GEMNEWS

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DIAMONDS

More firms processing fracture-filled diamonds. Although the Fall 1994 article on fracture-filled diamonds (Kammerling et al., *Gems & Gemology*, pp. 142–177) only specifically covered products by Yehuda, Koss, and Goldman Oved, it cautioned that other firms are also treating diamonds to decrease fracture visibility. After noticing an ad in *Mazal U'Bracha*, the editors asked the advertisers—David Levy & Max Dahan, of Ramat Gan, Israel—for more information. In May, Mr. Dahan kindly provided the details that follow. (We plan to examine some of the the stones in question at a later date.)

The firm's laboratory opened in August 1991; about 30,000 carats of diamonds have been treated in the last 30 months, according to Mr. Dahan. These stones ranged from 1 point (0.01 ct) to 20.50 ct. In a recent 1,500-ct sample of diamonds they treated, about 25% (by weight) were one-third carat and smaller; about 20% were 40-to-90 points; about 25% were 1 ct; and the remaining 30% were 1.5 ct and larger. Mr. Dahan states that there is practically no limit to the size or shape of diamonds that can be treated. He added that the greatest demand in treated diamonds now is for those with an apparent clarity of SI$_1$ after fracture filling.

Mr. Dahan further noted that the durability of the treatment depends not only on the chemical composition of the glass, but also on the physical dimensions and position of the fracture. For instance, a filled fracture running through the table is less sensitive to damage by ultrasonic and steam cleaning, but more sensitive to damage by ultraviolet radiation; whereas a filled fracture at the girdle of the stone is less sensitive to ultraviolet radiation, but more susceptible to damage by cleaning techniques.

Synthetic diamonds misrepresented as Canadian rough. Pacific Gemological Associates (PGA) of Vancouver, British Columbia, reported on a new variation on one of the trade's oldest tricks.

A client with significant interests in mineral exploration in northern and western Canada brought to PGA's attention a package of diamond microcrystals. These diamonds were being represented as a typical core result for a property in Saskatchewan in which the clients had been asked to invest. Examination of the stones, however, proved that all were synthetic.

Initial observation of the parcel alerted PGA, as *all* the crystals were about the same size, color, and shape (very atypical for a mine-run sample). Furthermore, the crystals had an elongated, modified octahedral (possibly cubo-octahedral) habit. More significantly, stones examined in detail showed evidence of metallic flux inclusions and "stop-sign" graining. All these features were reminiscent of the synthetic diamonds described by Shigley et al. in, for example, "The Gemological Properties of the DeBeers Gem-Quality Synthetic Diamonds" (*Gems & Gemology*, Vol. 23, No. 4, 1987, pp. 187–206).

This is the first time that PGA is aware of synthetic diamonds being misrepresented as natural to mining and investment industries.

COLORED STONES

Large aquamarines from Nigeria. The firm G.R.K. Gems, of New York City, had an impressive display of large, transparent aquamarines from Nigeria at Tucson this past February. The stones, which were fashioned in Jaipur, India, ranged from 9.52 ct to 436.15 ct (a 48 × 35 mm emerald cut). The 47 stones in the collection had a combined weight of 2,500 ct.

Clinochlore and other rare collector stones from the former Soviet Union . . . In the Spring 1995 Gem News (pp. 65–67), we described some rare gemstones from Canada that were seen at the Tucson gem shows this year. Also in evidence were a number of rare collector stones from various republics of the former Soviet Union. Samir Pierre Kanaan, of Paris, France, loaned one of the editors (EF) some of these for examination, the results of which are detailed here. Although none of these is durable enough for use in jewelry, all made for very interesting faceted stones. Mr. Kanaan also indicated that a number of small colorless crystals of leucophanite, $(Ca,REE[\text{rare earth element}])CaNa_2Be_2Si_4O_{12}(F,O)_2$, are coming from Russia, and are suitable for faceting.

Also found recently was color-change *clinochlore*, $(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$, in an unspecified area of Russia. Russian geologists call it "corundophilite," an obsolete name for this species. We examined several small rough fragments and two faceted gems (a 0.43-ct hexagonal rose cut and a 0.25-ct cut-corner rectangular modified step cut). Because of clinochlore's perfect cleavage, it is very difficult to facet and tends to shatter if not handled carefully. The faceted stones were dark green in fluorescent illumination or daylight, and changed to a dark brownish reddish purple in incandescent light. We found that the gemological properties for both, as reported below, were essentially identical.

Because of the poor polish, we were able to obtain approximate indices of refraction only for α = 1.585 and γ = 1.600, and none for β. We determined a specific gravity of about 2.73 and observed a weak-to-moderate pleochroism of orangy red and purple. Both stones were inert to long- and short-wave ultraviolet radiation. Mohs hardness, according to the mineralogical literature, is 2–2½.

With the hand-held spectroscope (confirmed by spectrophotometry), the stones showed total absorption to nearly 470 nm, with a faint line at about 470 nm, intense absorption between 550 and 620 nm, and lines at about 660, 680, and 690 nm. Energy-dispersive X-ray fluorescence (EDXRF) analysis confirmed the presence of magnesium, aluminum, silicon, and iron as major constituents. It also detected lesser amounts of chromium, nickel, and vanadium. The color change can be attributed to absorption caused by chromium (Cr^{3+}).

Görgeyite, $K_2Ca_5(SO_4)_6 \cdot H_2O$, a rare hydrated potassium calcium sulfate associated with salt deposits, has also been found in an undisclosed area of Russia. We studied a near-colorless, 0.64-ct rectangular step cut. The indices of refraction were α = 1.556 and γ = 1.587 (because of the crystallographic orientation of the table, we could not determine β). The specific gravity was 2.91. The sample was inert to both long- and short-wave UV radiation, and revealed no spectral absorption features in the hand-held spectroscope. With magnification, we saw many small healed fractures and feathers, as well as a cleavage plane—containing what appeared to be a liquid film—running through the stone. EDXRF confirmed the presence of the major constituents sulfur, potassium, and calcium. Görgeyite has a reported Mohs hardness of 3½.

A number of transparent crystals of *kaliborite*, $KHMg_2B_{12}O_{16}(OH)_{10} \cdot 4H_2O$, have been found in the salt-bearing beds of the Inder uplift near Inder Lake in Kazakhstan, north of the Caspian Sea. We examined a near-colorless 0.43-ct rectangular step cut. On this biaxial stone, we determined indices of refraction of α = 1.503, β = 1.524 to 1.530, and γ = 1.549. The specific gravity was 2.11. The gem was inert to both long- and short-wave UV, and produced no spectrum in the hand-held spectroscope. A group of many low-relief, colorless, rounded-to-flattened crystals were visible with magnification in one area of the stone; we found them to be highly birefringent. EDXRF analysis confirmed the presence of magnesium and potassium, the only two major constituents we could identify. No impurities were noted. The reported Mohs hardness for kaliborite is 4-4½.

Preobrazhenskite, $Mg_3B_{11}O_{15}(OH)_9$, also comes from the Inder deposit in Kazakhstan. We studied a near-colorless, flat, 0.09-ct rectangular stone that was only partially faceted (the pavilion was a rough crystal surface). The indices of refraction were approximately equal for α and β, both about 1.570, and γ = 1.599. The specific gravity was 2.47. Both long- and short-wave UV radiation produced a faint yellowish orange fluorescence. No absorption lines were visible in the hand-held spectroscope. Magnesium was the only major constituent that could be detected by EDXRF analysis. The stone was filled with small, low-relief, flattened-to-rounded crystals that were highly birefringent. Because preobrazhenskite is known to enclose kaliborite and boracite crystals during its growth in this deposit (see Roberts et al., *Encyclopedia of Minerals*, 2nd ed., Van Nostrand Reinhold, New York, 1990), it is possible that the inclusions are one of these two species. Preobrazhenskite has a reported hardness of 4½–5 on the Mohs scale.

. . . and other unusual gems seen at Tucson. Among other unusual gems that the editors encountered at Tucson was a 29.65-ct oval faceted sillimanite, reported by the vendor (John Bachman, Boulder, Colorado) to have been mined in Orissa, India, at the same deposit that is producing many cat's-eye sillimanites. Although the stone was pale yellow under incandescent light, Mr. Bachman said that it appeared pale green in daylight.

Neal Littman, of San Francisco, California, had a 434-ct faceted "rainbow" calcite that displayed exceptionally strong dispersion. This stone was faceted by Art Grant, of Hannibal, New York, who also cut the 1,156-ct gem described by Drs. Cornelius Hurlbut and Carl Francis in the article "An Extraordinary Calcite Gemstone," *Gems & Gemology*, Winter 1984, pp. 222–225. The twinning that is responsible for the exaggerated dispersion shown by this material was clearly seen through the stone's table facet. Mr. Littman also had a 3.35-ct iridescent andradite cabochon that exhibited its phenomenon in the form of a distinct eye that was predominantly blue with golden yellow seen at one end.

Mark H. Smith, of Bangkok, showed the editors a 56.94-ct green sphene from Sri Lanka that was shield-cut to showcase the stone's strong dispersion. He also had a 21.46-ct, faceted pale-green sillimanite and a 4.02-ct near-colorless, transparent faceted chrysoberyl from Sri Lanka.

Phenomenal feldspars from India. Feldspars that display both adularescence and chatoyancy are not new to the gem market. In the editors' experience, many cat's-eye moonstones are of Indian origin. These stones usually have a grayish white body color, although we also see stones that are medium light greenish gray or light to medium light brownish orange.

At Tucson this year, the editors saw some chatoyant moonstones with an atypical darker orange body color. According to Manu Nichani of Temple Trading, Encinitas, California, this material became available last year from deposits near the city of Madras, in the south-

Figure 1. These two phenomenal feldspars, a 1.65-ct cat's-eye moonstone (left) and a 2.39-ct sunstone, are from the state of Tamil Nadu, in southern India. Courtesy of Temple Trading; photo by Shane F. McClure.

ern Indian state of Tamil Nadu. (These deposits have also produced the more common colors previously mentioned.) When one of the editors (RCK) remarked that the fairly dark color of this new material (figure 1) was similar to that of some sunstone feldspar of Indian origin, Mr. Nichani said that the latter material is also mined in Tamil Nadu, near the city of Trichy. Furthermore, the two mining areas are less than 100 miles (160 km) apart.

Michael Randall, Gem Reflections of California, San Anselmo, had some interesting sunstones that displayed weak, four-rayed asterism. Although he did not know the exact locality, they were reportedly from southern India.

Temple Trading was also selling faceted "rainbow moonstone" (actually labradorite feldspar). These 5 × 10 mm marquise cuts were well oriented to show the phenomenon across the table when examined face up.

Parti-colored fluorite from Brazil. Fluorite from China has been on the market in great quantities for several years. We regularly see this material at gem shows in a variety of forms, including mineral specimens, carvings, and beads. In our experience, the vast majority of this material is banded in green and purple. What caught the eye of one of the editors at the booths of some Brazilian dealers at the February 1994 and 1995 Tucson shows were parti-colored fluorite cabochons, most of which had areas of bright yellow as well as green and/or purple (see, e.g., figure 2). According to one dealer, this material came from the state of Santa Catarina in southern Brazil, having formed hydrothermally in pockets in a basaltic lava flow.

This material was available from several Brazilian firms at the 1995 Tucson show. In addition to the multicolored cabochons seen last year, we also encountered faceted stones. Some of these had been fashioned to show three colors. Others were bicolored (purple/yellow, yellow/green, and purple/green). One of the editors also encountered a few stones that were only one color, including some step-cut medium-toned green stones that looked very much like light-toned emeralds. The sources of the material seen this year were reported by various dealers as being either in the Brazil-Peru or Brazil-Argentina border areas.

Unusual opal carvings. Much opal occurs as thin seams in a host rock. To make use of such material, lapidaries often fashion it into assembled stones, including doublets and triplets. They may also fashion it to include the matrix with the opal: For example, so-called boulder opal from Australia typically has a thin layer of opal on top of the ironstone matrix in which it formed.

In Tucson this year, we noted two novel types of gem carvings that incorporated both opal and its matrix. The first (figure 3) were transparent to semitransparent, slightly milky opals from Oregon that were "illusion carved"—cut from the back to produce a three-dimensional effect when viewed from the front of the stone—into scenes of deer, elephants, and fish. In forest or savanna motifs, the yellowish brown matrix formed the ground on which the animals stood; in the aquatic scenes, the matrix formed the seabed and seaweed. The material was preformed in the United States and then carved in China, according to the vendor, Eric Braunwart, of Columbia Gem House, Vancouver, Washington.

The second type was offered by Donald K. Olson and Associates of Bonsall, California. This firm has two artists in their group who create opal intarsia. Some of these carvings have a three-dimensional effect from layers of dendritic opal that have been backed with scenic

Figure 2. These five fashioned fluorites (1.81 to 30.01 ct) are from Brazil. The largest is from the southern state of Santa Catarina. Photo by Maha DeMaggio.

Figure 3. This carving creatively incorporates Oregon opal and matrix into its design. Courtesy of Columbia Gem House; photo © GIA and Tino Hammid.

slabs of other gem materials, for example, agate. About 50 such "pictures" are produced annually.

Update on opal from Ethiopia. The Spring 1994 Gem News noted that there was a new source for opal, Ethiopia (pp. 52–53). In May of this year, Dr. Paul Downing of Majestic Opal, Estes Park, Colorado, provided an update on opal from this northeast African nation.

According to Dr. Downing, opal is being recovered from an area known as Yita Ridge in the Menz Gishe District of Shewa Province, about 240 km (149 miles) northeast of Ethiopia's capital, Addis Ababa. Dr. Downing believes that this deposit is different from the one we described earlier, which we had been told was in the far south of the country, possibly in Harerge Province, not far from the Kenya border. This apparently new deposit is being commercially worked by a joint Ethiopian–U.S. firm, the Ethio-American Resource Development Corporation, which holds a claim through Ethiopia's Department of Mines and Energy.

The deposit appears to be quite extensive, with the opal found in rhyolite nodules. Gem-quality material ranges in body color from colorless to yellow to orange to dark reddish brown ("caramel"), and exhibits strong play-of-color in many hues and patterns. A small amount of transparent-to-translucent material has been fashioned as cabochons, and some transparent material has been faceted. Although the find is still in the exploration phase, some of the fashioned material is now entering the U.S. market.

The deposit also produces porous white hydrophane opal; when soaked in water, it exhibits strong play-of-color. Dr. Downing is experimenting with this material in an effort to produce marketable impregnated opal.

Figure 4. These sapphires (from left—0.73, 0.91, and 1.43 ct) are from southern Madagascar, an increasingly important source of colored stones. Photo © GIA and Tino Hammid.

Sapphires from Madagascar. Commercial quantities of fine sapphire are now being produced on the island of Madagascar. Recently, we had the opportunity to conduct gemological tests on eight Madagascar sapphires, loaned to GIA by Bill Marcue, of D.W. Enterprises, Boulder, Colorado. (Three of these stones are shown in figure 4.) The following properties were determined: color—medium to medium dark blue to slightly violetish blue; color distribution—even in four of the stones and fairly pronounced banding in the other four; diaphaneity—transparent; R.I.—o = 1.768 to 1.769, ε = 1.759 to 1.760; birefringence—0.008 to 0.009; pleochroism—distinct dichroism in slightly greenish blue to green-blue (extraordinary ray) and violetish blue to violet-blue (ordinary ray), varying with depth of body color; Chelsea filter reaction—inert (appeared the same color as the filter). All eight stones were inert to long-wave UV, and three were inert to short-wave; the other five fluoresced a very faint-to-weak, uneven, chalky greenish blue to short-wave UV. When examined with a desk-model spectroscope, all of the stones showed at least a faint absorption line at about 451 nm; five showed an additional absorption line at about 460 nm; and two of these five had a further, weak 470-nm line. In addition, five of the stones exhibited a weak "chromium" line at about 694 nm, which appeared to be an emission line. Luminescence spectroscopy confirmed that this line was due to emission.

Magnification revealed a number of features. In addition to the color banding mentioned above, we also noted "burst" primary fluid inclusions and discoid fractures around negative crystals (both evidence of heat treatment), partially healed "fingerprint" inclusions, and crystal inclusions whose nature could not be determined because of the heat treatment.

Chemical analysis performed on one sample with energy-dispersive X-ray fluorescence spectroscopy revealed, as expected, that aluminum was the major constituent. Iron accounted for about 0.5 wt.% (as FeO) and titanium for 0.036 wt.% (as TiO_2). There was also a trace amount of gallium, as is common in natural sapphires. Chromium was not detected. The weak emission line mentioned previously is typically due to minute amounts of chromium, well below the detection limits of our instrument. The UV-visible absorption spectrum showed that the blue color is due to a broad absorption centered at around 700 nm, which is typical of the iron-titanium charge transfer when measured in a direction perpendicular to the optic axis. No other absorptions appeared to contribute to the blue color. We observed small peaks at about 377, 387, and 451 nm. These are typical of Fe^{3+} and have been observed in blue sapphires from many localities. We also noted an additional very weak "shoulder" at about 460 nm.

Although we do not know the specific locality for these stones, a recent, brief report by C.C. Milisenda in the *Zeitschrift der Deutschen Gemmologischen Gesellschaft* (Vol. 44, No. 1, 1995, pp. 3–4) describes sapphires from a new occurrence near Bekily in Madagascar's southwestern Province of Toliara. The properties reported for these stones are similar to those determined for our eight samples.

An indication of the perceived commercial significance of Madagascar's sapphire deposits can be found in a March/April 1995 *ICA Gazette* report that 43 Thai gem dealers have invested in a new company formed to develop the deposits in southern Madagascar. This company, the Gems Industry Corporation, was negotiating for several mining leases and plans to import heavy mining equipment.

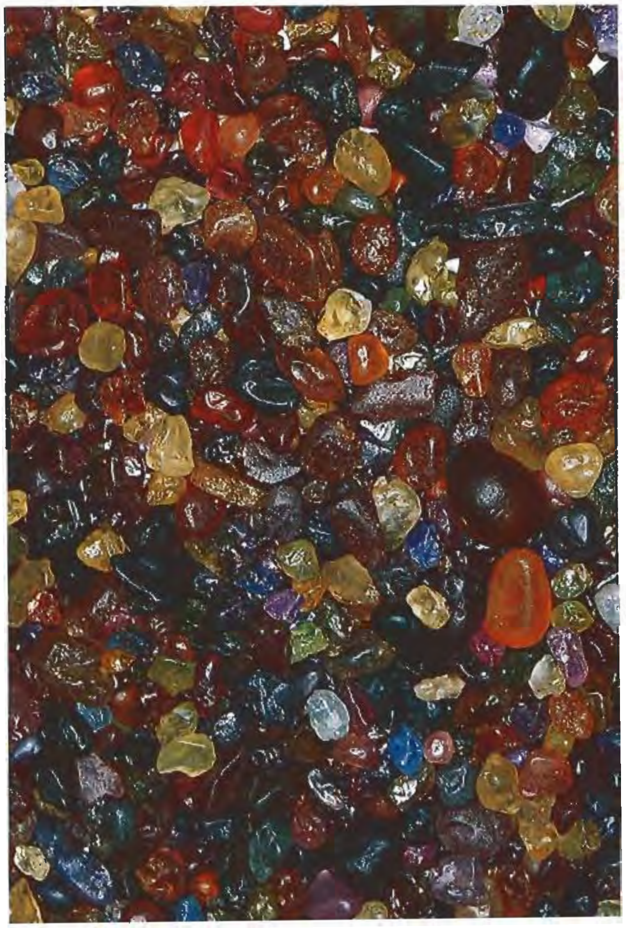
Sapphires and other gems from Tanzania. The Spring 1995 Gem News section included an entry on sapphires from a new deposit in the far south of Tanzania (pp. 64–65). One of the editors (HAH of the SSEF Swiss Gemmological Institute in Basel, Switzerland) has provided more information about the gems from this new locality. He has also learned more about the locality itself from dealer Werner Spaltenstein, of Multicolor, Bangkok, who has claims in this area.

The SSEF received its first parcel of mixed faceted stones from this source in August 1994. They ranged in color from blue to purple to "mauve;" some were very bright while others had a dull appearance. Most were no larger than 1 ct. In overall appearance they were reminiscent of darker suites of Umba sapphires and garnets that this editor has seen. In January 1995, SSEF received a second, larger parcel (about 1,000 carats) of rough stones, reportedly from the same deposit (see, e.g., figure 5).

The mining areas, said to be in the Songea District, are adjacent to the Muhuwesi Forest Reserve, about 200 km (320 miles) west of the Indian Ocean coast. One area village is called Puchapucha. Various mining claims have been staked along the riverbeds in the area, where the Muhuwesi and Mtetesi rivers converge. In this savanna terrain, the riverbeds show discontinuous outcrops of what appear to be igneous and metamorphic rocks. Pegmatites, pyroxenites, amphibolites, and gneisses are expected to be found. To date, gemstone pebbles are being collected from the surface gravels by hand; no shafts have been sunk, nor has any machinery been used. Some 200 diggers are working the river gravels under waterfalls and at rapids when the water is low. Although production figures are vague at best, Mr. Spaltenstein estimates that about 20–30 kg (44–66 pounds) of alluvial gem rough is recovered each month.

Most surprisingly, these gemstone gravels strongly resemble gem concentrates from Sri Lanka with respect to mineral content, colors, and degree of mechanical wear. However, East African "specialties" are also encountered in the mineral mix. To date, the editor has identified blue sapphire (in good-quality "Burma" to "Ceylon" colors, which could produce cut stones up to 5 ct), fancy sapphires (including pink, purple, brown, gray, and green), and some ruby; spinel in light-to-dark blue, purple, violet, and almost black; garnet, including yellow-to-brown grossular (and a polycrystalline hessonite-colored type), tsavorite, pyrope-almandine (including rhodolite), spessartine, and malaia; chrysoberyl in yellow to

Figure 5. Reportedly from a new source in southwestern Tanzania, these mixed rough gems are part of a parcel of about 1,000 carats. The largest piece is approximately 10 mm long. Photo courtesy of Dr. Henry A. Hänni, SSEF.



green to brown (some cat's-eye material and alexandrite has also been reported); tourmaline in brown to yellow and green; rock crystal quartz, citrine, and amethyst; zircon in yellow, brown, and green; kyanite; and violet scapolite. Gold and diamonds have also been found. The editor believes that the area will produce additional, rarer gem materials in the future.

Spessartine garnet from Namibia. The vivid orange spessartine garnets that had such an impact at the Tucson show when they debuted two years ago (and which were subsequently confirmed to be from Namibia; see Spring and Winter 1993 Gem News, pp. 61 and 293, respectively) were again on hand this year. Colgem Ltd., of Ramat Gan, Israel, which first introduced the material, again had a large selection at the 1994 and 1995 Tucson shows. They showed what they purport to be the largest faceted Namibian spessartine cut to date, a 29.77-ct cushion shape, and the largest "eye-clean" stone cut to date, a 14.77-ct triangular mixed cut.

Israel Z. Eliezri of Colgem said that the material was initially marketed under the trade name "Hollandine" garnet, but now most of the trade—and Colgem—are using the term "Mandarin" garnet.

Chemical analyses show that the material averages 85 mol.% spessartine (manganese garnet), 12.5 mol.% pyrope (magnesium garnet), and 2.5 mol.% grossular (calcium garnet), according to Mr. Eliezri. This accounts for the purity of the stones' orange color, as manganese is the only element present that produces the orange color in these garnets. Rough with a small iron content is also recovered, but this material has an undesirable brown component and so is not being cut.

At Tucson this year, Nicholas DelRe, of the GIA Gem Trade Laboratory in New York, learned of another, relatively new find of spessartine garnet in Namibia from Alan Roup of G.E.M. Ltd., Jerusalem, Israel. Because the material is found in a schist matrix (unlike the other Namibian find), much of the garnet is included. Mr. Roup believes that many of the inclusions are tremolite. Mr. DelRe acquired one specimen for examination, a 0.66-ct cat's-eye cabochon (figure 6). The gemological properties of this gem were: color—orange; optical character—singly refractive; R.I.—over-the-limits (greater than 1.81); S.G.—4.10; ultraviolet fluorescence—inert to both long- and short-wave UV. The absorption spectrum, seen with a hand-held prism spectroscope, was consistent with that of spessartine garnet—a cutoff at 435 nm, with weak bands at 460, 480, and 520 nm. With magnification, two types of inclusions were noted (figure 7). Some were apparently hollow tubes, but others, which appeared to be doubly refractive when examined between crossed polarizers, were probably tremolite, as Mr. Roup suggested.

Figure 6. This 0.66-ct cat's-eye spessartine garnet is from a deposit in Namibia. Photo by Nicholas DelRe.

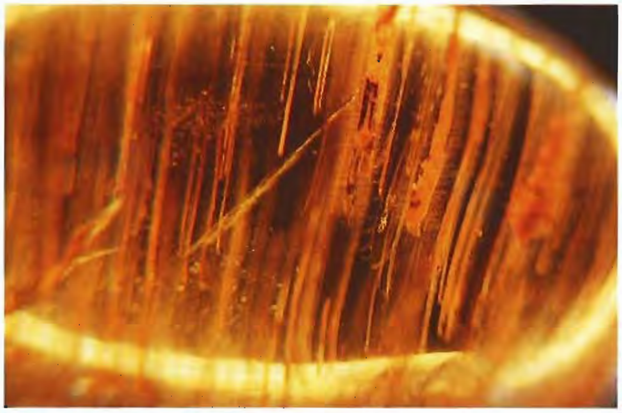


Figure 7. Some inclusions in the stone in figure 6 are hollow tubes; others are birefringent acicular crystals, possibly tremolite. Photomicrograph by Nicholas DelRe; magnified 30×.

Production of spessartine from both deposits is estimated at less than 40 kg per month, according to Chris Johnston (reported by E. Wright, "Dealers Weigh Mandarin's Fate," *Colored Stone*, Vol. 8, No. 4, July–August 1995, pp. 1, 20, 22, 24). In the same article, Howard Boltz estimates gem yields of 20% from the rough garnet. Clean faceted stones weighing more than 1 ct continue to be rare.

SYNTHETICS & SIMULANTS

Amber simulant: Natural resin in plastic. One simulant seen at every Tucson show since at least 1993 is a form of reconstructed amber. Reportedly produced in the former Czechoslovakia from Baltic amber (Spring 1993 Gem News, p. 63), this material is visually similar—with its eye-visible, veil-like grain boundaries—to other pressed

Figure 8. This 8.32-ct cabochon (19.13 × 19.23 × 7.03 mm) consists of plastic with embedded fragments of natural resin. Photo by Maha DeMaggio.

amber that the editors have seen. Recently, the editors came across another material that was labeled variously "pressed," "reconstructed," "reconstituted," and "synthetic" amber. Two firms from Poland that were marketing the material at the 1995 Tucson show independently confirmed that it was produced in Gdansk, a Polish city on the Baltic Sea. A promotional flier from one of the firms said that the starting material was "small pieces of amber taken from the deep ground or from washing up on the shore in the Baltic region. . . . After being ground they are set in fresh tree sap. After drying they are refinished, polished, and hand-made into jewelry and other artifacts."

This material was available in many forms, including round and oval cabochons in a range of sizes, star shapes for hanging on cords, heart-shaped cabochons with bails for use as pendants, and flexible bracelets, produced by stringing oblong shapes on double strands of elastic cord. It is visually distinct from true pressed amber because it displays very clearly defined irregular transparent-to-semitransparent yellow-brown fragments in a lighter-toned transparent yellow groundmass (figure 8). We purchased several samples and tested one 8.32-ct round cabochon to document its gemological properties.

The spot R.I. was 1.56, and hydrostatic weighing revealed an S.G. of 1.24. Under crossed polarizers, strong anomalous double refraction with strain colors was noted. When exposed to long-wave UV radiation, the body of the cabochon fluoresced a moderate greenish yellow, and the included fragments fluoresced a moderate bluish white. Under short-wave UV, the body fluoresced a faint yellowish orange, and the fragments were inert. When touched gently with a thermal reaction tester, the cabochon produced an acrid odor. However, when a surface-reaching fragment was similarly tested, it produced a resinous odor.

Fourier-transform infrared (FTIR) spectroscopy was conducted on a second piece of this material. One of the amber-like fragments showed strong absorption peaks at 4057, 4250, 4358 and 4431 cm^{-1}; moderate peaks at 4636, 4672, and 5876 cm^{-1}; and weak absorptions at 5252, 5674, and 5807 cm^{-1}. These features are all consistent with those of a reference sample of natural amber that we also tested. The matrix material showed a strong absorption peak at 1725 cm^{-1} and weak absorptions at 1503 and 1673 cm^{-1}, features consistent with those of an unsaturated polyester resin.

We concluded that the cabochon consists of plastic in which fragments of a natural resin—probably amber—are embedded. Similar materials have been examined previously in both the GIA Gem Trade Laboratory and the Gem Testing Laboratory of Great Britain (see "Amber in Plastic," Gem Trade Lab Notes, *Gems & Gemology*, Fall 1983, pp. 171–172, and "Amber 'Imitation,'" *Journal of Gemmology*, January 1989, pp. 296–297).

A shortage of raw amber has led many factories in the amber centers of Gdansk and Krolewiec to produce a simulant developed in Germany called "polybern," according to Dr. Patty C. Rice, in her book *Amber, the Golden Gem of the Ages* (2nd rev. printing, 1987, Kosciuszko Foundation, New York). This consists of small amber chips embedded in synthetic resin (the name is derived from "poly" for polyester resin and "bern" from the German name for amber, "bernstein"). Dr. Rice reports that large amounts of a Polish-produced material, which contains less natural amber than "polybern" and has a layered appearance, have entered the market. We believe that we have seen both types of these materials.

Interestingly, at an April 1995 gem show in Santa Monica, California, one of the editors came across some identical-appearing material being offered as "reconstructed" amber, with a prominently displayed note

Figure 9. These synthetic corundums are being marketed as "recrystallized sapphire" (left, 0.66 ct) and "recrystallized ruby" (0.65 ct). Photo by Maha DeMaggio.

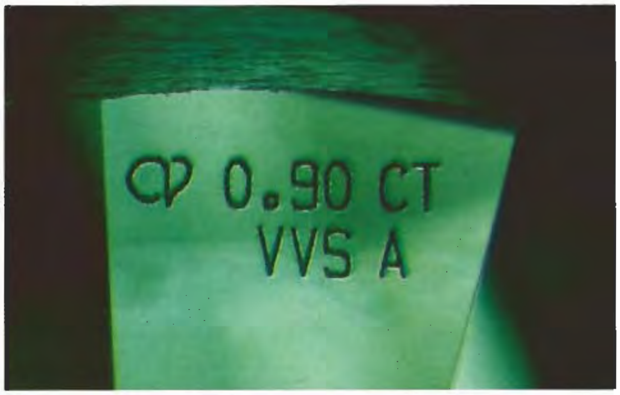


Figure 10. A trademark, carat weight, and quality grade—in characters about 0.15 mm high—are included in this laser inscription on the pavilion of a synthetic emerald. Courtesy of Kyocera Corporation.

describing it as amber chips in synthetic resin. This was the first time that the editor had seen such material so unambiguously identified. Even the gemologically naive would know what they were purchasing.

Update on "recrystallized" corundum. An entry in the Spring 1995 Gem News section (p. 71) mentioned synthetic corundum that was being marketed as "recrystallized ruby" and (pink) "recrystallized sapphire" by the TrueGem Company, of Las Vegas, Nevada. Subsequently, we obtained (through third parties) three faceted samples for examination. One was a 0.66-ct pink rectangular modified brilliant; the other two were red oval modified brilliants, weighing 0.54 ct and 0.65 ct (see, e.g., figure 9). All three had numbers inscribed on their girdles (see the next entry for more on inscribed stones).

Gemological examination of these three stones revealed the following properties: diaphaneity—transparent; color distribution—even; pleochroism—orangy pink/purplish pink (the 0.66 ct), orangy red/purplish red (the other two); optic character—uniaxial negative; color filter reaction: red (all three stones); RI—1.760–1.768 (0.66 ct), 1.762–1.770 (other two); birefringence—0.008; SG—3.99 to 4.01; luminescence to long-wave UV—strong, even red, with no chalkiness observed; luminescence to short-wave UV—moderate to strong, even red, with no chalkiness observed (strongest in the 0.66 ct stone); spectroscopy—typical ruby/pink sapphire spectrum (all three stones). The pink stone appeared "clean," that is, inclusion-free, when observed with the microscope; however, growth banding was visible in both red samples when viewed with immersion and brightfield illumination, and in one red stone we saw curved striae.

To complete our characterization of these stones, we obtained "semiquantitative" chemical analyses with X-ray fluorescence spectroscopy, using a Tracor-Northern (Spectrace) 5000 system and analysis conditions typically employed by GIA for corundum samples. The following elements were determined quantitatively: aluminum, chromium, titanium, vanadium, iron, and gallium. In all three stones, the concentrations of these elements were consistent with a pulled synthetic product, such as that grown by flame fusion or Czochralski pulling. These concentrations are *not* consistent with those seen by GIA Research in natural rubies and pink sapphires. Because the manufacturer states that the last step in "recrystallization" is Czochralski pulling, our results were not surprising.

Figure 11. This pipe bowl (59.10 × 59.90 × 40.05 mm) from Vietnam, is composed of a partially devitrified glass. Photo by Maha DeMaggio.

Laser-inscribed synthetic colored stones. One unusual feature of the three "recrystallized" synthetic corundums described in the previous entry is that all had identification numbers inscribed on their girdles. Lasers have been used for many years to inscribe information on diamonds. For example, the GIA Gem Trade Laboratory offers laser inscription of the appropriate Diamond Grading Report number or other message on a stone's girdle.

At Tucson this year, representatives of the Kyocera Corporation showed us a laser inscription on a pavilion facet, just below the girdle, of one of their synthetic emeralds. The inscription characters were about 150 μm (0.15 mm) high and included a trademark (a stylized CV for "Crescent Vert"), the stone's carat weight, and its quality grade (figure 10).

A Kyocera representative explained that, in the past, the firm had only marketed their synthetic gem materials in Japan in jewelry, never as loose stones. This Kyocera-produced jewelry is hallmarked so that it can be easily identified. However, the firm has begun marketing some loose stones in Japan. The purpose of the laser inscription

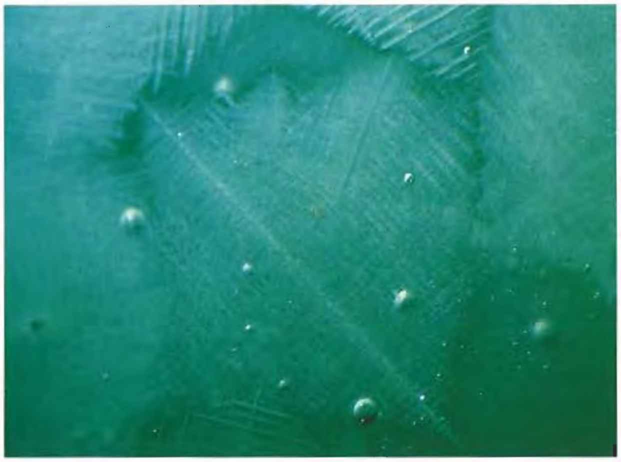


Figure 12. Magnification reveals gas bubbles and fibrous inclusions in the specimen shown in figure 11. Photomicrograph by Maha DeMaggio; magnified 40×.

is to make these loose stones as easily recognized in the Japanese market as Kyocera's gem-set jewelry.

Partially devitrified glass imitation of jadeite. During a visit to ruby and sapphire localities in Vietnam, *Gems & Gemology* Editor Alice S. Keller and one of the Gem News editors (RCK) also spent some time in Ho Chi Minh City. Of particular note was one area of the city where gemstones were offered in shops selling a diverse range of goods that also included antiques and handicrafts of more recent production. Among the items of ethnographic interest were opium pipes fashioned from a number of materials, including ivory, bone, bamboo inset with mother-of-pearl, and a bright green, mottled substance that superficially resembled jade. (The use of jade in opium pipes is described by B. Rapaport in "The Chinese Opium Pipe: The Art and Beauty of an Evil Custom," *Arts of Asia*, Vol. 25, No. 2, March/April 1995, pp. 66–77.) A pipe with bowl (or "damper"; figure 11) and end fittings composed of this latter material was purchased and subsequently examined gemologically at GIA.

The material was a fairly saturated, slightly yellowish green, similar to what is known in the trade as "apple jade." It had a mottled appearance, with somewhat circular, semitranslucent whitish areas surrounded by areas of somewhat higher transparency and slightly more saturated color. Magnification revealed numerous spherical gas bubbles throughout the piece, as well as hemispherical cavities that broke the surface. Also observed were bundles of fibrous inclusions corresponding to the areas that appear white to the unaided eye (figure 12). This internal scene is reminiscent of what is seen in the partially devitrified glass imitation of jade known by the trade name "Meta Jade." However, this pipe-bowl material differed significantly in its macroscopic appearance: "Meta Jade" typically exhibits angular, fibrous patches of lower transparency within an essentially transparent groundmass.

We determined the following gemological properties for the pipe bowl (with those of a sample "Meta Jade" in parentheses): spot R.I.—1.51 (1.48); absorption spectrum—general absorption below 510 nm and above 590 nm (general absorption below 480 nm and above 560 nm); long-wave UV fluorescence—weak yellowish green (faint yellowish green); short-wave UV fluorescence—moderate yellowish green (inert); Chelsea filter reaction—negative (negative).

X-ray powder diffraction analysis confirmed the presence of a crystalline fluorite phase, thereby verifying partial devitrification of the glass. EDXRF analysis revealed more iron in the Vietnamese material as well as the presence of rubidium, yttrium, and zirconium (absent in the "Meta Jade" sample).

On the basis of our investigation, we determined that the Vietnamese imitation of jade was a partially devitrified glass with properties similar to, yet distinct from, those of the Japanese-manufactured product known as "Meta Jade."

Iridescent hematite simulant. At Tucson this year, we came across a hematite-rich rock (most likely a slate or shale) from the Prescott, Arizona, area that was being marketed as "Iridescent Specularite." The material had a near-metallic luster and black body color. The iridescence forms when the surface oxidizes. According to the miner, Robert Poley, of Prescott, Arizona, this is accomplished in one of two ways: either the material is left exposed to weather on the mine dump, or pieces (such as the one in figure 13) are placed with an iron nail in a bucket of water. Protective surface coatings are not used because they interfere with the optical phenomenon. The iridescent layer is very thin and would probably be removed by polishing.

Kyocera plastic-impregnated synthetic opals. One of the more unusual manufactured products seen at Tucson this year was impregnated synthetic opal in a wide range of

Figure 13. The iridescent layer on this piece (10.03 × 6.63 × 1.39 cm) of "Iridescent Specularite," most likely a hematite-rich slate or shale, was produced by oxidation. Photo by Maha DeMaggio.

Figure 14. These six polished freeforms (ranging from 3.59 to 4.30 ct) are typical of the Kyocera polymer-impregnated synthetic opals. Photo by Maha DeMaggio.

body colors (figure 14). This material was being displayed by representatives of Kyoto-based Kyocera Corporation and their U.S.-based subsidiary, Kyocera America, San Diego, California. The different body colors were reportedly produced by impregnating the synthetic opal with various colors of polymers. This material is now being test marketed in Korea and Japan.

To characterize this material, we studied 20 samples, including 13 freeform polished pieces (3.06 to 4.48 ct) and seven cabochons (0.21 to 0.57 ct). We determined the following gemological properties: color—a wide range (see table 1); diaphaneity—semitransparent to semitranslucent; color distribution—even body color, all samples showing play-of-color; no pleochroism; singly refractive with strong anomalous double refraction; Chelsea filter reaction—red; R.I.—1.455 to 1.470 for the polished free forms, and 1.461 to 1.468 for the (more easily measured) cabochons; SG—1.88 to 1.91 (low for natural gem-quality opal). Luminescence to ultraviolet radiation, and the spectrum seen with the hand-held spectroscope, depended on the color of the stone (again, see table 1). Also, the spectra seen with the hand-held spectroscope were highly dependent on the orientation of the sample, as is typical for opals in general.

With the microscope, we observed a clearly recognizable "lizard skin" pattern with a curved, slightly irregular columnar structure (giving a more natural appearance). Some stones showed growth layers perpendicular to the columns.

Because there had been debate about whether this material was a true synthetic opal (that is, composed of ordered arrays of silica spheres), we investigated further using a scanning electron microscope with attached energy-dispersive X-ray fluorescence (EDXRF) analysis instrumentation. Two freeforms were chosen for examination, washed in isopropyl alcohol, and mounted on aluminum stubs without further processing. Both specimens showed oriented layers of approximately 100-nm-diameter spheroids (figure 15). Only silicon was detected using the attached EDXRF system; however, carbon and oxygen are not detectable with this instrument, and conditions were not optimal for the detection of heavy elements. We regard these observations as sufficient proof that the material is synthetic opal.

Next, we examined all 13 freeforms with Fourier-transform infrared (FTIR) spectroscopy, concentrating on the region between 6000 and 4000 cm^{-1} (samples are opaque at longer wavelengths). All spectra were virtually identical, showing a double peak at 5810 and 5725 cm^{-1} (in the same region, but different in detail, as peaks seen in plastic-treated natural opal), an opal peak at 5262 cm^{-1}, a low broad peak at 4660 cm^{-1}, and five peaks at 4383, 4343, 4270, 4166, and 4058 cm^{-1}. (Again, these last five peaks were in the same region, but different in detail, from peaks seen in plastic-treated natural opals.) The "plastic" peaks (5810–5725, 4660, 4383–4058 cm^{-1}) were similar to those seen in samples of polypropylene and polystyrene. However, because the "diagnostic" peaks for plastics are found in regions of the infrared where opal is opaque, it was impossible to determine precisely which plastic is in the Kyocera plastic-impregnated synthetic opals. This infrared spectrum has also been seen—with slightly different peak assignments—by DuToit et al. ("Lab Report," pp. 58–59, *JewelSiam*, Vol. 6, No. 3, June–July 1995).

Jeffery Bergman of Gem Source, Bangkok, Thailand, has shared some information about apparently similar material he examined. He heated samples to 600°C to burn off the plastic and study the base material; according to this test, the plastic-impregnated synthetic opals that he examined were about 20% plastic by weight (with the highly absorbent, chalky residue still showing play-of-color).

Platinum alloy as an ornamental material. Opaque ornamental gem materials, such as hematite and marcasite, are now enjoying renewed popularity. Another opaque "gem," actually a manufactured material with a high platinum content and metallic luster, is marketed as "Platigem." It was developed by researchers at the metallurgical firm Mintek, in Randburg, South Africa. Recently, Dr. Herman Steyn, director of the Physical Metallurgy Division, provided GIA with samples for examination.

"Platigem" is an intermetallic compound of platinum, aluminum, and copper. We examined five faceted samples, ranging from 1.09 to 12.63 ct (three are shown in figure 16). The "stones" had the following gemological properties: color—light yellow to brownish pink, evenly distributed in all; luster—metallic; diaphaneity—opaque; R.I.—over-the-limits of the standard gemological refrac-

TABLE 1. Color-dependent properties of Kyocera polymer-impregnated synthetic opals.[a]

Color	UV Fluorescence		Absorption spectrum (nm)
	Long wave	Short wave	
White	wk. purplish blue	mod. blue	wk. 500, wk. 550, wk. 580 bands
Purplish pink	str. orangy pink	mod. orangy pink	470–580 band
Orangy pink	wk. pink	wk. pink	general absorption 500–580
Reddish orange	mod. pink orange	wk. to mod. pink orange	470–550 band
Orangy yellow	wk. yellow	mod. to str. orangy yellow	diffuse band at 500–530 580 band, 610 band
Light blue	wk. blue	v. wk. blue	545, 580, 630 bands
Blue	v. wk. blue	v. wk. blue	540, 580, 630 bands
Grayish blue	inert	inert	470 cutoff, 515 band, 550–650 band
Gray	v. wk. greenish yellow	wk. greenish yellow	420–430 band, 445–460 band, 545, 580, 630 bands
Dark gray	wk. greenish yellow	v. wk. green-yellow	470 cutoff, 545, 580, 630 bands
Dark brown	mod. orange	mod. orange	470 cutoff, 490–590 band, 635 band
Black	inert	v. wk. orange	440 cutoff, wk. 470 band, 530–550 band, 590–620 band

[a] *v. = very, wk. = weak, mod. = moderate, str. = strong*

tometer (greater than 1.81); ultraviolet fluorescence—none (inert to both long- and short-wave UV radiation); absorption spectrum—no features noted with a desk-model spectroscope; reaction to magnet—none (not attracted). Specific gravities ranged between 8.66 and 8.77. Mohs hardness, determined on just one sample, was about 5½. When examined in reflected polarized light, the specimens appeared isotropic, with no obvious pleochroism.

Figure 15. A scanning electron microscope reveals the structure of the polymer-impregnated synthetic opal: layers of 100-nm spheres. The dark stripes are artifacts due to charge build-up on the surface of the stone. Magnified 10,000×; photomicrograph by Mary L. Johnson.

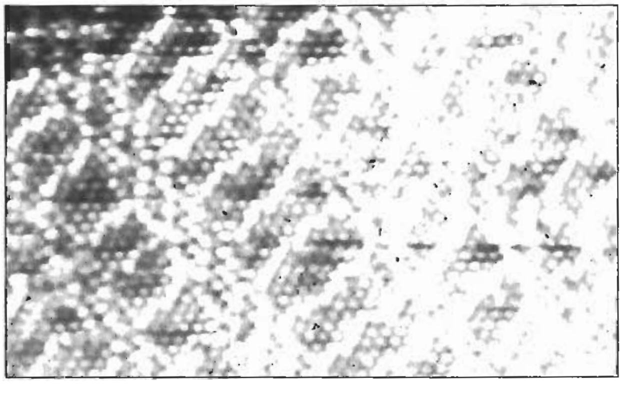


Figure 16. "Platigem," a platinum-aluminum-copper intermetallic compound, comes in a subtle range of colors. These stones weigh, from left, 12.63, 10.52, and 11.63 ct. Photo by Maha DeMaggio.

Several "Platigem" compounds are used to produce these interesting gems. They are made from the brassy yellow intermetallic compound $PtAl_2$, mixed with 5 wt.% to 25% wt.% copper (which provides an orange-to-"copper" pink color). Information about these compounds appeared in the *Journal of Materials Science* (J. Hurley and P. T. Wedepohl, "Optical Properties of Coloured Platinum Intermetallic Compounds," Vol. 28, 1993, pp. 5648–5653). $PtAl_2$ has the same crystal structure as fluorite, and the composition can be approximately determined from the unit-cell spacing, according to the authors. To further understand our samples, we took an X-ray powder diffraction pattern of one brownish pink stone. Except for four faint lines, the diffraction pattern could be matched with that of a cubic compound with a unit-cell edge of 5.958 Å (595.8 pm), which implies about 21% copper in this particular compound. Note that this pattern does not at first resemble that of fluorite, since some lines that are faint in the fluorite pattern are prominent in the "Platigem" diffraction pattern.

"Platigem" is a trademarked name, and the intermetallic compounds themselves have been patented. Mintek also developed an 18k gold alloy, "Spangold," which exhibits an interesting surface effect as a result of phase transformations.

INSTRUMENTATION

New gemological spectrometer at Tucson. Martin Bell, of River Gems, Albuquerque, New Mexico, and John Allaman, of Sarasota Instruments, Osprey, Florida, showed some of the capabilities of a prototype gemological spectrometer at the Tucson show. The goal of this instrument is to improve on the hand-held spectroscope, which many jewelers find difficult to use.

A gem to be tested is placed in an integrating sphere and illuminated with a flash lamp. The light transmitted by the stone is directed through an optical fiber to a diffraction grating, which disperses the light on a diode-array detector. The resulting spectrum is displayed on the screen of an attached laptop computer. Currently, the resolution is about 3 nm. The developers hope to have the instrument ready to sell in 1995, for less than US$10,000.