GIA GEM TRADE
LAB NOTES

**Editors**
Thomas Moses ◆ Ilene Reinitz
Shane F. McClure
*GIA Gem Trade Laboratory*

**Contributing Editors**
*GIA Gem Trade Laboratory, East Coast*
G. Robert Crowningshield
*GIA Gem Trade Laboratory, West Coast*
Karin Hurwit ◆ Mary L. Johnson
Cheryl Y. Wentzell

## DIAMOND

### Cabochon Cut

Black opaque materials, usually fashioned as cabochons or beads, are submitted regularly to the Gem Trade Laboratory for identification; many require advanced testing (see, e.g., M. L. Johnson et al., "Some Gemological Challenges in Identifying Black Opaque Gem Materials," *Gems & Gemology*, Winter 1996, pp. 252–261). Nevertheless, the identity of the two black cabochons shown in figure 1 came as quite a surprise to us.

The refractive index was over the limits of a standard refractometer, and the specific gravity, measured by the hydrostatic method, was 3.44. With magnification, the cabochons showed a poor polish and an aggregate structure, with several transparent-to-translucent, near-colorless areas seen on the base of each piece (figure 2). The near-colorless areas showed weak yellow fluorescence to long-wave ultraviolet radiation, but the rest of each cabochon was inert. These properties suggested that the material was diamond, so we performed a hardness test on an inconspicuous portion of the basal edge of each piece, by rubbing it against a faceted piece of synthetic corundum and observing the result at 10∞ magnification. Together, the high degree of friction between the two materials, plus the scratch produced on the synthetic corundum, indicated a hardness of 10—and confirmed the identification of these cabochons as diamond.

*Figure 1. Unlike most black opaque materials, these cabochons (3.55 and 3.56 ct, approximately 9.26 mm in diameter and 4.56 mm in depth) did not require advanced testing for identification because standard gemological tests proved them to be diamond.*

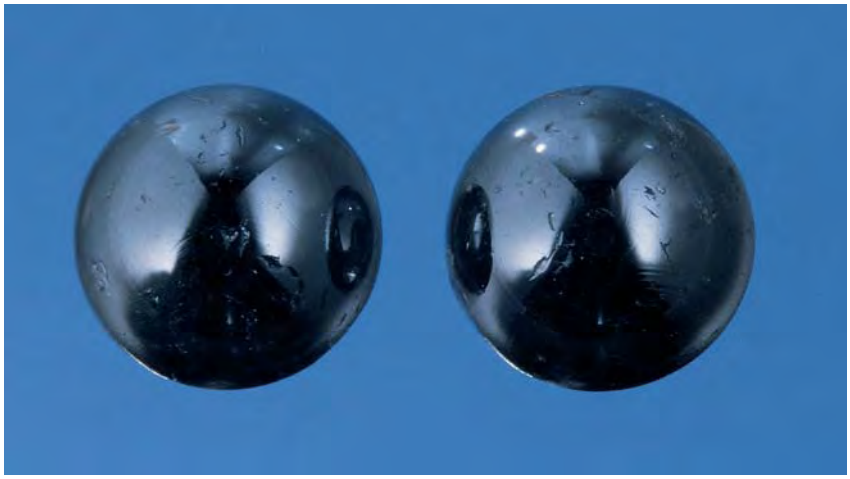


*Figure 2. Fiber-optic illumination revealed the aggregate nature of the cabochons shown in figure 1, as seen here through the base of one of them. Magnified 15×.*

We have reported on many unusual diamond cuts in this section, but these are the first diamonds we have seen fashioned as cabochons. We noted that the transparent areas on the bottoms of the two pieces were similar in size, shape, and placement. When we asked our client (who actually cut these gemstones) about this, he told us that the rough material had been shaped first into a bead, then sawed in half to make the two cabochons.

*IR*

*Editor's note: The initials at the end of each item identify the editor(s) or contributing editor(s) who provided that item.*

Gems & Gemology, *Vol. 33, No. 3, pp. 212–218*

*Figure 3. This 5.54 ct Fancy Vivid orange diamond is rare for its intensity of color. Diamonds in the orange hue range are typically darker, less saturated, and often modified by brown.*

**Rare Fancy Vivid Orange**

In the Fall 1996 issue (pp. 206–207), we reported on a diamond of rare color: a 3.40 ct heart shape that was graded Fancy Intense pinkish orange. At that time, we noted the unusual hue as well as an exceptionally strong saturation. A 5.54 ct cushion-shaped diamond (figure 3), which was recently submitted to the East Coast lab, shared certain gemological properties with that heart shape and gave us an opportunity to expand our reporting of rare colors.

The current stone was more saturated and more of a "pure" orange than the previously described heart shape; it received a color grade of Fancy Vivid orange. While we encounter diamonds in the orange hue range from time to time, we seldom encounter one that we can describe simply as "orange," with no modifiers. The intensity of the stone's color also adds to its rarity. In the system used by the GIA Gem Trade Laboratory to describe colored diamonds, the Fancy Vivid grade represents those light- to medium-toned diamonds of the strongest saturation range (if the stone was darker in tone, the description would be Fancy Deep).

The rough was reported to be of South African origin and to have appeared predominantly brown, with only a hint of orange. Like the Fancy Intense pinkish orange diamond described earlier, this stone also proved to be a type IIa diamond (as determined by infrared spectroscopy). The diamond fluoresced moderate yellow to long-wave UV radiation and moderate orange to short-wave UV.

*John King and TM*

**With Surface Droplets of Filling Material**

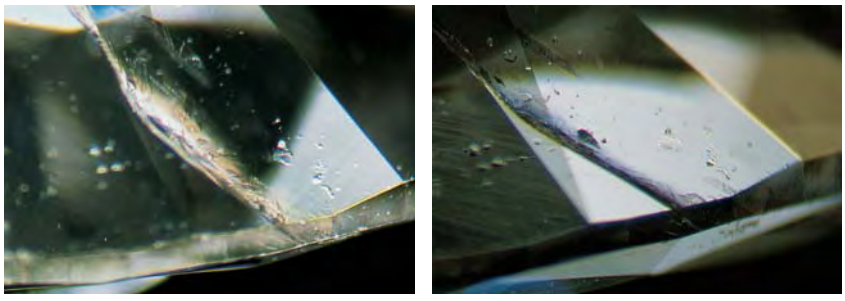
The most prominent visual feature of most fracture-filled diamonds—the brightfield and darkfield flash-effect colors—should be familiar to *G&G* readers (see, e.g., R. C. Kammerling et al., "An Update on Filled Diamonds: Identification and Durability," *Gems & Gemology*, Fall 1994, pp. 142–177; and S. F. McClure and R. C. Kammerling, "A Visual Guide to the Identification of Filled Diamonds," *Gems & Gemology*, Summer 1995, pp. 114–119 plus chart). In recent months, however, staff members in both the East and West Coast laboratories have seen fracture-filled diamonds in which these flash-effect colors were less pronounced. Examples from the East Coast lab were shown in the Spring 1997 Lab Notes section (pp. 56–57). More recently, the West Coast lab examined a fracture-filled near-colorless marquise brilliant (0.49 ct) that had extremely subtle flash colors—and surface features that provide a plausible explanation for this subdued appearance.

With magnification, one surface-reaching "feather" in the stone showed low relief over most of its extent, with extremely subtle yellow and purple flash colors (figure 4). However, a portion of this fracture near the surface of the stone had very high relief, with no evidence of filling material. Transparent droplets were visible on the surface of the diamond near this apparently "unfilled" portion of the feather (figure 5). The use of energy-dispersive X-ray fluorescence (EDXRF) spectroscopy confirmed the presence of lead (Pb) in this stone, which we have found in all effective diamond-filling materials that we have tested to date. In fact, we would not expect EDXRF to detect Pb in a gem diamond of this appearance unless some sort of filler was present.

In the Fall 1994 article by Kammerling et al. (cited above), we reported that heating a fracture-filled diamond could cause the flash-effect colors to be more subdued. The features we observed in this stone might well have been created if the diamond had been heated with a torch after it was filled. Although the filling material deep within the fracture probably was damaged by heating, the filling material nearer the surface of the stone had actually boiled out and then condensed as small droplets.

*MLJ and SFM*

*Figure 4. The yellow darkfield (left) and purple brightfield (right) flash-effect colors in this fracture-filled 0.49 ct marquise brilliant are very subtle, as is typically seen in a filled diamond that has been subjected to heat. Magnified 30×.*



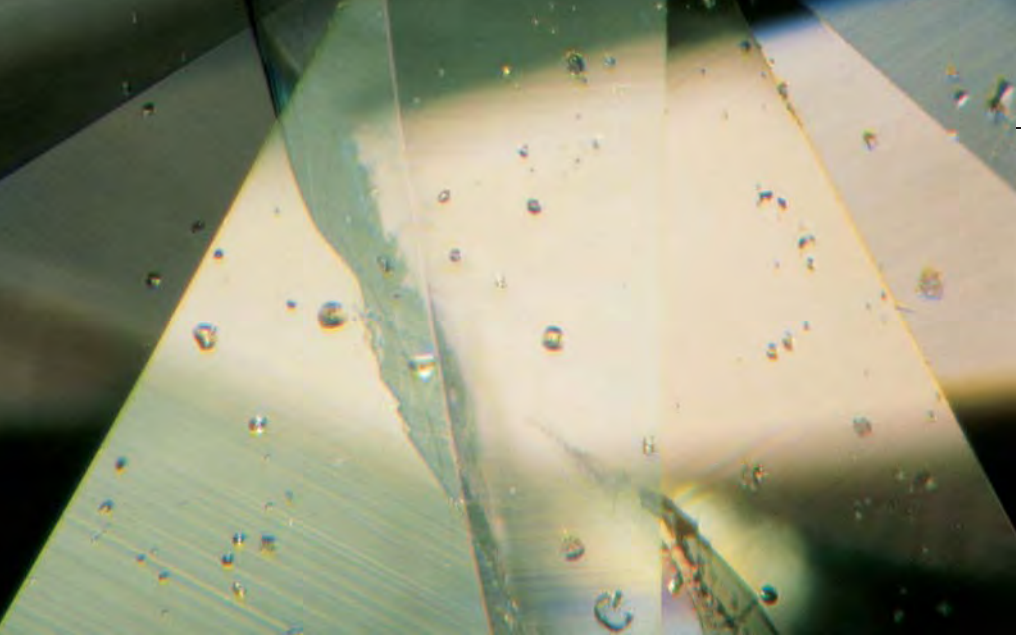


*Figure 5. Small droplets on the surface of the filled diamond in figure 4 are probably condensed filler material that boiled out of the filled fracture when the stone was heated. Magnified 40×.*

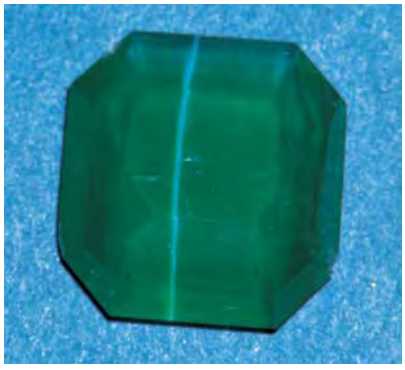
### A Faceted Cat's-Eye EMERALD

Most chatoyant stones are fashioned as cabochons. In general, the cat's-eye phenomenon is due to the presence of parallel bands of included materials (or hollow tubes) in a stone that has been shaped so that light is concentrated along a line perpendicular to these parallel bands. In the rare cases where a potentially chatoyant stone has been fashioned as something other than a cabochon, or with the long axis of the cabochon oriented parallel to the inclusions, the result may be an overall sheen, but it is usually not a sharp "eye."

In summer 1997, a 3.19 ct semitransparent green stone was submitted to the West Coast lab for identification. Although faceted, the stone showed an obvious and sharp "eye" (figure 6). The gemological properties of this emerald-cut stone were consistent with emerald, including: R.I.'s of 1.570–1.578, an S.G. of 2.68 (measured with a DiaMension noncontact measurement system, manufactured by Sarin Technologies Ltd.), and typical "chrome lines" seen with a desk-model spectroscope. It was inert to both long- and short-wave UV radiation. With magnification, we could see small, dark, opaque crystals—probably chromite—as well as fractures and curved bands of parallel white fibrous inclusions resembling the "silk" commonly seen in rubies and sapphires. These inclusions confirmed the identification of the stone as a natural emerald, and no evidence of clarity enhancement was present.

The observations through the microscope also made it clear that the orientation of the white fibers was responsible for the chatoyancy. The curvature of the "silk" itself—not of the stone's surface—and the orientation of the curve to the table of the stone concentrated the light into a sharp "eye." Although cat's-eye emeralds are known from both Colombia (see Winter 1996 Gem News, pp. 284–285) and Brazil (see, e.g., Gem News: Spring 1992, p. 60; Spring 1995, pp. 60–61; and Fall 1995, p. 206), this is the first faceted cat's-eye emerald we have seen.

*Figure 6. This 3.19 ct (11.05 × 10.73 × 3.69 mm) faceted emerald shows a sharp "eye."*



*MLJ, Dino DeGhionno, and Philip Owens*

### JADEITE JADE

#### Impregnated, with Exceptional Transparency

Polymer impregnation in jadeite jade is an identification challenge frequently encountered at the GIA Gem Trade Laboratory. While we rely on infrared spectroscopy for conclusive evidence of impregnation, standard gemological testing can reveal features suggestive of this treatment. These features have been documented in the article "Identification of Bleached and Polymer-Impregnated Jadeite" (Fritsch et al., *Gems & Gemology*, Fall 1992, pp. 176–187) and in a number of Lab Notes (e.g., Spring 1995, p. 55).

An 8.25 ct variegated green-and-white carving was submitted to the East Coast laboratory for identification. Standard gemological testing revealed properties typical of jadeite jade, particularly a refractive index of 1.66 by the spot method, and the presence of chromium lines in the spectroscope (which also indicates natural green color). The bulk of the carving was inert to both long- and short-wave UV.

Usually, a distinctive surface texture is the first indication of impregnation; in this case, however, it was the unusual internal structure that initially raised our suspicions. The carving had near-colorless areas of exceptional transparency surrounding isolated green grains of jadeite (figure 7). Although untreated jadeite is often variegated green-and-white, it is quite rare to see the "white" areas with this degree of transparency (see, however, Gem Trade Lab Notes, Summer 1995, pp. 123–124). When we examined the piece further, we discovered residual polymer, most noticeably in a drilled hole (figure 8), but also in depressed areas of the carving. These areas fluoresced strong yellow to long-wave UV

*Figure 7. The "white" areas in this polymer-impregnated green-and-white jadeite jade carving were extremely transparent. Magnified 20×.*

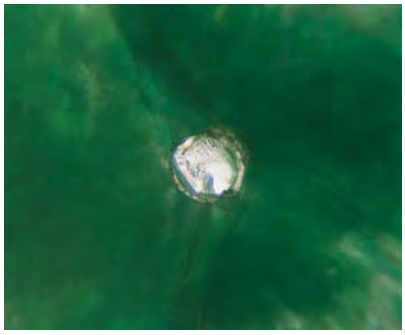


*Figure 8. Excess polymer is visible in this hole drilled in the carving shown in figure 7. Magnified 20×.*

radiation, while the rest of the piece remained dark. Visible outlines of grain boundaries in both the white and green areas further supported our suspicion that the piece had been impregnated; this was subsequently confirmed by infrared spectroscopy.

The infrared spectrum revealed yet another unusual feature in this thin (and apparently very heavily impregnated) carving: The polymer peaks were so strong that the typical jadeite spectrum was dwarfed in comparison, and the absorption peaks typical of jadeite were not recognizable until the spectrum was greatly magnified. *Elizabeth Doyle*

**Resembling Nephrite Jade**

One of the unavoidable temptations for any gemologist is the "Sight ID": the identification of a stone without the use of a refractometer, a spectroscope, a microscope, or any other instrument. In many cases, the materials to be identified are indeed what we suspected them to be, which raises the risk of increasing our hubris to unacceptable levels; then another, more challenging sample arrives to restore necessary humility.

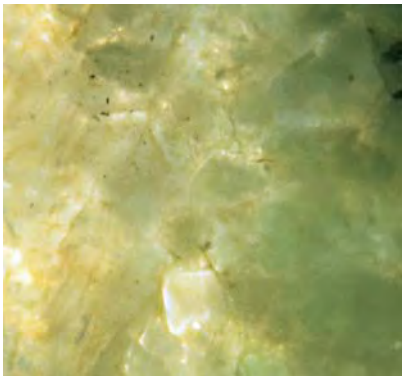
In spring 1997, the West Coast laboratory examined a sample that illustrates the hazards of attempting instrument-free identifications. The pierced and carved lid (to an urn that was not submitted) measured 97.8 × 97.7 ∞ 49 mm. The carving was translucent, with a glassy luster and a mottled brownish green color. Perhaps a better descriptive term than "mottled" for the distribution of color might be "cloudy" (nebulous), since the color patches appeared to have diffuse margins, and there were no strongly saturated areas. At this point, the practitioner of the "Sight ID" technique would have proclaimed it to be nephrite on the basis of its luster, diaphaneity, and desaturated color.

Gemological properties immediately confounded this expectation: We obtained an R.I. of 1.66; observed a line at 437 mm (characteristic of jadeite) and chrome lines with the spectroscope; and resolved an aggregate optic character with the polariscope—as expected for jadeite, nephrite, and many other aggregates and rocks. The piece was inert to both long- and short-wave UV radiation; it was too large for us to obtain specific-gravity measurements.

With magnification, we observed features expected for jadeite, not nephrite, as well as the reason for the nephrite-like appearance. Jadeite jade and nephrite jade, both aggregate materials, owe their toughness to different microstructures: In jadeite, the material consists of intergrown blocky jadeite crystals with interfingering margins; whereas nephrite is a felted (compressed and intertwined) aggregate of actinolite-to-tremolite amphibole fibers. This lid was carved from material consisting of rather large (millimeter-size) jadeite grains with translucent-to-semitranslucent green cores and near-colorless transparent margins (figure 9); such cloudy-cored "phantom" jadeite crystals were new to our experience. The appearance of the overall piece was due in part to the green cores, as well as to the thin, iron-stained fractures throughout it. As with all jadeite jades, we checked this piece for polymer impregnation using Fourier Transform infrared spectroscopy (FTIR); no absorptions indicative of impregnation were seen.

*MLJ*

*Figure 9. Jadeite "phantom" crystals, with translucent green cores and near-colorless rims, were seen with low magnification in this carved lid. The center crystal measures about 0.5 mm across.*



**Synthetic Green PERICLASE**

In the Spring 1996 Gem Trade Lab Notes (pp. 48–49), we reported on a 5.49 ct colorless periclase that might have been confused with grossular garnet. At the end of that entry, we noted that green synthetic periclase, as reported in the literature, might cause even more concern because of its resemblance to green garnet.

As fate would have it, the West Coast laboratory was recently asked to identify the 115.32 ct transparent yellowish green piece of rough shown in figure 10, which had been represented as a natural periclase from

*Figure 10. The shape of this 115.32 ct piece of rough synthetic periclase was dictated by well-developed cubic cleavage.*

Ghana. Gemological properties were: R.I.—1.736; S.G.—3.59; optic character—singly refractive with weak anomalous double refraction; no fluorescence (inert) to either long- or short-wave UV radiation; and no absorption features seen with the handheld spectroscope. When a strong parallel beam of light was directed into the piece from a fiber-optic light source, we saw strong red transmission. With magnification, we noted numerous blocky crystals in addition to well-developed cleavage along cube planes. This cleavage actually dictated the shape of the rough (and proved that the piece could not be grossular garnet, since garnets do not show cleavage in any direction). Chemical analysis by EDXRF spectroscopy showed a high magnesium content, with small amounts of chromium, calcium, and iron; this confirmed the identity of the material as periclase (pure periclase is magnesium oxide, MgO).

Periclase has not been reported as occurring in nature in anything close to this size as facetable single-crystal material. In fact, we could not find any reference to a known natural faceted periclase of any size (we could not conclusively identify the emerald-cut stone described in the Spring 1996 issue as natural or synthetic)—or to natural periclase colored green by chromium. However, large transparent pieces of synthetic periclase have been reported as by-products of the manufacture of refractory magnesia by a company in Australia (see G. Browne, "Australian Synthetic Periclase," *Australian Gemmologist*, November 1993, pp. 265–269). This process uses magnesite nodules—magnesium carbonate—from the Kunwarara deposit near Rockhampton, Queensland, which are crushed and heated to produce calcined magnesia. This material can then be electrofused to form ingots of fused synthetic periclase. These ingots have a 2-m-diameter central core of cryptocrystalline synthetic periclase, which is surrounded by two rims of differing structure. The inner rim, where the gem-quality crystals form, is approximately 10 cm wide. One of the habits of these crystals, as described by Browne, is "pseudocubic masses bounded by cleavage planes," which exactly describes the rough we examined.

The process for producing synthetic periclase differs greatly from all other known growth processes for synthetic gems, and the internal characteristics generated by electrofusion are not well documented. Square, plate-like negative crystals were observed in some samples of known synthetic periclase seen in the Gem Trade Laboratory in 1969, a material marketed under the name Lavernite ("Developments and Highlights at the Gem Trade Lab in Los Angeles," *Gems & Gemology*, Spring 1969, p. 22.) However, since natural periclase is so rarely found in gem-quality crystals of any size, the inclusions we observed could not assist in identifying this piece as natural or synthetic. In this instance, we reasoned that since the size and color of this specimen were so far removed from any periclase that has been found in nature, this item must be synthetic. As discussed in the earlier entry, we have not found definitive criteria to establish whether a smaller faceted piece of such material would be natural or synthetic.

*Maha DeMaggio and SFM*

*Editor's note*: An 18.98 ct yellowish green pear-shaped brilliant, examined in the East Coast lab at press time, also turned out to be synthetic periclase. It had the same R.I., S.G., and chemical constituents described above; was inert to long-wave UV, but fluoresced an extremely weak orangy yellow to short-wave UV radiation; and showed weak red transmission to the fiber-optic light. With magnification, we saw a pinpoint cloud and a small round bubble. *IR*

## QUARTZ

### Quench-Crackled and Dyed to Imitate Amethyst

Last winter, a client called the East Coast lab to ask us about an alleged new treatment that uses lasers to induce a purple color in rock crystal. The client stated that this treated material had been offered for a price even lower than that of synthetic amethyst. Although we were aware that radiation might be able to intensify the purple color in amethyst (G. R. Rossman, "Color in Gems: The New Technologies," *Gems & Gemology*, Summer 1981, pp. 60–71), we did not know of any mechanism whereby a laser could induce purple color in near-colorless quartz. At our request, then, the client sent us two beads for examination (figure 11).

The beads were light to medium purple, but even to the unaided eye the color looked uneven. With magnification, we observed that the material was fractured throughout, with the purple color concentrated in these fractures (figure 12). Small flat surfaces on the beads allowed us to measure the refractive indices at 1.54 and 1.55, indicating quartz. When the

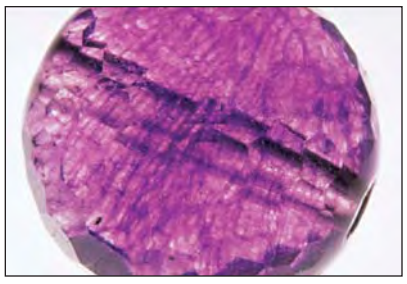
*Figure 11. These purple beads, each about 10 mm in diameter, were offered as amethyst. They are actually colorless quartz that has been quench-crackled and dyed purple.*

beads were exposed to both long- and short-wave UV radiation, the fractures fluoresced a weak to medium orange, whereas the solid areas of the material were inert. The mid-infrared spectrum showed several overlapping peaks between 3000 and 4000 $cm^{-1}$, which are seen in all varieties of quartz, plus additional structure around 2900 $cm^{-1}$, which is similar to the absorptions seen in polymer-impregnated materials. These properties led us to the conclusion that the beads had been quench-crackled and dyed. The pervasive cracks effectively hid any other internal features, so we could not determine whether the starting material was natural or synthetic quartz.

Over the years, we have reported on quench-crackled quartz in both green and red, imitating emerald and ruby (see, for example, Winter 1981 Lab Notes, pp. 229–230, and Gem News: Winter 1989, p. 247, and Fall 1992, pp. 205–206). However, this is the first time we have seen quartz dyed purple to simulate amethyst.

*IR*

*Figure 12. Magnification readily revealed the extensive network of fractures and the concentration of purple color in the fractures of the beads shown in figure 11. Magnified 10×.*



## TOPAZ

### Fashioned to Imitate Diamond Rough

In the hands of a clever lapidary, almost any near-colorless rough material can be fashioned into an object resembling a diamond crystal. We have reported on a number of cubic zirconia imitations of diamond rough (see Lab Notes, Winter 1988, pp. 241–242, and Fall 1996, p. 205; and Gem News, Spring 1994, p. 47). The high refractive index of cubic zirconia results in a good-looking imitation, but such pieces feel suspicious in the hand because of their high specific gravity. Recently we reported on an imitation made from topaz (Lab Notes, Spring 1997, p. 57). With a specific-gravity range that includes the value for diamond, such an imitation has the appropriate heft, but the lower refractive index gives a suspect appearance.

In late spring 1997, the East Coast lab received two specimens for identification, both of which appeared to be diamond rough in the form of distorted octahedra with characteristic dodecahedral grooves. The larger (63.65 ct) "crystal" was near-colorless, while the smaller (26.88 ct) stone had numerous dark inclusions and an uneven light blue color (see figure 13). The stones did not have an adamantine luster, but they did show a greasy-looking patina similar to that sometimes seen in waterworn diamond crystals. Although the specific gravities, measured hydrostatically, were 3.55 and 3.54, respectively, none of the other properties was consistent with those of diamond.

In fact, the optical and physical properties revealed that the true identity of these two specimens was topaz. Both were doubly refractive, and we found a biaxial optic figure in the larger piece. Although the roughened surfaces were not ideal for R.I. measurement, we obtained values of 1.60 and 1.61 by the spot method. Both pieces showed weak yellow fluorescence to long-wave UV radiation and no reaction to short-wave UV. Hardness tests on discreet areas of each piece of rough showed them to

*Figure 13. These two "crystals," fashioned to look like diamond rough, were identified as topaz. They weighed 63.65 and 28.88 ct.*

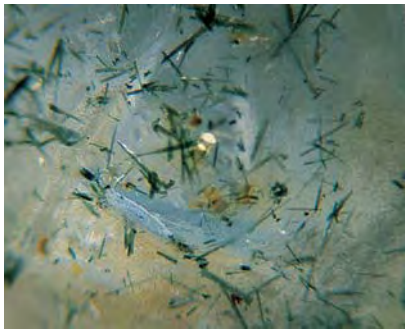


*Figure 14. The many long, narrow inclusions in this topaz are tourmaline and chlorite crystals. They give an overall blue color to the otherwise near-colorless topaz host. Magnified 15×.*

*Figure 15. The shape, orientation, and raised relief of the "trigons" on this fashioned topaz do not reproduce the appearance of actual trigons on diamond crystals. Magnified 5×.*

be between 7 and 9 on the Mohs scale. Neither piece showed any features in the hand spectroscope.

Using magnification, we identified the dark inclusions in the smaller piece by their crystal habit and blue, gray, and green colors as tourmaline and chlorite (figure 14), which are not known to occur in diamond. When this same stone was examined with diffused light, it was apparent that most areas were near-colorless and the overall blue color was caused by the inclusions. The trigons on both pieces also showed a number of characteristics that are not seen in diamond: They were raised above the surface rather than depressed into it, were different in shape from the faces on which they occurred, and (as shown in figure 15) were not inverted (as described for natural diamond in Y. L. Orlov, *The Mineralogy of the Diamond*, John Wiley and Sons, New York, 1973, especially pp. 72–106). In reflected light, we saw weak polishing lines on some areas of the 26.88 ct piece, which proved that these surfaces were not naturally occurring.

It is evident that a great deal of lapidary artistry was used to manufacture these specimens. They serve to remind us that a gemologist must never be swayed by the "obvious" appearance of an unknown specimen before reaching a conclusion.

*GRC and IR*

*PHOTO CREDITS*

*Nicholas DelRe supplied the pictures used in figures 1, 2, 7, 8, and 11–15. Shane McClure provided figures 4 and 5. Maha DeMaggio supplied the photos used in figures 6, 9, and 10; and the picture used in figure 3 is courtesy of Sotheby's.*