Gem Trade LAB NOTES

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AMBER, with Unusual Inclusions

Figure 1 illustrates a metallic inclusion in a fashioned piece of Dominican amber that the New York lab examined recently. The inclusion appears to be massive pyrite or marcasite, although the fact that iron and nickel are mined locally suggests that it may be bravoite $(Fe,Ni)S_2$, another member of the pyrite group. The reddish coloration around the inclusion indicates a chemical reaction with the amber. Such inclusions are encountered occasionally by amber workers and may present a problem in polishing. *RC*

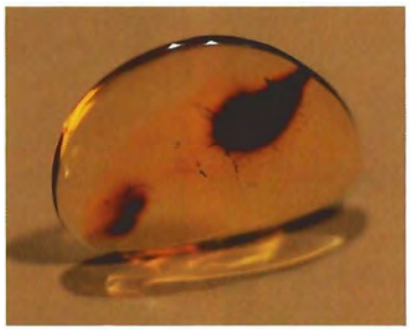


Figure 1. Metallic inclusion in Dominican amber.

AMETHYST, with Confusing Inclusions

With amethyst rising in popularity, as reported in recent trade publications, more stones are being examined. However, the separation of natural from synthetic stones continues to baffle the trade. A stone with no inclusions cannot at present be identified by routine tests. At one time, the presence of "bread crumb" inclusions was accepted as an indication of synthetic origin. Conversely, certain included crystals, "fingerprint" inclusions, and "zebra stripe" healed fractures were accepted as evidence of natural origin. Lately, however, there has been some indication that cutters of synthetic amethyst are aware of these distinctions, and have been including "fingerprints" or other irregularities that they formerly had eliminated in their efforts to produce clean stones.

Recently, an amethyst was submitted to the New York laboratory that had a low-relief crystal with a flattened gas bubble at the interface between the inclusion and the host (figure 2). This crystal indicated a natural stone. However, at the opposite end of the stone, equally convincing "bread crumbs" (figure 3) indicated a synthetic stone. We still do not know if this stone is synthetic or natural. *RC*

Figure 2. Included low-relief crystal with flattened gas bubble in amethyst. Magnified 30×.

Figure 3. "Bread crumb" inclusion in amethyst. Magnified 30×.

DIAMOND

Damaged in Cutting

When a diamond cutter has a blocked stone break on the wheel for no apparent reason (figure 4), he is usually philosophical and dismisses it as all in a day's work. However, when five out of a lot of 16 rough stones end up breaking, he begins to search for the reason. The possibility exists that rough material from certain mines has undergone serious deformation resulting in weak directions and internal strain. Unfortunately, the source of the approximately 2.5-ct diamond illustrated in figure 4 is not known. It is one of the five that broke on the wheel. *RC*

Fancy Blue Diamond

Frequently when the laboratory staff is testing a blue diamond for conductivity, it becomes necessary to

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

Figure 4. Blocked out 2.5-ct diamond that broke on the wheel. Magnified 10×.

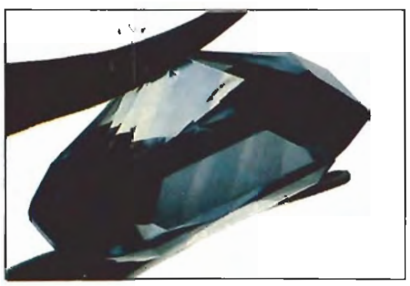


Figure 5. Color zoning in a 2-ct fancy blue diamond. Magnified 10×.

probe very carefully until certain "sensitive" areas are touched. The color zoning shown in figure 5, taken in the New York lab, suggests the reason for the difficulty: current is conducted most readily along the blue bands. In addition to causing problems when testing, such color zoning makes it difficult for the planner of the rough to orient the stone for best color. *RC*

FLUORITE Carving, Damaged by Sulfuric Acid

The carving illustrated in figure 6 was sent to the Los Angeles laboratory for examination. Our client explained that after soldering a 14K gold bail on the carving, which he thought was amethyst, he had placed the piece in a sulfuric acid and water solution (nine parts water to one part acid) for one hour to remove soldering flux and tarnish from the gold. When he removed the carving from the "acid bath," our client realized that the smooth, shiny, delicately carved surface had become frosted and heavily etched (see figure 7). The client asked the laboratory to determine whether or not the stone had been "rough cut to a frosted condition and then coated with something to give it a finish rather than being polished in the appropriate manner." Interestingly, when we viewed the carving there was no bail on it.

The surface of the carving was too heavily etched to provide a refractive index reading. When tested with a polariscope, the material was determined to be singly refractive, thus ruling out amethyst. Using hardness points in an inconspicuous place, we estimated the material to be approximately 4 on the Mohs hardness scale. A very weak bluish purple fluorescence was observed when the carving was exposed to long-wave ultraviolet radiation, and an extremely weak greenish white fluorescence was noted on exposure

Figure 6. This fluorite carving, which measures approximately 45.75 × 29.70 × 11.90 mm, was originally thought by the owner to be amethyst.

Figure 7. Extensive etching caused by immersion of the fluorite carving shown in figure 6 in a sulfuric acid solution. Magnified 30×.

to short-wave ultraviolet radiation. Using the hydrostatic method, we found the specific gravity to be approximately 3.20. The carving was therefore determined to be fluorite, which is very susceptible to attack by sulfuric acid. *RK*

HEXAGONITE, Cat's-eye

The Los Angeles laboratory recently had the opportunity to examine two rare pink cat's-eye hexagonites. The name *hexagonite* was applied to this purple-to-pink variety of tremolite many years ago, in reference to its apparently hexagonal structure. The material was later shown to be actually monoclinic. The two hexagonites that we examined weighed 1.86 ct and 2.72 ct; figure 8 shows the smaller stone. These two rare cabochons were cut from material found at Fowler, St. Lawrence County, New York. Hexagonite also occurs at Edwards and Balmat, New York.

It has been reported in the past that many hexagonites are heavily fractured and therefore difficult to cut. Both of the cabochons that we examined were indeed heavily included, with parallel cleavage planes, fractures, parallel needles, opaque dark brown euhedral crystals, and irregularly shaped cavities filled with an opaque dark brown material. The properties of tremolite are compared with those of the cat's-eye hexagonites we examined in table 1. *RK*

Figure 8. Cat's-eye hexagonite, 1.86 ct.

OPAL

Unusual Gilson Synthetic

One of the GIA students showed us a quite unusual synthetic opal that we had not yet encountered in our laboratory. The almost rectangular piece of material, which measured approximately 8.7 × 6.8 × 4.9 mm, was translucent brownish orange with a very pronounced play of color; it resembled top-quality Mexican fire opal. However, a side view of the piece revealed a very peculiar structure that became even more obvious under magnification (figure 9). The piece appeared to have been assembled, with rather thin, colorless top and bottom layers that showed no play of color. The center area, however, was a brownish orange and showed a rather unusual play of color; the different hues were confined to certain areas, as if they had been arranged in distinct columns. When the stone was viewed through the colorless layers, the snakeskin pattern characteristic of synthetic opal became visible in the cross sections of the color columns.

We also noticed other differences within the same piece. The refractive index of the colorless material was 1.495, but that of the center area was slightly lower, at 1.47. Although neither area fluoresced to short-wave ultraviolet radiation, the near-colorless area showed a chalky white fluorescence to long-wave ultraviolet rays, while the center area remained inert. The different areas varied in hardness as well. The colorless surface area was easily indented by a pin and started to flow readily as soon as the hot needle of the thermal reaction tester was held just above it. The center area was definitely much harder; the pin left no mark on the surface. Although there was no flowing when the hot needle was applied to the center area, the needle did discolor the translucent brownish orange material and leave a white opaque spot. We have no idea why the synthetic opal was covered on the top and bottom surface with this transparent colorless plastic. *KH*

Yellow-Green Opal

The New York lab recently examined a 2.30-ct semitransparent,

TABLE 1. Gemological properties of cat's-eye hexagonite and tremolite.

	Refractive index	Birefringence	Pleochroism	Specific gravity	Cleavage
Cat's-eye hexagonite	1.60–1.62 (spot)	Approx. 0.02	Weak orangy pink, purplish pink, and purple	Approx. 3.00 (heavy liquids)	One direction with parallel cleavages
Tremolite[a]	1.600–1.625	0.025	Weak orangy pink, purplish pink, and purple	2.98–3.03	Good two directions

[a] *As reported in W. R. Phillips and D. T. Griffin (1981)* Optical Mineralogy, the Nonopaque Minerals. *William Freeman & Co., San Francisco, CA*

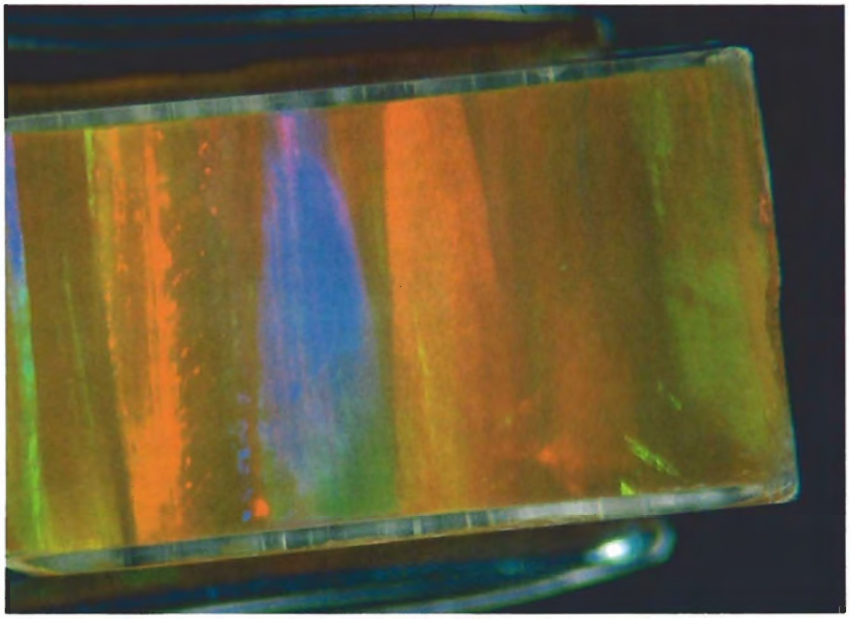


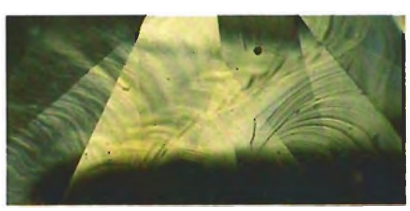
Figure 9. Colorless outer layers are clearly evident on the top and bottom of this synthetic opal. Magnified 10×.

faceted, yellowish green opal (figure 10) that reportedly came from Mexico. Our first impression based on the oily appearance was that the stone might be highly fluorescent, particularly when it was examined in daylight at the window. Sure enough, the stone fluoresced an extremely strong, bright, yellowish green when exposed to either long- or short-wave ultraviolet radiation. The intense fluorescence seemed to follow the pattern of the internal botryoidal flow structure (figure 11). There was no phosphorescence.

Figure 10. A 2.30-ct faceted yellowish green opal.

When we checked the stone with a Geiger counter, it was found to be slightly radioactive (0.1 to 0.4 mR/hr), only a little above the background count. When the stone was left on unexposed X-ray film for approximately five days, the radiation of the stone exposed the film, so that it took its own radiograph. That the radioactive property might be due to the presence of a trace of uranium is suggested by the absorption pattern as observed on a spectrophotometer chart. The vague bands at 4950 Å (495 nm) and 4600 Å (460 nm) plus the cutoff at about 4300 Å (430 nm) in the violet (seen with difficulty in the hand spectroscope), closely resemble the pattern for a uranium glass recorded in Webster's monumental book, *Gems.* The refractive index of 1.455 and the specific gravity of 2.18 are in the normal range for opal. *RC*

Figure 11. Flow structure in the faceted yellowish green opal shown in figure 10. Magnified 15×.



PEARLS

Freshwater Cultured Pearls from China

A large lot of undrilled fancy-colored pearls reported to be of natural origin were brought to our Los Angeles laboratory for identification. We were told that these pearls had been purchased in China. The pearls were all symmetrical in shape, primarily slightly off-rounds and ovals, and they ranged in size from approximately 4 to 5.5 mm in diameter. As shown in figure 12, the colors varied from different shadings of rose to purple, lavender, and bronze. They all showed a very high, almost metallic, luster. All of the pearls also showed a more or less strong fluorescence (depending on the intensity of their body color) when exposed to X-radiation, which indicates freshwater origin. The X-radiograph revealed the characteristic irregular voids that prove that these were mantle tissue–nucleated cultured pearls. These pearls had the most intense color and highest luster of any of the symmetrical freshwater cultured pearls that we have encountered to date in the Los Angeles laboratory. *KH*

Imitation Pearls

One fact the manufacturers of imitation pearls must consider is that of comparative weight or "heft." Most use an opalescent glass bead center that approximates the specific gravity of pearls or cultured pearls. Shell bead centers are also essentially the same as pearls in this respect. Plastic bead centers have been used, but their low specific gravity is a detriment. Recently, the New York lab examined one half of a bead that indicated an advance in several ways. A

Figure 12. Some of the colors observed in the Chinese freshwater mantle tissue-nucleated cultured pearls examined in the Los Angeles lab (4–5.5 mm in diameter).

Figure 13. An 8-mm imitation pearl showing a metallic core and iridescent ring. Magnified 15×.

Figure 14. The metallic cores of imitation pearls similar to the one shown in figure 13 are clearly evident in this X-radiograph.

central core consisting of several small metallic spheres provided weight for the essentially plastic bead. Iridescence was provided by finely divided particles of unknown composition reminiscent of those seen in the Slocum imitation opal; these particles lay in a ring halfway between the metallic core and the surface (figure 13). The plastic above the iridescent layer is quite transparent and thick enough to allow repolishing if the bead were damaged. The usual coated imitation pearl cannot be repaired because the coating is so thin.

Figure 14 is an X-radiograph of a section of a necklace that was made with these new imitations. The metallic spheres are embedded in a white plastic matrix. One sphere was tested with a hot point. It behaved very much as a lead solder would, indicating a low melting point. *RC*

QUARTZ, Very Dark Reddish Gray Cat's-eye

The 6.97-ct cat's-eye quartz shown in figure 15 was submitted to the Los Angeles laboratory for identification. Refractive indices of 1.540–1.550 were obtained on the flat base of the cabochon. The specific gravity was determined to be approximately 2.67. No distinct bands or lines were observed in the absorption spectrum when the stone was examined with a hand-held spectroscope. The stone was inert to both long-wave (366 nm) and short-wave (254 nm) ultraviolet radiation. Examination with the microscope revealed numerous parallel long, thin, red needles throughout the stone, which caused the chatoyancy. Small, circular, orange disks were also observed throughout the stone. This is the first time that the Los Angeles lab has seen a cat's-eye quartz of this particular color. *RK*

Star SAPPHIRE, Diffusion-treated

The New York lab was recently asked to examine a star sapphire weighing approximately 10 ct that the client had started to recut only to discover that he had ground off one leg of the star (figure 16). Examination under magnification revealed that the star existed only on the surface, a result of diffusion treatment whereby an excess of titanium oxide is allowed to form oriented needles in the surface lattice structure of the corundum. Further proof that the stone had been subjected to the heat required for the diffusion treatment process is provided by the melted appearance of the base of the cabochon (figure 17). *RC*

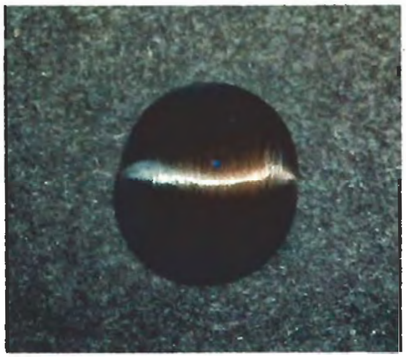


Figure 15. A 6.97-ct cat's-eye quartz.

SCAPOLITE, Dark Cat's-eye

The Los Angeles laboratory recently received for identification the 52.92-ct nearly opaque, extremely dark yellowish green-brown chatoyant round double cabochon shown in figure 18. Testing with a refractometer revealed a weakly birefringent spot reading at approximately 1.56. The cabochon was inert to long-wave ultraviolet radiation, but a barely perceptible red fluorescence was observed when the stone was exposed to short-wave ultraviolet radiation. The specific gravity was determined by the hydrostatic method to be approximately 2.70. Microscopic examination revealed minute, parallel needles throughout, as well as several large and small fractures. Using a hardness test on the base of the cabochon, we estimated the stone to be around 6 on the Mohs hardness scale.

A minute amount of powder was then scraped from the girdle of the stone for X-ray diffraction analysis. We obtained an X-ray powder diffraction pattern that came very close to matching ASTM file pattern 29-1036 for mizzonite. Mizzonite is a member of the scapolite (wernerite) group, which also includes marialite, dipyre, and meionite.

This is the first cat's-eye scapolite of this color that we have encountered. *RK*

Figure 16. The star in this approximately 12-ct sapphire was found to be produced by diffusion treatment when one leg was ground off in the course of recutting. Magnified 10×.

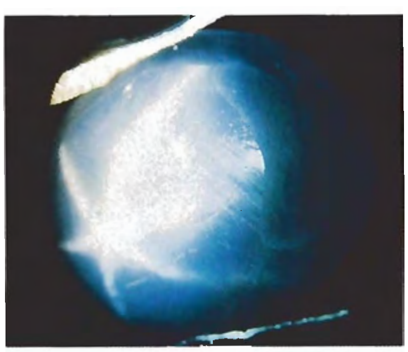
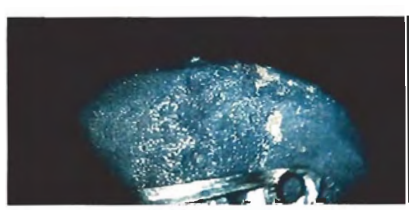


Figure 18. A dark green-brown cat's-eye scapolite, 52.92 ct.

TOPAZ Imitation

A beautiful pink cushion antique mixed-cut stone weighing more than 100 ct was submitted to the New York lab for identification. The refractive index of 1.63 and the general appearance suggested a fine pink topaz. A cursory glance under low magnification disclosed what appeared to be "fingerprint" inclusions (figure 19). However, the stone proved to be singly refractive and the "fingerprints" to be nothing more than veils of gas bubbles—in glass. *RC*

Figure 17. The melted base of the star sapphire shown in figure 16 provided further evidence that it had been diffusion treated. Magnified 10×.



ZIRCON, Cat's-eye

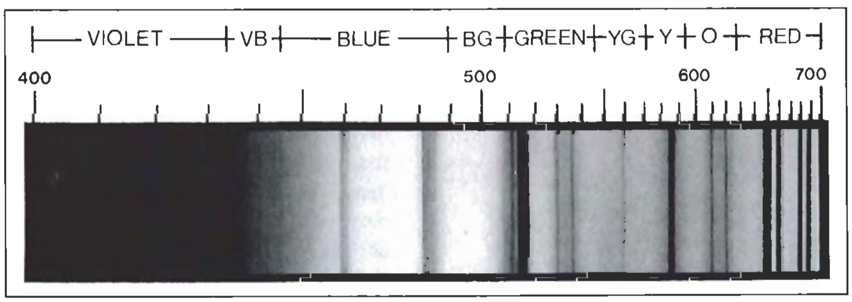
The Los Angeles laboratory recently identified three cat's-eye zircons ranging from 1.60 to 2.97 ct (see figure 20). These chatoyant zircons were different in both color and diaphaneity from two cat's-eye zircons recently reported in *Gems & Gemology:* a 3.43-ct translucent, heavily included grayish green oval cabochon (Winter 1983), and an 8.63-ct translucent brownish yellow oval cabochon (Summer 1984).

The three stones we examined were all translucent and were light gray, light orangy brown, and medium gray, respectively, in color. They were reportedly from Sri Lanka. These three chatoyant cabochons were readily identifiable as zircon by the presence of characteristic absorption spectra. Numerous bands and lines were observed throughout the visible-light spectrum of each stone. Figure 21 shows a

Figure 19. Gas bubbles appear in a "fingerprint" pattern in this glass imitation of topaz. Magnified 10×.

Figure 20. Three very translucent cat's-eye zircons that weigh 1.60, 2.28, and 2.97 ct, respectively.

Figure 21. Absorption pattern of cat's-eye zircon.



drawing of this image as observed through a hand-held spectroscope.

It should also be noted that two of the stones fluoresced a very weak dull orange to long-wave ultraviolet radiation while the third was inert (all were inert to short-wave ultraviolet radiation). With magnification, dense concentrations of parallel bands of small mineral flakes were evident throughout all three stones, with strong doubling visible. Cavities and fractures were observed on the base of all three stones; on one they were stained an intense orange, on another a large fracture was stained dark brown, and no stains were observed on the base of the third stone. *RK*

PHOTO CREDITS

Steve Hofer took the photos used in figures 1, 3–5, 10, and 13. Ricardo Cardenas supplied figures 2, 11, and 19. Shane McClure is responsible for figures 6, 7, 9, 12, 15, and 18. Figure 8 came from Tino Hammid. The X-radiograph in figure 14 was furnished by Bob Crowningshield, and Dave Hargett photographed the stone seen in figures 16 and 17. Figure 20 came from John Koivula, and the absorption pattern used for figure 21 is reprinted from the 11th edition of the Handbook of Gem Identification, *by R. T. Liddicoat, Jr.*