GEM NEWS

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DIAMONDS

New diamond cut: "Tycoon cut." At the March 2000 AGS Conclave in Philadelphia, Toros Kejejian of Tycoon, Los Angeles, showed his former instructor (now GIA president) Bill Boyajian a new twist on emerald-cut diamonds. The "Tycoon cut" (figure 1) is a rectangular—or square—mixed cut with step-cut facets on the pavilion and a centered rhombus on the table. The cut (patent pending) is designed to provide more brilliance than a standard emerald cut.

The 6.93 × 5.09 × 3.39 mm F-color diamond shown in figure 1 had the following proportions: table—79%, length-to-width ratio—1.36, total depth—66.6%, and pavilion depth—56.6%. "Tycoon cut|" and a serial number were inscribed on the faceted girdle.

Figure 1. This 1.04 ct colorless diamond has been fashioned as a "Tycoon" cut, a new alternative to emerald or step cuts. Courtesy of Toros Kejejian; photo by Maha Tannous.

Diamond presentations at the PDAC conference. This year's conference of the Prospectors and Developers Association of Canada was held in conjunction with the annual meeting of the Canadian Institute of Mining and Metallurgy on March 5–10 in Toronto. Attendance was very high (12,000), and the mood was optimistic. With so many subjects presented, however, diamonds played a less prominent role than at the 1999 PDAC conference (summarized in the Summer 1999 Gem News, pp. 142–143). Here are highlights of some of the diamond reports.

Matthew Field of De Beers and **Charles Siwawa** of Debswana emphasized the importance of Botswana's Orapa diamond mine: It produces 25.6% of the total rough for De Beers–owned mines (and 6.7% of the world's production). Recent improvements to the recovery process have doubled Orapa's production capability. These developments, combined with the fact that Botswana is politically and economically stable, help ensure that Orapa will be a major and reliable contributor to the world's diamond supply for several decades to come.

Bruce Yago of Lakefield Research Ltd. discussed the important role of modern diamond service laboratories: They enable junior companies to join the hunt for diamonds without having to build their own (expensive) facilities for processing exploration samples. Mr. Yago predicted that the use of organic heavy liquids (such as bromoform, tetrabromoethane, and methylene iodide, all of which give off toxic fumes) for the recovery of diamonds eventually will be proscribed and replaced by mechanical and aqueous methods, such as Wilfley tables, water columns, and miniature dense-media separation plants that use nontoxic ferrosilicon liquids.

Representatives of several diamond exploration and mining companies gave presentations in the **Industry Exchange Forum**. Canada's first diamond mine, Ekati, managed by BHP, is on course at a planned annual production of 3 million carats. The Diavik project (figure 2), managed by Rio Tinto–Kennecott, received a setback last winter when their application for a land-use permit was refused; recent submission of a revised environmen-

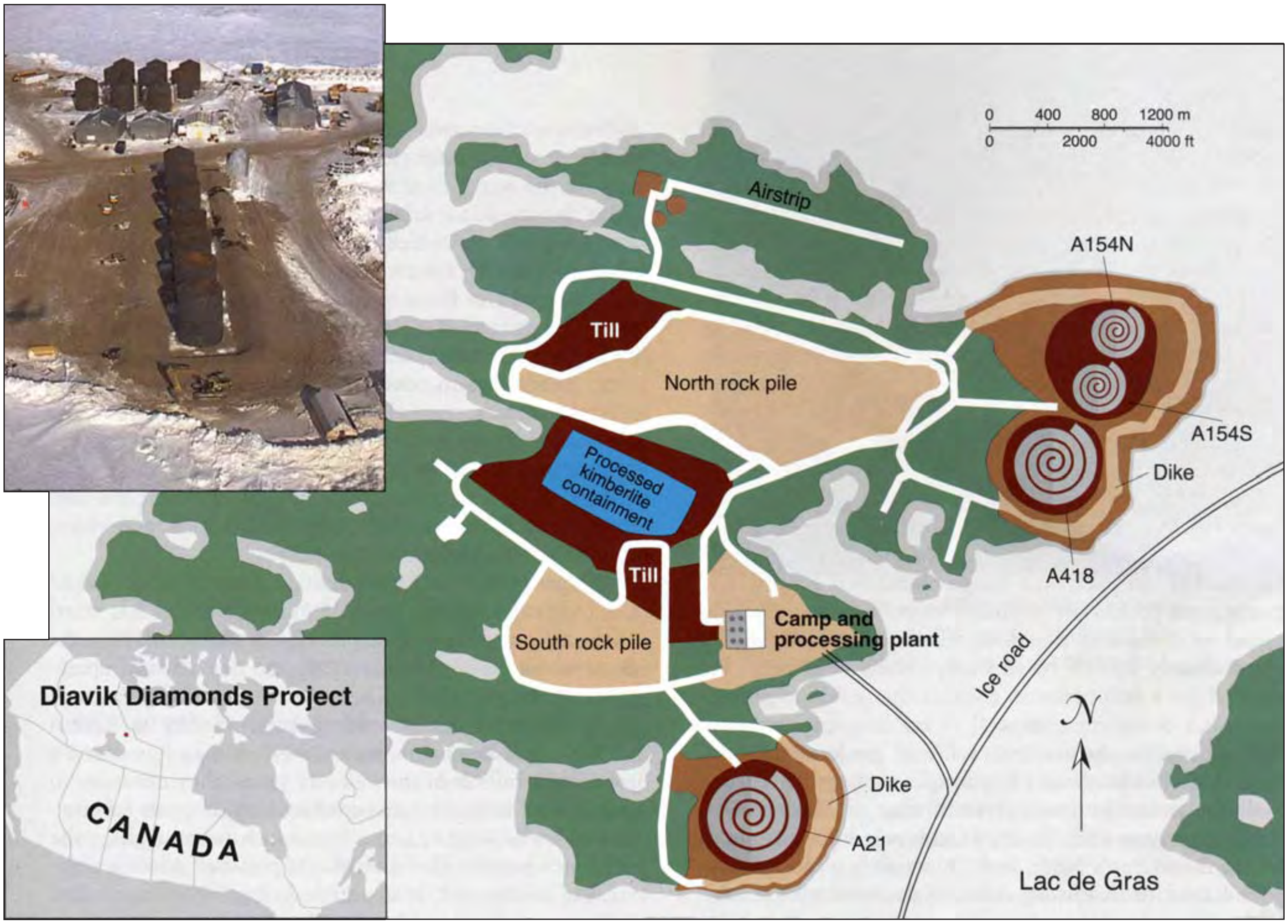

Figure 2. This map shows the projected layout of the Diavik project; the inset photo shows fuel tanks being assembled on-site in April 2000. Map and photo courtesy of Aber Resources.

tal impact statement resulted in the permit being granted just in time for heavy equipment to be rushed to the site while the winter road was still passable. As a result, start-up of the mine is still planned for late 2002 or early 2003. If Diavik has other setbacks, Winspear's Snap Lake property may well become Canada's second diamond mine. Because the Snap Lake operation will leave a much smaller "footprint," the permit process should be easier and faster than at Diavik. Snap Lake involves a small open pit on dry land, which would progress to underground mining of a shallow-dipping kimberlite dike. Operations at two other promising diamond projects—Kennady Lake, managed by Monopros (De Beers), and Jericho, managed by Tahera (previously Lytton)—have not advanced far enough to determine if economic exploitation is feasible.

Diamond exploration is continuing in Alberta, where Ashton has discovered more than two dozen kimberlites in the Buffalo Hills area. Several contain diamonds, but to date none appears to be a promising project. The decision by Monopros to bulk-sample the Victor kimberlite pipe, the largest in a cluster of 15 pipes, has given new impetus to diamond exploration in the James Bay Lowland area of Ontario. Another area of interest is Wawa, along the northeast corner of Lake Superior, where Canabrava, Diabras, and Band Ore are active.

Other ongoing diamond exploration activities worldwide were described in numerous booth displays. There were no formal presentations or booth displays about GE POL diamonds or "conflict diamonds," although both topics were raised in private conversations.

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Israel's 2nd International Rough Diamond Conference. An abundance of information was exchanged at this conference, held March 21–23 in Tel Aviv. In attendance were about 240 top people in the diamond industry, plus about 600 local diamantaires. The 13 speakers, whose talks are summarized below, included representatives of major diamond-producing companies, banks, and brokers, as well as various government agencies.

De Beers CEO **Gary Ralfe** discussed the company's "strategic review." Rather than continue to serve as custodian to the diamond industry, De Beers will aim to be a leader in diamond production and to compete in the rough diamond market. Recognizing these new realities, **Des Kilalea**, diamond analyst for Fleming Martin Securities, said that the comfortable years when the De Beers Central Selling Organisation (CSO) absorbed the world's surplus diamonds are over. For producers, this will mean lower prices, higher cut-off grades, and a search for front-end partners, such as the Aber-Tiffany link. For cutters and manufacturers, it means better links to rough sources, greater cost control, clever technologies, and increased spending on marketing and advertising. For consumers, it means more competitive prices, e-commerce, and branding.

According to **Paul Goris**, managing director of the Antwerp DiamondBank, "We have to reconcile ourselves to the fact that the days of a predictable and stable market, an exclusive single-channeled supply, and guaranteed profits are probably over, and that the diamond business is in transition to a free-market environment already known by so many other industries." He pleaded for a strict ban on conflict diamonds to protect consumer confidence, as well as for frequent consultation among producers, cutters, and bankers to avoid large price fluctuations. He offered a strategy for coping with the future business environment, dubbed "EBT": strong Equity in one's business, a detailed Business plan to submit to one's bank, and Transparency (no secrecy, price fixing, or hidden agendas) in the business process. **Richard Hambro**, chairman of I. Hennig & Co., echoed Paul Goris's theme that the diamond business of the future would be less predictable and more competitive.

Doug Bailey, CEO of Ashton Mining, discussed the risks—and potential rewards—of diamond exploration. For instance, he estimated that although C$1 billion had been spent exploring for diamond properties in Canada, the resulting properties are worth $3.5 billion. Ashton has 40% equity of the Argyle mine, and recently announced the discovery of additional underground reserves of 22 million tonnes valued at US$1 billion, which will extend mine life beyond 2010.

Gordon Gilchrist, managing director of Argyle Diamonds, described the challenges of marketing their product, a high proportion of which are small, brown, heavily included stones. When the mine opened in 1983, it quickly added 25 million carats annually to world diamond production, which had been about 50 million carats a year. Although until mid-1996, most of the production was sold through the CSO, Argyle has continually explored ways to market the brown diamonds on its own. The company helped develop the Indian diamond-cutting industry, which grew 185% in volume and 220% in value from 1983 to 1993. It also launched a promotion of "champagne" and "cognac" diamonds.

James Rothwell, president of BHP Diamonds, explained the three channels through which Ekati mine diamonds are marketed. All the diamonds are sorted and valued by government workers in Yellowknife, Northwest Territories (NWT), so that the Canadian government can extract the exact royalty. Thirty-five percent of the rough is sold under contract to De Beers, and 10% is reserved for sale to diamond-cutting factories that are being set up in Yellowknife. The remaining 55% is sold in Antwerp for the same prices as in Yellowknife. The run-of-the-mine production from the first pipe (Panda) averaged $165/ct, which is very high for a primary deposit. Updating the situation with the Diavik project, **Robert Gannicott**, president of Aber Resources, admitted that at more than $900 million, the capital cost is high. Nevertheless, the project remains economically robust under a wide range of economic variables. **Jake Ootes**, NWT Minister of Education, Culture and Employment, reiterated the importance of diamond mining in the Northwest Territories.

Sergei Oulin, vice president of Almazy Rossi-Sakha Co. (Alrosa), said that since 1996 his company has started mining two new open pits (Jubileynaya in 1996 and Butuobinskaya/Nyurba in 1999) and one alluvial operation (Anabar, in 1997). They also reopened the Zarnitsa pit (1999), and started underground mining at Aikhal (1998) and Internationalaya (1999). Alrosa has spent a total of $2 billion in the last five years; they now aim to sell 70% of their production to domestic buyers and cutters at below world prices. To discourage smuggling, the supply of rough and the output of polished goods will be strictly monitored. It is planned that 97% of polished diamonds will be exported. **Tim Haddon**, president of Archangel Diamond Corp. (ADC), explained Archangel's ongoing struggle to get their Russian partner to carry out the terms of an agreement that would transfer the license for the Verkhotina area to a Russian joint stock company, Almazny Bereg, in which ADC has a 40% equity. He hopes that Vladimir Putin, the new president of Russia, will resolve the matter.

Chris Jennings, of SouthernEra, noted that Angola's Camafuca deposit is the world's largest kimberlite (167 hectares) and is formed by five pipes that lie next to one another beneath the Chicapa River. Rather than divert the river, SouthernEra plans to mine the kimberlite with dredges in paddocks. **Inge Zaamwani**, managing director of Namdeb, discussed the history and development of that company, and noted that more than 50% of the diamonds Namdeb produces now are recovered from offshore deposits.

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COLORED STONES AND ORGANIC MATERIALS

Baltic amber with lizard inclusion. Figure 3 illustrates a lizard inclusion in a piece of Baltic amber that was found in June 1997 among Holocene fossil beach sediments in Gdansk-Stogi (Poland). The lizard (preserved length 3.7 cm) is encased in a piece of amber that measures about 3.5 × 2.0 × 1.0 cm. The infrared spectrum led us to identify the amber as succinite (i.e., fossilized tree resin that contains relatively high amounts of succinic acid). The body structure of the animal suggests that it belongs to the *Lacertidae* family. Although the lizard is incomplete—the front part of the head, dorsal fragment of the trunk, and tip of the tail are missing—it is well preserved; all body elements, which are covered with three types of scales, are perfectly visible. This specimen, from the collection of G. Gierlowska, represents the second almost complete lizard discovered in Baltic amber. It was loaned to the Museum of the Earth, Polish Academy of Sciences, Warsaw, for further investigation; a detailed report was recently published by M. Borsuk-Bialynicka et al. ("A lizard from Baltic amber [Eocene] and the ancestry of the crown group lacertids," *Acta Palaeontologica Polonica*, Vol. 44, No. 4, 1999, pp. 349–382).

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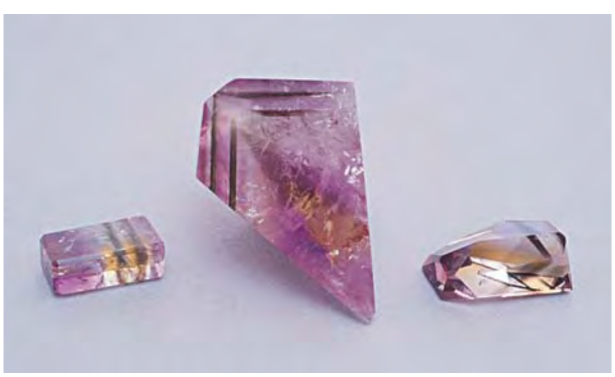
Figure 3. This piece of Baltic amber (succinite), which contains a 3.7-cm-long lizard, was found in Poland in 1997. Photo by G. Gierlowska.

Ametrine with layers of smoky quartz. Ametrine (amethyst-citrine) from Bolivia has been prevalent in the gem trade for many years (see, e.g., Gem News, Fall 1989, pp. 178–179, and Spring 1993, p. 53). At this year's Tucson gem show, H. Marancenbaum of Steinmar Ltd. (Santa Cruz, Bolivia) kindly provided two rough fragments, three slightly polished crystals, and two fantasy-cut specimens of ametrine to the SSEF Swiss Gemmological Institute. Mr. Marancenbaum reported that these samples originated from the Yuruty mine, a new operation that is located in the same geologic unit (Murciélagos limestones) in Bolivia as the well-known Anahí mine (Vasconcelos et al., *Gems & Gemology*, Spring 1994, pp. 4–23).

An investigation of these Yuruty mine samples by the present contributor revealed an interesting new aspect to this bicolored quartz. In addition to the typical amethyst and citrine sectors (along the major and minor rhombohedral forms; again, see Vasconcelos et al., 1994), five of the samples also showed a similar pattern of two distinct layers of smoky quartz. These layers are oriented parallel to the minor rhombohedral form z $\{01\bar{1}1\}$, within the citrine sector (see, e.g., figure 4). In the slightly polished crystals, the smoky layers were observed just below the surface. In this area, the color of both amethyst and citrine is rather pale. The two (broken) fragments that did not show smoky quartz layers were presumably derived from the central portion of a crystal; they did display more intense amethyst/citrine coloration.

Figure 4. Two parallel zones of smoky quartz are evident in these three ametrine specimens (27.3–299.7 ct) from the new Yuruty mine in Bolivia. Photo © SSEF Swiss Gemmological Institute.



The growth conditions of this unusual ametrine evidently facilitated the enhanced accommodation of aluminum impurities in the z sectors. Natural irradiation of these aluminum-rich zones would give rise to the smoky quartz color layers.

Approximately 30 tons of material have been produced at the Yuruty mine since February 1999, according to Mr. Marancenbaum. Large quantities of rough and cut amethyst, citrine, and ametrine from this new mine were available at this year's Tucson show, and he anticipated that about 10,000 carats of cut material monthly could be expected in the near future.

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Bicolored cat's-eye beryl from Pakistan. Also at the February 2000 Tucson show, Dudley Blauwet of Dudley Blauwet Gems, Louisville, Colorado, showed this contributor two bicolored beryl cabochons that each displayed an interesting chatoyant band along the color boundary. Mr. Blauwet reports that the rough was mined in 1997–1998 from a pegmatite in the Shigar Valley area, above the village of Haiderabad in Pakistan. The deposit is situated on the southwest flank of Buspar Peak, at an elevation of about 12,000 feet (3,660 m). Approximately 100 crystals or fragments with the distinctive chatoyant band have been recovered to date, measuring up to 4 × 5 cm. About one dozen cabochons were cut; he loaned the largest one (30.37 ct; figure 5) to GIA for closer examination.

The color boundary, which was sharp and evenly centered, was oriented perpendicular to the c-axis. One half of the stone was greenish blue, and the other was very pale pink. Spot R.I. readings of 1.56 were recorded for both colors. The pink half was transparent to translucent due to abundant "fingerprints" composed of wavy planes of two-phase (liquid-gas) inclusions. The greenish blue half was transparent but contained numerous growth tubes oriented parallel to the c-axis, which caused subtle chatoyancy. With a magnification of 40×, tiny colorless crystals were visible at the ends of these tubes. Scattered dark gray-green prisms (which appear to be tourmaline) also were seen in the greenish blue portion, particularly along the contact with the pink half. The 2.5-mm-wide chatoyant band lay within the greenish blue portion, very near the color boundary. The band appeared colorless due to the scattering of light associated with the chatoyancy; it contained abundant fine structures oriented parallel to the c-axis, as well as the growth tubes described above.

Figure 5. A narrow chatoyant band is present along the color boundary of this 30.37 ct bicolored beryl from Pakistan. Courtesy of Dudley Blauwet; photo by Maha Tannous.

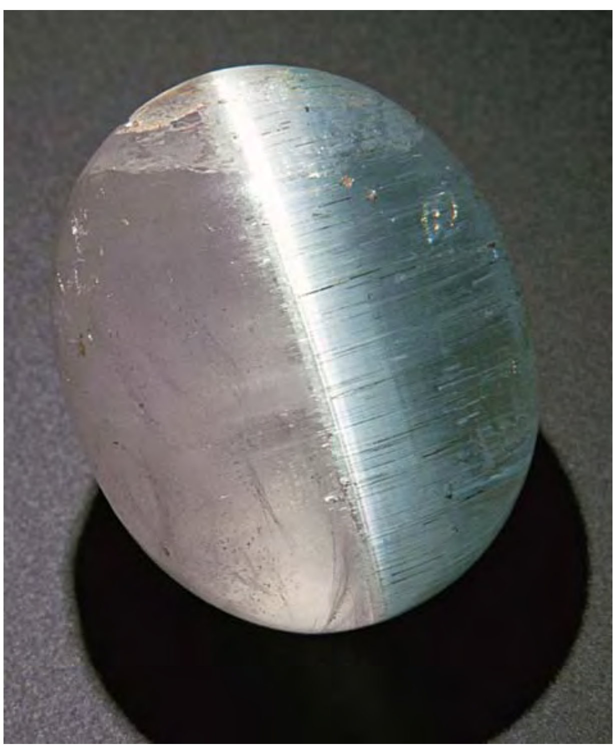

Figure 6. Purchased in Brazil, this 2.36 ct bicolored stone is a natural intergrowth of emerald and colorless quartz. Photo by Jaroslav Hyrsl.

Mr. Blauwet indicated that the pink portion is always present at the crystal terminations, and that the small size of this zone renders most of the rough unusable for cutting bicolored pieces. He also stated that some of the rough failed along the color boundary/chatoyant band during cutting, because of structural weakness in this area. For these reasons, few fashioned stones have been produced.

Brendan M. Laurs
Senior Editor, Gems & Gemology

Natural emerald and quartz intergrowth. A very unusual colorless and green bicolored stone was purchased by this contributor in 1998 in Belo Horizonte, Brazil. The 2.36 ct stone measured 7.96 × 7.53 × 4.84 mm. At first glance, the stone appeared to be an assembled doublet with the join between the two halves oriented perpendicular to the table facet (figure 6), rather than parallel to the table plane as is common with most doublets. However, close examination with a microscope showed that it was actually a natural intergrowth of two separate minerals.

The refractive index of the colorless, semitransparent half was 1.545–1.553, which confirmed it as quartz. The green portion showed an R.I. of 1.583–1.591, was strongly dichroic (bluish green and yellow-green), did not react to a Chelsea filter, and did not show any sign of red transmission; its spectrum with a handheld spectroscope confirmed that it was emerald.

The emerald portion was inert to both long- and short-wave UV radiation, whereas the quartz half fluoresced a strong white (concentrated in fractures) to short-wave UV (with no reaction to long-wave UV). This suggests that this stone was probably "filled" with some type of substance, although none of the known or potential emerald fillers mentioned by Johnson et al. (*Gems & Gemology*,

Figure 7. Subhedral plates of what appear to be mica or chlorite (see arrows) are present in both the emerald and quartz portions, as well as at the contact between them. Photomicrograph by Jaroslav Hyrsl; magnified 10×.

Summer 1999, pp. 82–107) had this type of fluorescence.

Both portions were found to contain natural inclusions. Subhedral brownish green flakes with a distinct basal cleavage, which appear to be mica or chlorite, were present in both halves, as well as in the contact between the two minerals (figure 7). Part of the contact consists of an air-filled crack that appears mirror-like at some angles. The emerald portion is characterized by parallel hollow channels, which rarely contain an anisotropic phase. Some of the channels also contain two-phase inclusions. Very rare, extremely small three-phase inclusions also were observed, but of a type different from those known to occur in emeralds from Colombia. The three-phase inclusions in this stone were either parallelepipeds or asymmetrical; each contained a bubble and a small anisotropic solid phase. On the basis of the inclusions, we believe that this unusual bicolored stone probably comes from the Belmont mine near Itabira in Minas Gerais, Brazil (see H. A. Hänni et al., "The emeralds of the Belmont Mine, Minas Gerais, Brazil," *Journal of Gemmology*, Vol. 20, Nos. 7/8, 1987, pp. 446–456). *Jaroslav Hyrsl (Hyrsl@bbs.infima.cz) Kolin, Czech Republic*

Update on some Madagascar gem localities. This island nation continues to supply an impressive array of gem varieties, in some cases of high quality and in enormous quantities. To gather first-hand information on the gem production and geology of the deposits, in November-December 1999 this contributor visited three gem-producing areas: the sphene deposits in northern Madagascar; the tourmaline-, beryl-, and spodumene-bearing pegmatites in the central part of the country; and the alluvial gem deposits at Ilakaka in southern Madagascar. The guide for most of the trip was Dr. Federico Pezzotta of the Natural History Museum of Milan, who is involved in several geologic studies throughout Madagascar (in collaboration with the local public institutions) and is a consultant to the Italian-Malagasy joint venture Pyramide Co.

In recent years, Madagascar has become perhaps the world's leading supplier of large facet-grade sphene (or titanite, which is the name currently accepted by the International Mineralogical Association). This attractive green to yellowish brown gemstone shows colorful dispersion (figure 8), but it is rarely faceted in large sizes due to the flat shape of the crystals. However, Madagascar has yielded faceted sphenes over 20 ct (see, e.g., Spring 1998 Gem News, p. 53); Allerton Cushman & Co., of Sun Valley, Idaho, displayed a 35.29 ct Madagascar sphene at the June 2000 JCK Show. The crystals are mined over a large region of northern Madagascar from *in situ* hydrothermal veins (i.e., alpine clefts) that formed during retrograde metamorphism of amphibolite-grade rocks during the late stages of the Pan-African Orogeny, according to Dr. Pezzotta. These veins also contain large quantities of transparent quartz crystals locally associated with albite (pericline), apatite, epidote, rutile, schorl, clinochlore, dolomite, and hematite.

To access the mines, we flew from Antananarivo to Sambava, and then drove three hours on a paved two-lane road to Vohemar on the northeastern coast, and another three hours northwest on a fairly good dirt road to Daraina, a small town where much of the sphene is traded. Production had been sporadic, and we saw very little sphene rough. However, one of the sphene prospects we visited had produced 5 kg of gem rough and

Figure 8. Sphene from northern Madagascar shows a range of color, although "pure" green is most rare. These samples weigh 0.92–2.52 ct. Courtesy of Madagascar Precious Gems (Budsol Co.); photo by Maha Tannous.

Figure 9. This Malagasy dealer in Antsirabe, known locally as "Papa Emeil," had a variety of rough and cut Madagascar gems. Photo by Brendan Laurs.

several very fine crystal clusters in February 1998, according to Dr. Pezzotta.

We briefly visited Milanoa, a small gem-trading town about 50 km south of Daraina. Apatite, which is heated to obtain its bright greenish blue color, reportedly comes from a primary deposit about 40 km southwest of Milanoa. Most of the sapphire traded in Milanoa comes from alluvial deposits in the Ambilobe area (sometimes identified as "Diego Suarez," after the city to the north). A dealer in Daraina reported that about 200 miners were active in this area, having recently returned from Ilakaka, where they could not obtain productive claims. Significant stones are occasionally recovered: We were shown an approximately 50 g gemmy dark blue sapphire crystal that was reportedly found in a river about 40 km west of Milanoa in early November 1999.

After returning to Antananarivo, we drove about three hours south on national highway 7 to Antsirabe, which is the traditional hub of the gem trade in Madagascar due to its proximity to abundant gem-bearing pegmatites. Most of the dealers we visited (see, e.g., figure 9) had rough and faceted stones from Ilakaka, as well as stocks of other gems such as amethyst, garnets, and multicolored tourmaline (probably liddicoatite). We visited several pegmatites in the central portion of the Sahatany Valley, which produces tourmaline (red and multicolored), beryl (morganite), and spodumene (kunzite), as well as the rare gem mineral rhodizite. Only one of these pegmatites was being actively mined. According to Dr. Pezzotta, these late Pan-African granitic pegmatites are hosted by marble, quartzite, and schist, and have been worked in shallow hand-dug pits and tunnels since the turn of the century. Gem production fell sharply after the mines in this part of the valley were nationalized in 1974. More recently, activity has slowed due to the migration of miners to Ilakaka. Our reconnaissance of the workings suggested that some of the pegmatites still hold significant potential for gem production.

For the journey to Ilakaka, I joined Tom Cushman of Allerton Cushman & Co., who was one of the first dealers to visit Ilakaka after sapphires were discovered there in 1998. We flew from Antananarivo to Tulear, and then drove about three hours northeast on national highway 7 to Ilakaka.

The Ilakaka gem deposits are hosted by conglomerate layers within the Paleozoic-Mesozoic Isalo Formation (part of the Karoo Supergroup), which covers an enormous portion of south and east Madagascar. Most of the mining is done in an area that measures about 30 × 65 km, but the gem-bearing region extends at least 30 km north and 100 km southwest of the town of Ilakaka. The miners hand dig pits—typically a few meters, although deeper pits are sometimes excavated (figure 10)—in the weathered sediments to reach the conglomerates, which are loaded into sacks and taken to the nearby stream for washing. The gems are hand picked from primitive sieves made by poking holes through sheet metal that is supported by a wooden frame. The stones are sold to Malagasy middlemen, who offer them to overseas buyers (mostly from Sri Lanka and Thailand) at a local central selling area called the Comptoir.

The sapphires range from near-colorless to pink, purple, and blue (figure 11). Within just two days, we noted several gem species besides sapphire: spinel (dark gray-blue to green-blue, and grayish pink), garnet (purplish red, red, yellow-orange), chrysoberyl (including cat's-eye and alexandrite), topaz (pale yellow or blue), tourmaline (dark yellow-green to red-brown or brownish pink), andalusite, kyanite, zircon (reddish brown and greenish brown), and quartz (colorless, smoky, and amethyst). All of these gem materials have been documented previously from this area (see, e.g., reports by H. A. Hänni in the Summer 1999 Gem News, p. 150, and F. Pezzotta, in *extraLapis* No. 17, 1999, p. 92). The sapphire rough typically ranged from 1 to 3 ct, with 10 ct considered large. Transparent pebbles of spinel, garnet, and chrysoberyl commonly weighed up to 25 ct.

According to Mr. Cushman, about 80% to 90% of the blue sapphires from Ilakaka need to be heated (to improve or even out their color); a somewhat lower proportion of pinks require heat treatment (to remove the purple component). As has been reported in the trade press, several buyers were disappointed initially with the response of the sapphires to heat treatment: Over-dark blues did not get lighter with heating, and some of what appeared to be *geuda*-type sapphire did not alter to blue. None of the rough at the Comptoir showed any evidence of heat treatment, despite prior reports to the contrary (see, e.g., J. Henricus, "Mixing heated material with natural at mines," *Jewellery News Asia*, July 1999, p. 49). Although we could not confirm whether any sapphires are heat-treated within Madagascar, in Antananarivo I was offered faceted pink and blue sapphires that showed evidence of heating (i.e., discoid fractures surrounding inclusions). Zircon is heat-treated in Madagascar at relatively low temperatures to lighten the red-brown color to a more desirable pale orangy yellow. If heated too long, the stones will become overly pale.

At the June 2000 JCK show, Mr. Cushman provided a further update on the Ilakaka area. During a visit there in May 2000, he noted that there is a new mechanized mining operation just south of the Comptoir, on the opposite side of the Ilakaka River. Heavy equipment, including a large excavator, bulldozer, and two dump trucks, is being used in conjunction with a three-story-tall processing plant, with water supplied by from the Ilakaka River. The mining is being conducted by a Thai company (Société Mining Discovery), and all rough is sent directly to Bangkok. Mr. Cushman also stated that a major new mining area has developed about 60 km southwest of Ilakaka that shares its "boom town" atmosphere. According to Alexander Leuenberger of Larimar SARL in Antananarivo, this new mining area is located at Mahasoa.

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Senior Editor, Gems & Gemology

Figure 10. At Ilakaka, Madagascar, miners dig pits through the weathered sandstone to reach the productive gem-bearing conglomerate layers. At the time this photo was taken (December 1999), this was the largest hand-dug excavation at Ilakaka. Photo by Brendan Laurs.

Freshwater cultured "Kasumiga pearls," with Akoya cultured pearl nuclei. Frieden of Switzerland, a client of the SSEF Swiss Gemmological Institute, submitted three strands of attractive Japanese freshwater cultured pearls that was believed to be the product called Kasumiga, after the pearl-culturing region of Lake Kasumigaura, north of Tokyo. Kasumiga pearls are said to be grown in *Hyriopsis schlegeli* × *Anadonta plicata* hybrid mussels. Each of the 40-cm-long strands consisted of approximately 40 pearls, which ranged from 9 to 13 mm in diameter. The client had requested information about the presence or absence of a nucleus, the thickness of the nacre, and whether the overgrowth formed in freshwater or saltwater.

Figure 11. Sapphires in a range of colors have been recovered from Ilakaka. These samples weigh 1.42–4.76 ct; photo by Maha Tannous.

X-radiographs revealed the presence of two drill holes in most of the cultured pearls, at a random orientation to each other (figure 12). *Gems & Gemology* reported such features in Japanese freshwater cultured pearls nearly 40 years ago (see R. Crowningshield, "Fresh-water cultured pearls," Spring 1962, pp. 259–273).

With the client's permission, we ground away half of one cultured pearl and polished the surface (figure 13). The bead nucleus was covered by a very thin (0.2 mm) overgrowth of nacre, which was separated by a slight gap from a much thicker (>2 mm) layer of freshwater nacre (figure 14). An energy-dispersive X-ray fluorescence analysis of the aragonite at the pearl's surface showed an abundance of manganese: three times more than in average saltwater nacre. This confirmed the freshwater origin of the outer nacre layer. It appears, then, that drilled low-quality Akoya (saltwater) cultured pearls were used as bead material for these Kasumiga freshwater cultured pearls. The resulting freshwater cultured pearls have a remarkable diameter with thick nacre layers and appealing surface quality. *HAH*

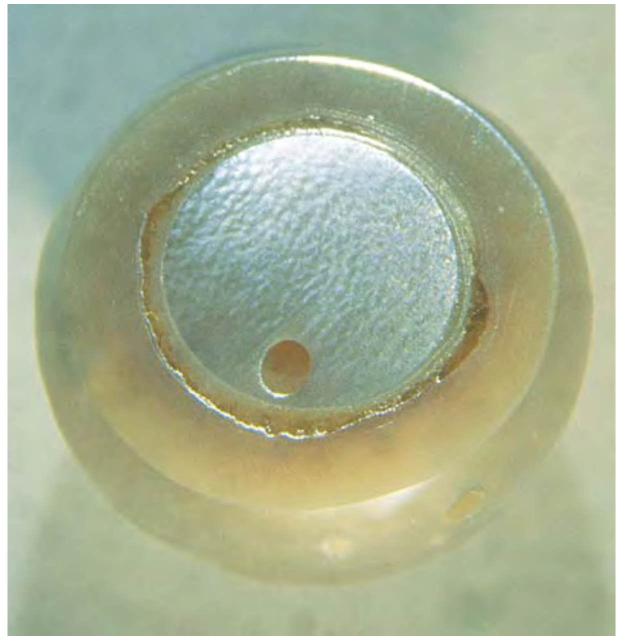


Figure 13. This 9.7 mm Kasumiga freshwater cultured pearl appears to have been nucleated by a nacre-covered shell bead (7 mm in diameter) that shows a normal drill hole. Photo by H. A. Hänni.

Trapiche ruby: An update. Trapiche rubies from Mong Hsu, Myanmar, consist of six transparent-to-translucent ruby sectors separated by translucent-to-opaque yellow or white planes that form a fixed six-rayed star. Many samples also reveal a hexagonal yellow, black, or red core (figure 15). The yellow or white "arms" of the six-rayed stars consist of ruby with a dense concentration of solid, liquid, or two-phase inclusions. The solid inclusions have been identified as calcite and dolomite (K. Schmetzer et al., "Trapiche rubies," *Gems & Gemology*, Winter 1996, pp. 242–250).

The chemical zoning in Mong Hsu trapiche rubies was examined by K. Schmetzer et al. ("Element mapping of trapiche rubies," *Journal of Gemmology*, Vol. 26, No. 5, 1999, pp. 289–301). From subsequent chemical and microscopic examinations, I. Sunagawa et al. ("Texture formation and element partitioning in trapiche ruby," *Journal of Crystal Growth*, Vol. 206, 1999, pp. 322–330) concluded that the arms formed first, during a period of dendritic growth. The transparent-to-translucent triangular or trapezoidal ruby sectors formed later, by layer-by-layer growth on smooth interfaces (figure 16).

Figure 12. Most of the cultured pearls in this X-radiograph of a strand of Japanese Kasumiga cultured pearls reveal the drill hole through the bead nucleus as an oblique line (the length of which depends on its inclination to the direction of observation) that ends at the thicker nacre layer. X-radiograph by H. A. Hänni.

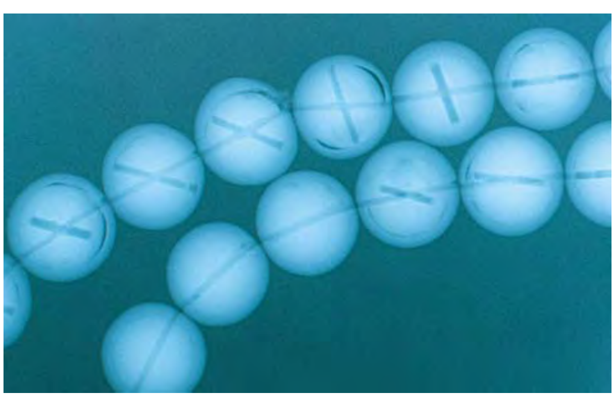
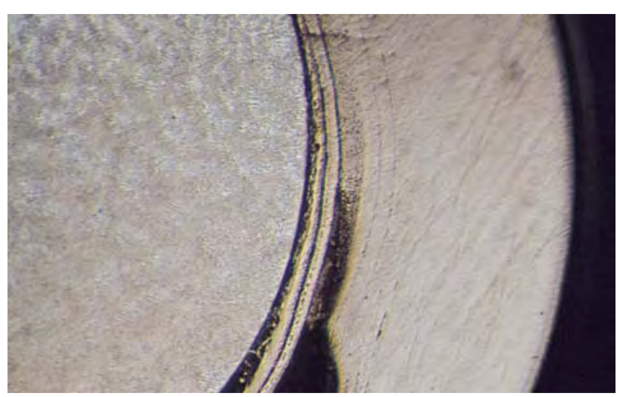


Figure 14. With magnification and reflected light, the two generations of nacre, separated by a gap, are clearly visible in the Kasumiga cultured pearl shown in figure 13. The relatively high manganese content of the outer layer proved that it formed in fresh water rather than salt water. Photo by H. A. Hänni.



Although trace-element mapping has indicated chemical zoning (e.g., of chromium and titanium) in the six ruby sectors of some trapiche rubies, direct microscopic observation had not previously revealed growth zoning that might indicate the mechanism by which these regions formed. However, we recently observed distinct zoning in several trapiche rubies found by one contributor (DS) within parcels of Mong Hsu rough obtained at the gem market at Mae Sai, in northern Thailand.

The layer-by-layer growth pattern in the ruby sectors was clearly seen in polished slabs cut perpendicular to the c-axis of these crystals. In its simplest form, this growth zoning consists of sequential parallel ruby layers. In some samples (again, see figure 15), alternating red and dark violet-to-black layers were found, with layers of both colors oriented parallel to the hexagonal dipyramid ω $(14\ 14\ \overline{28}\ 3)$. This crystal form is the commonly observed dominant growth plane in Mong Hsu rubies. The presence of this growth zoning confirms the sequential layer-by-layer growth mechanism for the ruby sectors of Mong Hsu trapiche rubies, as proposed by Sunagawa et al. (1999).

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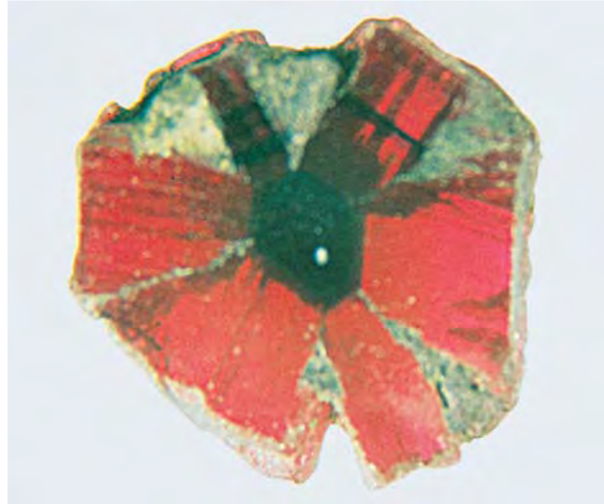


Figure 15. This trapiche ruby from Mong Hsu, Myanmar, consists of a dark violet, almost black core, six white arms that widen toward the outer edge of the crystal, and six trapezoidal ruby sectors. In some of these transparent ruby sectors, a distinct red and dark violet color zoning parallel to dipyramidal growth planes was observed with magnification. The sample measures about 5.5 × 6 mm. Photo by K. Schmetzer.

Spinel from Ilakaka, Madagascar. As discussed in the "Update on Madagascar" entry above and in numerous other publications, this recently discovered mining area has become well known for its large production of blue and fancy-color sapphires and numerous other gems. Besides garnet, one of the most abundant of these other gem materials appears to be spinel.

To help characterize the gem spinels from Ilakaka, this editor studied 120 samples: 80 pebbles that ranged from 0.5 to 40 ct were selected from different parcels of mixed rough that were obtained from Ilakaka; and 40 faceted gems (0.2 to 4.0 ct) were selected from mixed parcels of corundum and spinel, all of which had been purchased in Ilakaka and faceted in Madagascar. The samples were separated into a total of five groups on the basis of their color. Roughly half were violet to grayish violet, purplish violet, or bluish violet (figure 17). Of the remaining half, about 30 were violetish blue to blue (figure 18), and about 20 were purple to reddish purple (figure 19, right). Another five samples were red, pink (figure 19, left), or orange, and the remaining five samples were greenish blue to bluish green (figure 17, inset).

Refractive indices, measured on all faceted samples, ranged from 1.716 to 1.719. Specific gravity values (measured hydrostatically) ranged from 3.59 to 3.64. Microscopic examination revealed the presence of birefringent mineral inclusions in about one-third of the spinels. When examined between crossed polarizers, most of the otherwise inclusion-free spinels showed weak anomalous double refraction.

Natural spinels typically have complex spectra that, in general, consist of the superimposed absorption bands of several basic types of spectra (see, e.g., J. E. Shigley and C. M. Stockton, "Cobalt-blue gem spinels," Spring 1984 *Gems & Gemology*, pp. 34–41; and K. Schmetzer et al., "Color of natural spinels, gahnospinels, and gahnites," *Neues Jahrbuch für Mineralogie Abhandlungen*, Vol. 162, No. 2, 1989, pp. 159–180). This is also the case for

Figure 16. In trapiche rubies, the arms develop by dendritic growth, and then the ruby sectors form by layer-by-layer growth. In some cases, (right), a core grows first by a different smooth-surface mechanism. Figure adapted with permission from Sunagawa et al. (1999).

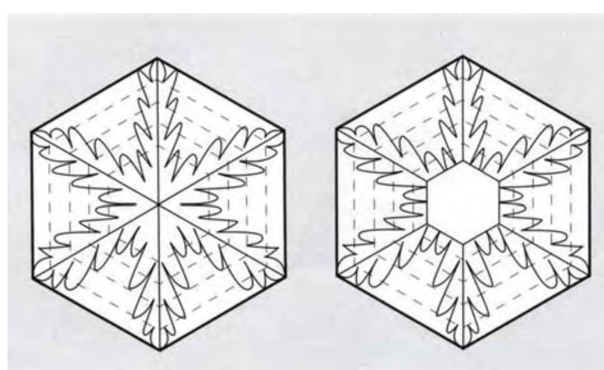


Figure 17. These three violet to purplish violet spinels from Ilakaka, Madagascar, are predominantly colored by iron; the samples weigh 1.30–1.67 ct. Inset: Two bluish green samples (1.21 and 0.78 ct), also colored by iron, represent spinel colors that have been seen only rarely in lots from Ilakaka. Photos by Maha Tannous.

Ilakaka spinels that are colored by iron or chromium, or by a combination of iron plus cobalt or iron plus chromium. A general scheme of the colors (and their causes) found thus far in Ilakaka spinels is given in figure 20.

Absorption spectra in the visible and UV range showed distinct features for the five groups. The largest (violet) group revealed spectra typical for spinels that are colored predominantly by iron. The violetish blue to blue samples showed the same features, plus absorption bands that have been assigned to cobalt in spinels; the most prominent was a band at 625 nm. Other cobalt-related bands overlap with iron bands, but the influence of cobalt on the color can be estimated by the intensity of the 625 nm absorption.

Figure 18. These three blue spinels from Ilakaka (0.99 to 2.09 ct) are colored by cobalt and iron. Photo by Maha Tannous.

The small group of greenish blue to bluish green samples again revealed a basic iron spectrum, which is superimposed by an absorption band at about 645 nm. This absorption band has been assigned to Fe^{2+}/Fe^{3+} charge transfer (see Schmetzer et al., 1989, above). The remaining two groups of purple to red or pink samples revealed a chromium spectrum, with absorption maxima at 543, 413, and 388 nm. A continuous series was observed from pink or red samples colored predominantly by chromium to violet samples colored predominantly by iron. Intermediate spinels (orange, reddish purple, or purple) exhibited an iron spectrum that was superimposed by chromium absorption bands of variable intensity.

The different color groups observed thus far in spinels from Ilakaka represent the full range of colors and spectral features observed in samples from other localities, such as Sri Lanka. *KS*

TREATMENTS

Unusual treated chalcedony. A number of small-volume gem and mineral dealers set up "shop" on small tables along the Interstate 10 corridor in Tucson, Arizona, during the Tucson gem shows each year in late January and early February. While the first impression might be that these goods are of questionable interest to the greater gem and jewelry community, closer inspection shows that there are some fascinating items to be found.

One such item was a translucent white oval cabochon with a large, well-centered, silvery gray metallic-looking dendritic plume formation (figure 21). The 26.87 ct cabochon measured 31.10 × 22.79 × 5.10 mm, and was represented as chalcedony with a dendritic formation composed of electrically induced metallic tin. It was a "one-only item" in a large group of obviously treated light blue-green translucent chalcedony cabochons that also contained electrically induced dendrites, but of elemental copper. We had encountered the latter dendrites

Figure 19. The pink spinel (1.36 ct) is predominantly colored by chromium, and the color of the purple sample (3.74 ct) is caused by a combination of chromium and iron. Photo by Maha Tannous.

in chalcedony on several prior occasions (see, e.g., Winter 1986 Gem News, p. 246). However, we had not previously examined a treated chalcedony with dendritic plumes represented as elemental tin, so we purchased this cabochon for testing and photography.

While standard gemological tests easily established that the cabochon was chalcedony, we turned to EDXRF analysis (by Sam Muhlmeister, of GIA's Research Department) to determine the chemical nature of the dendrites. This technique detected only silicon and tin. The strength of the tin peak, together with the metallic appearance of the dendritic plumes both macroscopically and microscopically, left no doubt that the dendrite formation was indeed composed of elemental tin.

This particular tin dendrite was probably produced by the same type of electrically stimulated chemical reaction sequence that is used to induce copper dendrites in chalcedony. G. W. Fischer provides step-by-step descriptions of the treatment processes used to form both copper and tin dendrites in porous translucent chalcedony in his book *Gemstone and Chemicals: How to Create Color and Inclusions* (self-published, 1991).

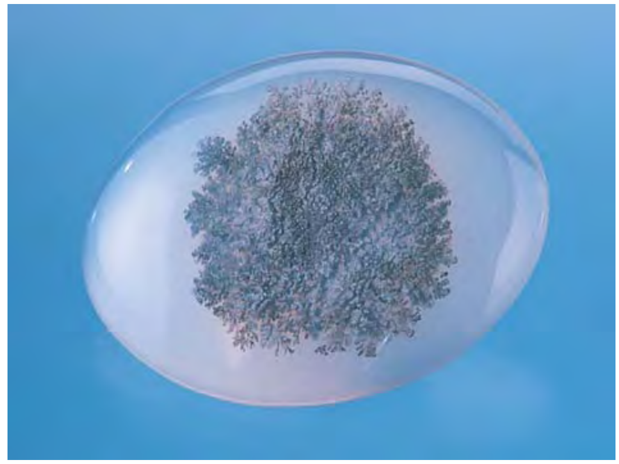
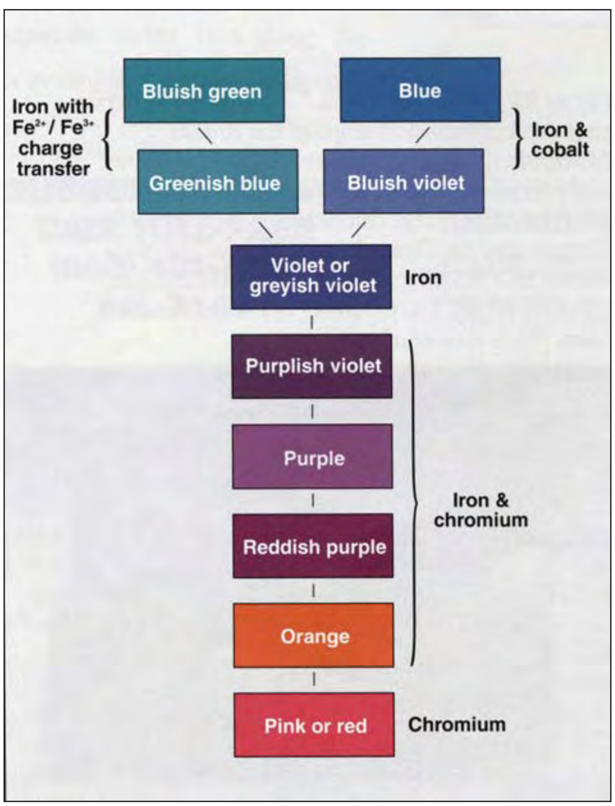


Figure 21. This 26.87 ct cabochon of chalcedony contains an electrochemically induced dendritic plume formation composed of elemental tin. Photo by Maha Tannous.

Figure 20. This schematic diagram shows the colors—and their causes—found in spinels from Ilakaka.



Induced copper dendrites in chalcedony are relatively attractive because of the color of the metal and the blue-green body color that the copper salt solution gives to the host chalcedony. However, the induced tin dendrites in the chalcedony we examined are a dull silvery gray, and the solution apparently does not produce an attractive color in the host either. It is probably this lack of visual appeal that has limited the production of chalcedony with induced tin dendrites.

SYNTHETICS AND SIMULANTS

Black diamond imitation. Black diamonds have become increasingly popular. Many manufacturers design jewelry that highlights them, often as large areas of melee. The main problem for the manufacturer is to make sure that the black diamonds are not treated or imitations. Beginning in late 1999, Franck Notari and Pierre-Yves Boillat of GemTechLab in Geneva, Switzerland, brought to the attention of this editor some unusual black diamond imitations. In the course of examining more than 17,000 black diamonds for jewelry manufacturers who specialize in this material, they separated out approximately 30 faceted samples (0.20 to 0.41 ct) because of their unusual luster (duller than is usually seen in black diamonds), uneven surface appearance, and luminescence excited by UV radiation (long- and short-wave, as described below). These samples also appeared slightly grayer than typical black diamonds (see, e.g., figure 22).

When examined with a 10× loupe or a binocular microscope, the material appeared inhomogeneous, with black shiny fragments of variable dimensions in a duller, lighter-color matrix. Most of the shiny fragments measured approximately 0.10 mm in maximum dimension. Although some were much smaller, a few reached nearly 1 mm. These fragments were relatively homogeneous in some samples, while in others they varied in

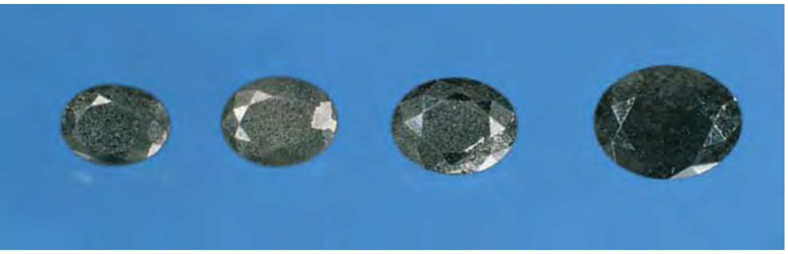


Figure 22. The three samples on the left are imitation black diamonds that are actually composed of diamond fragments in a metallic matrix; the 0.45 ct stone on the far right is a natural black diamond. From left to third right: 0.25 ct, Si-based matrix; 0.21 ct, Si-based matrix with some Rh recorded; 0.34 ct, Fe-based matrix. Photo by Alain Cossard.

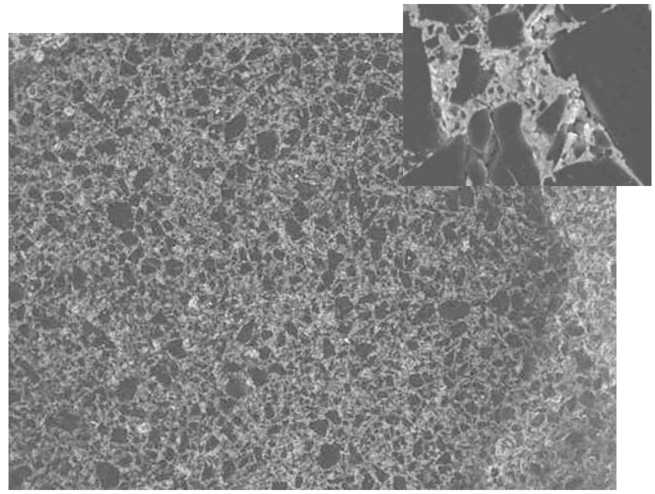


Figure 23. As seen with an SEM in this backscattered electron image (magnified 55×), the homogeneous dark areas are diamond and the lighter matrix is made of silicon, in this case with traces of rhodium. The inset (magnified 2300×) shows the "cauliflower" appearance of the matrix, contrasting with the sharp edges of the diamond fragments. Photos by Alain Barreau.

size by a factor of more than 10. Clearly, this material was not monocrystalline, as a natural faceted black diamond would be, but rather was a composite product that imitates black diamond. This composite nature was confirmed by the luminescence to long- and short-wave UV radiation, which revealed that the background was inert, but contained numerous tiny spots emitting various colors that corresponded to the fragments mentioned above. Some samples showed essentially the same fluorescence color in all the fragments; in others, the color varied greatly from grain to grain. Some grains even fluoresced more than one color.

Despite the inhomogeneous nature of these pieces, use of a carefully calibrated Digital Jemeter from Sarasota Instruments revealed approximate R.I. values of about 1.86 to 2.03. These values are consistent with the lower luster of these imitations compared to that of diamond (which has an R.I. of 2.42). The samples ranged in specific gravity from 3.04 to 3.52. Six samples were analyzed further at the University of Nantes. Laser Raman microspectrometry with a Jobin Yvon T64000 microprobe confirmed that the fragments were diamond, but the matrix gave no noticeable spectrum (perhaps because the surface condition was extremely poor). Secondary- and backscattered-electron images produced by a JEOL 5800 scanning electron microscope (SEM) showed shards of a material embedded in a matrix of higher atomic number (figure 23). At higher magnification (e.g., 2000×), the matrix had a "cauliflower" appearance and was often inhomogeneous. Microanalysis using an energy-dispersive spectrometer (with an "ultrathin" window) attached to the SEM confirmed that the shards contain carbon and no heavier elements.

The chemical composition of the matrix varied from sample to sample and, in some cases, within a sample. In one specimen, iron (Fe) and vanadium (V) dominated the composition (with traces of silicon and aluminum); in the other five, silicon (Si) was the main or only component. Among those five, two showed an admixture of rhodium (Rh) in variable amounts, one some Fe, and one was very inhomogeneous with some areas rich in Fe, V, and titanium, as well as traces of potassium, calcium, aluminum, chromium, tungsten, and molybdenum. This contributor believes that the rhodium probably is residual of plating applied to a silver setting while the stone was mounted. We were not

Figure 24. "Aurora Borealis," a 131 ct opal carving that depicts the north slope of the Brooks Mountain range in Alaska, took "Best of Show" and first place in the Carving division of the 2000 AGTA Cutting Edge competition. Fashioned from Oregon opal by Thomas Harth Ames, the piece stands 65.1 × 37.2 × 6.3 mm. Photo © 2000 John Parrish and AGTA. Courtesy of the American Gem Trade Association.

permitted to break a stone to check whether rhodium was present internally, or only on the surface.

Jean-Pierre Chalain of the SSEF Swiss Gemmological Laboratory informed us that he had seen two similar black diamond imitations in the summer of 1999. They were sent for study to Dr. Paul Spear of the De Beers DTC Research Centre in Maidenhead, United Kingdom. Dr. Spear established, by X-ray diffraction and chemical microanalysis, that these two samples consisted of diamond fragments in a matrix of iron-nickel or silicon. These conclusions are consistent with our findings.

Therefore, it appears that black diamond imitations, similar in concept but not all identical in chemical composition, have entered the gem market. They resemble "compacts"—abrasive materials made of small diamond particles that are cemented by a metal, generally cobalt or iron. One might wonder if this is a product engineered specifically as a gem simulant, or the by-product of a material developed for a specific industrial application. *EF*

ANNOUNCEMENTS

Tenth annual Cutting Edge awards. Judges chose 16 winners and five honorable mentions in this year's 10th annual Cutting Edge competition, sponsored by the American Gem Trade Association (AGTA) in Dallas, Texas, on April 29 and 30.

"Best of Show" and first place in Carving were awarded to "Aurora Borealis," a 131 ct rectangular opal carving fashioned by Thomas Harth Ames of Arvada, Colorado (figure 24). Other first-place awards were: Classic Gemstone—Allen Kleiman of Boulder, Colorado, for his 10.18 ct cushion-cut sapphire; Faceting—Joseph Krivanek of Alma, Colorado, for a 12.93 ct mixed square-cut rhodochrosite; New/Innovative/Combination—Thomas Trozzo of Culpeper, Virginia, for a 42.98 ct concave fancy-cut ametrine; Pairs & Suites—Stephen Avery of Lakewood, Colorado, for a 9.25 total carat weight "trishield" spessartite garnet pair; Objects of Art—Dalan Hargrave of San Antonio, Texas, for a scepter made of cat's-eye quartz, beryl, tourmaline, rose quartz, sunstone, peridot, and amethyst.

The competition was open to all colored gemstones of natural origin that were fashioned in North America by a professional lapidary artist. Entries were evaluated on the basis of design, quality of lapidary work, technique, quality and rarity of gem materials, and overall beauty. The winning gemstones were displayed at this year's JCK Show in Las Vegas, and the winners will be honored at the February 2001 AGTA Tucson GemFair.

The Dresden Green at the Smithsonian. The famous Dresden Green diamond will be on display for the first time in the United States, in the Harry Winston Gallery at the Smithsonian Institution's National Museum of Natural History, from October 2000 to January 2001. On loan from the Albertinum Museum, part of the Dresden State Museum, Germany, where it has resided since 1741, this approximately 41 ct diamond is the largest natural-color green diamond known. A full report on this diamond was published by R. E. Kane et al. in the Winter 1990 issue of *Gems & Gemology* (pp. 248–266). For more information, call the Museum at 202-357-2700.

Gem 2000. Presented by the Canadian Gemmological Association, Vancouver Community College, and the Vancouver Chapter of GIA Alumni and Associates, the Gem 2000 conference will be held October 20–22 in Vancouver. Several prominent industry figures will cover a variety of current topics in gemology. A variety of GIA Extension education classes will also take place before and during the conference, and an intensive six-day course on grading rough diamonds will be taught after the conference by John Louis Raath of Johannesburg, South Africa. For more information, visit www.giaalumni.bc.ca, or contact Donna Hawrelko at 604-926-2599 (phone), 604-926-7545 (fax), or e-mail donnahawrelko@hotmail.com.

Mineralientage München. The Munich Mineral Show 2000 will take place October 6–8, and will feature a special exhibit titled *Diamond—The Millennium Crystal*. In addition to 750 exhibitors and numerous collectors' showcases, the show will host a design competition in Unique Jewellery. For more information, fax 089-6135400, e-mail info@mineralientage.de, or visit http://mineralientage.de.

Gemstones at upcoming scientific meetings. These upcoming meetings will feature sections on gemstones:

- The 4th International Mineralogy and Museums Conference will take place in Melbourne, Australia, from December 3–7, 2000. The International Mineralogical Association Commission on Gem Materials will present a symposium in honor of Ralph Segnit on *Gems and Gem Materials*. Contact Dr. Bill Birch at 61-3-9270-5043 (fax), bbirch@mov.vic.gov.au (e-mail), or visit the Web site www.mov.vic.gov.au/mineralogy/mm4web/.
- *A Field Course on the Rare Element Pegmatites of Madagascar* will take participants to famous gem-bearing pegmatites on June 9–24, 2001. The itinerary will also include a brief visit to the Ilakaka alluvial gemstone deposit. Two days of scientific presentations in Antananarivo will round out the symposium. The meeting is being organized by the Museum of Natural History of Milan (Italy), the Department of Geology and Geophysics at the University of New Orleans, the Geological Survey at the Ministry of Energy and Mines in Antananarivo (Madagascar), and Pyramide Co., Antananarivo. A deposit and preregistration form are required; contact William B. "Skip" Simmons (e-mail wsimmons@uno.edu, or fax 504-280-7396).