

DIAMOND

Two Noteworthy Stones from the Americas

The October 11, 1996, *Rapaport Diamond Report* included an article on the purchase of a 28.3 ct rough diamond, recently recovered from the Kelsey Lake mine in Colorado (see also Winter 1996 Gem News, pp. 282–283). The highly etched brownish yellow crystal yielded a 5.39 ct pear-shaped brilliant (figure 1). A rather deep, etched feather was seen in the pavilion

of the finished stone (figure 2). Although this stone was submitted to the laboratory for an Identification and Origin of Color Report only, we would have graded the clarity in the SI range; the color was graded as Fancy Deep Brownish Yellow.

Fluorescence to long-wave ultraviolet radiation was strong in intensity and predominantly blue with small zones of strong yellow. The diamond fluoresced a weaker yellow to shortwave UV. The absorption spectrum, seen at low temperature using



Figure 2. An etched feather can be seen in the pavilion of the Kelsey Lake diamond shown in figure 1. Magnified 57×.

Figure 1. This 5.39 ct Fancy Deep Brownish Yellow diamond was cut from a 28.3 ct piece of rough recovered from the Kelsey Lake mine in Colorado.



a desk-model spectroscope, showed a strong "Cape series" and weak sharp bands at about 545 and 563 nm. These properties are consistent with hydrogen-rich diamonds (see E. Fritsch and K. Scarratt, *Journal of Gemmology*, "Gemmological Properties of Type Ia Diamonds with an Unusually High Hydrogen Content," Vol. 23, No. 8, 1993, pp. 451–60). Although the distinctive properties of this class of diamond were observed decades ago, hydrogen's role in causing the color was only recognized in the last five years. These hydrogen-rich diamonds have also occurred in other recently

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developed sources, such as in Australia, Russia, and the Jwaneng mine in Botswana.

Only a few days after we saw the Kelsey Lake stone, a long-time GTL client submitted a 2.15 ct old-minecut diamond (figure 3) that was reportedly from Brazil. Graded Fancy Intense Greenish Yellow, this stone revealed gemological properties common to stones with strong "green transmission" luminescence. The H3 optical center that is associated with this effect gives rise to absorption bands at about 494 and 503 nm. Diamonds with this optical center not only routinely fluoresce strongly to UV radiation, but they also are excited by visible light—often appearing quite green when exposed to a strong incandescent light source (figure 4). This strong luminescence may influence the color grade of such diamonds, as it did with this one. In our experience, some diamonds with these properties do originate from Brazil and Venezuela, thus lending support to this stone's reported provenance (see also J. F. Cottrant and G. Calas, "Étude de la coloration de quelques diamants du Muséum National d'Histoire Naturelle," *Revue de Gemmologie*, No. 67, 1981, pp. 2–8).

According to our client, the stone was reportedly given by Pedro II (emperor of Brazil from 1831 to 1889) to his niece. A member of the Braganza royal family,

Figure 5. Many chips can be seen on the girdle of this 2.66 ct round-brilliant-cut diamond, which was originally set in a four-prong lady's ring.



Figure 3. This 2.15 ct old-minecut diamond was graded Fancy Intense Greenish Yellow.

which ruled Portugal from 1640 until 1910, Pedro II was purportedly greatly interested in diamonds and mineral specimens.

The submission of diamonds of known or well substantiated provenance provides the laboratory with the opportunity not only to document the properties of such stones, but also to help answer ongoing questions related to the origin of color in diamonds. TM

Damaged from Wear

When appropriate, GIA GTL diamond grading reports on round brilliants contain a comment that the average crown angles are less than 30° or exceed 35°. These comments are intended to alert the reader of the report that the crown angles deviate seriously from

Figure 6. Damage to the diamond in figure 5 is related to the combination of a thin girdle and shallow crown angles, as can be seen in this profile view.

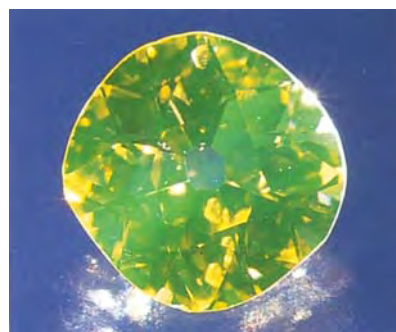


Figure 4. The green transmission luminescence in the diamond in figure 3 is best seen when the stone is excited with a strong incandescent light source, such as fiber-optic illumination.

industry norms and, in the case of shallow angles, warn of a threat to the stone's durability.

The East Coast lab recently issued a report on just such a stone—a 2.66 ct yellow diamond that had been removed from a four-prong ring setting. As can be seen in figure 5, the unusually thin girdle was chipped in many places. When the stone was viewed from the side (figure 6), the crown angles appeared to be very shallow. Just how shallow was seen when the stone was viewed in a GIA Proportion Scope (figure 7): The angles averaged less than 25°. In addition, the pavilion angle were less than

Figure 7. A GIA Proportion Scope revealed that the diamond in figures 5 and 6 had crown angles of about 25°.

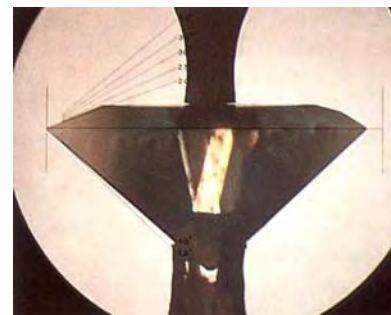




Figure 8. Only a muted pink flash color could be seen in this filled fracture in a 1.05 ct oval diamond. Magnified 30 $\times$.

41°. This combination of cutting faults usually leads to damage during normal wear. The potential for damage to such a stone can be minimized by choosing mountings, such as gypsy or bezel settings, that protect the girdle area.

GRC and TM

Identifying Filled Fractures: New Challenges

Over the last six months, the East Coast lab examined four diamonds with unusual-appearing fractures. These stones gave us an advanced lesson in distinguishing filled fractures from unusual-appearing fractures that are unfilled, a lesson that required checking for all the features summarized by McClure and Kammerling in "A Visual Guide to the Identification of Filled Diamonds" (Summer 1995 *Gems & Gemology*, pp.114–119, plus chart).

A 1.05 ct oval modified brilliant showed muted, subtle flash-effect colors (figure 8), similar to those observed in filled diamonds that had been heated (see Kammerling et al, "An Update on Filled Diamonds: Identification and Durability," Fall 1994 *Gems & Gemology*, pp. 142–177, especially figure 27). This prompted us to examine the fracture closely at higher magnification, which revealed a dendritic pattern typical of filled fractures, together with flow structure and cloudiness in the fracture plane (figure 9).

A contrasting unfilled example

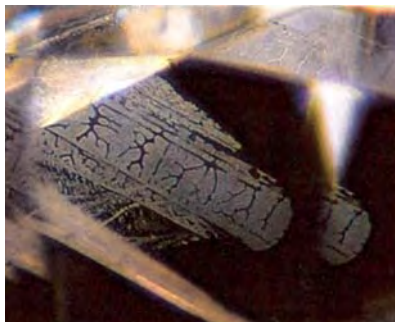


Figure 9. At higher (63 $\times$) magnification, the dendritic pattern of the flow structure and cloudiness of the fracture shown in figure 8 confirmed that it was filled.

was provided by a cleavage in a 1.23 ct round brilliant (figure 10). Although large in area, this break was nearly invisible from most angles. Higher magnification, with a variety of lighting techniques, revealed neither flash colors nor any internal structure—all of which indicated that the cleavage was not filled. An X-radiograph confirmed this conclusion. The entire stone, including the fracture, was transparent to X-rays, whereas fracture-filling material would have been opaque.

An unusual inclusion that

Figure 10. This large cleavage in a 1.23 ct round brilliant diamond stretches from the pavilion to the table. Although not filled, the cleavage was only visible from a few viewing angles. Magnified 15 $\times$.



proved to be fracture-filled was seen in the 1.01 ct round brilliant shown in figure 11. A laser drill hole led to a crystal inclusion centered in a large fracture. The walls of the drill hole showed a rough texture, as did the fracture at the point of drill-hole contact. At the point of contact, the surface of the fracture appeared burned. The rest of the fracture was smoother and showed flow structures. We observed flash colors only in the areas of the fracture that surrounded the crystal; these ranged from orange to pink and blue.

The complicated group of fractures in figure 12 illustrate the importance of viewing angle in identifying filled fractures. From most sides, this 1.48 ct marquise showed both the characteristic flash colors of filled fractures and the natural iridescence of unfilled fractures. The profile view of this diamond (figure 13) showed one unfilled fracture that displayed a whole rainbow of interference colors, and another fracture, nearly perpendicular to the first, with a blue flash color. This diamond illustrates the importance of not halting the examination of a stone before it is viewed from all sides, as not all fractures in a filled stone can or will absorb the filling. The

Figure 11. Flash colors and flow structure characteristic of fracture filling are visible in parts of this complex inclusion in a 1.01 ct round brilliant diamond. Magnified 45 $\times$.

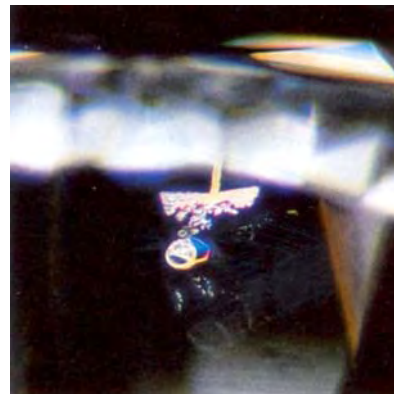




Figure 12. Some of the fractures in this 1.48 ct marquise are filled and others are unfilled.

many fractures and their reflections in this diamond made the presence of fracture filling unusually difficult to identify.

IR and Vincent Cracco

Imitation

From time to time, mineral specimens—loose crystals or pieces of rough—are submitted to GIA GTL for identification. Transparent-to-translucent, near-colorless specimens are usually submitted in the hope that they will turn out to be diamond. Sometimes these specimens have been doctored to resemble diamond crystals. Although occasionally minerals other than diamond are used for this purpose, the most common imitation diamond rough that we see is fashioned from cubic zirconia (see, for instance, Lab Notes, Winter 1988, pp. 241–242, and Fall 1996, p. 205; Gem News, Spring 1994, p. 47).

Standard gemological testing alone was sufficient to identify a specimen of near-colorless rough that was submitted to the East Coast lab last winter. The rough had triangular engravings, resembling trigons, on part of its surface (figure 14). The specific gravity was also approximately that of diamond—and very different from that of CZ. However, one flat



Figure 13. In profile, the stone in figure 12 can be seen to contain naturally iridescent unfilled fractures (to the right of the tweezer) as well as a blue flash effect (visible throughout the region to the left) from reflections of filled fractures. Magnified 20×.

(cleaved or polished) surface gave refractive indices of about 1.61–1.63. The fact that the material was doubly refractive meant that it clearly could not be either diamond or CZ. With magnification, we observed fluid inclusions, which also typically are not encountered in diamond.

This combination of properties identified the rough as topaz. The markings were probably added to

Figure 14. Trigons were engraved on this 17.56 ct colorless topaz rough to make it look like a diamond.



simulate "trigons," to better convince the unwitting buyer that this was a diamond. Although the term is a misnomer and rarely used today, colorless topaz was once called "slave's diamond" because of its resemblance to diamond (see M. Bauer, *Precious Stones*, Charles E. Tuttle & Co., Rutland, Vermont, 1969, p. 330).

Nicholas DelRe

HORNBILL "IVORY"

An elaborate yellow metal brooch (figure 15) was sent to our East Coast lab for identification of its large center carving. Accented by two large pearls, this semi-translucent red and yellow portrait of Buddha measured about 70 × 47 × 12.5 mm.

Only very limited gemological tests could be performed because of the mounting. However, we did get a vague spot refractive index reading, in the low 1.50s, from a small, fairly well-polished area on one side. The carving fluoresced a faint bluish white to short-wave ultraviolet radiation, which is similar to the response of some dentine ivories as well as of hornbill "ivory," a nondentine material that is among the rarest of gem materials.

Observation with a microscope at about 10× magnification revealed numerous thin, parallel fibers in the yellow part of the carving, with a few small dark-pigmented granules scattered throughout. These structural characteristics are typical of an organic material such as ivory. The thin layer around the main carving was uniformly red, with no internal features apparent. The transition from the red to yellow areas was gradual, with no obvious demarcation separating the different colors. These characteristics proved that the carving was a single piece and not assembled. We concluded from these properties, especially the distinctive red and yellow coloring and the structure seen with magnification, that this carving was fashioned from hornbill "ivory."



Figure 15. This portrait of Buddha is carved from rare hornbill "ivory."

Hornbill "ivory" is obtained from the casque (the large protuberance covering a portion of the head and bill) of the helmeted hornbill, an exotic bird (*Rhinoplax vigil*) native to southeast Asia and Borneo. (Because this material is not fashioned from teeth or tooth modifications, such as tusks, it is not considered a true

ivory.) Comprehensive articles have appeared in *Gems & Gemology* (A. S. Munsuri, "Hornbill Ho-Ting," Fall 1973, pp. 208-211; R. E. Kane, "Hornbill Ivory," Summer 1981, pp. 96-97) and in the *Journal of Gemmology* (G. Brown and A. J. Moule, "Hornbill Ivory," January 1982, pp. 8-19). The distinctive bright red border of the yellow helmet makes this material easy to identify despite its rarity. *KH*

Editor's Note: The helmeted hornbill has been declared endangered throughout the region where it lives. Commerce in recent hornbill "ivory" is now illegal in most countries, including the United States. However, hornbill-"ivory" pieces 100 years old or older may be legal to own and import, provided they have not been repaired recently.

MOGUL TALISMANS

An interesting set of three large baroque beads, which reportedly once belonged to the Mogul emperor or Akbar Shah (1542-1605), were

submitted to the East Coast laboratory for testing. The set (figure 16) consisted of a natural pink spinel, a natural blue sapphire, and an aquamarine. Standard gemological testing readily identified the materials from which each bead was fashioned.

The spinel's gemological properties were within normal published values. Mineral inclusions established that the stone was natural. It fluoresced strong red to long-wave UV radiation and moderate red to short-wave UV. As expected from the fluorescence, the stone showed several sharp "organ pipe" lines beyond 650 nm in the red end of the spectrum, which are due to the presence of chromium. The sapphire fluoresced weak red to long-wave UV. It had a moderately strong 450 nm line with weak "chrome lines" in its absorption spectrum. Long, fine needles, pristine crystals, and fluid-filled "fingerprint" inclusions were visible with magnification, indicating that the stone had not been heat treated.

The aquamarine had a "spot" refractive index of 1.57 and a rather strong iron line at 427 nm. The most distinctive feature was its color. Before the now-common

Figure 16. A set of beads, which reportedly once belonged to a Mogul emperor, consists of a 114.38 ct spinel, a 106.57 ct sapphire, and an 87.72 ct aquamarine



Figure 17. The spinel bead in figure 16 is inscribed with the names "Akbar Shah" and "Jehangir," as well as with the (Moslem calendar) date "971."





Figure 18. This 4.86 ct cat's-eye opal cabochon was cut from a band similar to those in the accompanying 8.59 ct piece of rough



Figure 19. Chatoyancy in this 2.92 ct quartz cabochon is caused by reflection of light from the parallel array of coarse rutile needles.

practice of heat treating aquamarines to make them blue, the green color was actually considered more desirable (see, e.g., K. Nassau's *Gemstone Enhancement*, 1st ed., Butterworth, Oxford, England, 1984, p. 98). The aquamarine bead is this green color.

Because it is often difficult to validate historical information, we were unable to verify the age(s) of the beads. However, careful observation can sometimes provide indications of authenticity. The green color of the aquamarine bead is one such indication. In addition, all the beads had crude conical drill holes, which indicates that they were drilled with hand tools and not by machine. Further, the names Akbar Shah and Jehangir (his son), together with the date 971 (on the Moslem calendar, which is 1565 on the Gregorian calendar) are inscribed on the spinel (figure 17). These inscriptions are in keeping with a tradition of engraving gemstones with the names of rulers in India. An inscribed Mogul spinel from the time of Jehangir is in the collection of the Victoria & Albert Museum in London (Benjamin Zucker, pers. comm., 1996).

TM and GRC

OPAL, with True Chatoyancy

In 1983, a piece of greenish yellow banded rough—identified as opal—was donated to the GIA collection. Later that year, we were shown a 1.5 ct brownish orange chatoyant stone that was purportedly cut from

one of the bands of this type of material (see Spring 1983 Lab Notes, pp. 45–46). Although this cabochon was also identified as opal, it was very different in color from the rough specimen in our collection. The Fall 1990 Gem News section (pp. 232–233) reported on a 0.76 ct opal that had a sharp "eye" and showed an excellent "milk and honey" effect. Because such chatoyancy is relatively rare in opal, the laboratory was not able at that time to determine the reason for this phenomenon. (A different type of chatoyancy—and even asterism—is seen in opals with chatoyant play-of-color, including some stones from Jalisco, Mexico [see, e.g., Winter 1990 Gem News, p. 304], and especially Idaho.)

Earlier this year, staff members at the East Coast lab remembered the greenish banded rough while identifying a 4.86 ct cat's-eye opal. When this cabochon and the rough piece were examined side by side (figure 18), the similarity in color of the two specimens was evident; now it was easier to believe that the previous examples had been cut from similar rough. This material is unusual in that it shows chatoyancy caused by linear inclusions—that is, "true" chatoyancy. Such inclusions are uncommon in opal, which is primarily composed of small spheres of silica.

TM and GRC

QUARTZ, Cat's-eye Effect Caused by Large Rutile Needles

The cat's-eye phenomenon in gemstones is usually caused by either of two forms of fine parallel inclusions. One form involves hollow tubes, as in cat's-eye emeralds and tourmalines (see, for instance, Winter 1990 Gem News, pp. 306–307). The other involves needle-like inclusions, as in the cat's-eye apatite illustrated in the Fall 1995 Gem News (pp. 205–206). In many samples of cat's-eye and star quartz, the inclusions that cause this phenomenon are very fine rutile needles. This was not the case, however, with a 2.92 ct cabochon submitted to the West Coast laboratory in summer 1996: The rutile inclusions responsible for the cat's-eye effect were large and prominent (figure 19). In fact, had this stone not demonstrated chatoyancy, we would have simply called it rutilated quartz. However, because this stone fit the criteria for both cat's-eye quartz and rutilated quartz, our conclusion stated that it was cat's-eye rutilated quartz.

MLJ and SFM

PHOTO CREDITS

Nicholas DelRe supplied the pictures used in figures 1, 2, 14, 15, and 18. Figures 3, 4, and 19 were taken by Maha DeMaggio. The photos in figures 5–13 were taken by Vincent Cracco. Figures 16 and 17 are courtesy of Dr. Gary Hansen, St. Louis, Missouri.