

GEM N.E.W.S

Editors • Mary L. Johnson and John I. Koivula

Contributing Editors

Dino DeGhionno and Shane F. McClure,
GIA GTL, Carlsbad, California

Emmanuel Fritsch, IMN, University of Nantes, France

Henry A. Hänni, SSEF, Basel, Switzerland

Karl Schmetzer, Petershausen, Germany

DIAMONDS

Diamond exploration in Alberta, Canada . . . So far, more than 200 kimberlites (most of them without diamonds or subeconomic) have been found in Canada's Northwest Territories, writes Professor A. A. Levinson of the University of Calgary, Alberta. Just south of the Northwest Territories, the province of Alberta is becoming

Figure 1. A new kimberlite district has been identified in the Buffalo Hills area of north-central Alberta, south of the future Ekati and Diavik mines in the Northwest Territories. Most of Alberta had been staked for diamond exploration (shaded in yellow) as of March 1998. Map modified from "Alberta Diamond and Mineral Exploration Activity Map," April 1998, by EnerSource, Calgary, Alberta.



ing a hotbed of diamond exploration (figure 1). More than 80% of the stakable land in the Texas-size province has been staked for diamonds by at least 30 companies, including De Beers (operating as Monopros). Geologically, Archean-age rocks underlie much of the province, which is favorable for the occurrence of diamond-bearing kimberlites.

Although De Beers has been exploring in northern Alberta with varying degrees of intensity since the mid-1970s, no significant results were ever announced. Since 1996, however, more than 20 kimberlites have been discovered, many containing diamonds. Most of these were found by a consortium led by Ashton Mining of Canada that includes the Alberta Energy Company and Pure Gold Minerals. Many of the kimberlites are in the Buffalo Hills area of north-central Alberta (figure 2), which is now recognized as a distinct kimberlite province. The largest diamond recovered thus far weighed 1.31 ct, which suggests that there may be an economic population of jewelry-size stones.

Compared to the harsh conditions at remote sites in the Northwest Territories, diamond exploration in Alberta is both easier and more economical. Alberta has an excellent network of roads and many available services. The kimberlites are covered only by shallow till deposits (with some even visible as surface outcrops); they are not found under lakes as they frequently are in the Northwest Territories. Geophysical exploration has identified many anomalies that remain to be evaluated, any of which might represent a near-surface kimberlite pipe. Thus, there is "guarded optimism" (in Professor Levinson's words) that a mineable diamond deposit will be found and developed in Alberta. However, it will take several years before the true potential of this region can be determined.

. . . and anticipated production in the Northwest Territories. Professor Levinson also noted that this year

will “mark a milestone in the annals of the world production of rough diamonds,” because the Ekati mine in the Lac de Gras region of the Northwest Territories (NWT) will begin operation this fall. The estimated production of about 4.2 Mct (million carats) per year would make Canada the sixth largest diamond producer (by volume) in the world. Another mine is at an advanced stage of development: At the Diavik project, about 16 miles (26 km) southeast of Ekati, a production of 6.5 Mct per year is anticipated beginning in 2002. If these production expectations are met, Canada will produce more diamonds annually than South Africa.

Cooperation among the mining companies, indigenous peoples, and the government of NWT is essential for a successful mining venture. In addition to various environmental safeguards, the government of NWT had requested “value-added activities”—that is, that the Territories would not merely be exporting raw materials, but might also be involved with the later processing steps (such as sorting, cutting, and polishing) that add value to the diamonds produced. In this regard, the government of NWT has come to an understanding with BHP Diamonds Inc. and Dia Met Minerals Ltd., the major-share partners in the development of the Ekati mine. BHP Diamonds Inc. (the operating company) will establish a diamond valuation facility that will be used at first for training, basic sorting, and government valuation; more-detailed sorting may follow as the work force gains more skills and expertise. BHP will also facilitate the sale of rough diamonds (for cutting and polishing) to qualified northern manufacturers at competitive prices, while the government will have primary responsibility for attracting and retaining those manufacturers. Both parties will work together to ensure that potential manufacturers have the necessary qualifications and a valid business plan.

International Rough Diamond Conference in Israel. Throughout 1998, Israelis are celebrating the 50th anniversary of the founding of the State of Israel. In honor of this anniversary, the diamond industry distinguished itself with a fascinating conference titled “Israel’s Tribute to the Rough Diamond Producers—International Rough Diamond Conference,” held June 23–24 in Tel Aviv. Professor A. A. Levinson provided the following report from this conference.

Israel is the world’s largest cutting center for gem-quality diamonds (as distinct from the near-gems cut in India). The purpose of this conference was to acknowledge the contributions of the world’s rough diamond producers to the success and prosperity of the Israeli cutting industry.

Approximately 200 foreign delegates and 300 members of the Israeli diamond industry attended the two-day conference. Renowned diamond journalist Chaim Even-Zohar was the moderator. The list of speakers included executives of companies that play major roles in dia-



Figure 2. Diamond-bearing kimberlite was discovered in this natural clearing in the heavily wooded Buffalo Hills area of Alberta. Petroleum exploration geologists had been using the clearing as a natural helicopter landing pad for several decades before the outcropping was identified as kimberlite. Photo courtesy of Ashton Mining of Canada.

mond mining, exploration, manufacturing, and financing, as well as government decision makers from several countries. One objective of the conference was to inaugurate the new Rough Diamond Trading Floor at the Israel Diamond Exchange in Ramat Gan. This was done on the first day by Prime Minister Benjamin Netanyahu, who noted that a free market for rough diamonds was being created, and encouraged rough suppliers to trade in Israel. The ceremony was followed by a forum with presentations by two senior Israeli government officials and the presidents of the two Exchanges, as well as the president of the Israel Diamond Manufacturers Association and the director of the (research-oriented) Israel Diamond Institute. Several of these speakers noted the positive role the Israeli government has played by virtue of its policies of minimum regulation and enlightened taxation with respect to the diamond industry (for instance, taxes generally are assessed at 1% of turnover, regardless of profit).

The second day of the conference featured 15 talks by presenters from the world diamond industry. De Beers was represented by three officials from the CSO (A. Oppenheimer, T. Capon, and S. Lussier), who covered topics ranging from the historic relationship between the CSO and Palestine (later Israel) since 1940, through projected polished diamond consumption into the next century, to the controversial concept of branded “De Beers Diamonds,” which are currently being test marketed in England. High-ranking officials from the major producing countries of Botswana (B. Marole), Russia (S. Oulin), and Angola (J. D. Dias) discussed various aspects of the diamond industry as it relates to their economies, including the advantages of marketing some or all of their rough production through the CSO. Other speakers, representing smaller producers (D. M. Hoogenhout and L. Leviev),



Figure 3. These two agates from Botswana, 71.62 and 93.85 ct, show structures but not the colors that resemble the flames of candles. Photo by Maha DeMaggio.

explained their mining operations and why they find it advantageous to market independently.

New exploration ventures, particularly in Canada, attracted much attention. Rio Tinto (G. Sage), which operates the Argyle mine in Australia, is also developing the Diavik mine in Canada (scheduled to open in 2001); this will insure that Rio Tinto will be a major force in rough diamonds well into the future. The exploration activities on four continents of Ashton Mining (a minority stakeholder in the Argyle mine) were reviewed by R. J. Robinson. Some of the most notable future producers attended not as speakers but rather as delegates to familiarize themselves with the cutting industry. These included BHP Diamonds President J. Bothwell, whose Canadian Ekati mine will start producing this October.

Figure 4. These two "flame agates" are from Villa Ahumada, Mexico, the classic locality for such agates. The larger of the two weighs 51.95 ct. Photo by Maha DeMaggio.



Financial aspects were covered by P. K. Gross of the Belgian bank ABN-AMRO, a major lender to the diamond industry. Mr. Gross outlined methods of "risk analysis." At present, the total bank indebtedness of the four main diamond-cutting centers (Antwerp, Mumbai, Tel Aviv, and New York) is at an almost record level of US\$4.5 billion. Even more worrisome is the industry's debt to capital ratio, now about 1 to 1.5. Evaluation of the inherent share value, and near-term potential, of publicly traded rough-diamond producers in South Africa and Canada was discussed by South African mining analyst D. Kilalea, who reported that the current picture is not bright.

The program was rounded out by an overview of world rough diamond production in relation to polished demand by Mr. Even-Zohar, a discussion of the cooperation between rough suppliers and their customers by Y. Hausman, and a colorful presentation by M. Rapaport on the relationship between rough and polished prices. Overall, the conference provided an excellent opportunity for dialogue between the world's rough diamond producers and their customers (particularly the Israeli diamond manufacturers). However, the topics covered have ramifications for the entire industry. In particular, there appeared to be a general concern that the diamond industry is currently in a less-than-satisfactory condition, which most speakers attributed primarily to the economic conditions in Southeast Asia and Japan, as well as to the strong U.S. dollar. Without doubt, the International Rough Diamond Conference was a great success.

COLORED STONES AND ORGANIC MATERIALS

"Flame agate": What's in a name? *Agate*, like the names of other chalcedony varieties, is often subject to misun-

Figure 5. It does not take much imagination to see why the name flame agate was applied to Mexican stones displaying colorful patterns, like the one shown here. Photomicrograph by John I. Koivula; magnified 5x.



derstanding, misuse, and/or misinterpretation. This results at least in part from the fact that there is no international body that decides how a particular agate or chalcedony should be named. *Flame agate* is a case in point. Should such agates be red to orange or yellowish orange, like the color of flames, or is any coloration, such as brown, acceptable? Is structural pattern a required criterion, or is it the only requirement? Dr. H. G. Macpherson, in the book *Agates* (British Museum of Natural History, 1989), used the term *flame agate* to refer to agate of any color in which the pattern resembles a candle flame. Based on Macpherson's use of the term, the two inexpensive, tumble-polished Botswana agates shown in figure 3, would qualify as flame agates.

A much earlier and more specific use of the term *flame agate* can be found in the classic 1959 reference *Gemstones of North America*, by John Sinkankas. In this work, Sinkankas describes a very specific highly translucent, colorless agate with few typical agate bands, but rather containing long streaks or "flames" of a bright red color. This material came from Chihuahua, Mexico, west of Villa Ahumada, and has been well established among agate collectors as "flame agate." Two excellent cabochons of Mexican "flame agate" are shown in figure 4, while a magnified image of the typical flame pattern is shown in figure 5. Leland Quick, in *The Book of Agates* (1963), also refers to this Mexican agate as "flame agate," and agrees with the Sinkankas reference for the use of the term. When we compare the Mexican agates to the tumble-polished Botswana agates in figure 3 (or to the so-called flame agate image in Macpherson's book), it is easy to see why the descriptive name *flame agate* was first applied to the Mexican material. It is also easy to see how the term has become less focused and much more broadly used.

In short, no one governs the use of such descriptive terms in gemology. As a result, their original meaning may be lost through general usage. With respect to *flame agate*, it is suggested that both color and pattern are important, and that the name should be applied appropriately.

Update on benitoite mining. Benitoite was the subject of a feature article in the Fall 1997 issue of *Gems & Gemology* (B. Laurs et al., "Benitoite from the New Idria District, San Benito County, California," pp. 166–187). Since that time, the only commercial deposit of gem benitoite, the Benitoite Gem mine, has been placed under a 14-month option for evaluation by AZCO Mining Inc., of Vancouver, British Columbia, Canada. This option extends to February 1, 1999, at which time AZCO may elect to purchase the mine for \$1.5 million.

In a press release dated May 7, AZCO supplied the 1998 production figures for the Benitoite Gem mine. In a mining season that ran just over one month, about 900 tons of alluvial material were processed by the present owners, producing 522 grams of "gem-quality" benitoite



Figure 6. This photo shows a portion of a spectacular benitoite specimen that was recovered last year. The white natrolite has been partially removed to expose the benitoite crystals. The entire specimen measures about 40 × 40 cm, and also contains neptunite and joaquinite crystals (not shown here); the benitoite crystals range up to about 4 cm in their longest dimension. Courtesy of the Collector's Edge; photo © Geoffrey Wheeler Photography.

rough. AZCO is nearing the completion of its bulk sampling and drilling of the deposit, and is engaged in geologic reconnaissance of the district.

Earlier this year, a spectacular benitoite specimen was meticulously prepared and then sold to a private collector by the Collector's Edge of Golden, Colorado. This specimen (figure 6) was recovered from a boulder that was discovered at the Benitoite Gem mine in spring 1997 (see figure 8, p. 173, of the Laurs et al. article for a photo of the original boulder).

Beryl from Madagascar: Aquamarine . . . The island republic of Madagascar is unusually rich in many kinds of gems, including sapphires, emeralds, tourmalines, and garnets, all of which have been profiled in the pages of *Gems & Gemology*. At the Tucson show this year, Tom Cushman of Allerton Cushman & Co., Sun Valley, Idaho, also showed the Gem News editors a large faceted aquamarine (figure 7) from Farafangana in southern Madagascar. It appears that this stone had not been heated, as the long axis had a greenish blue pleochroic color. The rough was reportedly mined about two years ago.

. . . and trapiche beryl. A light grayish green six-sided "trapiche" beryl (figure 8) was shown by Sunil Tholia, president of Universal Point, Forest Hills, New York, to GIA GTL (New York) gemologist Nick DelRe in Tucson. This stone was one of several Mr. Tholia had that reportedly came from the mining area surrounding Mananjary,



Figure 7. The crystal from which this 20.48 ct aquamarine was cut was mined in southern Madagascar. Stone courtesy of Allerton Cushman & Co.; photo by Maha DeMaggio.

Madagascar. The specimen measured $15.15 \times 14.65 \times 10.85$ mm and weighed 13.74 ct. The refractive index (spot) was about 1.58, and the specific gravity was about 2.64, measured by the hydrostatic method. These properties are consistent with what we expect in such stones. The trapiche structure was most obvious in transmitted light (figure 8, right). We detected no evidence of clarity enhancement in the stone.

“Almost blue” Sri Lankan color-change garnets. In the Spring 1996 Gem News section (p. 53), we described a 3.29 ct color-change garnet that had the bluest color (in daylight-equivalent fluorescent light) we had seen up to that time; this color was described as bluish green. In the past few months, some very dark, desaturated color-change garnets (made available to the Gem News editors in Carlsbad and to contributing editor Emmanuel Fritsch in Nantes, France) also appeared to be somewhat blue with fluorescent illumination.

The 0.99 ct cushion mixed cut shown in figure 9 was loaned to the Gem News editors by Barry Schenk of M. M. Schenk Jeweler, Chattanooga, Tennessee. This stone had been purchased in Sri Lanka in 1997. Dr. Fritsch examined two stones, 0.48 and 0.59 ct, loaned by John Bachman, a colored-stone dealer in Boulder, Colorado, who stated that they came from Athiliwewa, Sri Lanka (see the Winter 1996 Gem News, pp. 285–286, for more on garnets from this locality). Because the possible existence of blue garnets continues to intrigue many gemologists, we characterized these stones in detail.

The gemological properties for the three stones are summarized in table 1. Although there is some variation in the specific properties, on the whole they are consistent with those for pyrope-spessartine garnets. The samples also contained similar inclusions, although more information was gained from those in France, as the GIA in Carlsbad had not acquired its laser Raman microspectrometer at the time of examination. Prominent in the 0.99 ct stone were oriented needles (figure 10), some of which showed stress or partially healed fractures in polarized light. The two smaller stones contained similar needles, identified as rutile by Raman analysis (with a Jobin Yvon T6400 spectrometer). These two stones also contained large, transparent, birefringent crystals, rounded or angular, that were proved by Raman analysis to be a carbonate, probably dolomite (figure 11); large, flat stacks of black hexagonal plates (probably graphite or hematite); and a small transparent inclusion that showed a Raman spectrum typical of spinel.

Because the chemical analyses of the stones examined in France showed no detectable chromium, Dr. Fritsch speculates that the combination of Mn^{2+} and V^{3+} absorptions was responsible for the color change in stones in which Cr^{3+} was absent, and contributed to the color change even in stones where Cr^{3+} was present.

Cat’s-eye opal from Tanzania. Hussain Rezayee, an independent gem dealer based in Los Angeles, California, recently brought several parcels of this material to the



Figure 8. This 13.74 ct trapiche beryl crystal was found near Mananjary, Madagascar. In transmitted light (right), the spoke-like structure typical of trapiche emerald or beryl is evident. Courtesy of Universal Point, Inc.; photos by Nick DelRe.

Figure 9. This 0.99 ct pyrope-spessartine garnet from Sri Lanka changed color from dark grayish greenish blue in daylight-equivalent fluorescent light (left) to dark grayish violet in incandescent light (right). Stone courtesy of Barry Schenk; photos by Maha DeMaggio.



attention of the *Gems & Gemology* editors. The opal was found as nodules weathered in place in a field near Kasulu in Tanzania, near the border with Burundi. Mr. Rezayee's associates have collected "a few tons" of the rough opal since late 1995, and they report that the easily worked surface deposits are now nearly depleted. Only

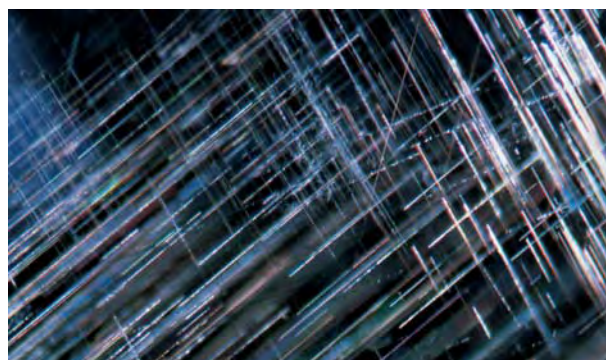
TABLE 1. Gemological properties of three grayish greenish blue color-change garnets.

Property	Carlsbad sample	Nantes samples
Weight	0.99 ct	0.48 and 0.59 ct
Color in daylight	Dark grayish greenish blue (fluorescent light)	Grayish greenish blue (daylight)
Color in incandescent light	Dark grayish violet	Purple
Optic character	Singly refractive with weak anomalous double refraction	Singly refractive with weak anomalous double refraction
Color filter reaction	Orange	Orange
Refractive index	1.760	1.77
Specific gravity	3.88	About 3.91
Fluorescence to LW and SWUV	Inert	Inert
Luminescence to visible light	None	None
Absorption spectrum	400–450 nm cutoff, weak absorption at 450–470 nm, diffuse bands at 480–490 nm, 504 and 520 nm, and 560–580 nm	435 nm cutoff; 460, 480, 504, and 520 nm lines; and wide band at 573 nm
Inclusions	Oriented needles, some showing stress	Rutile needles, carbonate, graphite(?), spinel
Chemical analysis	EDXRF	SEM-EDS (0.48 ct)
Major elements	Mg, Al, Si, Mn	Mg, Al, Si, Mn
Minor to trace elements	Fe, Ca, V, Cr, Zn, Y, Zr	Fe, Ca, V
UV-visible spectrum	Absorption minimum (transmission maximum) at 475 nm; weak absorption peaks at 504 and 525 nm superimposed on a strong broad peak centered at 573 nm; and a strong peak centered at 685 nm	UV cutoff at about 430 nm; weak band at 483 nm; and a broad, slightly asymmetric band with apparent maximum at 580 nm

about 1% can be fashioned into cat's-eye stones, and to date, about 30,000 carats have been cut. Mr. Rezayee sorts the material into 18 color categories; the five oval cabochons in figure 12, with sizes between 10.92 × 9.63 × 7.48 mm (4.04 ct) and 13.49 × 10.45 × 8.40 mm (6.71 ct), were representative of the range of colors in the material we saw. All five showed sharp eyes.

The gemological properties of these five stones were as follows: color—yellow, orange, brownish orange, and orangy brown; color distribution—even in all but the darkest stone, which showed brown color zones; diaphaneity—translucent to semi-translucent; optic character—isotropic with anomalous double refraction; (Chelsea) color filter reaction—none; refractive index—1.44 (spot reading); specific gravity—2.03–2.11; fluorescence—inert to both long- and short-wave UV radiation; spectroscopy spectrum—none seen in the yellow and orangy brown stones, low-wavelength cutoff at about 400–500 nm in the orange and brownish orange stones. Using a microscope, we saw: red-brown staining along fractures, resembling dendrites, in the yellow stone; red-brown needle-like inclusions and brown breadcrumb-like inclusions; and patchy "clouds," sometimes elongated transverse to the chatoyant band. The acicular inclusions, when visible as distinct needles, were also parallel to the overall mass of much finer needles that caused the chatoyancy, but these masses of much smaller needles

Figure 10. The 0.99 ct color-change garnet in figure 9 contained oriented parallel arrays of needles, as are commonly seen in garnets. Photomicrograph by John I. Koivula; magnified 17×.



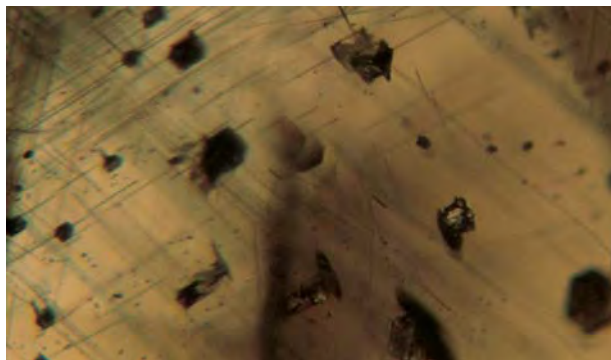


Figure 11. In addition to rutile needles, this 0.59 ct color-change garnet contained carbonate crystals, probably dolomite. Photomicrograph by Emmanuel Fritsch; magnified 25 $\times$.

were not obvious at 63 $\times$ magnification. Some crazing was visible, but for the most part these curved fractures were iron stained, which indicates that they existed prior to the cutting of the stones; that is, they were relatively stable at the time they were mined.

Additional testing yielded the following information. For all five stones, FTIR spectroscopy revealed a typical natural opal spectrum between 1000 and 6000 cm^{-1} , with no evidence of polymer impregnation. EDXRF analysis showed silicon as a major element (expected for opal), and minor iron and calcium. Three stones (one orange, two orangy brown) contained traces of zinc; the two orangy brown stones also contained traces of manganese.

Figure 12. These five cat's-eye opals (4.04–6.71 ct) from southern Tanzania show the range of colors examined by the editors. Photo by Maha DeMaggio.



Of rubies and rubles. A new find of rubies in Russia has quickly attracted the interest of mineral and gem collectors worldwide. The rough material is being recovered from the Rais mine, located in the Polar Urals in Siberia. Samples of these rubies, in their host matrix, were provided for examination by the Mineral Department of The World of Science, Rochester, New York, through a loan arranged by William Pinch of Pittsford, New York. The crystals are dark slightly brownish red; they occur as well-formed hexagonal prisms with sharp interfacial angles.

The ruby crystals are contained in a matrix consisting primarily of white feldspar and greenish brown mica, as identified in GIA's Research Department by laser Raman microspectrometry. Some of the rubies have pinacoidal terminations, while others, like the one shown in figure 13, are terminated by parting planes that result from excessive lamellar twinning. Detailed microscopic examination of the matrix also revealed the presence of ruby microcrystals.

The gem potential of this deposit is unknown at the current time. As reserves are established and mining continues, more details will become available. Mr. Pinch stated that the crystals seen thus far make excellent mineral specimens. Some of the material is cabochon quality, although lamellar twinning could cause problems with parting during the fashioning process.

Star sapphire from Madagascar. Star and trapiche blue sapphires are being recovered from a new alluvial deposit in northern Madagascar, according to Randy Wiese, of Michael Couch and Associates, Fort Wayne, Indiana. The stones are found in northeast Madagascar, about 120 km south of the island's northern tip, near the east coast. (The mine was recently shut down, however, after an endangered species was discovered living in the area—see, e.g., *ICA Gazette*, May-June 1998, pp. 6–7.) Blue sapphires from southern Madagascar were described in a comprehensive Summer 1996 article by D. Schwarz et al. ("Sapphires from the Andranondambo Region, Madagascar," *Gems & Gemology*, pp. 80–99) and a Fall 1996 Gem News update (pp. 217–218).

We examined five representative stones, weighing 1.37 to 6.88 ct (figure 14). All five showed good stars. Their gemological properties were quite uniform: color—dark blue; color distribution—uneven with hexagonal banding; diaphaneity—semi-transparent to semi-translucent; refractive indices—1.762–1.770 (spot measurements); specific gravity—4.00–4.01; fluorescence—inert to both long- and short-wave UV radiation. All five showed the same absorption spectrum through the hand-held spectroscopy: bands at 450, 460, and 470 nm. When viewed through the microscope, all showed straight growth banding oriented in hexagonal patterns, "fingerprint" inclusions, and clouds of "silk." One stone showed iron stains, and another had a surface-breaking opaque reddish brown inclusion that Raman analysis



Figure 13. Mined in Siberia, this 20 × 14 mm ruby is contained in a matrix of feldspar and mica. The large crystal “face” is actually a parting plane that parallels the lamellar twinning. Photo by Maha DeMaggio.



Figure 14. These star sapphires, which weigh 1.37 to 6.88 ct, are from northern Madagascar. Photo by Maha DeMaggio.

proved to be columbite. These stones could be mistaken for synthetic star sapphires (so-called “Linde stars”) if the straight growth banding was interpreted as curved banding due to the curvature of the cabochon surface.

TREATMENTS

Jadeite boulder fakes. Although various treatments (i.e., dyeing and polymer impregnation) are used to improve the apparent color of fashioned jadeite, most buyers do not suspect that rough jadeite can also be altered. Larry Gray of the Mines Group, Boise, Idaho, submitted one such faked boulder to the Gem News editors for examination. The rough boulder was apparently still covered with its alteration crust, or rind, with a few “windows” (figure 15, left) polished into it. However, when the boulder was sawn, the “windows” were found to be thin slices of better-color green jadeite that had been placed under a fabricated crust (figure 15, right).

The sawn boulder measured 96.30 × 84.60 × 34.10 mm, with a weight of 422 grams. The core of the boulder was a dark mottled grayish green, with more saturated

green “windows,” and the crust was a mottled dark brown. By shining a strong light through the edge of one “window,” we were able to observe an absorption spectrum with the handheld spectroscope: This showed a line at 437 nm, but no detectable “chromium lines.” (Chromium lines would be expected in a piece of jadeite with as intense a green color as the windows suggested.) Only two features—besides the appearance where the boulder had been sawn—provided any suggestion that the quality of this piece had been falsified. First, weak yellow fluorescence to long-wave UV radiation was seen in areas of the crust surrounding the “windows” (probably caused by the binding material). Second, the crust in many places—not just by the windows—reacted when it was approached by a hot point. This latter observation suggests that much of the crust, not just that covering the edges of the “windows,” may have been made of ground rock plus an organic binding material.

A similar fake was reported on the Canadian Institute of Gemmology’s Web site (<http://www.cigem.ca/357.html>) after the 1997 Tucson show. This boulder had been



Figure 15. Left: this “window” (about 1.5 cm long) in a jadeite boulder suggests that the boulder is of reasonably good quality. Right: when the boulder was sawn, the owner found that the “windows” were thin slices of jadeite that had been placed under a fabricated crust. Photos by Maha DeMaggio.



Figure 16. A plasma-deposited titanium coating creates the iridescent, high-luster surfaces in this 24-mm-long pendant-set cabochon and the two free-form cabochons. Pendant courtesy of Maxam Magnata; photo © GIA and Tino Hammid.

sliced into three pieces, hollowed out, and filled with a “leaf-to-emerald green jelly” that enhanced the appearance of a “window” polished on the surface. Again, the fraud was not obvious until the boulder was sawn.

Titanium- and gold-coated drusy materials in jewelry.

The appearance of a material can be substantially changed by altering its luster as well as its color. To this end, very thin layers of metals and oxides are used to create lustrous (but still transparent) materials with unusual colors. Examples include blue “Aqua Aura”-coated quartz (Gem News, Winter 1988, p. 251; Fall 1990, pp. 234–235) and the many colors of coated quartz that we reported in the Fall 1996 Gem News (pp. 220–221). As these layers are very thin, the coated material is generally not appropriate for many jewelry purposes.

However, the techniques for applying these coatings—among them, plasma deposition and sputtering—can also be used to apply thicker metallic coatings with better durability. Because the metals are opaque, though, all but the thinnest coatings tend to be opaque as well. One of the more spectacular metals used for such coatings is titanium, since it reacts with oxygen or oxidizers to form titanium oxide layers with bright “interference” colors and a metallic to submetallic luster. Among the

colors reported by J. B. Ward (“The Colouring and Working of the Refractory Metals Titanium, Niobium, and Tantalum for Jewellery and Allied Application,” *Worshipful Company of Goldsmiths [London] Technical Advisory Committee Project Report No. 34/1, 1978*) are: “gray, pale amber, dark amber, brown, purple, maroon, navy blue, sky blue, rich purple, bottle green, lime green, peacock blue, and gray brown.” Over the past few years, we have seen many items—from quartz crystals to arrowheads—that had such coatings. Few, though, would be considered gem materials.

Recently, Maxam Magnata, of Fairfield, California, began selling drusy gem materials with this thicker plasma-deposited coating (see, e.g., figure 16). Mr. Magnata and his partner, Abigail Harris, are marketing these materials as “Titania Gemstones.” Although they do not specify the type of drusy material that has been coated, a similar piece of unknown provenance that was examined in the Gem Trade Laboratory proved to be drusy quartz and chalcedony (resembling a section of a geode). Durability, although much improved, continues to be a concern, and Ms. Harris and Mr. Magnata caution that their “Titania Gemstones” should be cleaned with a soft toothbrush and water or mildly acid solutions (not detergent). Such coatings should not be buffed or polished.

This year at Tucson, Mr. Magnata also showed us fashioned pieces that had been coated with “hardened” 23K gold (figure 17). He explained that these coatings are applied to drusy quartz using vacuum deposition (sputtering); in some cases, an iridium-rich layer is added for hardening. For “black drusy”—on a base composed of quartz and manganese oxide (psilomelane)—an additional layer of transparent silica is added for protection. The

Figure 17. From left to right, these three free-form cabochons are “gold drusy,” psilomelane drusy partially covered with 23K gold, and psilomelane drusy; the last measures 19 × 26 mm. Photo by Robert Weldon; courtesy of Maxam Magnata.



gold coatings can be applied with a mask, so only part of the piece is coated. The same cautions apply for this material as for the "Titania Gemstones," and ultrasonic cleaning should not be used.

Surface-treated topaz. Gemstone treaters are constantly looking for new ways to add color to otherwise colorless gem materials. When simple heat treatment is not sufficient, other methods (such as irradiation or chemical diffusion) are often attempted. Following the success of diffusion treatment of corundum, the process has been tried on many other gem materials. Some of these attempts have resulted in surface coatings (e.g., quartz coated with blue cobalt glass, Summer 1994 Gem Trade Lab Notes, pp. 118–119), but we are not aware of any that have produced actual diffusion.

Last year we were told of several new colorless topaz treatments which have produced pink, orange, red, and bluish green colors. All these treatments have been represented as diffusion. We had the opportunity to examine specimens of all of these colors and determined that two different treatment processes are actually being used.

The pink, orange, and red colors have been treated by what appears to be a sputter-coating process, which produces a spotty surface coloration. This coating is not permanent; it can be scratched off easily with a needle or any other sharp object (figure 18). Indeed, at the Tucson show this year, several large parcels of the red material showed obvious paper wear on the facet junctions. This is clearly not a surface-diffusion process.

The bluish green material, however, is different. A parcel of approximately 30 stones was supplied to us for study by the inventor of the process, Richard Pollak of United Radiant Applications in Del Mar, California, and

Figure 18. The pink surface coating on this topaz was easily scratched with a pin, as seen here in reflected light. Photomicrograph by Shane F. McClure; magnified 23×.



Figure 19. These two stones represent the range of color seen in the bluish green to greenish blue surface-treated topaz supplied for this study. Photo by Maha DeMaggio.

the distributor, Gene Dente of Serengeti Company, San Diego, California. Although Mr. Pollak believes that the material is diffusion treated, and the treatment process is similar to that used for diffusion, Mr. Pollak confesses that he does not completely understand the exact mechanism taking place. A patent on this process is currently pending.

We examined six samples from the parcel in detail. These samples represented the range of color present in that parcel (bluish green to greenish blue; figure 19) and weighed from 5.64 to 6.36 ct. The gemological properties were as follows: refractive indices—1.610–1.611 for the low index and 1.620 for the high; diaphaneity—transparent; pleochroism—weak, green and bluish green; optic character—biaxial positive; (Chelsea) color-filter reaction—pink to red; fluorescence—inert to both long- and short-wave UV radiation; absorption spectrum using a desk-model spectroscope—three bands centered at 545, 585, and 640 nm.

When these samples were examined with a microscope, the bluish green color revealed a spotty appearance (figure 20), similar to that seen on the surface of the other colors of coated topaz described above. Many of the stones had chips on the keel line of the pavilion or elsewhere on the stone. All of these chips penetrated the colored layer and revealed the colorless material beneath (again, see figure 20). Penetration of the colored layer into the topaz could not be seen, even with magnification as high as 210×. Two of the stones showed blue concentrations at the point where some fractures reached the surface (figure 21). It first appeared that this might be similar to the "bleeding" we have observed in some diffusion-treated sapphires, but on closer inspection we could find no penetration of the color into the fractures themselves. With reflected light, we saw irregularities at these blue concentrations that made the surface look as if it had

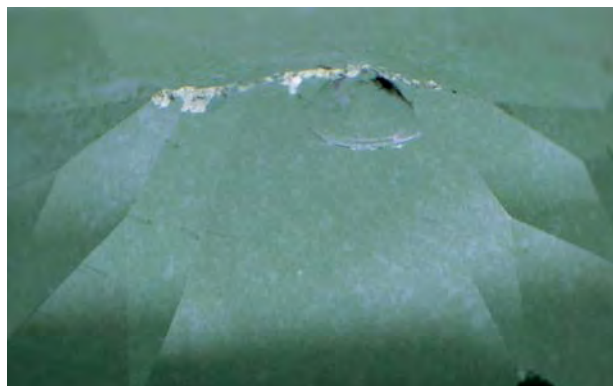


Figure 20. Spotty surface coloration is clearly visible on this treated topaz. Notice also the small chips at the culet that break through to the colorless material underneath. The large chip at the culet must have been present before the stone was treated, as it is covered by the treatment. Photomicrograph by Shane F. McClure; magnified 23 $\times$.



Figure 21. Blue color concentrations can be seen around several minute fractures on the table of this surface-treated topaz. Photomicrograph by Shane F. McClure; magnified 23 $\times$.

been melted. Again, the blue color was confined to the surface, at least at the magnifications available to us.

The chemistry of each of the six samples was determined by EDXRF. High concentrations of cobalt were detected, which is consistent with the color of the material, its absorption spectrum, and its reaction in the Chelsea filter.

We also attempted to determine the hardness of the bluish green/greenish blue color layer. To our surprise, we could not scratch it with a needle or with a Mohs 7 hardness point. It was only when we used a Mohs 8 hardness point (i.e., topaz) that we were finally able to scratch the treated surface. We also put half of one stone in a solar simulator for 164 hours to test the stability of this treatment to light. No fading of the color was observed in comparison to the other half of the stone, which we kept in the stone paper as a control.

Further investigation is necessary to understand the physical mechanisms taking place during this treatment process. Given the hardness of the color layer, it is clear that we are not dealing with a typical applied coating. It is also possible that there is some penetration of the color into the stone.

INSTRUMENTATION

New faceting machine. Development engineer Nick Michailidis has designed a new faceting machine, which he recently demonstrated to GIA staff. The "Diamante" (figure 22) can facet both diamonds and colored stones, and can do so in manual and automatic modes. The cutter can perform all the operations that turn a sawed and bruted diamond into a fashioned gem, such as blocking, polishing crown and pavilion mains, brilliantteering, table polishing, and girdle polishing. These operations can also be performed on colored stones.

The major features of the "Diamante" include: a portable benchmount (the machine has overall dimensions of 30 $\times$ 56 $\times$ 35.5 cm high), low vibration and noise levels, easy conversion between diamond and colored stone faceting, specially formulated cast-iron laps for diamond cutting (although it uses commercial 8 inch [20 cm] laps for colored stone polishing), a high-torque reversible motor with variable speed control, and a special fixture for re-faceting cast-iron laps. The precision quill head enables quick inspection of the stone without losing the stone orientation, and it can position facet angles to 0.1 $^\circ$. Other diamond holders and colored stone dops are available.

In addition to the spatial advantages that result from use of a single instrument for all steps in diamond

Figure 22. This new faceting machine, Imperial Gem Instruments' "Diamante," can be used to perform all steps in faceting both diamonds and colored stones. Photo by Nick Michailidis.



faceting, Mr. Michailidis notes a personnel advantage for small factories, as it is easier to train employees to proficiency on one machine rather than require that they learn to use several machines. He is marketing this machine through his company, Imperial Gem Instruments of Santa Monica, California.

ANNOUNCEMENTS

AGTA Announces Tanzanian Miners' Relief Effort. At the JCK Las Vegas Show in June, the American Gem Trade Association (AGTA) announced its Merelani Miners Relief program. This fund-raising drive comes in response to a recent catastrophe at the tanzanite mines in Merelani, Tanzania. In addition to the press release from the AGTA, we have some information from gem dealer Michael Nemeth of San Diego, California, who visited the region soon after the disaster (and who previously reported on conditions at Merelani in the Summer 1996 Gem News section, pp. 135-136).

In early April of this year (April 8, according to Mr. Nemeth), heavy rains led to the flash-flooding of several pits in Block B at Merelani, down to 1,000 feet (about 330 m). Although the disaster occurred during a holiday, 14 mines were being worked during the cool weather of the night and early morning. In addition, some workers were in the mines seeking shelter because of crude or nonexistent facilities on the surface. An early estimate of the loss of life was approximately 200 people, with 65 bodies recovered as of May 21, when AGTA representatives Philip Zahm and Jeff Schneider visited the area.

Ironically, the disaster came just as tanzanite production in Block B showed signs of increasing after a year-long dearth of stones. Mining was halted immediately after the disaster but has since resumed in some areas. Nevertheless, the task of cleaning out the flooded chambers (figure 23) will take months.

The tragedy has prompted the Tanzanian government and the mine owners to improve the primitive conditions at Merelani, where most of the mining is done by hand. The government has already dug a new drainage canal to redirect rain runoff away from the mines. AGTA's goal is to raise \$100,000, which will be used to construct a multi-purpose building on-site for the miners, as well as to train and equip a basic emergency medical team and a basic mine-rescue team. AGTA has already obtained pledges from medical and rescue trainers to volunteer their time and expertise. Anyone interested in contributing to the relief program should contact AGTA headquarters at 181 World Trade Center, 2050 Stemmons Freeway, Dallas, TX 75207 (Phone: toll-free in the U.S., 800-972-1162; outside the U.S., 214-742-4367).

Birthstone Exhibit at the Carnegie Museum. A collection of birthstones will be displayed at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, through September 6. The exhibit features 127 specimens of rough and cut gems and crystals based on AGTA's offi-



Figure 23. These Tanzanian miners are using a rudimentary rope-and-bucket system to remove dirt and debris from the flooded mine shaft. Photo by Jeff Schneider.

cial lexicon of birthstones, including a collection of natural fancy-color diamonds, a 17th-century diamond and ruby necklace, a wide range of pearls, and a 15 ct emerald. For more information, call (412) 622-3131, or visit the Carnegie's Web site at <http://www.clpgh.org/cmmh>.

Ninth annual conference of the Canadian Gemmological Association. On October 24 and 25, 1998, the Canadian Gemmological Association will hold its annual conference in Montreal, Quebec, at the Montreal Board of Trade, 5 Place Ville Marie. Although other subjects will be explored—including Canadian diamonds and Tahitian cultured pearls—the main topic will be emeralds, including production, cutting, marketing, and treatments. Among the guest speakers will be M. Boucher (on diamonds); M. Coeroli (on pearls); J.-P. Riendeau (on light sources); and K. Scarratt, A. Groom, contributing editor H. Hänni, and J.-C. Michelou (on emeralds). There will also be workshops on emerald treatments, to be held in both French and English. For conference reservations or additional information, please contact François Longère at (514) 844-3873.