Gem Trade LAB NOTES

EDITOR
C. W. Fryer
GIA, Santa Monica

CONTRIBUTING EDITORS
Robert Crowningshield
Gem Trade Laboratory, New York
Karin N. Hurwit
Gem Trade Laboratory, Los Angeles
Robert E. Kane
Gem Trade Laboratory, Los Angeles

Needle-like Inclusions in EPIDOTE

The Santa Monica laboratory recently examined a very dark green oval modified brilliant cut that weighed approximately 5 ct. The stone resembled deep green tourmaline in appearance, but the refractive index reading of 1.739–1.779 was much higher than that of tourmaline (1.624–1.644). It was strange that despite the high birefringence (0.040), no apparent doubling of facet junctions was visible with the microscope. However, we did notice numerous straight and some curved needle-like inclusions of unknown origin (figure 1). John Koivula, chief gemologist in GIA's Research Department and an inclusion expert, identified the needle-like inclusions as probably tremolite, an amphibole. The dichroscope revealed very distinct pleochroic colors, green and olive brown, in the stone. Because the overall color was so dark, we could not obtain an optic figure in the polariscope. Spectroscopic examination showed a quite characteristic absorption spectrum: a broad band centered at 455 nm, a faint line at 470 nm, and a cut-off area starting at 430 nm. This collection of data proved that the stone is epidote. *KH*

Figure 1. These straight and curved (out of focus) inclusions were determined to be tremolite needles in epidote. Magnified 63×.

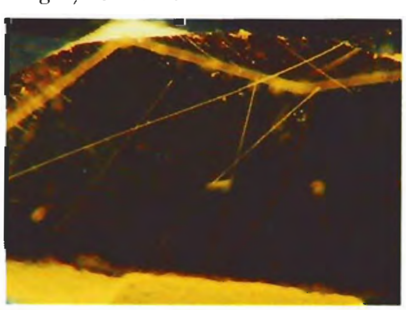


Figure 2. These 7-mm diameter, high-dome cabochons set in yellow metal earrings were found to be a new type of opal assemblage. Magnified 10×.

A New OPAL Assemblage

The New York laboratory recently received a striking pair of 7-mm-diameter, high-dome cabochon "opals" set in yellow metal cluster earrings (figure 2). Close examination with a loupe revealed that the "diamonds" are actually foil-backed glass. We then became suspicious of the center stones, and with, as we learned, good reason. The "opals" did not fluoresce, but cement at the base glowed orange. When we looked through the stones as in figure 3, the "opal" appeared to be contained within a capsule. Out of the setting, the assemblage became very obvious. As evident in figure 4, the "opals" are composed of a glass "cup" filled with opal chips in clear cement. The relatively thick-walled glass container suggests a measure of durability. The trade name "Multi-Opal Triplets" has been proposed by the distributors of this product.

RC

Editor's Note: The initials at the end of each item identify the contributing editor who provided that item.

Figure 3. A close examination through the side of one of the cabochons seen in figure 2 shows the outer glass container. Magnified 10×.

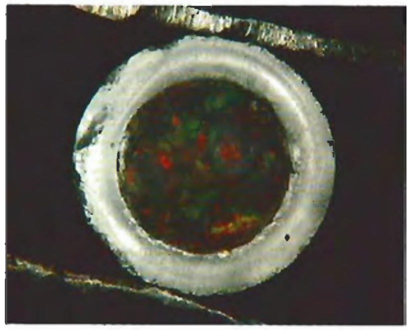


Figure 4. This view of the base of the opal assemblage seen in figure 3 clearly reveals the thick glass outer container. Magnified 10×.

Figure 5. Distinct areas of orient and lack of orient can be seen on this 9 × 14 mm cultured pearl. Magnified 10×.

Figure 6. Abrasion striations on the cultured pearl shown in figure 5 indicate "working" of the surface. Magnified 23×.

PEARLS

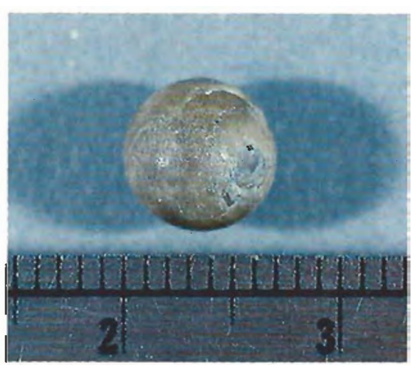
A Cultured Pearl Puzzle

A very high quality 9 × 14-mm cultured pearl was recently returned to the supplier by his customer, who claimed that it was inferior because it had changed in appearance since the purchase. Both the customer and the supplier agreed that this originally had been a fine drop-shaped cultured pearl. It was not misshapen, was thickly nacred, and in general displayed fine orient and luster. The New York laboratory was asked if they could determine why the top half of the pearl had apparently lost its orient and become a milky color, resembling "opal" glass (figure 5).

Although the pearl displayed evidence of "working" (notice the abrasion striations shown in figure 6), there is no way to determine whether this could have affected the orient, causing the eventual change in the top half. Neither the laboratory, nor any of the several pearl dealers asked, had ever seen this apparent loss of orient before. Nor could anyone offer a possible solution to the puzzle.

Dave Hargett

Figure 7. This 7-mm "fossilized pearl" was found in Utah.



A "Fossilized Pearl" from Utah

A graduate student from Southern Utah State College sent the Santa Monica laboratory a specimen that someone at the college had identified as a fossilized pearl. The specimen was found in the Tropic Shale Formation, of Upper Cretaceous age, in Tropic, Garfield County, Utah, 10 miles east of Bryce Canyon National Park. It is yellowish brown in color and measures approximately 7 mm in diameter (figure 7). Even though the surface was rough, we were able to determine on the refractometer that the material has the high birefringence that is characteristic of all carbonates. When examined with the microscope, the bead revealed what appeared to be a concentric structure. At one point where the top layer had been removed and the underlying layer was exposed, a peculiar structure became visible. The vaguely hexagonal pattern is illustrated in figure 8. This pattern resembles in appearance the external and internal structure of pearls. K. Scarratt, of the Gem Testing Laboratory in London, also illustrated these characteristics in "Notes from

Figure 8. The structure of the "fossilized pearl" shown in figure 7 (here at 50× magnification) resembles that of a natural pearl.

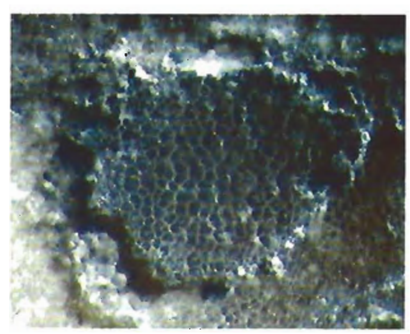


Figure 9. A 15.73-ct cat's-eye peridot.

the Laboratory-9," *Journal of Gemmology* (1987), Vol. 20, No. 5, p. 287. Although this piece showed similarities to pearl, because there was no evidence of nacre we could identify it only as a calcareous concretion. *KH*

PERIDOT, Cat's-Eye

Many years ago, Webster stated that "A cat's-eye peridot is known," but provided no additional information. In his *Color Encyclopedia of Gemstones,* Arem reported that "cat's-eye and star peridots are known, but are very rare." Perhaps one reason that we encounter phenomenal peridot only very rarely is that the preferred cutting style for this gemstone is faceting rather than cabochon.

A long-time friend of GIA recently gave the Los Angeles laboratory the opportunity to examine the very interesting 15.73-ct cat's-eye peridot illustrated in figure 9. Even to the unaided eye, it was readily evident that this oval cabochon is filled with small dark brown inclusions, so much so that the overall body color of the gem is affected. Examination with the microscope revealed that these inclusions are ultra-thin and vary greatly in size and shape; some are rectangular, while others exhibit dendritic formations. John Koivula suggested that they are most probably an iron compound closely related to ilmenite ($Fe^{+2}TiO_3$). The dendritic appearance of many of these inclusions is characteristic of both rapid crystallization and an exsolution product. Their orientation in definite crystallographic directions gives rise to the chatoyancy. At certain viewing positions an additional, weaker ray is seen, creating a star with one prominent ray and one vague ray. Oriented exsolution ilmenite together with hematite is also believed to be the cause of asterism in some star beryls. *RK*

QUARTZITE, Dyed Yellow

At the February 1987 Tucson Gem and Mineral Show, many dealers were offering large quantities of round drilled bead necklaces and earrings as "yellow jade." Because of the general appearance and unnatural color, it was obvious to the unaided eye that this material was not jade, but rather was another material which had been dyed yellow. We obtained representative samples for testing at the Los Angeles laboratory, including the necklace and earrings shown in figure 10.

A spot reading of 1.55 was ob-

Figure 10. These 35-mm-long earrings and 8-mm-diameter beads were originally sold as yellow jadeite but proved to be dyed yellow quartzite.

tained for the beads, and an aggregate reaction was observed with the polariscope. The material fluoresced a moderate dull chalky yellowish orange to long-wave ultraviolet radiation and a weak dull reddish orange to short-wave U.V. The specific gravity was estimated with heavy liquids to be approximately 2.65. Examination of the visible-light absorption spectrum with a "hand-held" type of spectroscope unit revealed a very dark general absorption in the violet and blue regions that gradually tapered off at around 490 nm, and dark absorption in the far red (680–700 nm). No distinct lines or bands were observed. Microscopic examination revealed a typical quartzite structure, which in part consists of a fine network of small thin fractures. Although no dye concentrations were observed in the fractures, rubbing the piece with an acetone-soaked cotton swab produced a distinct yellow stain on the cotton which proved that the material was indeed dyed.

On the basis of these findings, the material was determined to be dyed quartzite. It had apparently been misrepresented to the Tucson dealers, another example of the jeweler-gemologist's "need to know."

RK

SAPPHIRE

A Synthetic Blue Sapphire

The blue oval cut shown in figure 11, which was submitted to the New York lab for identification, is interesting for a number of reasons. The stone has an extremely deep pavilion and a shallow crown, with a total depth-to-width ratio of approximately 115% — so that it is actually deeper than it is wide. In addition, to the unaided eye it appears to be free of inclusions and has a pleasant light blue color. These facts suggested that the stone might be an old, "native cut," unheated Ceylon sapphire. However, careful examination with the microscope revealed a shadow of curved color banding near the culet and suspicious stress cracks on some facets. The strong chalky blue fluorescence to short-wave U.V. radiation suggests that the stone either was subjected to extreme heat in treatment or is of synthetic origin. The curved color banding together with the Plato test positively identified it as a Verneuil flame-fusion synthetic sapphire.

Figure 11. This 8.70 × 7.30-mm stone was determined to be a Verneuil flame-fusion synthetic sapphire.

Figure 12. The concentration of color in the culet area of the synthetic sapphire shown in figure 11 lends the color to the entire stone when seen face up. Note also the unusual depth-to-width ratio of this stone.

The stone is also an excellent example of how a very small color zone can produce a pleasant face-up color. Notice in the side view (figure 12) that the top of the stone is colorless; the small blue area near the culet, visible at this angle, is virtually the entire extent of color. Blue synthetic sapphire boules often have color only in a thin layer near the surface. Figure 12 also shows the extreme depth-to-width ratio of this stone. *Clayton W. Welch*

Synthetic Yellow Sapphire

The visibility of curved color banding or striation in Verneuil flame-fusion synthetic corundum is, in general, directly related to the depth of color in the stone. Dark-colored synthetic sapphires are more apt to show color banding than light-colored (e.g., yellow) ones. Consequently, the color striations in change-of-color synthetic sapphires are usually very prominent and sometimes even eye visible. The curved striae in synthetic rubies and curved bands in blue sapphires can almost always be seen with the microscope, although not always easily. Yellow synthetic sapphires, however, often have no detectable banding and the Plato test is sometimes needed to separate them from "clean" natural sapphires.

The New York laboratory recently examined an unusual 15.54-ct synthetic yellow sapphire in which curved color banding was readily eye visible in both diffuse transmitted light and ordinary overhead illumination (figure 13). This vivid color

Figure 13. The curved striae in this 15.54-ct yellow flame-fusion synthetic sapphire are unusually apparent.

zoning was probably caused by accidental fluctuations in the concentration of the coloring dopant during the growth of the boule.

Clayton W. Welch

Unusual Inclusions in Heat-Treated Blue Sapphire

The New York laboratory recently examined an unusual 3.05-ct blue sapphire. The presence of discoid fractures was a very good indication that this natural sapphire had been heat treated. However, the stone also contained some misty or cloudy areas that we have not observed before in sapphire. Figure 14, taken at 45×, shows these inclusions well. We have no explanation as to their cause. *RC*

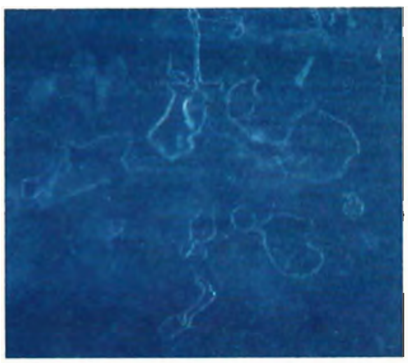


Figure 14. The Gem Trade Laboratory had never before encountered misty irregular inclusions such as those seen here in a 3.05-ct heat-treated sapphire. Magnified 45×.

SAPPHIRINE, A Rare Gemstone

The 0.34-ct oval mixed cut illustrated in figure 15 was recently sent to the Los Angeles laboratory for identification. When viewed with the unaided eye using overhead illumination, the stone appeared opaque and black. However, when examined in transmitted or diffused illumination, the stone was revealed to be transparent and brown-green. Testing with a refractometer and a mono-

Figure 15. The extremely dark brown-green color of this 0.34-ct sapphirine makes this example of a rare gem material even more unusual.

chromatic filter light source revealed that the stone is biaxial negative with refractive index values of 1.711 and 1.718, and a corresponding birefringence of 0.007. Examination with a "hand-held" type of spectroscope unit revealed no absorption lines or bands.

The specific gravity of this stone was determined to be approximately 3.50 by comparing its sinking rate in methylene iodide (3.32 S.G.) to that of a diamond (3.52 S.G.). The stone was inert to long- and short-wave ultraviolet radiation. Strong pleochroic colors of dark bluish green, medium yellowish green, and medium orangy brown were observed with the dichroscope. Microscopic examination revealed several parallel needle-like growth tubes partially filled with a mineral substance (figure 16). These properties all indicated that this unusual stone is sapphirine, a mineral that is only rarely encountered as a cut gemstone. X-ray powder diffraction analysis confirmed the identification.

Sapphirine, which has the chemical formula $(Mg,Al)_8(Al,Si)_6O_{20}$, occurs in the monoclinic crystal system, and possesses a hardness of 7½. Sapphirine crystals are usually small and tabular and are disseminated in a rock matrix; only extremely rarely are they encountered in gem quality. Sapphirine derived its name from its usual resemblance in color to blue

Figure 16. Parallel growth tubes can be seen in the sapphirine shown in figure 15 at 30× magnification.

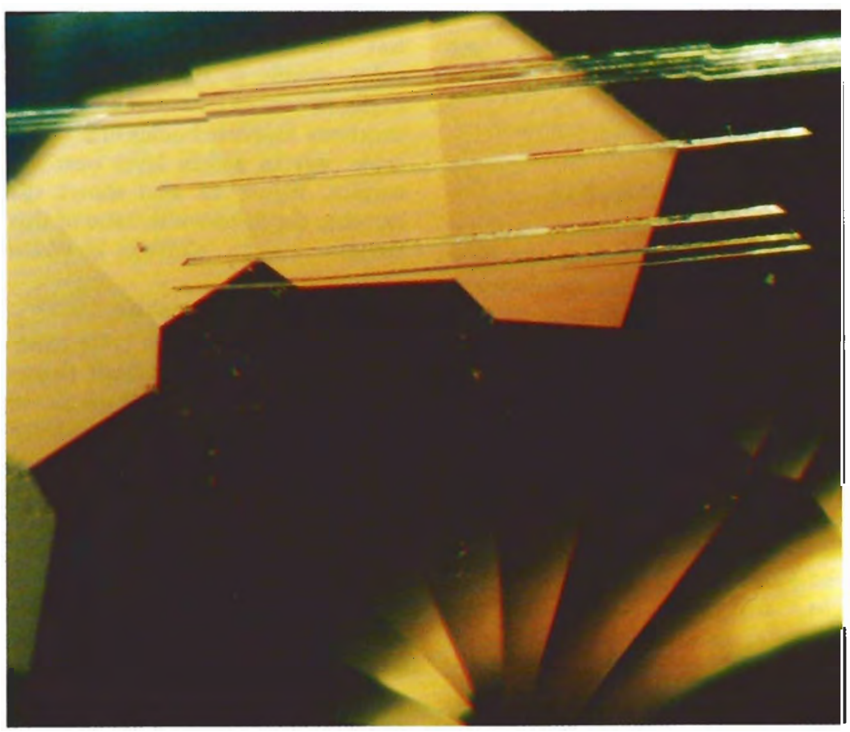


Figure 17. The intense blue color of these sapphirines is often considered the typical color for this rarely encountered gemstone (faceted stone weighs 1.01 ct).

sapphire; however, the two minerals have completely different chemical, optical, and physical properties. Although we have only seen six or seven faceted gem-quality sapphirines in the laboratories, the "normal" color is a deep blue (see figure 17). We did encounter two sapphirines of a purplish pink and a pink-purple color, one of which was described and illustrated in the Fall 1985 issue of *Gems & Gemology* (pp. 156–157).

The sapphirine described here and illustrated in figure15 is the first brown-green one we have encountered. Our client reported that this stone was found at the ruby deposits in Bo Rai, Thailand. *RK*

SERPENTINE, Dyed Yellow and Reddish Orange

Also at the February 1987 Tucson Gem and Mineral Show, dealers from Beijing were displaying and selling various gems and minerals from China, as well as gems, carvings, and jewelry made of materials from other geographic localities but fashioned in the People's Republic of China. Among the many attractive and interesting objects displayed were carved and pierced 25-mm round beads of dyed serpentine. We purchased a few beads for testing at the Los Angeles laboratory.

To determine the depth of the dye penetration and for further testing, we cut one bead in half and polished a flat surface (see figure 18).

Figure 18. Dyed serpentine bead cut in half. The left side shows shallow dye penetration, while the right side shows the carved surface.

A 1.565 refractive index reading was obtained on the flat surface, and a vague spot reading of 1.56 was observed for the carved portion of the bead. Exposure of the undyed portion to long-wave ultraviolet radiation revealed a moderate dull gray-green fluorescence; to short-wave U.V. radiation this portion fluoresced a weak dull purplish red. Exposure of the dyed areas to long-wave ultraviolet radiation revealed a variable, strong chalky yellow to moderate orange-red fluorescence; to short-wave U.V., these areas flouresced a patchy weak orange-red. When we examined the visible-light spectrum with a "hand-held" type of spectroscope unit, we observed no absorption lines or bands. Dye was easily removed from the bead when it was gently rubbed with an acetone-soaked cotton swab. Using hardness points, we estimated the hardness to be approximately $4^1/_2$ on the Mohs scale. *RK*

TOPAZ, Bicolor

The Los Angeles laboratory recently received for identification the attractive 7.08-ct bicolored (purplish pink and orangy yellow) pear-shaped modified brilliant shown in figure 19. Subsequent testing revealed that the

Figure 19. This 7.08-ct topaz is an excellent example of a true bicolor.

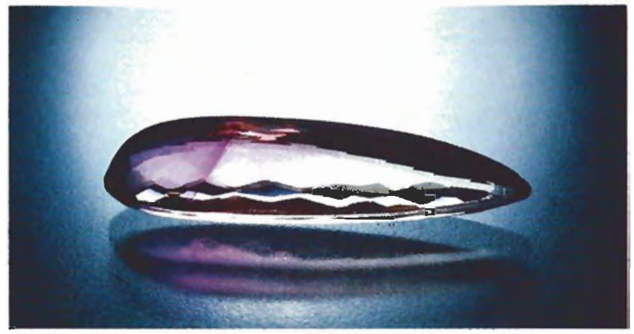


Figure 20. A sharp line separates the color zones in the bicolored topaz seen in figure 19.

stone is topaz. Two distinct colors are often seen in some topaz, particularly "imperial," which generally is the result of strong pleochroism and the orientation in cutting. The stone that we examined is a fine example of a true bicolor topaz. A sharp line of demarcation with a twinning plane divides the purplish pink and the orangy yellow zones (see figure 20).

Both colored portions of the stone had refractive indices of 1.630 and 1.639. Exposure to long-wave ultraviolet radiation revealed a weak red fluorescence for the pink portion and a moderate red for the orangy yellow section. Exposure to short-wave ultraviolet radiation showed a weak chalky green fluorescence for the orangy yellow portion, but the pink area was inert. These different fluorescence reactions are as expected for the two different colors of topaz. When the stone was examined with a "hand-held" type of spectroscope, no bands or lines were observed in either portion; however, both the purplish pink and the orangy yellow areas exhibited a vague absorption in the far red end of the visible spectrum (around 700 nm). Microscopic examination revealed inclusions typical of topaz (two-phase inclusions, small crystals, angular and straight growth features), although the orangy yellow portion was more included than the purplish pink section. *RK*

FIGURE CREDITS

Figure 1 was taken by Chuck Fryer; David Hargett is responsible for figures 2–6; Scott Briggs took figure 7. The photo used in figure 8 was supplied by John Koivula. Figures 9, 10, and 18 are © Tino Hammid. Figures 11–14 are the work of Clayton Welch. Shane McClure produced figures 15, 17, 19, and 20. The photomicrograph in figure 16 is by Robert E. Kane.