctada*. **Shigeru Akamatsu** (Mikimoto & Co., Tokyo) reviewed the history of pearl culturing. Among other issues, he discussed the present status of the Japanese akoya product, which is suffering from “red tides” and over-warm water temperatures. There are plans to move to a smaller but higher-quality production, mostly by reducing the number of pearl farms and the number of shells under cultivation to reduce stress on the animals.

Nicholas Sturman (Gem & Pearl Testing Laboratory,



Figure 33. These natural pearls, shown here on a shell from the host oyster *Pinctada radiata*, were recovered from the Persian Gulf. Photo by Nicholas Sturman.

Bahrain) reviewed pearl testing techniques, saying he prefers X-ray luminescence over measuring Mn content to separate freshwater from saltwater pearls. He emphasized the importance of proper X-radiography and the difficulty of identifying keshis. He also reminded the audience that production of natural pearls in the Persian Gulf (e.g., figure 33) is quite small today, with pearl fishing more a hobby than a commercial enterprise. For example, only about 4 kg were recovered in Kuwait in 2005. **Stephen Kennedy** (Gem Testing Laboratory of Great Britain, London) reviewed pearl treatments and their detection, noting that some “chocolate” pearls, for example, are created by the bleaching and subsequent dyeing of gray-to-black pearls.

These contributors pointed out the importance of unsubstituted, short, polyacetylenic molecules (“polyenes”) in the coloration of freshwater cultured and many other pearls, rather than carotenoids, which are found only in the pen-shell pearls of the genus *Pinna*. **Sutas Singhamroong** (Dubai Gemstone Laboratory, UAE) presented a preliminary study of Persian Gulf natural pearls, which grow in a variety of shapes and are mainly small, white to “cream” colored (with about 2–3% being yellow). The UV luminescence of the white pearls is typically a strong greenish white. The gray pearls contain more organic matter in their nacre, and typically have a lower SG (down to 2.0).

The technical seminar concluded with a panel discussion on how pearl certification can help the industry. Among other issues, the point was made that nacre quality is as important as nacre thickness. Lower-quality nacre can be recognized by its chalkier appearance, the defects it induces around drill holes, and the presence of thicker-



Figure 34. These cultured pearls (8.6–9.9 mm in diameter) were harvested in 2007 from the Sea of Cortez, Mexico. Photo by Douglas McLaurin.

than-average conchiolin layers just beneath the surface, as seen in X-radiographs.

A number of speakers addressed pearl production during the summit. **Daniele Naveau** (Robert Wan, Tahiti) discussed efforts to reduce the number of Tahitian farms in order to increase quality, in particular to insure nacre thickness above 0.8 mm. In parallel, there is a need for standardization of certification. **Enrique Arizmendi** (Perlas del Mar de Cortez, Guaymas, Mexico) described the history of natural pearl production in Mexico's Sea of Cortez, which ended in 1914. Current efforts with the *Pteria sterna* have resulted in an annual production of about 3.5 kg of multicolored cultured pearls (e.g., figure 34).

Three presenters addressed the incredible boom in Chinese freshwater cultured pearls: **Shi Hongyue** (Gems and Jewellery Trade Association of China), **Dr. Qiu Zhili** (SunYat-sen University, Guangzhou), and **He Naihua** (China's World Pearl Association). Production has risen from the first 0.61 kg of whitish "rice krispies" from *Cristaria plicata* in 1971 to the current 1,500 tonnes of larger, often colored cultured pearls from the *Hyriopsis* genus (an increase of more than two million-fold). This large mollusk has pearl-producing cycles of five-to-six years, with up to 70 grafts per animal. Only about 5% of the cultured pearls are gem grade, 15% are ground into powder for medicinal use, and the rest are incorporated into various ornamental objects. Rounds represent less than 10% of the production. During the summit, Chinese delegates displayed several round white-to-purple freshwater cultured pearls of modest luster but very large size, about 17 mm. There is also a small production of saltwater cultured pearls from the *Pinctada martensii* (but the nacre is thin, 0.2–0.6 mm) and mabe from the *Pteria penguin*.

Stephen Arrow (Arrow Pearls, Broome, Western Australia) presented the history and current status of large

South Sea cultured pearls from *Pinctada maxima* on Australia's northwest coast. Some of the culturing is performed on the seabed, not in suspended baskets, with white being the targeted color, though the production of "golden" colors is around 25%. Good-quality rounds do not exceed 21 mm diameter and take about six years of cultivation. **Sarkis Hajjar** (Belppearl, Antwerp, Belgium) discussed the culturing of pink-to-purple freshwater pearls in Lake Kasumiga, Japan, based on the hybrid *Hyriopsis cumingi* × *H. schlegeli*. About 10 kg of such pearls are produced annually, with other cultivation sites currently being sought.

Both speakers on economics and marketing lamented the lack of reliable statistics for pearl jewelry and the industry. **Tawfique Abdullah** (Dubai Gold & Jewellery Group) lamented the poor communication between producers, manufacturers, and retailers, and argued for harmonization of standards among the various producing regions. He added that the pearl industry spends less than one percent of the production value on promotion, in comparison to 20–40% for other luxury goods. **Naheed Anees** (ARY Academy of Gems & Jewelry, Dubai) pointed out that the Gulf Cooperation Council countries represent 9% of the world's jewelry market, and the per capita jewelry consumption in UAE is about 20 times the world's average. She recommended developing programs to educate consumers about pearls, in particular about imitations, which are still common in the Middle Eastern market. She also proposed developing effective marketing techniques to show that pearl jewelry is no longer "old-fashioned," but rather can be innovative as well as inexpensive.

Emmanuel Fritsch

Stefanos Karampelas

University of Thessaloniki, Greece
IMN, University of Nantes, France

ANNOUNCEMENTS

New Portuguese-language gemology newsletter. A Portuguese language newsletter dedicated to gemology, gems, and jewelry was recently launched by LABGEM gemological laboratory. Called *Portugal Gemas*, the newsletter will be produced on a quarterly basis and be distributed electronically in PDF format. Free subscriptions are available at www.labgem.org.

Association of the Study of Jewelry & Related Arts. This new association, launched in January 2008, will promote jewelry studies in schools, museums, and institutions of higher learning. A quarterly magazine, *Adornment*, and an annual conference are both planned. ASJRA will work for the inclusion of jewelry history courses at the college and graduate level, and encourage the development of study programs for jewelry design students and jewelry history students at museums. Visit www.asjra.net.

CIM Conference and Exhibition. Held May 4–7, in Edmonton, Alberta, the 2008 meeting of the Canadian

Institute of Mining, Metallurgy and Petroleum will feature a session on the geology of diamonds in Canada. Visit www.cim.org/edmonton2008.

INTERTECH 2008. Addressing the latest developments in the manufacture and applications of industrial diamond, CVD synthetic diamond, and related materials, this conference will be held May 5–7, 2008, in Orlando, Florida. Visit www.intertechconference.com.

WDC 2008. The 33rd World Diamond Congress will be held May 12–15, 2008, in Shanghai, China. Visit www.worlddiamondcongress2008.com.

GAA 62nd Federal Conference. The Gemmological Association of Australia will host its 2008 conference on May 16–17 in Coober Pedy, South Australia. Visit www.gem.org.au/newsf.htm.

Santa Fe Symposium 2007. This 22nd annual symposium on jewelry manufacturing technology will be held in Albuquerque, New Mexico, May 18–20. Visit www.santafesymposium.org.

Art2008. Held May 25–30 in Jerusalem, Israel, the *9th International Art Conference on Non-destructive Investigation and Analysis* will focus on items of cultural heritage, but will have implications for gem testing. Visit www.isas.co.il/art2008.

Quebec 2008: GAC-MAC-SEG-SGA. Held May 26–28 in Quebec City, Canada, this joint conference organized by the Geological Association of Canada, Mineralogical Association of Canada, Society of Economic Geologists, and the Society for Geology Applied to Mineral Deposits will include special sessions on “Diamonds: From Mantle to Jewellery” and “Challenges to a Genetic Model for Pegmatites,” as well as a short course called “Rough Diamond Handling.” Visit www.quebec2008.net.

NDNC-2008. The growth, processing, characterization, properties, and applications of diamond and related materials will be covered at the 2nd International Conference on New Diamond and Nano Carbon, held May 26–29 in Taipei, Taiwan. Visit <http://diamond.iams.sinica.edu.tw/NDNC2008>.

Maine Pegmatite Workshop. This short course reviewing current information and theories about pegmatite paragenesis, mineralogy, and petrology will be held May 31 to June 6, 2008, in Poland, Maine. Visit <http://homepage.mac.com/rasprague/PegShop>.

SEG-GSSA2008: Africa Uncovered—Mineral Resources for the Future. Diamond presentations will be covered at this conference, hosted by the Society of Economic Geologists

and the Geological Society of South Africa, in Muldersdrift, South Africa, on July 6–9. Visit www.seg-gssa2008.org.

Goldschmidt 2008. Held July 13–18 in Vancouver, British Columbia, Canada, this geochemistry conference will include a session titled “Fluids Associated with Diamond Formation.” Short courses will include “Laser-Ablation-ICPMS in the Earth Sciences: Current Practices and Outstanding Issues” and “A Hands-On Introductory Tour of Kimberlites.” Visit www.goldschmidt2008.org.

IGC 2008. Held in Oslo, Norway, on August 5–14, the *33rd International Geological Congress* will include sessions with possible applications to gemology: mineral spectroscopy; metallogeny and mineral potential of Russia, Belarus and Ukraine; geology of Africa; and development strategies for the mining sectors of African countries. Visit www.33igc.org.

9th International Kimberlite Conference. Held August 10–15 in Frankfurt, Germany, this conference will bring together the academic and diamond exploration communities to exchange information on kimberlites and related rocks. Visit www.9ikc.com.

IUCr2008. Crystal growth, characterization, and analytical techniques will be covered at the *21st Congress of the International Union of Crystallography*, held in Osaka, Japan, August 23–31. Visit www.congre.co.jp/iucr2008.

6th International Conference on Mineralogy and Museums. Held September 7–9, at the Colorado School of Mines, Golden, Colorado, conference themes are the relationships between museums and research, collection management, and society. Gems will form a significant part of the program, and pre- and post-conference field trips are being planned to kimberlite and pegmatite sites in Colorado. Visit www.mines.edu/outreach/cont_ed/ICMM6.

Diamond 2008. The *19th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes, and Nitrides* will be held in Sitges, Spain, September 7–11. Presentations will be given on the growth, processing, and characterization of diamond. Visit www.diamond-conference.elsevier.com.

Rapaport International Diamond Conference. This conference will take place September 8, 2008, at the Waldorf Astoria Hotel, New York. Topics will include diamond finance, rough supply, manufacturing, commoditization, and fair trade jewelry. E-mail IDC@diamonds.net.

Exhibits

Exhibits at the GIA Museum. From May 21 through December 2008, “Facets of GIA” will explain the various

gemological services that GIA provides, including diamond grading, gem identification, education, and public outreach. As part of this exhibit, the Aurora Butterfly of Peace—a display comprised of 240 natural fancy-colored diamonds—will be featured through July 2008, courtesy of Alan Bronstein. Also currently on display in the Rosy Blue Student Commons are photo essays by Robert Weldon, manager of photography and visual communications at the GIA Library, and *Gems & Gemology* editor Brendan Laurs, depicting emerald mines in Colombia and the Paraíba-type tourmaline deposit in Mozambique, respectively (for more on the latter, see the article on pp. 4–30 of this issue). Advance reservations are required; to schedule a tour, call 760-603-4116 or e-mail museum@gia.edu.

Diamond Divas. On display at the Diamond Museum Province of Antwerp until June 8, 2008, this exhibit highlights diamond jewelry worn by royalty and celebrities from the past and present. Included will be pieces worn by Empress Josephine, Doris Duke, and Sophia Loren, among others, as well as the rarely seen Moon of Baroda diamond, worn by actress Marilyn Monroe during her iconic scene in the movie “Gentlemen Prefer Blondes.” Visit www.diamonddivas.be.

Gems! Colors of Light and Stone at the Bowers Museum. The Michael Scott collection has returned to the Bowers Museum in Santa Ana, California, with an expanded display of rare colored stones, carvings, and sculptures. The exhibit will run until June 16, 2008. Visit www.bowers.org.

The Aurora Collection at The Vault. “The Vault,” a new permanent collection of rare gemstones and mineral specimens, is now open at the Natural History Museum in London. Headlining the initial exhibit is the Aurora Collection, currently comprising 296 naturally colored diamonds (267.45 carats total weight) assembled by diamond collectors Alan Bronstein and Harry Rodman. Also on display is the 47.69 ct Star of Africa, which helped launch the 1869 diamond rush in South Africa, and the 1,385.95 ct Devonshire emerald crystal. Visit www.nhm.ac.uk/galleries.

Gold: Visions of the Americas. Beginning May 14, 2008, at the Musée de la Civilisation in Quebec City, Quebec, this exhibition will review the importance of gold to the cultures of North and South America, both ancient and modern. The 250 items on display will include gold objects and mineral specimens, as well as paintings, sculptures, and ethnographic objects. Visit www.mcq.org.

IN MEMORIAM

GRAHAME BROWN (1936–2008)

Grahame Brown, distinguished gemologist and longtime editor of *The Australian Gemmologist*, passed away January 15, 2008, after a battle with cancer. He was 71.

Although Dr. Brown was a practicing dentist until the end of his life, gemology became a fitting outlet for his remarkable intellect and energy. At the encouragement of a dentistry colleague in Brisbane, he began taking the Gemmological Association of Australia (GAA) diploma courses in 1973. The following year, Dr. Brown was awarded the association’s diploma with distinction, an accomplishment he repeated with the Gemmological Association of Great Britain in 1975. Numerous other diplomas and professional affiliations would follow.

Dr. Brown began teaching for the GAA in Queensland in 1975. Over the next two decades, he held a series of leadership roles within the association, serving as its president from 1989 to 1993. The GAA named him an honorary life member in 1990. Meanwhile, Dr. Brown was contributing influential articles to the association’s quarterly journal, *The Australian Gemmologist*, for which he served as editor from 1994 until his death. (Grant Pearson has been named the journal’s new editor.)



In addition to operating his own gem identification and appraisal consultancy and teaching for the GAA, Dr. Brown taught gem identification at the University of Queensland from 1989 to 1992. He frequently lectured at conferences worldwide, including GIA’s Second International Gemological Symposium in 1991. He was elected to the International Gemmological Conference (IGC) in 1995 and served as Australia’s delegate to the CIBJO Congress in 2002 and 2004.

Dr. Brown was a prolific author, publishing more than 500 gemological papers. His Summer 1991 *Gems & Gemology* article on treated Andamooka matrix opal remains the definitive work on the subject. He was a contributing editor to the fifth edition of Robert Webster’s *Gems: Their Sources, Descriptions and Identification* in 1994. From 2001 until his death, Dr. Brown was also editor of *The NCJV Valuer*, a gem and jewelry appraisal magazine.

Grahame Brown is survived by his wife, Helen, their three children, and six grandchildren. He will be missed by his many friends and colleagues throughout the world.